NEW INDY

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March 23, 2023

Ms. Katharine Buckner
South Carolina Department of Health and Environmental Control Bureau of Air Quality - Air Permitting Division
2600 Bull Street
Columbia, South Carolina 29201

Re: **New-Indy Catawba LLC**
Consent Order to Correct Undesirable Levels of Air Contaminants
Construction Permit Application

Ms. Buckner,

New-Indy Catawba LLC (New-Indy Catawba) operates a pulp and paper mill located in Catawba, South Carolina (Mill) and currently operates under Title V Operating Permit No. TV-2440-0005 (Title V Operating Permit or TV-2440-0005).

New-Indy Catawba has prepared this construction permit application as required by the South Carolina Department of Health and Environmental Control (SCDHEC) Consent Order to Correct Undesirable Levels of Air Contaminants, signed November 23, 2022 (Consent Order).

The attached document represents the construction permit application for this Project (Application). Appendix A of the application contains the required completed SCDHEC construction permit application forms. Appendix B of the application provides Project-related emissions calculations and supporting information. The Project-related emissions information has been refined since the previous submittal of the draft calculations on March 15, 2023. Comments received from SCDHEC regarding the Project-related emissions submitted on March 15 will be addressed by March 31, 2023. Appendix C of the application includes a description of air dispersion modeling performed for SCDHEC toxic air pollutants. The supporting air dispersion modeling files will be made available to the SCDHEC Air Modeling Section in electronic format.

If you have any additional questions regarding the attached construction permit application, please contact Bob Tourville at (803) 981 – 8009 or by e-mail at bob.tourville@new-indycb.com.

Sincerely,

Charles Cleveland
Technical Manager

attachment

cc: Sheryl Watkins, P.E. - ALL4
Steven Moore - ALL4
Environmental File 200-air-205-air_permits

New Condensate Stripper Construction Permit Application

NEW-INDY CATAWBA LLC – CATAWBA, SC MILL

March 2023

Submitted by:

New-Indy Catawba LLC – Catawba, SC Mill
5300 Cureton Ferry Road
Catawba, SC 29704

Submitted to:

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1. INTRODUCTION AND APPLICATION OVERVIEW

New-Indy Catawba LLC (New-Indy Catawba) operates a pulp and paper mill located in Catawba, South Carolina (Mill or the Mill) and currently operates under Title V Operating Permit No. TV-2440-005 (TVOP or TV-2440-0005), effective on July 1, 2019.

New-Indy Catawba has prepared this construction permit application as required by the Consent Order to Correct Undesirable Levels of Air Contaminants ("Consent Order"), issued on November 23, 2022, by the South Carolina Department of Health and Environmental Control (SCDHEC)[1]. For compliance with the provisions of the Consent Order, New-Indy Catawba is proposing a modification to their current foul condensate treatment system (condensate treatment system) to install a new foul condensate stripper (new steam stripper) and demote the existing steam stripper [existing steam stripper (ID 9801)] strictly to backup operation during periods of downtime experienced by the new steam stripper (Project). The Project also includes the installation of a stripper feed tank, methanol storage tank, and hot water tank to serve the new steam stripper. The stripper feed tank and methanol storage tank will be controlled in the LVHC system. The hot water tank is not expected to be a source of emissions. The Project will also satisfy the requirements of Item I.a. of Appendix A of Consent Decree Civil No. 0:21-cv-02053-SAL, United States of America v. New-Indy Catawba, LLC, dated November 16, 2022 (EPA Consent Decree). This document represents the construction permit application for this Project (Application).

[1] The November 23, 2022, Consent Order amends and replaces the Order to Correct Undesirable Level of Air Contaminants issued by SCDHEC on May 7, 2021.

2. PROCESS AND PROJECT DESCRIPTION

New-Indy Catawba is comprised of seven distinct process areas that include the following: the woodyard area, the kraft pulp mill area, the paper mill area, the chemical recovery area, the utilities area, the waste treatment area, and a miscellaneous area. A simplified process flow diagram for these process areas is included as Figure 2-1. A description of the process areas is presented below, with more detail provided in the areas that are impacted by the Project.

Southern pine logs and chips are received at the woodyard. Logs are debarked, chipped, and the chips are screened prior to storage for use within the pulping process. Likewise, purchased wood chips received are screened, and processed as needed, prior to use within the pulping processes.

The kraft (sulfate) process area is used to produce pulp. Pulp from the kraft process is produced from "cooking" wood chips in the continuous digester in a caustic solution at an elevated temperature and pressure. The pulp slurry from the continuous digester is sent to the blow tank, then to one of two parallel pulping lines, each consisting of an enclosed deshive refiner and a three-stage drum displacement washer system and associated filtrate tanks. Weak black liquor from the washer filtrate tanks is stored before being recycled to chemical recovery. Rejects from the refiners are sent to the screw presses, with the filtrate being screened and stored before being recycled to chemical recovery. Washed pulp is stored and then sent to the paper mill area. With the exception of the pulp storage tanks after pulp washing, the kraft pulp mill sources are currently collected and routed to the high volume low concentration (HVLC) or low volume, high concentration (LVHC) systems, and emissions are controlled through combustion in the Nos. 1 or 2 Combination Boilers.

Linerboard (the outside layer of a corrugated container) is produced in the paper mill area on one state-of-the-art paper machine. Unbleached market pulp is produced on one pulp dryer. A second paper machine at the Mill is currently idled.

Weak black liquor is concentrated in the Nos. 1-3 Evaporator Sets and is then fired in the recovery furnaces (chemical recovery area) that burn the organics extracted from the chips and recover cooking chemicals. The causticizing area utilizes the chemicals recovered by the recovery furnaces, and after adding lime, provides the cooking chemicals for the kraft process.

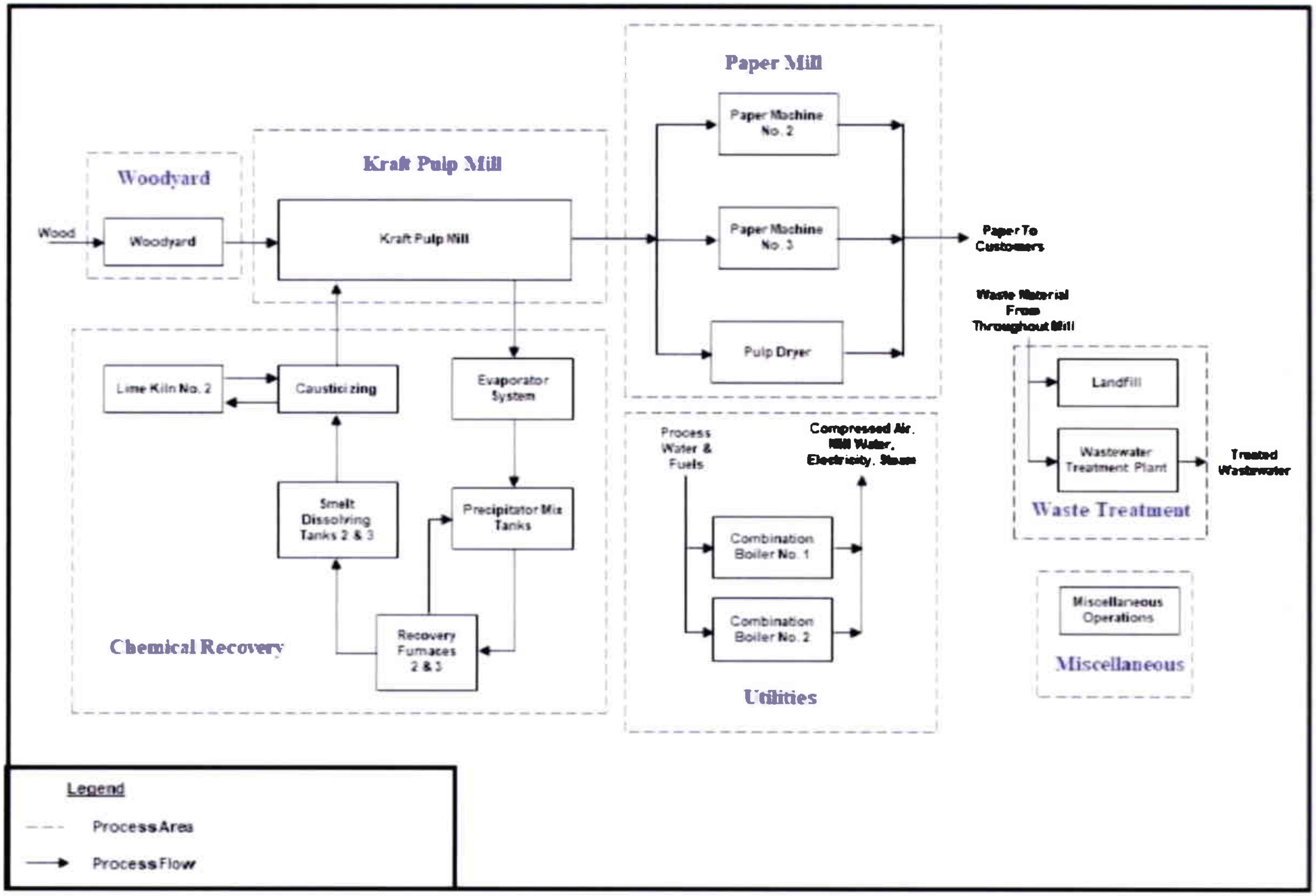
Emissions from the Evaporator Sets and Turpentine Recovery System are collected in the LVHC gas collection system and combusted in the Nos. 1 or 2 Combination Boilers. Several weak black liquor tanks are collected in the HVLC system and combusted in the Nos. 1 or 2 Combination Boilers. Evaporator condensates are segregated, with the combined condensates being recycled to the Brownstock washer system or sewered. The foul condensates are treated in a dual control device configuration: foul condensates are preferentially treated in the existing condensate steam stripper system, with the remaining flow being directed to the aerated stabilization basin (ASB) via the Hardpipe (ID 9802).

Steam and electricity are produced for facility-wide use by two combination boilers. The recovery furnaces also generate steam.

A waste treatment area receives wastewater and mill waste (solid waste) from the various previously mentioned areas of the facility. Wastewater undergoes biological treatment to remove the dissolved organic wastes prior to discharge into the receiving stream. Mill solid waste is deposited in an on-site landfill.

The miscellaneous areas include everything that is not captured in one of the aforementioned process operating areas, such as facility roads and the pulp storage tanks.

Figure 2-1 Simplified Mill Flow Diagram

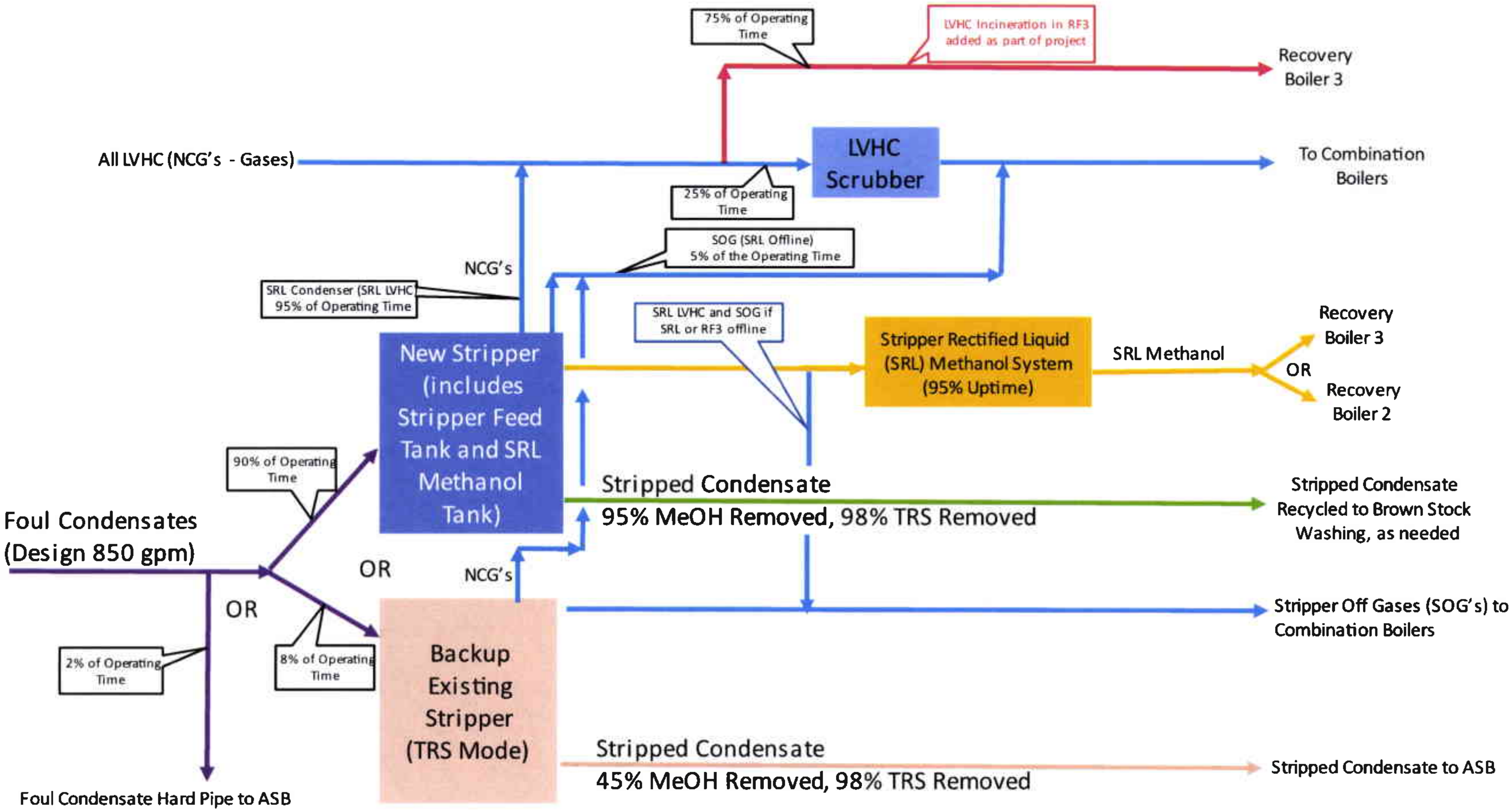


This document represents the construction permit application for this Project in accordance with the DHEC Consent Order. The Project consists of the following new equipment and proposed changes to the existing treatment scenarios:

1. Construct and operate a new low-pressure steam foul condensate stripper system that will process the pulping process condensates (foul condensate) for compliance with 40 CFR Part 63, Subpart S. The resultant stripped methanol will be condensed into a liquid [called stripper rectified liquid (SRL)] and combusted in the Nos. 2 and 3 Recovery Furnaces (ID Nos. 2505 and 5105). The methanol will be added to the black liquor at a maximum amount of 1% by volume. This methanol addition limit is required for safely operating the recovery furnaces. There are no anticipated changes in black liquor firing as a result of the project. The LVHC gases from the SRL condenser system, stripper feed tank, and SRL methanol tank will be combusted in the No. 3 Recovery Furnace. The LVHC system will include a 1.0 mmBtu/hr natural gas ignitor for combustion of the LVHC gases when black liquor firing is less than 50% of capacity. The existing Nos. 1 and 2 Combination Boilers (ID Nos. 2605 and 3705) will serve as back-up control for the new Stripper's LVHC gases when the SRL condenser system is not in operation. Stripped condensates will be recycled to the Brownstock washers (ID 5230), as needed;
2. Operate the existing steam stripper (ID 9801) as a backup to the new low-pressure steam stripper. The existing steam stripper will be operated to process the foul condensate and remove 98% of the total reduced sulfur (TRS) compounds; although with reduced methanol removal efficiency. Further methanol treatment through biological destruction will be accomplished by routing the stripped condensates to the existing Hardpipe system that discharges the foul condensates below the liquid surface of the existing ASB; and
3. Modify the No. 3 Recovery Furnace to combust gases collected in the LVHC system. The Nos. 1 and 2 Combination Boilers will serve as backup control for the LVHC gases following the Project. When these LVHC gases are combusted in the combination boilers, a caustic scrubber will be operated to provide 50% removal of the sulfur prior to combustion.

Figure 2-2 presents a simplified process flow with the possible operating scenarios for treatment of the foul condensates and the associated control scenarios for the new and existing steam stripper vent gases. Section 3.2.2.3 presents the prevention of significant deterioration (PSD) analysis that details the basis for the projected actual emissions (PAE) calculations for the proposed future operating scenarios.

Figure 2-2 Stripper Operating Scenarios



3. REGULATORY REVIEW

This section summarizes Federal and State air quality regulations that potentially apply to the Project. Discussions pertaining to applicable regulatory requirements are separated into three categories:

- Federal Air Quality Regulations
- South Carolina Air Quality Regulations
- Provisions of the SCDHEC Consent Order and EPA Consent Decree

3.1 FEDERAL AIR QUALITY REGULATIONS

For the purpose of this Application, potentially applicable Federal regulations consist of:

- Standards of Performance for New Stationary Sources (NSPS)
- National Emission Standards for Hazardous Air Pollutants (NESHAP)
- New Source Review (NSR) and PSD
- Compliance Assurance Monitoring (CAM)
- Requirements for Preparation, Adoption, and Submittal of Implementation Plans
- Title V Operating Permits

A discussion of each specific Federal air quality regulation is provided in the following subsections.

3.1.1 Standards of Performance for New Stationary Sources

U.S. EPA has promulgated NSPS at 40 CFR Part 60. NSPS requirements are promulgated under 40 CFR 60 pursuant to Section 111 of the Clean Air Act.

3.1.1.1 40 CFR Part 60, Subparts BB and BBa – Standards of Performance for Kraft Pulp Mills

40 CFR Part 60, Subpart BB – Standards of Performance for Kraft Pulp Mills applies to TRS emissions from digesters, brownstock washers, multiple-effect evaporators, recovery furnaces, smelt dissolving tanks, lime kilns, and condensate strippers that commenced construction, reconstruction, or modification after September 24, 1976, and on or before May 23, 2013. Subpart BBa applies to the same sources that commence construction, reconstruction, or modification after May 23, 2013.

The existing condensate stripper system and Nos. 1-3 Multi-effect Evaporator Sets with Concentrators are currently subject to 40 CFR 60, Subpart BB for TRS (Standards of Performance for Kraft Pulp Mills). Compliance with the TRS standard at 60.283a(a)(1) is currently demonstrated by combusting the stripper off-gases and evaporator vent gases in the Nos. 1 and 2 Combination Boilers per §60.283(a)(1)(iii) [combust the gases at a minimum temperature of 650 °C (1200 °F) for at least 0.5 seconds]. As there are no physical modifications to the existing condensate stripper and Nos. 1-3 Multi-effect Evaporator Sets with Concentrators, the Mill will continue to combust the existing stripper off-gases in the Nos. 1 and 2 Combination Boilers; however, following the Project, the vent gases from the Nos. 1-3 Multi-effect Evaporator Sets with Concentrators will be combusted in the No. 3 Recovery Furnace per §60.283(a)(1)(ii) [gases are combusted in a recovery furnace subject to §60.283(a)(2)] or in the Nos. 1 and 2 Combination Boilers per §60.283(a)(1)(iii).

Upon completion of the Project, the new condensate stripper system will be subject to 40 CFR Part 60, Subpart BBa for TRS (Standards of Performance for Kraft Pulp Mill Affected Sources for Which Construction, Reconstruction, or Modification Commenced After May 23, 2013). Compliance with the TRS standard at 60.283a(a)(1) will be demonstrated through collection of the stripper off-gases (SOG) in the existing SOG collection system and SRL gases in the existing low volume high concentration (LVHC) closed-vent collection system meeting the requirements of §63.450. The SOG will continue to be combusted in the Nos. 1 and 2 Combination Boilers per §60.283a(a)(1)(iii). The LVHC collection system gases will be combusted in the No. 3 Recovery Furnace per §60.283a(a)(1)(ii) or in the Nos. 1 and 2 Combination Boilers per §60.283a(a)(1)(iii). Emissions from the stripper feed tank will also be collected in the LVHC collection system. The Mill will continuously monitor the incineration of SOG and LVHC gases in the No. 3 recovery furnace, each combination boiler, and venting of the SOG and LVHC closed-vent systems as required by §60.284a(d)(3)(iii) and currently utilized for monitoring compliance with Subpart BB.

New-Indy Catawba will maintain records of excess emissions and malfunctions for the new stripper as required by §60.287a(b)(7) and (c), respectively. The Mill will report periods of excess emissions and malfunctions as required by §60.288a(a) and (d), respectively. As defined in §60.284a(e)(1)(vi), periods of excess emissions from the LVHC closed-vent system (condensate stripper system) that are less than one percent (1%) of operating time during a semi-annual period are not a violation of §60.283a(a)(1)(iii).

The stripper feed tank, methanol tank, hot water tank, Hardpipe, and ASB are not included in the definition of condensate stripper system under §60.281 or §60.281a and are not affected sources under Subparts BB or BBa.

3.1.1.2 40 CFR Part 60, Subpart Kb - Standards of Performance for Volatile Organic Liquid Storage Vessels (Including Petroleum Liquid Storage Vessels) for Which Construction, Reconstruction, or Modification Commenced After July 23, 1984

The Project includes a new stripper feed tank, new methanol tank, and a new hot water tank. 40 CFR Part 60, Subpart Kb includes standards of performance for new storage tanks. However, per 60.111b, the definition of storage tank does not include process tanks (tanks that collect material from one part of a process before sending it to another part of the process). Therefore, the new tanks are not subject to Subpart Kb.

3.1.2 National Emission Standards for Hazardous Air Pollutants

NESHAP found in 40 CFR Part 61 apply to specific compounds emitted from certain listed processes. 40 CFR Part 61 subparts do not apply to the Mill, and there are no Part 61 subparts that apply to the proposed Project. Applicability of Part 63 NESHAP is discussed below.

3.1.2.1 40 CFR Part 63, Subpart S – National Emission Standards for Hazardous Air Pollutants from the Pulp and Paper Industry

New-Indy Catawba is subject to 40 CFR Part 63, Subpart S, also referred to as Maximum Achievable Control Technology (MACT) I for the pulp and paper industry. This standard regulates hazardous air pollutant (HAP) emissions from pulping and bleaching systems. The affected source under this standard is the total of all HAP emission points in the pulping and bleaching systems. The Mill does not produce bleached pulp and is therefore not subject to the requirements of §63.445.

The Nos. 1-3 Multi-effect Evaporator Sets with Concentrators and Turpentine Recovery System were constructed prior to 1993 and are existing affected sources, while the existing condensate stripper was constructed after 1993, making it a new source under 40 CFR Part 63, Subpart S. Compliance is currently demonstrated by collecting the gases in the existing LVHC closed-vent system meeting the requirements of §63.450 and combustion of the SOG and LVHC system gases in the Nos. 1 and 2 Combination Boilers per §63.443(d)(4)(i) (introduce the HAP emission stream with the primary fuel or into the flame zone). The Mill currently complies with the pulping condensates collection requirements in §63.446(c)(1) [collect all named pulping process condensate streams listed in 40 CFR § 63.446(b)(1-5)] and the treatment requirements in §63.446(e)(4) [treat a minimum of 6.6 lb HAP per ton oven dried ton of pulp (ODTP)]. The Mill has utilized concurrent use of the existing steam stripper and Hardpipe for compliance with §63.446(e)(4).

Subpart S requires collection of LVHC gases from steam stripper systems, defined to include the stripper column, associated feed tanks, condensers, and any methanol rectification process. The new condensate stripper, stripper feed tank, methanol condenser, and methanol tank will be subject to this rule upon startup.

Following the completion of the proposed Project, SOG from the existing condensate stripper and vent gases from the existing Nos. 1-3 Multi-effect Evaporator Sets with Concentrators and Turpentine system will continue to be collected in the existing LVHC closed-vent system meeting the requirements of §63.450 and §63.453(k)(1-6). The existing SOG will continue to be combusted in the Nos. 1 and 2 Combination Boilers per §63.443(d)(4)(i). However, the vent gases from the LVHC collection system will be combusted in the No. 3 Recovery Furnace or in the Nos. 1 and 2 Combination Boilers (as backup) per §63.443(d)(4)(i). The Mill will update the leak detection and repair (LDAR) site inspection plan as appropriate per §63.454(b).

The Mill plans to demonstrate compliance with the pulping condensates collection requirements in §63.446(c)(3) [collect the pulping process condensates from equipment systems listed in §63.446(b)(1) through (b)(5) that in total contain 7.2 lb HAP/ODTP] and the treatment requirements in §63.446(e)(4) [treat a minimum of 6.6 lb HAP/ODTP]. The Mill will utilize the new condensate stripper for compliance with §63.446(e)(4) and will operate a continuous monitoring system for the parameters in §63.453(g)(1-3). Vents from the new condensate stripper (including the stripper feed tank, SRL condenser, and SRL methanol tank) will be collected in the existing LVHC closed-vent system meeting the requirements of §63.450 and combusted in the No. 3 Recovery Furnace or Nos. 1 and 2 Combination Boilers per §63.443(d)(4)(i). The Mill will update the LDAR site inspection plan as appropriate per §63.454(b) and will perform the required inspection and monitoring requirements per §63.453(k)(1-6). The new stripper will be included in semi-annual excess emission reports under §63.455. Per §63.446(g), periods of excess emissions reported under §63.455 are not considered a violation of §63.446(e)(4) provided that the time of excess emissions divided by the total process operating time in a semi-annual reporting period does not exceed 10 percent.

At the request of SCDHEC, the Mill is providing additional information regarding plans to demonstrate continuous compliance with the pulping condensate collection and treatment in the new steam stripper. These are as follows:

- Pulping condensate collection emissions limit of 7.2 lb HAP/ODTP:
    - HAP will be measured "as methanol" per §63.457(f)(2);
    - Daily sampling of foul condensates for methanol concentration representative of the inlet to the new stripper;

    - Continuous measurement of new steam stripper inlet foul condensate feed flow (gpm);
    - Daily measurement of pulp production (ODTP); and
    - Daily calculation of a 15-day rolling average collection (lbs methanol/ODTP) [Note: The Mill may use historical and/or collect future foul condensate sampling data to support a longer averaging period].
- Pulping condensate treatment in the new steam stripper to remove 6.6 lb HAP/ODTP:
    - HAP will be measured "as methanol" per §63.457(f)(2); and
    - Daily sampling of stripped condensates for methanol concentration representative of the outlet of the new stripper.
    - Continuous measurement of:
        - New steam stripper inlet foul condensate feed flow (gpm);
        - New steam stripper steam feed flow (lbs/hr);
        - Foul condensate to new steam stripper feed temperature (˚F); and
        - New steam stripper stripped condensate flow (gpm).
    - Daily measurement of pulp production (ODTP).
    - Daily calculation of the percent methanol removed in the steam stripper .
    - Daily calculation of the treatment in the new steam stripper [15-day (or other averaging period, as justified) rolling average methanol collected (lbs methanol/ODTP) multiplied by the calculated daily methanol percent removal in the new stripper].

Please note that the Mill may choose to establish a methanol concentration factor in lieu of daily methanol sampling at the inlet to the new steam stripper once sufficient data has been collected demonstrating consistency in the foul condensate methanol concentration. In addition, the Mill may choose to establish an effective steam to feed ratio (ESFR) curve for the new stripper system to be used to establish the methanol removal efficiency across the stripper in lieu of the method described above. The compliance approach will be delineated in the Notification of Compliance Status (NOCS) that will be submitted with the results of the initial compliance demonstration to be conducted within 180 days of startup of the new stripper system.

3.1.2.2 40 CFR Part 63, Subpart MM National Emission Standards for Hazardous Air Pollutants (NESHAP) for Chemical Recovery Combustion Sources at Kraft, Soda, Sulfite, and Stand-Alone Semichemical Pulp Mills

New-Indy Catawba is subject to 40 CFR Part 63, Subpart MM, also referred to as MACT II for the pulp and paper industry. This standard regulates particulate matter (PM) emissions from existing recovery boilers, smelt tanks, and lime kilns when processing black liquor or calcium oxide. The Nos. 2 and 3 Recovery Furnaces are currently subject to the existing source requirements of this regulation. The proposed Project will modify the LVHC collection system that delivers the LVHC gases to the No. 3 Recovery Furnace for combustion, but no changes in black liquor firing are expected for the recovery furnaces and PM emissions from black liquor combustion are not expected to increase. The Mill will continue to meet the existing PM emission limits under Subpart MM after completion of the Project.

3.1.2.3 40 CFR Part 63, Subpart EEEE – National Emission Standards for Hazardous Air Pollutants: Organic Liquids Distribution (non-Gasoline)

Subpart EEEE applies to organic liquids distribution (OLD) operations at major sources of HAP. The Project includes installation of a new methanol tank and a new hot water tank. However, these new tanks are not subject to this rule because they are part of the Mill's pulping system as defined under Subpart S. EPA confirmed that tanks in pulp and paper mills that are part of the pulping or bleaching systems are not subject to Subpart EEEE in a December 2004 determination (ADI Control Number M050008).

3.1.2.4 40 CFR Part 63, Subpart DDDDD – National Emission Standards for Hazardous Air Pollutants for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters.

New-Indy Catawba is subject to 40 CFR Part 63, Subpart DDDDD, also referred to as Boiler MACT. Boiler MACT sets forth emissions limits and work practice standards; testing and fuel analyses requirements; and monitoring, recordkeeping, notification, and reporting requirements that apply to boilers and process heaters located at major sources of HAP. The Nos. 1 and 2 Combination Boilers are subject to the requirements of 40 CFR Part 63, Subpart DDDDD. The Nos. 2 and 3 Recovery Furnaces are not subject to the rule per §63.7491(b). The Project will not affect the regulatory applicability of 40 CFR Part 63, Subpart DDDDD, for either combination boiler and will not affect compliance with the applicable emissions limits. The Mill will continue to comply with the currently applicable provisions of 40 CFR Part 63, Subpart DDDDD, in the same manner after completion of the Project.

3.1.3 New Source Review

The Mill is located in York County which is classified as in attainment of or unclassifiable for the National Ambient Air Quality Standards (NAAQS) for regulated NSR pollutants. Therefore, Nonattainment New Source Review (NNSR) regulations do not apply to this Project and the Project is analyzed for applicability as it relates to the PSD requirements. Implementation of the PSD regulations (i.e., 40 CFR §51.166) has been delegated in full to the State of South Carolina. Refer to Section 3.2.2.3 for a discussion of PSD applicability.

3.1.4 Compliance Assurance Monitoring

U.S. EPA developed the CAM rule at 40 CFR Part 64 as a means for providing reasonable assurance that continuous compliance with applicable requirements is achieved for certain emissions units located at major stationary sources subject to Title V permitting. CAM applies to pollutant-specific emissions units (PSEUs) that (1) are subject to an emissions limit or standard (2) use a control device to achieve compliance with that emissions limit or standard, and (3) have potential pre-control device emissions in the amount required to classify the unit as a major source under Part 70 of the Clean Air Act (CAA). Part 64 does not apply to emissions limitations or standards proposed after November 15, 1990 pursuant to Section 111 or 112 of the Clean Air Act (e.g., post-1990 NSPS or NESHAP). The proposed Project is not subject to CAM requirements because the new steam stripper is subject to 40 CFR Part 60, Subpart BBa and 40 CFR Part 63, Subpart S, which are standards proposed after November 15, 1990.

3.1.5 Requirements for Preparation, Adoption, and Submittal of Implementation Plans

U.S. EPA requires air agencies to develop and submit air quality data characterizing maximum 1-hour ambient concentrations of sulfur dioxide (SO_2) through ambient air quality monitoring or air quality modeling analysis at the air agency's election. These requirements are promulgated under 40 CFR Part 51.

3.1.5.1 40 CFR Part 51, Subpart BB—Data Requirements for Characterizing Air Quality for the Primary SO_2 NAAQS (SO_2 Data Requirements Rule or SO_2 DRR)

The Mill submitted facility-wide air dispersion modeling in November 2016 to comply with 40 CFR 51.1203(d). The Mill updated the facility-wide air dispersion modeling in October 2021. The actual SO_2 emissions following the Project are expected to remain below the SO_2 emission rates included in the modeling analysis submitted in 2016 and 2021. The Mill will continue to perform and annual review of the actual SO_2 emission rates against the 2016 and 2021 model emission rates to determine if an updated modeling demonstration is necessary.

3.1.6 Title V Operating Permits

New-Indy Catawba operates under TVOP TV-2440-0005 issued on May 7, 2019, with an effective date of July 1, 2019, and an expiration date of December 31, 2023. Through this Application, New-Indy Catawba is requesting a construction permit to perform the Project. Construction permit application forms required by SCDHEC are included in Appendix A. New-Indy Catawba will request a modification to the TVOP within 15 days of startup of the Project, which is required by the Consent Order to be no later than June 30, 2025.

3.2 SOUTH CAROLINA AIR QUALITY REGULATIONS

This section addresses the applicability of state air regulatory requirements to the Project.

3.2.1 Regulation 61-62.1: Section II, Permit Requirements

This regulation specifies the construction and operating permit requirements for new or modified sources. This permit application is intended to satisfy the construction permitting requirements of Regulation 62.1 Section II. Completed SCDHEC construction permit application forms are included in Appendix A.

3.2.2 Regulation 61-62.5: Air Pollution Control Standards

The list below identifies potentially applicable SC air pollution control regulations and standards associated with the Project.

- Standard No. 2 – Ambient Air Quality Standards
- Standard No. 3 – Waste Combustion and Reduction
- Standard No. 4 – Emissions from Process Industries
- Standard No. 7 – Prevention of Significant Deterioration
- Standard No. 8 – Toxic Air Pollutants

3.2.2.1 Standard No. 2 – Ambient Air Quality Standards

SCDHEC Standard No. 2 addresses the National Ambient Air Quality Standards (NAAQS). Except for an ambient air quality standard for gaseous fluorides, the SCHDEC ambient air quality standards are equivalent to the Federal NAAQS. New-Indy Catawba has previously submitted facility-wide air dispersion modeling evaluations to demonstrate compliance with Standard No. 2.

The Project may slightly increase the actual emissions of SO_2, nitrogen oxides (NO_X), and carbon monoxide (CO) from the No. 3 Recovery Furnace when burning LVHC gases. However, the maximum SO_2 and NO_X emissions from the No.3 Recovery Furnace when burning LVHC gases will be less than 10 percent of the emissions from burning the LVHC gases in the Nos. 1 and 2 Combination Boilers. The maximum SO_2 and NO_X emissions from LVHC combustion in the combination boilers are not expected to change as a result of the project. The CO emissions from burning LVHC gases will be unchanged when combusted in the recovery furnace or the combination boilers.

The emissions of SO_2, NO_X, CO, particulate matter (PM), PM less than 10 microns (PM_{10}), and PM less than 2.5 microns ($PM_{2.5}$) from the LVHC System natural gas ignitor in the No. 3 Recovery Furnace are well below the 1.14 pounds per hour modeling exemption threshold in the South Carolina Modeling Guidelines[2], Section 2.2.3. Therefore, the very small emissions increases from the LVHC natural gas ignitor have not been modeled for this permit application.

The additional steam potentially required from the combination boilers to operate the new condensate stripper will not exceed the current steaming capacity of each combination boiler, as reflected in the SO_2, NO_X, CO, PM, PM_{10}, $PM_{2.5}$ and CO emissions rates modeled previously. Therefore, no updates to the modeled emissions rates from the combination boilers are required for this permit application.

The SO_2 emissions from the Project will decrease by more than 100 tons per year. The reduction in SO_2 emissions meets the single factor emissions netting option 2 in the South Carolina Other Information Guidance[3]. The modeled SO_2 Emissions Rate from black liquor combustion in the 2016 and 2021 SO_2 DRR modeling is 18.70 lb/hr from the No. 3 Recovery Furnace. The maximum SO_2 emissions rate from burning black liquor in the 2018 Title V renewal application is 5.95 pounds per hour. The additional SO_2 emissions from LVHC gases and methanol combustion is 7.4 pounds per hour, making the new total SO_2 emissions 13.35 pounds per hour, more than 5 pounds per hour lower than the modeled SO_2 emissions rate from black liquor combustion. Therefore, no updates to the SO_2 modeling submitted previously in 2016 and 2021 have been prepared for this permit application.

The NO_X emissions will increase from the Project less than one-half the Prevention of Significant Deterioration (PSD) significance threshold, due primarily to increased steam usage by the new condensate stripper. The NO_X emissions due to the Project meet weight of evidence approach 1 in the South Carolina Other Information. The modeled NO_X Emissions Rate for Ambient Air Standards in the current Title V permit is 146.03 lb/hr from the No. 3 Recovery Furnace. The maximum NO_X emissions rate from burning black liquor in the 2018 Title V renewal application is 122.4 pounds per hour. The additional NO_X emissions from LVHC gases and methanol combustion is 2.3 pounds per hour, making the new total NO_X emissions 124.7 pounds per hour, more than 20 pounds per hour lower than the modeled NO_X emissions rate.

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[2] South Carolina Modeling Guidelines for Air Quality Permits (Revised April 15, 2019).

[3] Guidance Concerning Other Information Used for Permitting Requirements in Demonstrating Emissions Do Not Interfere With Attainment or Maintenance of any State of Federal Standard (Updated December 12, 2018).

Therefore, no updates to the NO_X modeling submitted previously have been prepared for this permit application.

The CO emissions will increase from the Project less than one-half the Prevention of Significant Deterioration (PSD) significance threshold, due primarily to increased steam usage by the new condensate stripper. The CO emissions due to the Project meet weight of evidence approach 1 in the South Carolina Other Information. The CO emissions from burning LVHC gases will be unchanged when combusted in the recovery furnace or the combination boilers. The modeled CO Emissions Rate for Ambient Air Standards in the current Title V permit is 330.96 lb/hr from the No. 3 Recovery Furnace. The maximum CO emissions rate from burning black liquor in the 2018 Title V renewal application is 102.9 pounds per hour. The additional CO emissions from LVHC gases and methanol combustion is 8.3 pounds per hour, making the new total CO emissions 111.1 pounds per hour, more than 200 pounds per hour lower than the modeled CO emissions rate. Therefore, no updates to the CO modeling submitted previously have been prepared for this permit application.

Therefore, no updates to the previous Standard No. 2 modeling demonstration are required.

3.2.2.1 Standard No. 3 – Waste Combustion and Reduction

Standard No. 3 applies to any source that burns any waste other than virgin fuels for any purpose. The standard contains various exemptions for the pulp and paper source category. Section I.J.1 specifies that recovery furnaces burning black liquor and TRS compounds are not subject to the standard. Section I.J.1 also specifies that gaseous process streams containing TRS compounds that are regulated in accordance with Section XI of Regulation 61-62.5, Standard No. 4, or NSPS are not subject to Standard No. 3. Because the SOG and LVHC collection system gases containing TRS that are regulated in accordance with Standard No. 4 or NSPS Subpart BB/BBa, combustion of those gases in combination boilers or recovery furnaces is not subject to Standard No. 3.

Standard No. 3 specifically states that any "facility with an emission unit and/or control device that complies with all the requirements of an applicable Maximum Achievable Control Technology (MACT) Standard under 40 CFR 63, including the testing and reporting requirements, may request an exemption from this standard." (61 -62.5, Section I.J.3.)

During development of the Pulp and Paper MACT regulations at 40 CFR 63, Subpart S, U.S. EPA reviewed the practice of combusting methanol condensed from stripper-off-gases. The U.S. EPA determined that the methanol condensate "does not appear to contain metal or chlorinated organic HAP's ..." (61 Fed. Reg. 9397) (emphasis added). The U.S. EPA also found that burning methanol condensate "will not increase the potential environmental risk over the burning of the steam stripper vent gases prior to condensation." U.S. EPA reaffirmed this conclusion in 2011 during its Residual Risk and Technology Review (RTR) of the Pulp and Paper (Subpart S) MACT. In the final RTR rule, U.S. EPA stated: "We conclude based on the Residual Risk Assessment cited here that the risks from the subpart S pulp and papermaking source category are acceptable and that the current standard protects the public health with an ample margin of safety. Consequently, we are re-adopting the MACT standards for subpart S pursuant to our 112(f)(2) review." (77 Fed. Reg. 55705)

Therefore, the combustion of black liquor and condensed methanol from stripper-off-gases in the recovery furnaces mill qualifies for the exemption from Standard No. 3 provided in Section I.J.3.

3.2.2.2 Standard No. 4 – Emissions from Process Industries

SCDHEC Regulation 61-62.5, Standard No. 4 establishes standards for opacity and certain other pollutants for specific sources in specific industries and establishes PM and opacity standards for industrial processes not otherwise regulated. The new steam stripper and the new tanks do not cause visible emissions into the atmosphere; therefore, this standard does not apply.

Section XI regulates emissions of TRS from Kraft Pulp Mills where construction or modification commenced prior to September 24, 1976 from recovery furnaces, digester systems, multiple-effect evaporator systems, lime kilns, and condensate stripper systems. The No. 2 Recovery Furnace is currently subject to Standard 4 and will continue to comply with the TRS limits after completion of the Project. The TRS emissions from the No. 3 Recovery Furnace, Nos. 1-3 Evaporator Sets with Concentrators, and the existing steam stripper are subject to 40 CFR Part 60, Subpart BB. The TRS emissions from the new condensate stripper will be subject to 40 CFR Part 60, Subpart BBa.

3.2.2.3 Standard No. 7 – Prevention of Significant Deterioration – Permit Requirements

PSD requirements apply to major stationary sources of regulated NSR pollutants that are located in areas that are in attainment with the NAAQS or unclassifiable. Implementation of the PSD regulations has been delegated in full to the State of South Carolina. These air quality regulations are contained in SCDHEC Regulation 61-62.5, Standard No. 7. The PSD regulations apply to major modifications at major stationary sources, which are considered those sources belonging to any one of the 28 source categories listed in the regulations that have the potential to emit (PTE) 100 tons per year (tpy) or more of an NSR-regulated pollutant, or any other source that has the PTE 250 tpy or more of an NSR-regulated pollutant. The Mill is considered a major stationary source because it emits or has the PTE 100 tpy or more of a regulated NSR pollutant.

Because it includes physical changes to the Mill, the installation of the new steam stripper is a "project" as defined in Standard No. 7(b)(40).

New-Indy Catawba has assessed the applicability of PSD to this Project by performing the hybrid test as prescribed under U.S. EPA's PSD rules (as adopted by South Carolina) at 40 CFR 52.21(a)(2)(iv)(f), described as the hybrid test for projects that involve multiple types of emissions units. The future emissions from the backup steam stripper system, existing foul condensate Hardpipe, existing ASB, existing evaporator and turpentine recovery system LVHC gases, and steam required for the existing steam stripper system are calculated as PAE per SCDHEC Regulation 61-62.5, Standard No. 7, paragraph (B)(41). The future emissions from the new steam stripper and the generation of steam to operate the new steam stripper are PTE per SCDHEC Regulation 61-62.5, Standard No. 7, paragraph (B)(37).

The PSD applicability analysis has been completed for the applicable NSR regulated air pollutants, including SO_2, NO_x, CO, volatile organic compounds (VOC), TRS, H_2S, PM, PM_{10}, PM $PM_{2.5}$, lead (Pb), sulfuric acid mist, and carbon dioxide as CO_2e (CO_2e). There are no increases in emissions of fluorides from the Project. Emissions calculations used for determining PSD applicability are included in Appendix B.

At this time, New-Indy Catawba has not excluded emissions the mill was capable of accommodating during the baseline period or excluded demand growth from the projected actual emissions as allowed under SCDHEC Regulation 61-62.5, Standard No. 7, paragraph (B)(41)(b)(iii). New-Indy Catawba may decide to utilize these two exclusions from PAE during this or future permitting if desirable.

3.2.2.3.1 Baseline Actual Emissions

Baseline actual emissions (BAE) from an existing source are defined by Standard No. 7, paragraph (B)(4)(b) as:

> "*the average rate, in tpy, at which the emissions unit actually emitted the pollutant during any consecutive 24-month period selected by the owner or operator within the 10-year period immediately preceding either the date the owner or operator begins actual construction of the project, or the date a complete permit application is received by the Department for a permit required under this section or under a plan approved by the Administrator, whichever is earlier, except that the 10-year period shall not include any period earlier than November 15, 1990.*"

BAE for all existing sources and pollutants are based on the 24-month period following conversion of the mill to manufacturing unbleached paper grades starting in March 2021 and extending through February 2023. For simplicity, baseline annual production rates are assumed to occur over 8,760 operating hours. The BAE for the existing steam stripper (aka future backup stripper) off gases (and the required steam) are adjusted using the actual operating days to reflect that the stripper did not return to service until May 3, 2021.

Sulfur Dioxide

The baseline actual SO_2 emissions from burning the SOG from the existing steam stripper and LVHC collection system gases are based on the average emissions factors developed from the most recent (October 2021) source testing for SO_2. The emissions are further sub-divided between LVHC and HVLC streams using the post-Project Columbia SO_2 emissions factors presented in Appendix C – Tab A of the July 2019 and April 2020 permit applications approved by SCDHEC in Construction Permit DF.

Nitrogen Oxides and Carbon Monoxide

The baseline actual NO_X and CO emissions from burning the SOG from the existing steam stripper are based on the post-Project Columbia NO_X emissions factors presented in Appendix C – Tab A of the July 2019 and April 2020 permit applications approved by SCDHEC in Construction Permit DF.

Volatile Organic Compounds

The baseline actual VOC emissions from the existing condensate stripper system are based on the actual amount of methanol stripped from the foul condensate during the baseline period for which records are available. The non-methanol VOC emissions (including the TRS compounds that are also VOC as further described in the next section) from the ASB from treatment of Mill process wastewater and the foul condensate not treated in the existing steam stripper are calculated using the U.S. EPA WATER9 Model. To calculate methanol emissions from the ASB, New-Indy Catawba used a spreadsheet version of the WATER9 calculations from the National Council for Air and Stream Improvement (NCASI) to calculate the fractions biodegraded and emitted developed from Procedure 5 (Multiple Zone Concentration Measurements) in 40 CFR Part 63, Appendix C, Form XIII ("NCASI Form XIII calculation spreadsheet"). The WATER9 Model and Form XIII calculation utilize site-specific liquid concentration data, the site-specific configuration of the treatment unit [including the area or length of unit, liquid depth, wind speed, aeration type (i.e., mechanical aeration)], and the total amount of aeration to calculate the emissions rate in grams per second (g/s).

Baseline actual methanol emissions from the ASB are based on the NCASI Form XIII calculations for NESHAP Subpart S performance testing conducted during the baseline period. The baseline actual VOC emissions from the LVHC collection system are based on the post-Project Columbia

VOC emissions factors presented in Appendix C – Tab A of the July 2019 and April 2020 permit applications approved by SCDHEC in Construction Permit DF.

Hydrogen Sulfide and Total Reduced Sulfur Compounds

The baseline hydrogen sulfide (H_2S) and total reduced sulfur (TRS) emissions from burning the SOG from the existing steam stripper and the LVHC collection system gases are based on the average emissions factors developed from the June 2021 source testing for H_2S and TRS. The emissions are further sub-divided between LVHC and HVLC streams using the post-Project Columbia H_2S and TRS emissions factors presented in Appendix C – Tab A of the July 2019 and April 2020 permit applications approved by SCDHEC in Construction Permit DF.

The baseline actual H_2S emissions from the ASB from treatment of Mill process wastewater and the foul condensate not treated in the existing steam stripper are calculated using the NCASI Hydrogen Sulfide Emissions Simulator, or "H2SSIM" Model, which utilizes site-specific wastewater configuration, site-specific liquid test results for H_2S, and site-specific data inputs [e.g., temperature, dissolved oxygen (DO), pH]. H2SSIM inputs are based on May and July 2022 sampling data for H_2S in the foul condensate, as well as dissolved oxygen (DO) data for the ASB taken during NESHAP Subpart S performance testing during the baseline period. The baseline emissions for methyl mercaptan (MMC), dimethyl disulfide (DMDS), and dimethyl sulfide (DMS) are calculated using WATER9 based on May and July 2022 sampling of the foul condensate. During the May and July 2022 testing, foul condensate sample results were representative of the concentrations before chemical oxidant was added. The Mill has been chemically oxidizing the contents of the Hardpipe prior to entry into the ASB since June 2021. For calculating BAE of H_2S and TRS emissions from the ASB, the May and July 2022 foul condensate samples were adjusted as follows to account for the effects of the chemical oxidant:

- H_2S concentrations in the Hardpipe effluent were reduced by 99%.
- DMS concentrations in the Hardpipe effluent were reduced by 90%.
- MMC concentrations in the Hardpipe effluent were reduced by 99% and assumed to be converted to DMDS.
- DMDS concentrations are assumed to not be reduced by chemical oxidant. DMDS concentrations in the Hardpipe effluent were increased to account for the oxidation of MMC to DMDS.

These adjustments are based on NCASI Technical Bulletin No. 949, Section 5.3.1 for Hydrogen Peroxide and additional bench scale study results and curves provided by NCASI. Pertinent pages from NCASI Technical Bulletin No. 949 and the bench scale study are attached as supporting information in Appendix B.

Steam Baseline

The BAE of products of combustion (NO_X, CO, VOC, PM, PM_{10}, $PM_{2.5}$, Lead, and CO_2e) for the steam required by the existing steam stripper are based on the actual heat input from fossil fuels to both combination boilers during the baseline period. New-Indy Catawba operates the two recovery furnaces as base-loaded steam generators with the combination boilers handling most swings in steam load. New-Indy Catawba burns all the biomass available in the combination boilers because biomass is the most cost-effective fuel on an MMBtu basis. Additional steam is generated from burning natural gas and No. 6 fuel oil as needed. During the baseline period, natural gas accounted for 97.9% of the fossil fuel heat input to both combination boilers, with No. 6 fuel oil constituting the remaining 2.1% of the fossil fuel heat input.

3.2.2.3.2 Projected Actual Emissions and Potential to Emit

PAE is defined by the SCDHEC Regulation 61-62.5, Standard No. 7, paragraph (B)(41) as:

> *"the maximum annual rate, in tpy, at which an existing emissions unit is projected to emit a regulated NSR pollutant in any one of the five (5) years (12-month period) following the date the unit resumes regular operation after the project, or in any one of the ten (10) years following that date, if the project involves increasing the emissions unit's design capacity or its potential to emit that regulated NSR pollutant and full utilization of the unit would result in a significant emissions increase or a significant net emissions increase at the major stationary source."*

As described previously, PAE are calculated from the existing steam stripper, existing foul condensate Hardpipe, existing ASB, existing LVHC collection system gases, and steam required for the existing steam stripper.

PTE is defined by the SCDHEC Regulation 61-62.5, Standard No Standard No. 7, paragraph (B)(37) as:

> *"the maximum capacity of a stationary source to emit a pollutant under its physical and operational design. Any physical or operational limitation on the capacity of the source to emit a pollutant, including air pollution control equipment and restrictions on hours of operation or on the type or amount of material combusted, stored, or processed, shall be treated as part of its design if the limitation or the effect it would have on emissions is federally enforceable."*

The future emissions from the new steam stripper system and the generation of steam to operate the new steam stripper system are PTE.

PAE and PTE were calculated for three different stripper operating scenarios as shown below in Table 3-1. The new stripper is expected to be online at least 90% of the annual operating time. The backup steam stripper is expected to be online 8% of the annual operating time. There will also be brief periods when the new stripper may need to go offline and the backup stripper brought into service. During these transition periods, untreated foul condensate will be discharged through the Hardpipe to the ASB. While in the Hardpipe prior to entering the ASB, the TRS compounds in the condensates will be chemically oxidized to reduce the potential for odors from the ASB when operating during these brief transition periods, which are expected to be equal to or less than 2% of the annual operating time.

The PAE and PTE for all scenarios are based on the design foul condensate sulfur loading [168 parts per million by weight (ppmw)] and maximum design foul condensate flow [850 gallons per minute (gpm)]. Emissions factors [on a pound per air-dried ton of pulp (lb/ADTP) basis] are calculated based on 2,444 ADTP/day, which is at the lower range of production for which the maximum design foul condensate flow is expected. The design foul condensate sulfur loading is based on liquid samples taken during the June 2021 site-specific testing. The sulfur concentration of 168 ppmw at the design foul condensate flow is equivalent to 0.70 pound of TRS as sulfur per ADTP. PAE are calculated for each of the three stripper operating scenarios based on 8,760 hours per year and a maximum pulp production of 2,700 ADTP/day.

The following sections provide further detail and different operating configurations within particular scenarios.

New Steam Stripper Online Scenario

While the new steam stripper is operating, the stripped condensate from the new steam stripper will be recycled to the brownstock washers, as needed.

The new stripper has two operating configurations, with and without the rectified methanol system operating. The rectified methanol system will separate methanol from the new stripper's offgases. The rectified methanol is referred to as SRL. As stated previously, the new steam stripper is expected to be online at least 90% of the annual operating time. The rectified methanol system is expected to be online 95% of the time that the new stripper is operating. A summary of the different operating control configurations for when the new stripper is operating is summarized in Table 3-2 below.

Table 3-1 Stripper Operating Scenarios

Stripper Operating Scenario	Stripper Scenario Operating Time	
	%	hrs
New Stripper Online	90%	7,884.0
Backup Stripper Online	8%	700.8
No Stripper Online (Foul Condensate to Hard Pipe)	2%	175.2

Table 3-2 New Stripper System Operating Scenarios

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time	
	%	hrs		%	hrs		%	hrs
New Stripper Online	90%	7,884.0	SRL Online	95%	7,489.8	SRL Methanol to RF2/3	100.0%	7,489.8
			SRL Online	95%	7,489.8	SRL LVHC to RF3	75.0%	5,617.4
			SRL Online	95%	7,489.8	SRL LVHC to CB1/CB2	25.0%	1,872.5
			SRL Offline	5%	394.2	SOG to CB1/CB2	100.0%	394.2

The SRL methanol is expected to contain approximately 40% of the TRS, with the remaining 60% in the LVHC off-gases from the rectified methanol system. The SRL methanol will be blended with black liquor and burned in both recovery furnaces at a maximum concentration of 1% for safe operation of each recovery furnace. The sodium fume inside the recovery furnace absorbs the sulfur from combustion of the black liquor and will also absorb the sulfur from combustion of the SRL methanol. We conservatively assumed 99% absorption within the salt fume based on information provided in NCASI Technical Bulletin No. 604. This is expected to occur 100% of the time the rectified methanol system is operating (SRL mode).

When operating in SRL mode, the LVHC off-gases from the rectified methanol system will be vented into the LVHC System. In addition, the LVHC gases from the evaporators and turpentine recovery system will be vented to the No. 3 Recovery Furnace as part of this project. The No. 3 Recovery Furnace is expected to be available for LVHC combustion at least 75% of the operating time. When the No. 3 Recovery Furnace cannot receive these gases, the LVHC will be combusted in the combination boilers the remaining 25% of the time. The LVHC gases will pass through the LVHC caustic scrubber prior to being combusted in the combination boilers. The LVHC scrubber removes approximately 50% of the sulfur from the gas stream. The LVHC gas scrubber is not necessary and will not be used when the LVHC gases are being combusted in the No. 3 Recovery Furnace because the salt fume in the recovery furnace provides the expected sulfur control.

Sulfur Dioxide, Hydrogen Sulfide, and Total Reduced Sulfur Compounds

As previously stated, the SRL methanol is expected to contain approximately 40% of the TRS as sulfur foul condensate loading of 0.70 lb S/ADTP. The sodium fume inside the recovery furnace absorbs the sulfur produced from combusting black liquor and will also absorb the sulfur produced by combusting the foul condensate present in the methanol. It is conservatively assumed that 99% of the sulfur from combusting the SRL methanol is absorbed by the sodium fume (NCASI Technical Bulletin 604), and the remaining 1% is oxidized to SO_2. This is expected to occur 100% of the time in SRL mode.

To calculate TRS and H_2S emissions from burning the SRL methanol in the recovery furnaces, a sulfur capture of 99% is applied with a 99% conversion factor to SO_2, for a combined capture and conversion factor of 99.9%.

Similarly, the LVHC gases from the rectified methanol system are expected to contain approximately 60% of the TRS as sulfur foul condensate loading of 0.70 lb S/ADTP and will be vented into the LVHC System. When the LVHC is combusted in the No. 3 Recovery Furnace, the sodium fume inside the recovery furnace is also expected to absorb 99% of the sulfur from the LVHC gases before it can be converted to SO_2. When the LVHC is combusted in the combination boilers, the LVHC scrubber will capture 50% of the sulfur before conversion to SO_2. H_2S and

TRS emissions from the rectified methanol system LVHC are calculated based on conservatively assuming 99.9% capture or conversion to SO_2 in the recovery furnace and 99% conversion to SO_2 in the combination boilers.

When the rectified methanol system is not operating, SOG from the new stripper will be vented to the combination boilers, and the TRS as sulfur foul condensate loading of 0.70 lb S/ADTP is assumed to be 100% converted to SO_2 to calculate SO_2 emissions. H_2S and TRS emissions from combusting SOGs in the combination boilers are based on conservatively assuming a 99% conversion to SO_2.

When the new stripper is operating, regardless of SRL status, there will be no foul or stripped condensate flow to the Hardpipe. Projected emissions of TRS compounds (excluding H_2S) from the ASB are calculated based on the WATER9 Model. Projected emissions of H_2S from the ASB are calculated based on the H2SSIM Model. Both WATER9 and H2SSIM emissions calculations are based on the average ASB influent concentrations from data collected during the 2021 and 2022 TRS testing efforts.

Nitrogen Oxides

When the rectified methanol system is operating, the methanol condenser is expected to condense more than 90% of the methanol in the SOG. The SOG also contains ammonia, which is also expected to be condensed with the methanol. The remaining ammonia will be vented with the SRL off-gases into the LVHC system. As a result, there will be an increase in ammonia when (1) SRL methanol is mixed with liquor and burned in the recovery furnaces and (2) the SRL LVHC off-gases are combusted in the No. 3 Recovery Furnace.

The ammonia in the methanol is expected to contribute less than 1% of the total nitrogen in the black liquor. The NO_X emissions from the recovery furnaces have been conservatively assumed to increase 1% when burning SRL methanol and the SRL LVHC.

The NO_X emissions from combustion of the SRL LVHC and SOG in the combination boilers are based on the post-Project Columbia NO_X emissions factors presented in Appendix C – Tab A of the July 2019 and April 2020 permit applications approved by SCDHEC in Construction Permit DF.

Carbon Monoxide

In SRL mode, the SRL methanol will be blended with the black liquor and burned in both recovery furnaces at a maximum concentration of 1% for safe operation of each recovery furnace. There is no information to suggest the CO emissions will change when the SRL methanol is burned in the recovery furnaces.

The CO emissions from combustion of the SRL LVHC and SOG are based on the post-Project Columbia CO emissions factors presented in Appendix C – Tab A of the July 2019 and April 2020 permit applications approved by SCDHEC in Construction Permit DF.

Volatile Organic Compounds

The projected actual VOC emissions for the new steam stripper system are based on the theoretical maximum methanol collection (16 lb/ODTP) at the maximum pulp production (2,700 ADTP/day).

In SRL mode, the SRL methanol will be blended with the black liquor and burned in both recovery furnaces at a maximum concentration of 1% for safe operation of each recovery furnace. The SRL methanol will be combusted in the recovery furnace to an expected 99.9% VOC destruction in the liquid phase.

When the new stripper is operating, there will be no foul or stripped condensate flow to the Hardpipe. Non-methanol VOC emissions (acetaldehyde, methyl ethyl ketone, propionaldehyde, and TRS VOCs) from the ASB are calculated based on WATER9, using the average ASB influent concentrations from data collected during 2021 and 2022 TRS and NESHAP Subpart S testing efforts. Methanol emissions from the ASB are based on the NCASI Form XIII calculation spreadsheet using the average ASB influent and effluent methanol concentrations from all data collected during 2021 and 2022 and the average zone treatment profiles from 2021 and 2022 NESHAP Subpart S performance tests.

Backup Stripper Online Scenario

As stated previously, once the new stripper is installed, the existing stripper will be demoted to the backup steam stripper role. The backup steam stripper is expected to be online 8% of the annual operating time. The backup steam stripper will be operated in "TRS mode" to remove TRS from the foul condensate. In TRS mode, the backup stripper will also remove approximately 45% of the methanol from the foul condensate. The SOG from the backup steam stripper will be vented to the combination boilers. The stripped condensate from the backup steam stripper will be discharged to the Hardpipe where the remaining unstripped methanol will be biologically treated in the ASB.

Sulfur Dioxide

The backup steam stripper will be operated in "TRS mode" to remove TRS from the foul condensate. SO_2 emissions from combustion of the backup stripper SOG in the combination boilers are conservatively calculated assuming all of the 0.70 lb S/ADTP of sulfur present in the foul condensate will be captured in the SOG and converted to SO_2 during combustion.

Nitrogen Oxides and Carbon Monoxide

The NO_X and CO emissions from combustion of SOG are based on the post-Project Columbia NO_X emissions factors presented in Appendix C – Tab A of the July 2019 and April 2020 permit applications approved by SCDHEC in Construction Permit DF.

Volatile Organic Compounds

The projected actual VOC emissions for the backup stripper are based on the maximum expected methanol collection (16 lb/ODTP) at the maximum pulp production (2,700 ADTP/day). To calculate VOC emissions from backup stripper SOG combustion, it is conservatively assumed that the methanol present in the foul condensate will be captured with the SOG and combusted with 98% control at the combination boilers.

Methanol emissions from the ASB are based on the NCASI Form XIII calculation spreadsheet using the average ASB influent and effluent methanol concentrations from all data collected during 2021 and 2022 and the average zone treatment profiles from 2021 and 2022 NESHAP Subpart S performance tests. The methanol concentration in the stripped condensate from the backup stripper is based on the theoretical maximum methanol collection (16 lb/ODTP) in the foul condensate and an expected 45% removal efficiency from the backup stripper operating in "TRS mode."

Acetaldehyde, methyl ethyl ketone, and propionaldehyde are assumed to be emitted at the same ratio to methanol as compared to the baseline. Emissions of TRS compounds that are also VOC are calculated using WATER9 with the design foul condensate loadings of TRS compounds being reduced by 98% in the backup stripper operating in "TRS mode" before entering the ASB.

Hydrogen Sulfide and Total Reduced Sulfur Compounds

To calculate TRS and H_2S emissions from backup stripper SOG combustion, it is conservatively assumed that the design foul condensate sulfur loading will be captured with the SOG and only 99% will be converted to SO_2 at the combination boilers.

Projected emissions of TRS compounds (excluding H_2S) from the ASB are based on WATER9. Projected emissions of H_2S from the ASB are calculated based on H2SSIM. Both WATER9 and H2SSIM emissions are based on the average ASB influent concentrations from data collected during 2021 and 2022 TRS testing and the design foul condensate sulfur loadings of TRS compounds being reduced by 98% in the backup stripper operating in "TRS mode."

No Stripper Online Scenario

The post-Project emissions also account for brief periods when the new stripper may need to go offline and the backup stripper brought into service. During these transition periods, untreated foul condensate will be discharged through the Hardpipe to the ASB. While in the Hardpipe prior to entering the ASB, the TRS compounds will be chemically oxidized to reduce the potential for odors from the ASB when operating during these brief transition periods, which are expected to be less than 2% of the annual operating time.

When there is no SOG being created by either stripper, there are no emissions of SO_2, NOx, or CO corresponding to the brief periods when all foul condensate is treated in the ASB.

Volatile Organic Compounds, Hydrogen Sulfide, and Total Reduced Sulfur Compounds

Methanol emissions from the ASB are based on NCASI Form XIII calculation spreadsheet using the average ASB influent and effluent methanol concentrations from all data collected during 2021 and 2022 and the average zone treatment profiles from 2021 and 2022 NESHAP Subpart S performance tests. The methanol concentration in the foul condensate is based on the maximum methanol collection (16 lb/ODTP).

Acetaldehyde, methyl ethyl ketone, and propionaldehyde are assumed to be emitted at the same ratio to methanol as compared to the baseline.

Emissions of TRS compounds are calculated using WATER9 and H2SSIM (H_2S) with the design foul condensate sulfur loadings of TRS compounds being adjusted based on NCASI Technical Bulletin No. 949 to account for the effects of the chemical oxidant, consistent with how baseline actual emissions are calculated.

- H_2S concentrations in the Hardpipe were reduced by 99%.
- DMS concentrations in the Hardpipe were reduced by 90%.
- MMC concentrations in the Hardpipe were reduced by 99% and assumed to be converted to DMDS.
- DMDS concentrations are assumed not reduced by chemical oxidant. DMDS concentrations of the Hardpipe were increased to account for the MMC oxidized into DMDS.

PAE and PTE Independent from Stripper Operating Scenario

LVHC Collection System

As stated previously, the No. 3 Recovery Furnace is expected to provide LVHC combustion at least 75% of the operating time. When the No. 3 Recovery Furnace cannot receive the LVHC gases, the LVHC gases will then be combusted in the combination boilers the remaining 25% of the time. The emissions from combusting LVHC gases are unaffected by the stripper operating scenario. PAE of SO_2, H_2S, and TRS are based on 2021 stack testing. The VOC PAE from the LVHC collection system are based on the post-project Columbia VOC emissions factors presented Appendix C – Tab A of the July 2019 and April 2020 permit applications approved by SCDHEC in Construction Permit DF.

No. 3 Recovery Furnace LVHC Ignitor

The No. 3 Recovery Furnace will also have a 1 MMBtu/hr natural gas-fired LVHC ignitor to be used when the black liquor load is less than 50%. The natural gas ignitor is expected to be required no more than 15% of the time the No. 3 Recovery Furnace is in operation. PAE of products of combustion from the ignitor are based on AP-42 emissions factors.

Steam for New Stripper and Backup Stripper

The steam requirements for the new stripper and the backup stripper were provided by the vendor and adjusted for the thermal efficiency of the combination boilers firing natural gas and No. 6 fuel oil. The projected fossil fuel usage reflects the highest No. 6 fuel oil usage occurring during the previous 10 years. The highest fuel oil usage was during calendar year 2014 and accounted for 18.4% of the fossil fuel heat input. The PAE and PTE of products of combustion are based on AP-42 emissions factors.

3.2.2.3.3 PSD Non-Applicability

The changes in emissions from the Mill as a result of the Project were compared to the significant emission rates in Standard No. 7, paragraph (B)(49). Based on the emissions calculations described above, presented in Appendix B, and summarized in Table 3-3, the Project is not subject to the PSD permitting requirements in paragraphs (J) through (R) of Standard No. 7.

Table 3-3 Summary of PSD Applicability for the Project (tpy)

Pollutant[(A)]	PM	PM_{10}	$PM_{2.5}$	NO_X	SO_2	CO	H2SO4	TRS	VOC	Pb	H_2S	Total CO_2e
Baseline Actual Emissions	1.26	1.16	1.09	132	770	27.1	1.28	13.4	249	1.24E-04	3.77	13,904
Projected Actual Emissions	13.4	10.4	8.45	148	629	64.2	2.43	15.6	248	2.08E-03	5.69	48,629
Net Emissions Changes (PAE - BAE)	12.2	9.28	7.36	16.1	-141.35	37.1	1.15	2.18	-1.4	1.95E-03	1.92	34,725
PSD Significant Emissions Rates	**25**	**15**	**10**	**40**	**40**	**100**	**7**	**10**	**40**	**0.6**	**10**	**75,000**
PSD Significant?	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**

A - HF is not emitted from new, modified, or affected emissions units.

3.2.2.4 Standard No. 7 – Prevention of Significant Deterioration – Air Dispersion Modeling Requirements

Standard No. 7 also includes PSD air quality increments that apply to all increases and decreases in PSD pollutant emissions following the PSD minor source baseline date. In York County the minor source baseline dates are December 1, 1981, for PM10 and March 3, 2017 for PM2.5. This Application does not trigger PSD review as discussed above; therefore, the project is unlikely to interfere with attainment or maintenance of State or Federal ambient air quality standards.

3.2.2.5 Standard No. 8 – Toxic Air Pollutants

SCDHEC Standard No. 8 regulates emissions of air toxics from new and existing sources. The Standard does not apply to fuel burning sources that burn only virgin fuel or specification used oil. Section I.D(1) of Standard No. 8 exempts sources subject to a Federal NESHAP. The Mill is subject to the Federal NESHAP for the pulp and paper source category (Subparts S and MM), industrial boilers (Subpart DDDDD), and reciprocating internal combustion engines (Subpart ZZZZ). Section I.D(2) of Standard No. 8 exempts non-NESHAP sources after a facility-wide residual risk analysis is completed. U.S. EPA published the results of facility-wide residual risk analyses for Subpart S sources on December 27, 2011, and for Subpart MM sources on December 30, 2017. The residual risk analyses completed by U.S. EPA concluded that there was no unacceptable risk from pulp and paper mills. Therefore, all emissions sources of HAP at New-Indy Catawba are exempt from Standard No. 8 under sections I.D(1) and/or I.D(2).

New-Indy Catawba emits two South Carolina toxic air pollutants (TAP) that are not listed HAP, H_2S and methyl mercaptan. Both compounds are generated by the Kraft pulping process and are components of TRS gases that are contained in LVHC and HVLC gases and in the pulping process condensates. Section I.D(3) allows sources to request an exemption for non-HAPs controlled by MACT controls to reduce HAP. This Project will improve emissions of H_2S and MMC from the Mill. However, because SCDHEC recently modeled emissions of H_2S and MMC and to demonstrate that emissions from these two TAPs following the Project remain below the maximum allowable ambient concentrations (MAAC) in Standard No. 8, the Mill has included an updated modeling demonstration in Appendix C.

The updated modeling analysis for TRS (as H_2S), H_2S and MMC in Appendix C focused on the changes to the emissions from the aerated stabilization basin. The TRS, H_2S and MMC emissions from the No. 3 Recovery furnace were not updated due to the insignificant maximum modeled concentrations from the No. 3 Recovery Furnace when compared to the overall maximum modeled concentrations for the Mill. The TRS (as H_2S) maximum modeled concentrations from the No. 3 Recovery Furnace were approximately 0.12% of the maximum modeled concentrations from the Mill. Similarly, the MMC concentrations were approximately 0.08% of the maximum concentrations from the Mill, and the TRS (as H_2S) maximum concentrations from the No. 3 Recovery Furnace were approximately 0.04% of the maximum mill concentrations.

3.2.3 Regulation 61-62.60: South Carolina Designated Facility Plan and New Source Performance Standard

Regulation 61-62.60 incorporates the 40 CFR Part 60 Subparts by reference. Refer to Section 3.1.1 for a discussion of 40 CFR Part 60.

3.2.4 Regulation 61-62.61 and 61-62.62: National Emission Standards for Hazardous Air Pollutants

Regulation 61-62.61 incorporates the 40 CFR Part 61 Subparts by reference. Refer to Section 3.1.2 for a discussion of the non-applicability of 40 CFR Part 61. Regulation 61-62.63 incorporates the 40 CFR Part 63 Subparts by reference. Refer to Section 3.1.2 for a discussion of applicability of 40 CFR Part 63.

3.2.5 Regulation 61-62.70 – Title V Operating Permit Program

Refer to Section 3.1.6 for discussion of the TVOP Program.

3.3 PROVISIONS OF THE SCDHEC CONSENT ORDER AND EPA CONSENT DECREE

This section addresses the provisions of the November 23, 2022 SCDHEC Consent Order and Part I of Appendix A of the November 16, 2022 EPA Consent Decree.

3.3.1 November 23, 2022 SCDHEC Consent Order

Items 4 through 6 of the Consent Order require that New-Indy Catawba:

- Install, operate, and maintain a primary stripper that is adequately sized to collect and treat all foul condensate streams in accordance with applicable state and federal air quality regulations. *The proposed new stripper will be sized at 850 gpm, which is designed to process foul condensates generated from producing the maximum pulp production of 2,700 ADTP/d, and New-Indy Catawba will operate the unit in accordance with applicable state and federal air quality regulations.*
- The primary stripper shall use low-pressure steam and must be designed for both methanol and sulfur compound removal with the off gases being treated in the recovery boilers to absorb the sulfur compounds in the stripper off gas. The proposed new stripper will utilize 60 pounds per square inch gauge (psig) steam. *The new stripper off-gases and SRL methanol will be*

incinerated in the No. 2 or 3 Recovery Furnace, with the exception of when the SRL system is unavailable (5% of the operating time of the new stripper).

- Complete preliminary engineering and submit a construction permit application for the primary stripper within one hundred and twenty (120) days of the execution of this order. *Preliminary engineering is complete and this application is being submitted by March 23, 2023.*
- New-Indy must optimize, operate, and maintain the existing stripper at its current design capacity to allow it to be operated independently of the primary stripper. To optimize the existing stripper at its current design, it will be operated in "TRS mode" to remove 98% of the TRS and approximately 45% of the methanol from the foul condensate.
- The following required events will be completed in the future:
    - Order the primary stripper within 30 days of submitting the application for the air construction permit.
    - Within 30 days of receiving the air construction permit, New-Indy Catawba must start civil engineering preparation.
    - Within 30 days of receiving the primary stripper, New-Indy Catawba must start installation and testing.
    - New-Indy Catawba must complete startup operations and place the primary stripper into operation no later than June 30, 2025.
    - New-Indy shall operate its steam stripper system, comprised of the primary stripper and the existing stripper, in accordance with all applicable state and federal air quality regulations
    - In the event the stripping system is out of service and foul condensate must be discharged to the ASB, New-Indy Catawba must use automated control of addition of a chemical oxidant, hydrogen peroxide, to treat the unstripped foul condensate prior to discharging into the ASB to maintain a rolling 90-minute average ORP of the foul condensate above 0 millivolts.
    - New-Indy Catawba must notify SCDHEC at least 48 hours prior to any planned downtime and within 24 hours of unplanned downtime for which the primary stripper will not be operational (and for the existing stripper when it should be operating but will not be).
    - New-Indy Catawba must submit reports to the Department regarding the implementation of the Consent Order to NewIndyOrderReports@dhec.sc.gov. For twelve consecutive months after execution of this order, the reports shall be submitted monthly on the 1st business day of the month. Thereafter, reports shall only be submitted every three months on the 1st business day of the month until the order terminates.

3.3.2 November 16, 2022 EPA Consent Decree

Item I(a) of Appendix A

Item I(a) of Appendix A of the Consent Decree contains requirements related to the uptime and monitoring of the foul condensate steam stripper at the Mill.

- New-Indy Catawba will operate their foul condensate treatment system (inclusive of the new and existing steam strippers) during all times that unbleached kraft pulp is being produced and foul condensate is being generated at the Mill.
- During periods the new steam stripper is experiencing downtime the existing steam stripper will be used.
- Periods of downtime in which both strippers are down will not exceed 576 hours for the first year and 460 hours annually thereafter.
- Peroxide will be added to the non-stripped condensate during the transition to the existing steam stripper and will continue to be added throughout the period in which the existing steam stripper is in operation.
- The Mill will notify the necessary authorities forty-eight (48) hours prior to any scheduled downtime and within twenty-four (24) hours of any unscheduled downtime and will operate both steam strippers according to 40 CFR Part 63, Subpart S.

Item I(b) of Appendix A of the Consent Decree

Item I(b) of Appendix A of the Consent Decree covers the maintenance, operation, and calibration of the system used to treat the unstripped foul condensate by the Mill. The Mill's foul condensate treatment system (inclusive of the new equipment to be installed with this application) will be capable of continuously measuring the oxidation reduction potential (ORP) of the foul condensate, automatically controlling the dosage of hydrogen peroxide to maintain a rolling ninety-minute average of the ORP of the foul condensate above 0 millivolts (mV) before it is discharged to the ASB, and treating the maximum amount of foul condensate produced when both steam strippers are down and when untreated foul condensate is discharged to the Hardpipe.

Item I(c) of Appendix A of the Consent Decree

Item I(c) of Appendix A of the Consent Decree contains recordkeeping requirements for data obtained by the ORP monitoring system used by the Mill. The Mill will maintain continuous records of the ORP monitoring system used by the Mill and will provide data to U.S. EPA upon request.

Item I(d) of Appendix A of the Consent Decree

Item I(d) of Appendix A of the Consent Decree includes reporting requirements for the ORP monitoring system used by the Mill. When untreated foul condensate is discharged to the Hardpipe, New-Indy Catawba will include the date, time, and value of any instance of a rolling ninety-minute average of the ORP falling below 0 mV in the Mill's semi-annual report for the previous six months.

APPENDIX A -
PERMIT APPLICATION FORMS

RECEIVED
MAR 23 2023
BAQ PERMITTING

SECTION 1 - FACILITY IDENTIFICATION

SC Air Permit Number (8-digits only) *(Leave blank if one has never been assigned)* 2440 - 0005	Application Date March 2023
Facility Name/Legal Identity *(This should be the official legal name under which the facility is owned/operated and should be consistent with the name registered with the S.C. Secretary of State's office, as applicable.)* New-Indy Catawba LLC	
Facility Site Name (Optional) *(Please provide any alternative or additional identifier of the facility, such as a specific plant identifier (e.g., Columbia plant) or any applicable "doing business as" (DBA) identity. This name will be listed on the permit and used to identify the facility at the physical address listed below.)*	
Facility Federal Tax Identification Number *(Established by the U.S. Internal Revenue Service to identify a business entity)* 83-1904423	

REQUEST TYPE (Check all that apply)

Exemption Request: ☐
Complete Section 1 and attach documentation to support exemption request.

Construction Application:
☒ Minor New Source Review Project
☐ Synthetic Minor Project
☐ Prevention of Significant Deterioration Project
☐ 112(g) Project

Expedited Review Request: ☐
If checked, include Expedited Form D-2212 in the construction application package.

Construction Permit Modification: ☐
Provide the construction permit ID (e.g. CA, CB, etc.) for which modification is requested:

Application Revision: ☐

CONSTRUCTION PERMIT APPLICATION FORMS BEING REVISED
(Amended construction permit forms must be filled out completely and attached to this modification request.)

Form #	Date of Original Submittal	Brief Description of Revision
D-2566	N/A	N/A
D-2573	N/A	N/A

FACILITY PHYSICAL ADDRESS

Physical Address: 5300 Cureton Ferry Road		County: York
City: Catawba	State: SC	Zip Code: 29704

Facility Coordinates *(Facility coordinates should be based at the front door or main entrance of the facility)*
Latitude: 34°50′37″N   Longitude: 80°53′25″W

FACILITY'S PRODUCTS / SERVICES	
Primary Products / Services *(List the primary product and/or service)* Linerboard / Pulp Manufacturing	
Primary SIC Code *(Standard Industrial Classification Codes)* 2631	Primary NAICS Code *(North American Industry Classification System)* 322130
Other Products / Services *(List other products and/or services)*	
Other SIC Code(s):	Other NAICS Code(s):

PROJECT DESCRIPTION
Project Description (What, why, how, etc.): Installation of a new steam stripper system to treat foul condensate prior to being recycled to the Brownstock washers. The new steam stripper will include a new stripper feed tank, new methanol tank, new hot water tank, and a new methanol rectification condenser. The rectified methanol will be burned in the recovery furnaces with the black liquor. The LVHC gases from the methanol condenser system, stripper feed tank, and methanol tank will be combusted in the No. 3 Recovery Furnace or back-up in the Nos. 1 or 2 Combination boilers. The hot water tank is not expected to be a source of air emissions. The existing steam stripper will serve as a backup to the new steam stripper. When both new and backup strippers are out of service, the condensate will be directed to the hard pipe with chemical oxidation prior to being treated in the aerated stabilization basin.

AIR PERMIT FACILITY CONTACT *(Person listed will be in our files as the point of contact for all air permitting related questions and will receive all air permitting notifications.)*			
Title/Position: Sr. Environ. Engineer	Salutation: Mr.	First Name: Bob	Last Name: Tourville
Mailing Address: P.O. Box 7			
City: Catawba		State: SC	Zip Code: 29704
E-mail Address: bob.tourville@newindycb.com		Primary Phone No.: (803) 981-8009	Alternate Phone No.:

The signed permit will be e-mailed to the designated Air Permit Contact. If additional individuals need copies of the permit, please provide their names and e-mail addresses.	
Name	**E-mail Address**
Steven Moore	smoore@all4inc.com

CONFIDENTIAL INFORMATION / DATA
Is confidential information or data being submitted under separate cover? ☒ No ☐ Yes*

If yes, submit **ONLY ONE COMPLETE CONFIDENTIAL APPLICATION, with original signature, along with the public version of the application.*

CO-LOCATION DETERMINATION
Are there other facilities in close proximity that could be considered collocated? ☒ No ☐ Yes*
If yes, list potential collocated facilities, including air permit numbers if applicable:

**If yes, please submit collocation applicability determination details in an attachment to this application.*

dhec

OWNER OR OPERATOR			
Title/Position: Technical Manager	Salutation: Mr.	First Name: Charles	Last Name: Cleveland
Mailing Address: P.O. Box 7			
City: Catawba		State: SC	Zip Code: 29704
E-mail Address: pete.cleveland@new-indycb.com		Primary Phone No.: 803-981-8000	Alternate Phone No.:
OWNER OR OPERATOR SIGNATURE			
I certify, to the best of my knowledge and belief, that no applicable standards and/or regulations will be contravened or violated. I certify that any application form, supporting documentation, report, or compliance certification submitted in this permit application is true, accurate, and complete based on information and belief formed after reasonable inquiry. I understand that any statements and/or descriptions, which are found to be incorrect, may result in the immediate revocation of any permit issued for this application.			

03/22/2023

Signature of Owner or Operator — Date

APPLICATION PREPARER (if other than Professional Engineer below)			
Title/Position: Senior Managing Consultant	Salutation: Mr.	First Name: Steven	Last Name: Moore
Mailing Address: 630 Davis Drive, Suite 203			
City: Durham		State: NC	Zip Code: 27560
E-mail Address: smoore@all4inc.com		Phone No.: (919) 234-5981	Cell No.: (864) 616-4711

PROFESSIONAL ENGINEER INFORMATION			
Consulting Firm Name: ALL4 LLC		SC Certificate of Authority License No.: 6409	
Title/Position: PE	Salutation: Ms.	First Name: Sheryl	Last Name: Watkins
Mailing Address: 300 Chastain Center Blvd, Suite 395			
City: Kennesaw		State: Georgia	Zip Code: 30144
E-mail Address: swatkins@all4inc.com		Phone No.: (678) 293-9428	Cell No.: (386) 503-0266
SC License/Registration No.: 34347			
PROFESSIONAL ENGINEER SIGNATURE			
I have placed my signature and seal on the engineering documents submitted, signifying that I have reviewed this construction permit application as it pertains to the requirements of *South Carolina Regulation 61-62, Air Pollution Control Regulations and Standards.*			

Sheryl Watkins 3-20-23

Signature of Professional Engineer — Date

SOUTH CAROLINA
PROFESSIONAL ENGINEER
LICENSED
No. 34347
SHERYL WATKINS

This form is subject to Retention Schedule 16303.

EQUIPMENT / PROCESS INFORMATION					
Equipment ID/ Process ID	**Action**	**Equipment / Process Description**	**Maximum Design Capacity (Units)**	**Control Device ID(s)**	**Emission Point ID(s)**
9801	☐ Add ☐ Remove ☒ Modify ☐ Existing	Existing Steam Stripper	850 gallons/minute	9820, 2605, 3705, 2901	2610S2, 2610S1, Fugitive
9802	☐ Add ☐ Remove ☒ Modify ☐ Existing	Hardpipe	850 gallons/minute	2901	Fugitive
9803	☒ Add ☐ Remove ☐ Modify ☐ Existing	New Steam Stripper (Methanol Condenser)	6.5 gallons/minute	5260, 5260C, 2605, 3705, 5105	5105S, 2610S2, 2610S1
9803	☒ Add ☐ Remove ☐ Modify ☐ Existing	New Steam Stripper (Condensed Methanol)	6.5 gallons/minute	2505, 5105	2505S, 5105S
9803	☒ Add ☐ Remove ☐ Modify ☐ Existing	New Steam Stripper (Stripper Off Gases)	850 gallons/minute	9820, 2605, 3705	2610S2, 2610S1
9804	☒ Add ☐ Remove ☐ Modify ☐ Existing	New Steam Stripper Feed Tank	80,400 gallons	5260, 5260C, 5105, 2605, 3705	2610S2, 2610S1, 5105S
9805	☒ Add ☐ Remove ☐ Modify ☐ Existing	New Steam Stripper Rectified Liquid Methanol Tank	1,300 gallons	5260, 5260C, 5105, 2605, 3705	2610S2, 2610S1, 5105S

This form is subject to Retention Schedule 16303.

CONTROL DEVICE INFORMATION								
Control Device ID	Action	Control Device Description	Maximum Design Capacity (Units)	Inherent/ Required/ Voluntary	Pollutants Controlled (Include CAS #)	Capture Efficiency	Destruction/ Removal Efficiency	Emission Point ID(s)
2505	☐ Add ☐ Remove ☐ Modify ☒ Existing	No. 2 Recovery Furnace	412,140 tons BLS/year	Required	See Appendix B/Narrative			2505S
2605	☐ Add ☐ Remove ☐ Modify ☒ Existing	No. 1 Combination Boiler	405 MMBtu/hr	Required	See Appendix B/Narrative			2610S2
2901	☐ Add ☐ Remove ☐ Modify ☒ Existing	Aerated Biotreatment (Aerated Stabilization Basin)	N/A	Required	See Appendix B/Narrative			Fugitive
3705	☐ Add ☐ Remove ☐ Modify ☒ Existing	No. 2 Combination Boiler	720 MMBtu/hr	Required	See Appendix B/Narrative			2610S1
5105	☐ Add ☐ Remove ☐ Modify ☒ Existing	No. 3 Recovery Furnace	744,600 tons BLS/year	Required	See Appendix B/Narrative			5105S
9820	☐ Add ☐ Remove ☒ Modify ☐ Existing	Stripper Off Gases Collection System	2,700 ADTP/day	Required	See Appendix B/Narrative			2610S1, 2610S2
5260	☐ Add ☐ Remove ☒ Modify ☐ Existing	LVHC Collection System	2,700 ADTP/day	Required	See Appendix B/Narrative			2610S1, 2610S2, 5105S
5260C	☐ Add ☐ Remove ☐ Modify ☒ Existing	LVHC Collection System Caustic Scrubber	2,700 ADTP/day	Required	See Appendix B/Narrative			2610S1, 2610S2, 5105S

This form is subject to Retention Schedule 16303.

Check Box for information addressed	Required Information
	Source identification and emissions:
☒	• Name of each source, process, and control device.
☒	• Assign each source an Equipment ID. The IDs must match the IDs listed in Section 2 of this application.
☒	• Assign an Emission Point ID for each source.
☒	• Assign a Control Device ID for each control device.
☒	• List each pollutant the source will emit.
☒	• List the Uncontrolled, Controlled, and PTE emissions for each source or equipment in lb/hr and tons/year.
☒	• Emission rates for each pollutant should be totaled and listed in lb/hr and tons/year.
☒	• Provide the CAS# for each Hazardous Air Pollutant (HAP) and/or Toxic Air Pollutant (TAP).
	Information to support emission rates:
☒	• Sample calculations.
☒	• Emission factors. Include the source, revision date, specific table and/or chapters. Include source test data if factors were derived from source testing.
☒	• Explanation of assumptions, bottlenecks, etc.
☐	• Source test information: A copy of the source test results may be requested. If the test results are not included in the application, the application should cite whether this was a DHEC approved test, and if not, explain where the test was conducted and other identifying information.
☐	• Manufacturer's data.
☐	• Vendor guarantees that support control device efficiencies.
☒	• New Source Review (NSR) analysis.
☒	• Other (e.g. example particle size analysis)

	Existing (Permitted) Facilities	
Check Box	**Required Information**	**Location in Application**
☒	Facility-wide emissions prior to construction/modification: • Include an explanation if these emissions do not match the facility-wide emissions submitted in the last application.	Appendix B
☒	Facility-wide emissions after construction/modification: • Include net change, if applicable.	Appendix B
	As applicable for the construction/ modification:	
☒	• Name of each source.	See Equipment/Process Information Above

Existing (Permitted) Facilities		
Check Box	**Required Information**	**Location in Application**
☒	• Assign each source an Equipment ID. The IDs must match the IDs listed in Section 2 of this application or on your current construction / operating permit.	See Equipment/Process Information Above
☒	• Assign a Control Device ID for each control device.	See Equipment/Process Information Above
☒	• Assign an Emission Point ID for each source.	See Equipment/Process Information Above
☒	• List each pollutant the source will emit.	Appendix B
☒	• List the Uncontrolled, Controlled, and PTE (if applicable) emissions for each source or equipment.	Appendix B
☒	• Emission rates for each pollutant should be totaled and listed in lb/hr and tons/year.	Appendix B
☒	• Provide the CAS# for each HAP and/or TAP.	Appendix B
Information to support facility-wide emission rates:		
☒	• Sample calculations.	Appendix B
☒	• Emission factors. Include the source, revision date, specific table and/or chapters. Include source test data if factors were derived from source testing.	Narrative, Appendix B
☒	• Explanation of assumptions, bottlenecks, etc.	Narrative
☒	• Source test information: A copy of source the test results may be requested. If the results are not included in the application, the application should cite whether this was a DHEC approved test and if not, explain where the test was conducted and other identifying information.	Appendix B
☐	• Manufacturer's data.	
☐	• Vendor guarantees that support control device efficiencies.	
☒	• NSR analysis.	Narrative
☒	• Other (please explain)	Appendix B

Check Box	State and Federal Air Pollution Control Regulations and Standards
☒	S.C. Regulation 61-62.1 Section II.E Synthetic Minor Construction Permits
☒	S.C. Regulation 61-62.5 Air Pollution Control Standards
☐	• Standard No. 1 Emissions from Fuel Combustion
☒	• Standard No. 2 Ambient Air Quality
☒	• Standard No. 3 Waste Combustion and Reduction (state only)
☒	• Standard No. 4 Emissions from Process Industries *(Note: If Section VIII of this Standard applies, include the process weight rate (PWR) in ton per hour for each applicable source or process.)*
☐	• Standard No. 5 Volatile Organic Compounds
☐	• Standard No. 5.2 Nitrogen Oxides Lowest Achievable Emission Rate
☒	• Standard No. 7 Prevention of Significant Deterioration (PSD)
☐	• Standard No. 7.1 Nonattainment New Source Review (NSR)
☒	• Standard No. 8 Toxic Air Pollutants (TAPs) (state only)
☐	S.C. Regulation 61-62.6 Control of Fugitive Particulate Matter
☒	S.C. Regulation 61-62.60 and 40 CFR Part 60 New Source Performance Standards (NSPS)
☒	S.C. Regulation 61-62.61 and 40 CFR Part 61 National Emission Standards for Hazardous Air Pollutants (NESHAP)
☒	S.C. Regulation 61-62.63 and 40 CFR Part 63 National Emission Standards for Hazardous Air Pollutants (NESHAP) for Source Categories
☒	40 CFR Part 64 Compliance Assurance Monitoring (CAM)
☐	S.C. Regulation 61-62.68 and 40 CFR Part 68 Chemical Accident Prevention Provisions
☒	S.C. Regulation 61-62.70 and 40 CFR Part 70 Title V Operating Program
☐	Other S.C. Air Pollution Control Regulations, as applicable.
☐	Other Federal Air Pollution Control Regulations, as applicable.
☐	40 CFR 98 Green House Gas (GHG) emissions *(Note: Quantify GHG emissions, if S.C. Regulation 61-62.5, Standard No. 7 or S.C. Regulation 61-62.5, Standard No. 7.1 is triggered.)*

Check Box	Completeness Checklist:
	Applicability Determination:
☒	• Is this regulation *applicable, reasonably applicable, potentially applicable,* or *not applicable?*
☒	• Is the basis for the applicability determination explained?
	Affected Sources:
☒	• Is the name and identification of each emission source or process included?
	Compliance Demonstration:
☒	• How will compliance be demonstrated?
☒	• Are specific methods or activities to be utilized by the facility to demonstrate compliance with each specific limitation and/or requirement provided?
☒	• Are control devices and control device requirements included?
☒	• Are monitoring, recordkeeping, and reporting requirements necessary to demonstrate compliance included?
	Regulatory Citations:
☒	• Are the regulatory citations identified?

Bureau of Air Quality
Emission Point Information

A. APPLICATION IDENTIFICATION	
1. Facility Name: New-Indy Catawba LLC	
2. SC Air Permit Number (if known; 8-digits only): 2440 - 0005	3. Application Date: March 2023
4. Project Description: New Condensate Stripper Permit Application	
5. Are other facilities collocated for air compliance? ☐ Yes ☒ No	6. If Yes, provide permit numbers of collocated facilities:

B. AIR CONTACT			
Consulting Firm Name (if applicable):			
Title/Position: Senior Environmental Engineer	Salutation: Mr.	First Name: Bob	Last Name: Tourville
Mailing Address: P.O. Box 7			
City: Catawba		State: SC	Zip Code: 29704
E-mail Address: bob.tourville@new-indycb.com		Phone No.: (803) 981-8009	Cell No.:

C. EMISSION POINT DISPERSION PARAMETERS

- Source data requirements are based on the appropriate source classification.
- Each emission point is classified as a point, flare, area, area circular, area polygon, volume, open pit, line, or buoyant line source.
- Contact the Bureau of Air Quality for clarification of data requirements.
- Include sources on a scaled site map. Also, a picture of area or volume sources would be helpful but is not required.
- A user generated document or spreadsheet may be substituted in lieu of this form provided all of the required emission point parameters are submitted in the same order, units, etc. as presented in these tables.

Abbreviations / Units of Measure:

- AGL = Above Ground Level
- BTU/hr = British Thermal Unit per hour
- ° = Degrees
- °F = Degrees Fahrenheit
- ft = feet
- ft/s = feet per second
- K = Kelvin
- m = meters
- UTM = Universal Transverse Mercator

Reminder: For all Emission Points, list the unique Emission Point ID for that source. Use the same emission point ID as shown in the current permit and provided in the last modeling submittal (as applicable). If the emission point ID has been changed from what was previously submitted, please list the current emission point ID with the old emission point ID in parenthesis

D. POINT SOURCE

Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height AGL (ft)	Exit Temp. (°F)	Exit Velocity (ft/s)	Inside Diameter (ft)	Discharge Orientation	Rain Cap? (Y/N)	Distance To Nearest Property Boundary (ft)	Building		
		Easting (m)	Northing (m)								Height (ft)	Length (ft)	Width (ft)
2610S1	No. 2 Combination Boiler Stack	510039.32	3855689.18	228	364	47.2	10.0	Vert.	N	3,937	N/A	N/A	N/A
2610S2	No. 1 Combination Boiler Stack	510020.32	3855678.18	228	405	62.3	10.0	Vert.	N	3,937	N/A	N/A	N/A
2505S	No. 2 Recovery Furnace	510095.85	3855743.58	195	365	99.1	7.0	Vert.	N	3,953	N/A	N/A	N/A
5105S	No. 3 Recovery Furnace	510032.37	3855802.28	225	342	61.7	10.5	Vert.	N	4,134	N/A	N/A	N/A

E. FLARE SOURCE

Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height AGL (ft)	Heat Release Rate (BTU/hr)	Exit Velocity (ft/s)	Exit Temp. (°F)	Heat Loss Fraction	Distance To Nearest Property Boundary (ft)	Building		
		Easting (m)	Northing (m)							Height (ft)	Length (ft)	Width (ft)

F. AREA SOURCE

Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height AGL (ft)	Easterly Length (ft)	Northerly Length (ft)	Angle From North (°)	Initial Vertical Dimension σ_z (ft)	Distance To Nearest Property Boundary (ft)
		Easting (m)	Northing (m)						

G. AREA CIRCULAR SOURCE								
Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height AGL (ft)	Radius of Area (ft)	Number of Vertices	Initial Vertical Dimension σ_z (ft)	Distance To Nearest Property Boundary (ft)
		Easting (m)	Northing (m)					

H. AREA POLYGON SOURCE								
Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height AGL (ft)	Initial Vertical Dimension (ft)	Number of Vertices	Area (ft^2)	Distance To Nearest Property Boundary (ft)
		Easting-1 (m)	Northing-1 (m)					
Fugitive	Aerated Stabilization Basin (Zone 1)	510803.40	3856319.69	20	0	15	547,769	1,969
Fugitive	Aerated Stabilization Basin (Zone 2)	510964.42	3856054.20	20	0	18	733,653	1,510
Fugitive	Aerated Stabilization Basin (Zone 3)	511052.13	3855887.21	20	0	10	783,500	1,180

I. VOLUME SOURCE									
Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height AGL (ft)	Physical Horizontal Dimension (ft)	Initial Horizontal Dimension σ_y (ft)	Physical Vertical Dimension (ft)	Initial Vertical Dimension σ_z (ft)	Distance To Nearest Property Boundary (ft)
		Easting (m)	Northing (m)						

J. OPEN PIT SOURCE								
Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height AGL (ft)	Easterly Length (ft)	Northerly Length (ft)	Pit Volume (ft^3)	Angle From North (°)
		Easting (m)	Northing (m)					

Bureau of Air Quality
Emission Point Information

K. LINE SOURCE									
Emission Point ID	Description/Name	UTM Coordinates (NAD83)				Release Height AGL (ft)	Line Length (ft)	Line Width (ft)	Initial Vertical Dimension σ_z (ft)
		Start Easting (m)	Start Northing (m)	End Easting (m)	End Northing (m)				

L. BUOYANT LINE SOURCE (must complete Line Source and Buoyant Line Source tables)							
Emission Point ID	Description/Name	Average Building Length (ft)	Average Building Height (ft)	Average Building Width (ft)	Average Line Source Width (ft)	Average Building Separation (ft)	Average Buoyancy Parameter (m^4/s^3)

M. EMISSION RATES						
Emission Point ID	Pollutant Name	CAS #	Emission Rate (lb/hr)	Same as Permitted? (1)	Controlled or Uncontrolled	Averaging Period
2610S2, 2610S1	Refer to Appendix B					
2505S						
5105S						
Fugitive						

(1) Any difference between the rates used for permitting and the air compliance demonstration must be explained in the application report.

APPENDIX B -
EMISSIONS CALCULATIONS

NEW-INDY CATAWBA MILL STRIPPER PROJECT

Stripper Operating Scenario	Operating Time	
	%	hrs
New Stripper Online	90%	7,884.0
Backup Stripper Online	8%	700.8
No Stripper Online	2%	175.2

LVHC Control Operating Scenario	Operating Time	
	%	hrs
RF3 Available for LVHC	75%	6,570.0
LVHC to CB1/CB2	25%	2,190.0

Summary of PSD Applicability
(tons/year)

Pollutant[A]	PM	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	H2SO4	TRS	VOC	Pb	H_2S	Total CO_2e
Baseline Actual Emissions	1.26	1.16	1.09	132	770	27.1	1.28	13.4	249	1.24E-04	3.77	13,904
Projected Actual Emissions	13.4	10.4	8.45	148	629	64.2	2.43	15.6	248	2.08E-03	5.69	48,629
Net Emissions Changes (PAE - BAE)	12.2	9.28	7.36	16.1	-141.35	37.1	1.15	2.18	-1.4	1.95E-03	1.92	34,725
PSD Significant Emissions Rates	**25**	**15**	**10**	**40**	**40**	**100**	**7**	**10**	**40**	**0.6**	**10**	**75,000**
PSD Significant?	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**

A - HF is not emitted from new, modified, or affected emissions units.

SO2 EMISSIONS CALCULATIONS

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		SO2 Emissions Factor		Sulfur Capture[C]	SO2 Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100%	8,004.0	SOG to CB1/CB2	100.0%	8,004.0	1,426	ADTP/day	1.06	Stack Test	NA	63.1	252.5
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,426	ADTP/day	1.97	Stack Test	NA	117.0	512.4
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B,E]	97.9%	7,835.7	NA	100.0%	7,835.7	29.5	mmBtu/hr	6.00E-04	AP-42	NA	0.02	0.1
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B,E]	2.1%	168.3	NA	100.0%	168.3	28.1	mmBtu/hr	2.20E+00	AP-42	NA	61.9	5.2
SO2 BASELINE ACTUAL EMISSIONS (BAE)															770.2
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90.0%	7,884.0	SRL Online	95%	7,489.8	SRL Methanol to RF2/3[G]	100.0%	7,489.8	2,700	ADTP/day	0.56	Vendor	99%	0.6	2.4
New Stripper Online	90.0%	7,884.0	SRL Online	95%	7,489.8	SRL LVHC to RF3[G]	75.0%	5,617.4	2,700	ADTP/day	0.84	Vendor	99%	0.9	2.7
New Stripper Online	90.0%	7,884.0	SRL Online	95%	7,489.8	SRL LVHC to CB1/CB2[G]	25.0%	1,872.5	2,700	ADTP/day	0.84	Vendor	50%	47.2	44.2
New Stripper Online	90.0%	7,884.0	SRL Offline	5%	394.2	SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	1.40	Vendor	0%	157.4	31.0
Backup Stripper Online	8.0%	700.8	NA	100%	700.8	SOG to CB1/CB2	100.0%	700.8	2,700	ADTP/day	1.40	Vendor	0%	157.4	55.1
No Stripper Online	2.0%	175.2	Foul Condensate to Hard Pipe	100%	175.2	Hydrogen Peroxide Addition	100.0%	175.2	NA	NA	NA	NA	NA	NA	NA
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	5.25	Stack Test	99%	5.9	19.4
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	5.25	Stack Test	50%	295.2	323.3
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5	NA	100.0%	985.5	1.0	mmBtu/hr	6.00E-04	AP-42	NA	0.00	0.0
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D,F]	81.6%	6,433.3	NA	100.0%	6,433.3	96.8	mmBtu/hr	6.00E-04	AP-42	NA	0.06	0.2
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D,F]	18.4%	1,450.7	NA	100.0%	1,450.7	92.2	mmBtu/hr	2.20E+00	AP-42	NA	202.9	147.2
Backup Stripper Steam - Natural Gas	8.0%	700.8	Natural Gas[D,F]	81.6%	571.9	NA	100.0%	571.9	25.3	mmBtu/hr	6.00E-04	AP-42	NA	0.02	0.004
Backup Stripper Steam - No. 6 Oil	8.0%	700.8	No. 6 Oil[D,F]	18.4%	128.9	NA	100.0%	128.9	24.1	mmBtu/hr	2.20E+00	AP-42	NA	53.1	3.4
SO2 PROJECTED ACTUAL EMISSIONS (PAE)															628.84
NET EMISSIONS CHANGE (PAE - BAE)															
NET EMISSIONS CHANGE (PAE - BAE)															-141.35

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline

C - Sulfur capture in recovery furnace >99, sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%

D - Historically high fuel oil percentage of fossil fuel heat input (2014)

E - Actual steam usage January 1 - December 16, 2022

F - Projected steam usage at 850 gpm from vendor

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System

H - reserved

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor

				Foul UNCTRL lb/ADTP	Methanol[G] UNCTRL lb/ADTP	LVHC[G] UNCTRL lb/ADTP
TRS as S		MW	AHL	0.70	0.28	0.42
sulfur	S	32.065				
sulfur dioxide	SO_2	64.064		1.40	0.56	0.84

H2SO4 EMISSIONS CALCULATIONS

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		H2SO4 Emissions Factor		Sulfur Capture	H2SO4 Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/ADTP	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
LVHC Collection System	100%	8,760 0	NA	100%	8,760.0	LVHC to CB1/CB2	100 0%	8,760 0	1,426	ADTP/day	4 93E-03	NCASI Technical Bulletin 858, Table 10	NA	0 3	1 3
H2SO4 BASELINE ACTUAL EMISSIONS (BAE)															**1 3**
PROJECTED ACTUAL EMISSIONS															
LVHC Collection System	100%	8,760 0	NA	100%	8,760 0	LVHC to RF3	75 0%	6,570 0	2,700	ADTP/day	4 93E-03	NCASI Technical Bulletin 858, Table 10	NA	0 55	1 82
LVHC Collection System	100%	8,760 0	NA	100%	8,760 0	LVHC to CB1/CB2	25 0%	2,190 0	2,700	ADTP/day	4 93E-03	NCASI Technical Bulletin 858, Table 10	NA	0 55	0 61
H2SO4 PROJECTED ACTUAL EMISSIONS (PAE)															**2.43**
NET EMISSIONS CHANGE (PAE - BAE)															
NET EMISSIONS CHANGE (PAE - BAE)															**1.15**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No 1 and No 2 during baseline

C - Sulfur capture in recovery furnace >99, sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Actual steam usage January 1 - December 16, 2022

F - Projected steam usage at 850 gpm from vendor

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System

H - reserved

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

NOX EMISSIONS CALCULATIONS

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		NOX Emissions Factor		Ammonia Increase[C]	NOX Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	SOG to CB1/CB2	100%	8,004.0	1,426	ADTP/day	0.415	Columbia	NA	24.7	98.7
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B,E]	97.9%	7,835.7	NA	100%	7,835.7	29.5	mmBtu/hr	2.80E-01	AP-42	NA	8.3	32.4
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B,E]	2.1%	168.3	NA	100%	168.3	28.1	mmBtu/hr	3.13E-01	AP-42	NA	8.8	0.7
NOX BASELINE ACTUAL EMISSIONS															**131.8**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3[G]	100%	7,489.8	2,852	TBLS/day	1.500	Title V	1.0%	1.8	6.7
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3[G]	75%	5,617.4	316.9	TBLS/day	1.500	Title V	1.0%	0.2	0.6
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2[G]	25%	1,872.5	270.0	ADTP/day	0.415	Columbia	NA	4.7	4.4
New Stripper Online	90%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100%	394.2	2,700	ADTP/day	0.415	Columbia	NA	46.7	9.2
Backup Stripper Online	8%	700.8	NA	100.0%	700.8	SOG to CB1/CB2	100%	700.8	2,700	ADTP/day	0.415	Columbia	NA	46.7	16.4
No Stripper Online	2%	175.2	Foul Condensate to Hard Pipe	100.0%	175.2	Hydrogen Peroxide Addition	100%	175.2	NA	NA	NA	NA	NA	NA	NA
Recovery Furnace #3 LVHC Ignitor	75%	6,570.0	Natural Gas[I]	15.0%	985.5	NA	100%	985.5	1.0	mmBtu/hr	2.80E-01	AP-42	NA	0.3	0.1
New Stripper Steam - Natural Gas	90%	7,884.0	Natural Gas[D,F]	81.6%	6,433.3	NA	100%	6,433.3	96.8	mmBtu/hr	2.80E-01	AP-42	NA	27.1	87.2
New Stripper Steam - No. 6 Oil	90%	7,884.0	No. 6 Oil[D,F]	18.4%	1,450.7	NA	100%	1,450.7	92.2	mmBtu/hr	3.13E-01	AP-42	NA	28.9	20.9
Backup Stripper Steam - Natural Gas	8%	700.8	Natural Gas[D,F]	81.6%	571.9	NA	100%	571.9	25.3	mmBtu/hr	2.80E-01	AP-42	NA	7.1	2.0
Backup Stripper Steam - No. 6 Oil	8%	700.8	No. 6 Oil[D,F]	18.4%	128.9	NA	100%	128.9	24.1	mmBtu/hr	3.13E-01	AP-42	NA	7.5	0.5
NOX PROJECTED ACTUAL EMISSIONS															**147.9**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**16.1**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Ammonia input to recovery furnace increases >1% (methanol input limited to 1% of black liquor input by BLRBAC)

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Actual steam usage January 1 - December 16, 2022

F - Projected steam usage at 850 gpm from vendor design

G - >90% of methanol condensed and burned in recovery furnace, < 10% of methanol vented into LVHC System.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor

CO EMISSIONS CALCULATIONS

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		CO Emissions Factor		CO Control	CO Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	SOG to CB1/CB2	100.0%	8,004.0	1,426	ADTP/day	0.0728	Columbia	NA	4.3	17.3
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7	NA	100.0%	7,835.7	29.5	mmBtu/hr	8.40E-02	AP-42	NA	2.5	9.7
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3	NA	100.0%	168.3	28.1	mmBtu/hr	3.33E-02	AP-42	NA	0.9	0.1
CO BASELINE ACTUAL EMISSIONS															27.1
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3	100.0%	7,489.8	NA	NA	NA	NA	NA	NA	NA
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3	75%	5,617.4	2,700	ADTP/day	0.0728	Columbia	NA	8.2	23.0
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2	25%	1,872.5	2,700	ADTP/day	0.0728	Columbia	NA	8.2	7.7
New Stripper Online	90%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	0.0728	Columbia	NA	8.2	1.6
Backup Stripper Online	8%	700.8	NA	100.0%	700.8	SOG to CB1/CB2	100.0%	700.8	2,700	ADTP/day	0.0728	Columbia	NA	8.2	2.9
No Stripper Online	2%	175.2	Foul Condensate to Hard Pipe	100.0%	175.2	Hydrogen Peroxide Addition	100.0%	175.2	NA	NA	NA	NA	NA	NA	NA
Recovery Furnace #3 LVHC Ignitor	75%	6,570.0	Natural Gas[I]	15.0%	985.5	NA	100.0%	985.5	1.0	mmBtu/hr	8.40E-02	AP-42	NA	0.1	0.0
New Stripper Steam - Natural Gas	90%	7,884.0	Natural Gas[D]	81.6%	6,433.3	NA	100.0%	6,433.3	96.8	mmBtu/hr	8.40E-02	AP-42	NA	8.1	26.2
New Stripper Steam - No. 6 Oil	90%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7	NA	100.0%	1,450.7	92.2	mmBtu/hr	3.33E-02	AP-42	NA	3.1	2.2
Backup Stripper Steam - Natural Gas	8%	700.8	Natural Gas[D]	81.6%	571.9	NA	100.0%	571.9	25.3	mmBtu/hr	8.40E-02	AP-42	NA	2.1	0.6
Backup Stripper Steam - No. 6 Oil	8%	700.8	No. 6 Oil[D]	18.4%	128.9	NA	100.0%	128.9	24.1	mmBtu/hr	3.33E-02	AP-42	NA	0.8	0.1
CO PROJECTED ACTUAL EMISSIONS															64.2
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															37.1

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - reserved

D - Historically high fuel oil percentage of fossil fuel heat input (2014)

E - Actual steam usage January 1 - December 16, 2022

F - Projected steam usage at 850 gpm from vendor design

G - reserved.

H - reserved

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

VOC EMISSIONS CALCULATIONS

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		VOC Emissions Factor		Removal[C]	VOC Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	LVHC to CB1/CB2	100.0%	8,004.0	1,426	ADTP/day	4.37	Stripped	98.0%	5.19	20.78
Aerated Stabilization Basin (ASB)	100.0%	8,760.0	Foul Condensate to Hard Pipe	100.0%	8,760.0	NA	100.0%	8,760.0	1,426	ADTP/day	8.73E-01	WATER9	NA	51.88	227.21
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,426	ADTP/day	3.10E-03	Columbia	NA	0.18	0.81
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7	NA	100.0%	7,835.7	29.5	mmBtu/hr	5.39E-03	AP-42	NA	0.2	0.6
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3	NA	100.0%	168.3	28.1	mmBtu/hr	1.87E-03	AP-42	NA	0.1	0.0
VOC BASELINE ACTUAL EMISSIONS															**249.43**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3[G]	100%	7,489.8	2,700	ADTP/day	14.40	Vendor	99.9%	1.62	6.07
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3[G]	75%	5,617.4	2,700	ADTP/day	1.60	Vendor	98%	3.60	10.11
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2[G]	25%	1,872.5	2,700	ADTP/day	1.60	Vendor	98%	3.60	3.37
New Stripper Online	90%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100%	394.2	2,700	ADTP/day	16.00	Vendor	98%	36.00	7.10
Backup Stripper Online	8%	700.8	NA	100.0%	700.8	SOG to CB1/CB2	100%	700.8	2,700	ADTP/day	16.00	Vendor	98%	36.00	12.61
ASB - New Stripper Online	90%	7,884.0	No Foul Condensate to Hard Pipe	100.0%	7,884.0	NA	100%	7,884.0	2,700	ADTP/day	0.29	WATER9	NA	32.40	127.72
ASB - Backup Stripper Online	8%	700.8	TRS Stripped From Foul Condensate	100.0%	700.8	NA	100%	700.8	2,700	ADTP/day	1.42	WATER9	NA	159.98	56.06
ASB - No Stripper Online	2%	175.2	Foul Condensate to Hard Pipe	100.0%	175.2	NA	100%	175.2	2,700	ADTP/day	2.20	WATER9	NA	247.05	21.64
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to RF3	75%	6,570.0	2,700	ADTP/day	3.10E-03	Columbia	NA	0.35	1.15
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	25%	2,190.0	2,700	ADTP/day	3.10E-03	Columbia	NA	0.35	0.38
Recovery Furnace #3 LVHC Ignitor	75%	6,570.0	Natural Gas[I]	15.0%	985.5	NA	100%	985.5	1.0	mmBtu/hr	5.39E-03	AP-42	NA	0.0	0.0
New Stripper Steam - Natural Gas	90%	7,884.0	Natural Gas[D]	81.6%	6,433.3	NA	100%	6,433.3	96.8	mmBtu/hr	5.39E-03	AP-42	NA	0.5	1.7
New Stripper Steam - No. 6 Oil	90%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7	NA	100%	1,450.7	92.2	mmBtu/hr	1.87E-03	AP-42	NA	0.2	0.1
Backup Stripper Steam - Natural Gas	8%	700.8	Natural Gas[D]	81.6%	571.9	NA	100%	571.9	25.3	mmBtu/hr	5.39E-03	AP-42	NA	0.1	0.0
Backup Stripper Steam - No. 6 Oil	8%	700.8	No. 6 Oil[D]	18.4%	128.9	NA	100%	128.9	24.1	mmBtu/hr	1.87E-03	AP-42	NA	0.0	0.0
VOC PROJECTED ACTUAL EMISSIONS															**248.05**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**-1.38**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - VOC destruction >98% in vapor phase, 99.9% in liquid phase.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Actual steam usage January 1 - December 16, 2022

F - Projected steam usage at 850 gpm from vendor design

G - >90% of methanol condensed and burned in recovery furnace, < 10% of methanol vented into LVHC System

H - reserved

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor

TRS EMISSIONS CALCULATIONS

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		TRS Emissions Factor		Sulfur Capture[C]	TRS Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	LVHC to CB1/CB2	100.0%	8,004.0	1,426	ADTP/day	2.88E-03	Stack test	NA	0.17	0.68
Aerated Stabilization Basin (ASB)	100.0%	8,760.0	NA	100.0%	8,760.0	NA	100.0%	8,760.0	1,426	ADTP/day	4.08E-02	H2SSIM/WATER9	NA	2.42	10.61
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,426	ADTP/day	9.01E-03	Stack test	NA	0.48	2.09
TRS BASELINE ACTUAL EMISSIONS															**13.38**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3[G,H]	100.0%	7,489.8	2,700	ADTP/day	0.33	Vendor	99.9%	0.04	0.14
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3[G,H]	75.0%	5,617.4	2,700	ADTP/day	0.49	Vendor	99.9%	0.05	0.15
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2[G]	25.0%	1,872.5	2,700	ADTP/day	0.49	Vendor	99%	0.55	0.51
New Stripper Online	90.0%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	0.81	Vendor	99%	0.91	0.18
Backup Stripper Online	8.0%	700.8	NA	100.0%	700.8	SOG to CB1/CB2	100.0%	700.8	2,700	ADTP/day	0.81	Vendor	99%	0.91	0.32
ASB - New Stripper Online	90.0%	7,884.0	No Foul Condensate to Hard Pipe	100.0%	7,884.0	NA	100.0%	7,884.0	2,700	ADTP/day	2.42E-02	H2SSIM/WATER9	NA	2.72	10.74
ASB - Backup Stripper Online	8.0%	700.8	TRS Stripped From Foul Condensate	100.0%	700.8	NA	100.0%	700.8	2,700	ADTP/day	2.72E-02	H2SSIM/WATER9	NA	3.06	1.07
ASB - No Stripper Online	2.0%	175.2	Foul Condensate to Hard Pipe	100.0%	175.2	Hydrogen Peroxide Addition	100.0%	175.2	2,700	ADTP/day	7.28E-02	H2SSIM/WATER9	NA	8.19	0.72
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	1.75E+00	Stack test	99.9%	0.20	0.65
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	8.76E-03	Stack test	NA	0.99	1.08
TRS PROJECTED ACTUAL EMISSIONS															**15.56**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**2.18**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline

C - Sulfur capture in recovery furnace >99.9% (see note H), sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%

D - Historically high fuel oil percentage of fossil fuel heat input (2014)

E - Actual steam usage January 1 - December 16, 2022

F - Projected steam usage at 850 gpm from vendor design

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System

H - Recovery Furnace captures 99% of sulfur and converts 99% of remaining uncaptured sulfur

					Foul UNCTRL lb/ADTP	Methanol[G] UNCTRL lb/ADTP	LVHC[G] UNCTRL lb/ADTP
TRS as S		MW		AHL	0.70	0.28	0.42
sulfur	S	32.065					
hydrogen sulfide	H_2S	34.081	82.3%		0.61	0.24	0.37
methyl mercaptan	CH_4S	48.107	6.4%		0.07	0.03	0.04
dimethyl sulfide	C_2H_6S	62.134	5.2%		0.07	0.03	0.04
dimethyl disulfide	$C_2H_6S_2$	94.199	6.1%		0.06	0.03	0.04
TRS as TRS	TRS				0.81	0.33	0.49

H2S EMISSIONS CALCULATIONS

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		H2S Emissions Factor		Sulfur Capture[C]	H2S Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	LVHC to CB1/CB2	100.0%	8,004.0	1,426	ADTP/day	4.13E-04	Stack test	NA	0.02	0.10
Aerated Stabilization Basin (ASB)	100.0%	8,760.0	Foul Condensate to Hard Pipe	100.0%	8,760.0	Hydrogen Peroxide Addition	100.0%	8,760.0	1,426	ADTP/day	1.36E-02	H2SSIM	NA	0.81	3.54
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,426	ADTP/day	5.03E-04	Stack test	NA	0.03	0.13
H2S BASELINE ACTUAL EMISSIONS															3.77
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3[G,H]	100.0%	7,489.8	2,700	ADTP/day	0.24	Vendor	99.9%	0.03	0.10
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3[G,H]	75.0%	5,617.4	2,700	ADTP/day	0.37	Vendor	99.9%	0.04	0.12
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2[G]	25.0%	1,872.5	2,700	ADTP/day	0.37	Vendor	99%	0.41	0.39
New Stripper Online	90.0%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	0.61	Vendor	99%	0.69	0.14
Backup Stripper Online	8.0%	700.8	NA	100.0%	700.8	SOG to CB1/CB2	100.0%	700.8	2,700	ADTP/day	0.61	Vendor	99%	0.69	0.24
ASB - New Stripper Online	90.0%	7,884.0	No Foul Condensate to Hard Pipe	100.0%	7,884.0	NA	100.0%	7,884.0	2,700	ADTP/day	9.27E-03	H2SSIM	NA	1.04	4.11
ASB - Backup Stripper Online	8.0%	700.8	H2S Stripped From Foul Condensate	100.0%	700.8	NA	100.0%	700.8	2,700	ADTP/day	9.81E-03	H2SSIM	NA	1.10	0.39
ASB - No Stripper Online	2.0%	175.2	Foul Condensate to Hard Pipe	100.0%	175.2	Hydrogen Peroxide Addition	100.0%	175.2	2,700	ADTP/day	9.54E-03	H2SSIM	NA	1.07	0.09
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	1.17E-01	Stack test	99.9%	0.01	0.04
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	5.87E-04	Stack test	NA	0.07	0.07
H2S PROJECTED ACTUAL EMISSIONS															5.69
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															1.92

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No 2 during baseline.

C - Sulfur capture in recovery furnace >99 9% (see note H), sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%

D - Historically high fuel oil percentage of fossil fuel heat input (2014)

E - Actual steam usage January 1 - December 16, 2022

F - Projected steam usage at 850 gpm from vendor design

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System

H - Recovery Furnace captures 99% of sulfur and converts 99% of remaining uncaptured sulfur

					Foul UNCTRL lb/ADTP	Methanol[G] UNCTRL lb/ADTP	LVHC[G] UNCTRL lb/ADTP
TRS as S		MW		AHL	0 70	0 28	0 42
sulfur	S	32.065					
hydrogen sulfide	H_2S	34.081	82.3%		0.61	0.24	0 37
methyl mercaptan	CH_4S	48.107	6 4%		0 07	0 03	0 04
dimethyl sulfide	C_2H_6S	62 134	5.2%		0.07	0.03	0.04
dimethyl disulfide	$C_2H_6S_2$	94 199	6 1%		0.06	0.03	0.04
TRS as TRS	TRS				0.81	0.33	0.49

PM EMISSIONS CALCULATIONS

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		PM Emissions Factor		PM Control	PM Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004 0	Natural Gas[B]	97.9%	7,835 7		100.0%	7,835.7	29.5	mmBtu/hr	7.60E-03	AP-42	NA	0.2	0.9
Backup Stripper Steam[A]	91.4%	8,004 0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	28.1	mmBtu/hr	1.61E-01	AP-42	NA	4.5	0.4
PM BASELINE ACTUAL EMISSIONS															1.3
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75 0%	6,570 0	Natural Gas[I]	15 0%	985 5		100.0%	985.5	1 0	mmBtu/hr	7.60E-03	AP-42	NA	7.60E-03	3.74E-03
New Stripper Steam - Natural Gas	90.0%	7,884 0	Natural Gas[D]	81 6%	6,433.3		100.0%	6,433 3	96 8	mmBtu/hr	7 60E-03	AP-42	NA	0 7	2 4
New Stripper Steam - No 6 Oil	90 0%	7,884 0	No 6 Oil[D]	18 4%	1,450 7		100 0%	1,450 7	92 2	mmBtu/hr	1 61E-01	AP-42	NA	14 8	10 8
Backup Stripper Steam - Natural Gas	8.0%	700 8	Natural Gas[D]	81 6%	571 9		100.0%	571 9	25 3	mmBtu/hr	7 60E-03	AP-42	NA	0.2	0 1
Backup Stripper Steam - No 6 Oil	8.0%	700.8	No 6 Oil[D]	18 4%	128 9		100.0%	128.9	24 1	mmBtu/hr	1 61E-01	AP-42	NA	3 9	0 3
PM PROJECTED ACTUAL EMISSIONS															13.4
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															12.2

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion Average fossil fuel distribution in Combination Boilers No 1 and No 2 during baseline

C - reserved

D - Historically high fuel oil percentage of fossil fuel heat input (2014)

E - Actual steam usage January 1 - December 16, 2022

F - Projected steam usage at 850 gpm from vendor design

G - reserved

H - reserved

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor

PM10 EMISSIONS CALCULATIONS

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		PM10 Emissions Factor		PM10 Control	PM10 Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	29.5	mmBtu/hr	7.60E-03	AP-42	NA	0.2	0.9
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	28.1	mmBtu/hr	1.17E-01	AP-42	NA	3.3	0.3
PM10 BASELINE ACTUAL EMISSIONS															1.2
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	7.60E-03	AP-42	NA	7.60E-03	3.74E-03
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	7.60E-03	AP-42	NA	0.7	2.4
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	1.17E-01	AP-42	NA	10.8	7.8
Backup Stripper Steam - Natural Gas	8.0%	700.8	Natural Gas[D]	81.6%	571.9		100.0%	571.9	25.3	mmBtu/hr	7.60E-03	AP-42	NA	0.2	0.1
Backup Stripper Steam - No. 6 Oil	8.0%	700.8	No. 6 Oil[D]	18.4%	128.9		100.0%	128.9	24.1	mmBtu/hr	1.17E-01	AP-42	NA	2.8	0.2
PM10 PROJECTED ACTUAL EMISSIONS															10.4
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															9.3

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline

C - reserved

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Actual steam usage January 1 - December 16, 2022

F - Projected steam usage at 850 gpm from vendor design.

G - reserved

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor

PM2.5 EMISSIONS CALCULATIONS

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		PM2.5 Emissions Factor		PM2.5 Control	PM2.5 Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	29.5	mmBtu/hr	7.60E-03	AP-42	NA	0.2	0.9
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	28.1	mmBtu/hr	8.80E-02	AP-42	NA	2.5	0.2
PM2.5 BASELINE ACTUAL EMISSIONS															1.1
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	7.60E-03	AP-42	NA	7.60E-03	3.74E-03
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	7.60E-03	AP-42	NA	0.7	2.4
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	8.80E-02	AP-42	NA	8.1	5.9
Backup Stripper Steam - Natural Gas	8.0%	700.8	Natural Gas[D]	81.6%	571.9		100.0%	571.9	25.3	mmBtu/hr	7.60E-03	AP-42	NA	0.2	0.1
Backup Stripper Steam - No. 6 Oil	8.0%	700.8	No. 6 Oil[D]	18.4%	128.9		100.0%	128.9	24.1	mmBtu/hr	8.80E-02	AP-42	NA	2.1	0.1
PM2.5 PROJECTED ACTUAL EMISSIONS															8.4
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															7.4

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline

C - reserved

D - Historically high fuel oil percentage of fossil fuel heat input (2014)

E - Actual steam usage January 1 - December 16, 2022

F - Projected steam usage at 850 gpm from vendor design

G - reserved

H - reserved

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor

LEAD EMISSIONS CALCULATIONS

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		Lead Emissions Factor		Lead Control	Lead Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	29.5	mmBtu/hr	5.00E-07	AP-42	NA	1.48E-05	5.78E-05
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	28.1	mmBtu/hr	2.80E-05	AP-42	NA	7.87E-04	6.63E-05
LEAD BASELINE ACTUAL EMISSIONS															1.24E-04
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	5.00E-07	AP-42	NA	5.00E-07	2.46E-07
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	5.00E-07	AP-42	NA	4.84E-05	1.56E-04
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	2.80E-05	AP-42	NA	2.58E-03	1.87E-03
Backup Stripper Steam - Natural Gas	8.0%	700.8	Natural Gas[D]	81.6%	571.9		100.0%	571.9	25.3	mmBtu/hr	5.00E-07	AP-42	NA	1.27E-05	3.62E-06
Backup Stripper Steam - No. 6 Oil	8.0%	700.8	No. 6 Oil[D]	18.4%	128.9		100.0%	128.9	24.1	mmBtu/hr	2.80E-05	AP-42	NA	6.75E-04	4.35E-05
LEAD PROJECTED ACTUAL EMISSIONS															2.08E-03
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															1.95E-03

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion Average fossil fuel distribution in Combination Boilers No 1 and No 2 during baseline

C - reserved

D - Historically high fuel oil percentage of fossil fuel heat input (2014)

E - Actual steam usage January 1 - December 16, 2022

F - Projected steam usage at 850 gpm from vendor design

G - reserved

H - reserved

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor

CO2 EMISSIONS CALCULATIONS

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		CO2 Emissions Factor		CO2 Control	CO2 Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	29.5	mmBtu/hr	1.17E+02	AP-42	NA	3,448.9	13,512
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	28.1	mmBtu/hr	1.66E+02	AP-42	NA	4,655.3	392
CO2 BASELINE ACTUAL EMISSIONS															13,904
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	1.17E+02	AP-42	NA	116.9	58
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	1.17E+02	AP-42	NA	11,313.5	36,392
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	1.66E+02	AP-42	NA	15,270.9	11,076
Backup Stripper Steam - Natural Gas	8.0%	700.8	Natural Gas[D]	81.6%	571.9		100.0%	571.9	25.3	mmBtu/hr	1.17E+02	AP-42	NA	2,958.3	846
Backup Stripper Steam - No. 6 Oil	8.0%	700.8	No. 6 Oil[D]	18.4%	128.9		100.0%	128.9	24.1	mmBtu/hr	1.66E+02	AP-42	NA	3,993.0	257
CO2 PROJECTED ACTUAL EMISSIONS															48,629
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															34,725

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline

C - reserved

D - Historically high fuel oil percentage of fossil fuel heat input (2014)

E - Actual steam usage January 1 - December 16, 2022

F - Projected steam usage at 850 gpm from vendor design

G - reserved

H - reserved

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

SUMMARY OF ASB EMISSIONS FACTORS

Scenario	ASB Emissions Factors (lb/ODTP)						
	H_2S	DMDS	DMS	MMC	Methanol	VOC[A]	TRS[B]
Baseline Actual Emissions	0.0151	0.0114	0.0185	3.28E-04	0.92	0.97	0.0453
New Stripper Scenario	0.0103	0.0028	0.0136	1.88E-04	0.30	0.32	0.0269
Backup Stripper Scenario	0.0109	0.0033	0.0147	1.30E-03	1.53	1.58	0.0302
No Stripper Scenario	0.0106	0.0504	0.0192	7.42E-04	2.31	2.44	0.0809

A - Includes VOC TRS compounds, methanol, acetaldehyde, methyl ethyl ketone, and propionaldehyde.

B - TRS as compounds

Stripper Inlet Foul Condensate - Table 2-17 (Weston report dated October 2, 2021, Work Order No. 15730.001.008)

		Concentration (ppm)				
Date	Sample Time	Hydrogen Sulfide	Methyl Mercaptan	Dimethyl Sulfide	Dimethyl Disulfide	Total TRS
6/24/2021	15:10	130	14	16	13	173
6/24/2021	15:10	140	14	16	17	187
6/24/2021	17:00	140	17	18	14	189
6/24/2021	18:45	150	19	18	16	203
6/25/2021	10:35	130	12	12	11	165
6/25/2021	12:05	120	10	12	9.6	151.6
6/25/2021	13:45	190	22	22	23	257
Average of all data		142.9	15.4	16.3	14.8	189.4
Max of 6/24 or 6/25		146.7	16.0	17.0	15.0	194.7

		MW
H2S	Hydrogen Sulfide	34.08 g/mol
Ch4S	Methyl Mercaptan	48.11 g/mol
C2H6S	Dimethyl Sulfide	62.13 g/mol
C2H6S2	Dimethyl Disulfide	94.20 g/mol
S	Sulfur	32.07 g/mol

Convert compound to equivalent S (ppm)

Hydrogen Sulfide	Methyl Mercaptan	Dimethyl Sulfide	Dimethyl Disulfide
138.0	10.7	8.8	10.2
82.3%	6.4%	5.2%	6.1%

S (ppm)	168	Maximum feed to stripper (AHL)
Lb S/gallon FC	1.40E-03	
Lb S/hr @850 gpm	71.3	
Lb S/ADTP (@2200 ODTP)[a]	0.70	

[a] Conservative Lb S/ADTP emissions factor using 2200 ODTP (2200 ODTP * ADTP/0.9 ODTP = 2444.4 ADTP) Emissions factor is representative of the lower end of the range of pulp production at the maximum steam stripper design of 850 gpm. Calculations are scaled to 2700 ADTP to represent worst case emissions.

Assumption
1. Assume no losses in feed tank
2. Assume 98% efficiency of S across stripper therefore 0.69 # S/ADTP in SOG

CONFIDENTIAL TAB M - New-Indy Catawba Monthly Production

Month	Kraft Mill ADTP	Combination Boiler No. 1 Natural Gas mmBtu	Combination Boiler No. 2 Natural Gas mmBtu	Total Natural Gas mmBtu	Combination Boiler No. 1 No. 6 Fuel Oil gallons	Combination Boiler No. 2 No. 6 Fuel Oil gallons	Total No. 6 Fuel Oil gallons	Total No. 6 Fuel Oil mmBtu		
Mar-21	42,474	61,175	99,507	160,683	0	2,057	2,057	309	1,370	
Apr-21	43,075	41,363	75,012	116,376	0	0	0	0	1,436	
May-21	46,962	38,834	63,467	102,301	0	0	0	0	1,515	
Jun-21	42,867	1,909	59,909	61,818	0	1,199	1,199	180	1,429	
Jul-21	49,371	67,565	55,824	123,389	3	97	100	15	1,593	
Aug-21	44,614	33,863	32,461	66,325	0	0	0	0	1,439	
Sep-21	40,177	40,779	41,811	82,590	86	0	86	13	1,339	
Oct-21	47,234	69,732	75,498	145,230	0	0	0	0	1,524	
Nov-21	39,185	60,664	80,397	141,061	0	0	0	0	1,306	
Dec-21	38,734	62,931	60,176	123,107	0	0	0	0	1,249	
Jan-22	43,690	84,088	82,251	166,339	69,200	66,720	135,920	20,388	1,409	
Feb-22	37,736	57,764	75,924	133,688	27,042	370	27,412	4,112	1,348	
Mar-22	43,944	62,423	82,083	144,506	335	0	335	50	1,418	
Apr-22	40,046	44,634	62,835	107,469	0	0	0	0	1,335	
May-22	38,896	39,982	73,918	113,900	0	0	0	0	1,255	
Jun-22	23,184	43,071	89,239	132,310	2,238	0	2,238	336	773	
Jul-22	39,890	64,532	86,134	150,666	0	0	0	0	1,287	
Aug-22	53,396	48,067	73,591	121,658	0	0	0	0	1,722	
Sep-22	45,044	60,782	65,899	126,681	24	0	24	4	1,501	
Oct-22	47,517	70,539	89,760	160,299	0	0	0	0	1,533	
Nov-22	40,133	82,534	114,164	196,698	0	0	0	0	1,338	
Dec-22	33,859	101,466	95,023	196,490	170,076	0	170,076	25,511	1,092	
Jan-23	35,464	95,982	92,733	188,715	102,558	0	102,558	15,384	1,144	1,041,075
Feb-23	39,276	78,431	96,813	175,244	21,626	53	21,679	3,252	1,403	520,537
Total	996,766			3,237,544				69,553		
Annual Average	498,383									
				97.9%				2.1%		

WASTEWATER TREATMENT PLANT – SUPPORTING INFORMATION
PEROXIDE ADDITION

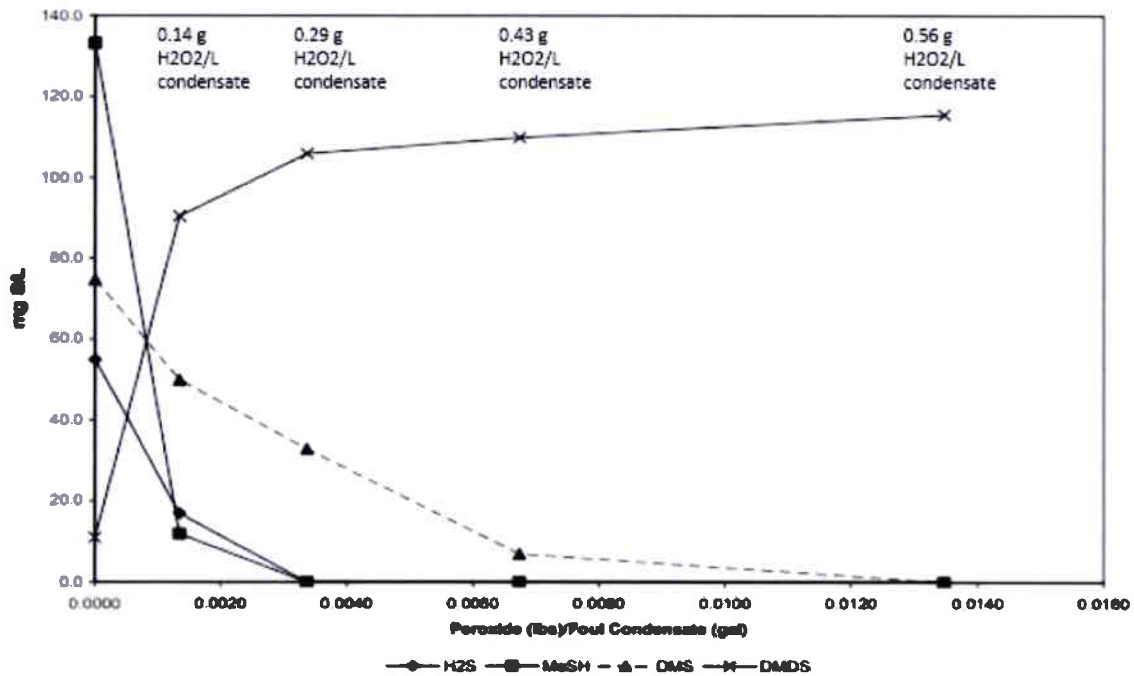
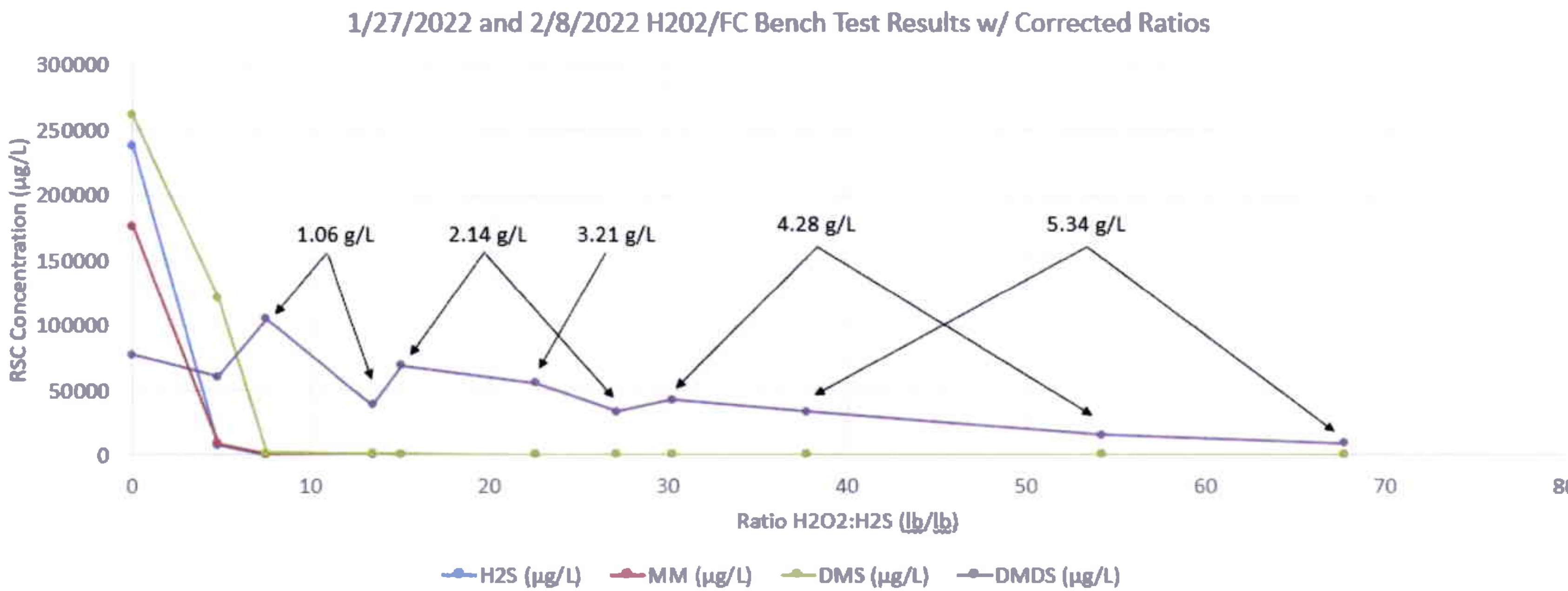


Figure 5.6 Hydrogen Peroxide Dose-Response Curve for Treatment of Foul Condensates

Source: TB949 H2O2 Mill Bench Scale Study

9



1/27/2022 and 2/8/2022 H202/FC Bench Test Results w/ Corrected Ratios
RSC Concentration (µg/L)
300000
250000
200000
150000
100000
50000
0
0
10
20
30
40
50
60
70
80
Ratio H2O2:H2S (lb/lb)
1.06 g/L
2.14 g/L
3.21 g/L
4.28 g/L
5.34 g/L
H2S (µg/L)
MM (µg/L)
DMS (µg/L)
DMDS (µg/L)

ncasi

NATIONAL COUNCIL FOR AIR AND STREAM IMPROVEMENT

SUMMARY OF INDUSTRY EXPERIENCE WITH ODOR MINIMIZATION AT WASTEWATER TREATMENT PLANTS

TECHNICAL BULLETIN NO. 949
MAY 2008

by
Diana Cook
NCASI West Coast Regional Center
Corvallis, Oregon

5.3 Oxidation

Several oxidizing agents have been used for destruction of odors resulting from H_2S. The approach is to oxidize the sulfide into nonvolatile forms such as elemental sulfur, thiosulfate, sulfite, and sulfate. Chemical oxidation reactions are generally slower than biochemical oxidation reactions (ASCE 1989). In the presence of large organic loads, as with industrial wastewaters, the economics of oxidizing agent use can be prohibitive due to competitive reactions with organic materials. Some of the commonly used oxidizing agents are chlorine, chlorine dioxide, hypochlorite, oxygen, and hydrogen peroxide. Industry experience with use of oxidizing agents is summarized herein.

5.3.1 *Hydrogen Peroxide*

Hydrogen peroxide (H_2O_2) can be used to chemically oxidize H_2S into either elemental sulfur or sulfate (the former at pH <8 to 9; the latter at pH >8 to 9), as shown in Equations 5.6 and 5.7. In the range of pH 7 to 9, both reactions may occur. Excess H_2O_2 can oxidize other wastewater components or decompose to release oxygen and water.

$$H_2O_2 + H_2S \rightarrow S + 2H_2O \quad \text{(Eq. 5.6)}$$

$$4H_2O_2 + S^{2-} \rightarrow SO_4^{2-} + 4H_2O \quad \text{(Eq. 5.7)}$$

H_2O_2 is a clear, colorless, nonflammable compound that is miscible with water in all proportions and is normally sold as a solution expressed as a percentage of the solution's weight (e.g., a 35% solution contains 35% H_2O_2 and 65% water by weight). Solutions of >8% are classified as oxidizers by the U.S. Department of Transportation. H_2O_2 can be obtained in small drums or tanks equipped with metering pumps and plumbed to the addition point. Storage containers must be properly vented because contamination or excess heat can accelerate decomposition to oxygen and water. Special safety handling is required, including eye protection and protective clothing.

Davies, Christy, and O'Connor (2000) reported on the effectiveness of using H_2O_2 to control odors resulting from release of H_2S at four locations around the WWTP at a pulp and paper mill in Canada. The specific objectives were to reduce H_2S concentration in an anaerobic spill basin effluent returned to the effluent clarification and treatment system; treat anaerobic sludge from the spill basin; minimize odors arising from sewering condensates; and treat all foul condensates from the mill during a scheduled shutdown of the steam stripper.

H_2O_2 was found to be effective for odor reduction at all the locations. It was added to the anaerobic spill basin effluent at a location that promoted good mixing prior to introduction into the clarifier. The residence time associated with transfer of effluent from the spill basin to the clarifier was sufficient to oxidize H_2S and minimize odor. Sludge dewatering equipment consisted of a screen, an agitation tank, a centrifuge, and a belt press. H_2O_2 was added to the agitation tank. In addition, an odor-controlling spray (Ecosorb) was applied to the air around the screens to capture any residual odors. H_2O_2 was also used to reduce odors during occasional sewering of condensates. Dosage levels were selected based on laboratory studies that indicated that ~200 mg H_2O_2/L of treated condensate was sufficient to remove odors. A solution containing 50% H_2O_2 was also used to reduce odors during steam stripper downtime events when foul condensates were piped directly into the aeration pond.

H_2O_2 and calcium peroxide (CaO_2) have been used in the presence of peroxidase, an enzyme found in horseradish, to remove odors in swine manure. Swine manure is known to contain large amounts of VFAs, phenolic compounds, and indolic compounds that have been implicated in odor. Peroxidase, in the presence of peroxides, has been found to polymerize phenolic odorants, thereby reducing associated odors (Govere et al. 2007).

H_2O_2 has also been used successfully as one element of a multi-pronged approach to control odor attributed to VFA generation in anaerobic environments (Davis and Smith 2001). H_2O_2 would be particularly beneficial for use in mills with high levels of water reuse (e.g., some recycle mills). Oxygen-limited environments in the process water transport system at those facilities can be ideal for anaerobic bacterial growth. Traditional oxidizers such as sodium hypochlorite, chlorine, and chlorine dioxide increase total chloride and conductivity in the reused effluent, which can disrupt process performance and cause corrosion. The multi-pronged approach used at a 100% recycled corrugating medium mill focused on good operating practices aimed at oxygenation, biocide application to control the amount of aerobic bacteria, and H_2O_2 use to prevent anaerobic environments in the secondary treatment system (Davis and Smith 2001).

NCASI assisted a bleached kraft mill that conducted a trial to investigate the effects of adding H_2O_2 to foul condensates. Foul condensates were piped directly to the first basin of a multi-stage ASB. Samples were collected at two locations (just prior to addition of peroxide and just following the addition point) over a five-day period to assess impacts on sulfide concentrations. Samples were analyzed using direct injection GC/PFPD (NCASI Method RSC-02.02; NCASI 2007). H_2O_2 was added as a 50% solution at a rate of 1.78 gallons per minute (GPM) to the foul condensate stream, which had a flow rate of 3 MGD, resulting in a concentration of approximately 0.51 g H_2O_2/L of foul condensate. The average reduction in sulfide concentration was over 79%, as illustrated in Figure 5.3.

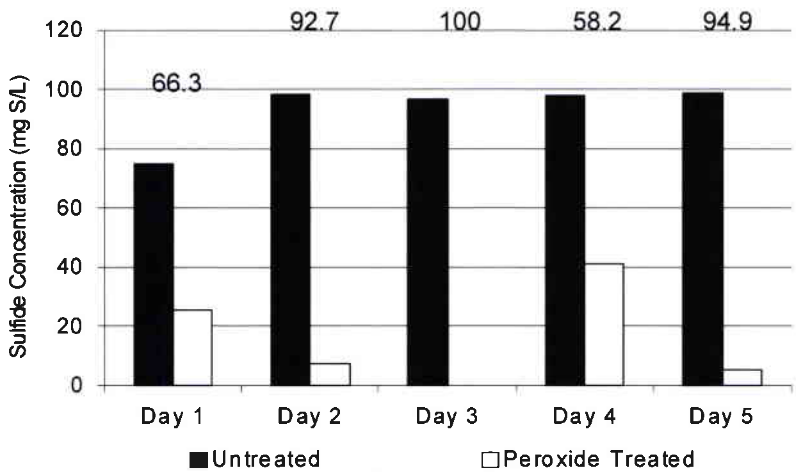


Figure 5.3 Sulfide Concentrations after Peroxide Addition (0.51 g/L) to a Foul Condensate [numbers above bars represent percent reductions in total sulfide observed each day]

Dosage and retention time trends were evaluated using a screening technique that involved collecting 25-mL samples in a 500-mL bottle that was closed and agitated for one minute. The cap was removed and a Jerome air monitor was used to measure volatile H_2S in the headspace. The effect of peroxide dose and retention time are illustrated in Figure 5.4. Reductions of >90% were observed after the first minute, and at some dosage rates they increased modestly with additional retention time. Figure 5.5 illustrates trends for doses of 0.5 and 1.0 GPM of a 50% H_2O_2 solution to the 3 MGD foul condensate at the four sampling locations (drop legs 1 through 4). Although some variability was observed, a significant reduction in sulfide was observed at the first drop leg under both addition rates investigated and increased gradually as the foul condensate progressed through the drop legs.

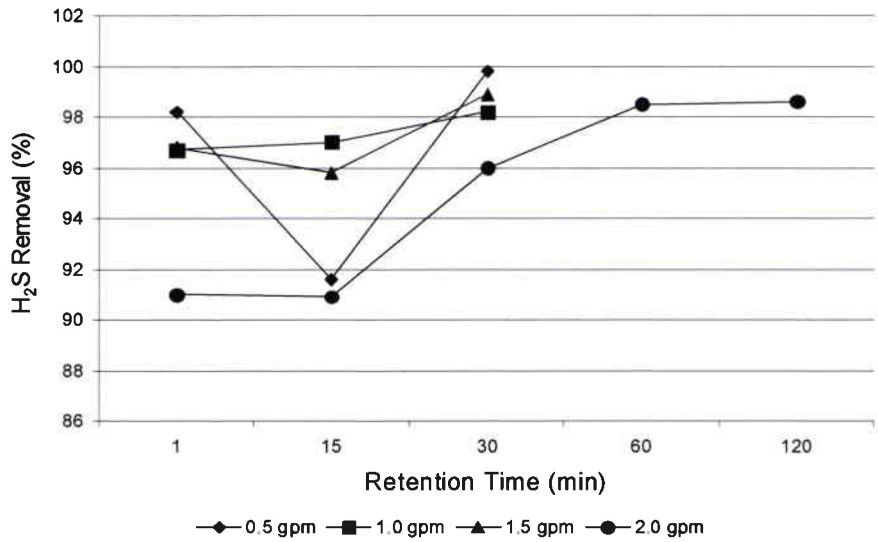


Figure 5.4 Effect of Hydrogen Peroxide Dose (0.14, 0.29, 0.43, and 0.56 g/L) and Retention Time on Sulfide Removal Efficiency [headspace measurements]

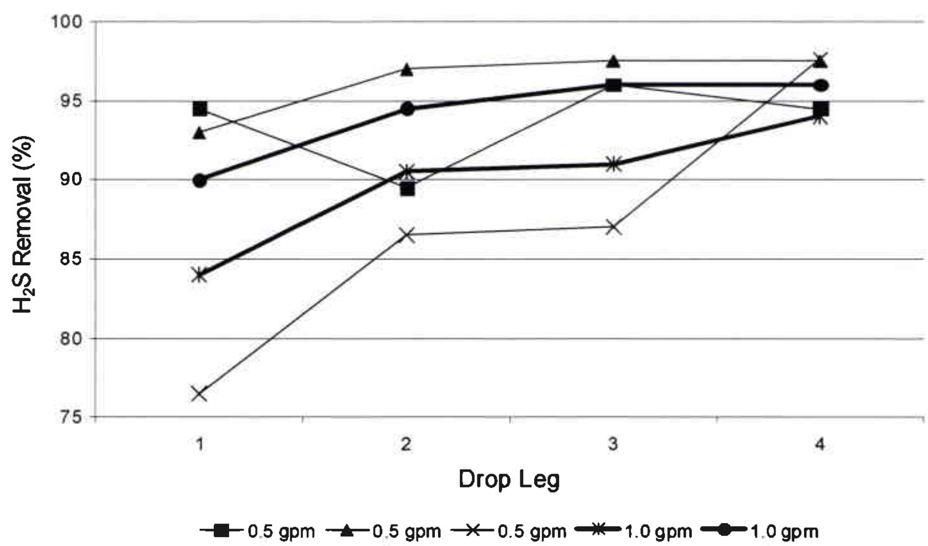


Figure 5.5 Effect of Hydrogen Peroxide Dose (0.14, 0.29, 0.43, and 0.56 g/L) and Sample Location on Sulfide Removal Efficiency [headspace measurements]

Another example of H_2O_2 use at a bleached kraft mill is illustrated in Figure 5.6. The mill conducted a bench study prior to an odor reduction trial to determine the dose-response curve for peroxide addition to foul condensates. Foul condensates were treated with the oxidant (50% H_2O_2; density 1.2 g/mL) volumes shown in the figure (equivalent to 0.14, 0.29, 0.43, and 0.56 g H_2O_2/L of foul condensate) at 50°C for 30 minutes in sealed vials. Samples were removed and analyzed by direct aqueous injection GC/sulfur chemiluminescence detectors (SCD) for sulfide, MeSH, DMS, and

DMDS. The data indicate that sulfide and MeSH were readily removed, but that DMS required significantly higher doses to achieve equivalent levels of removal. DMDS was not removed and in fact increased with peroxide dose, presumably due to oxidation of MeSH.

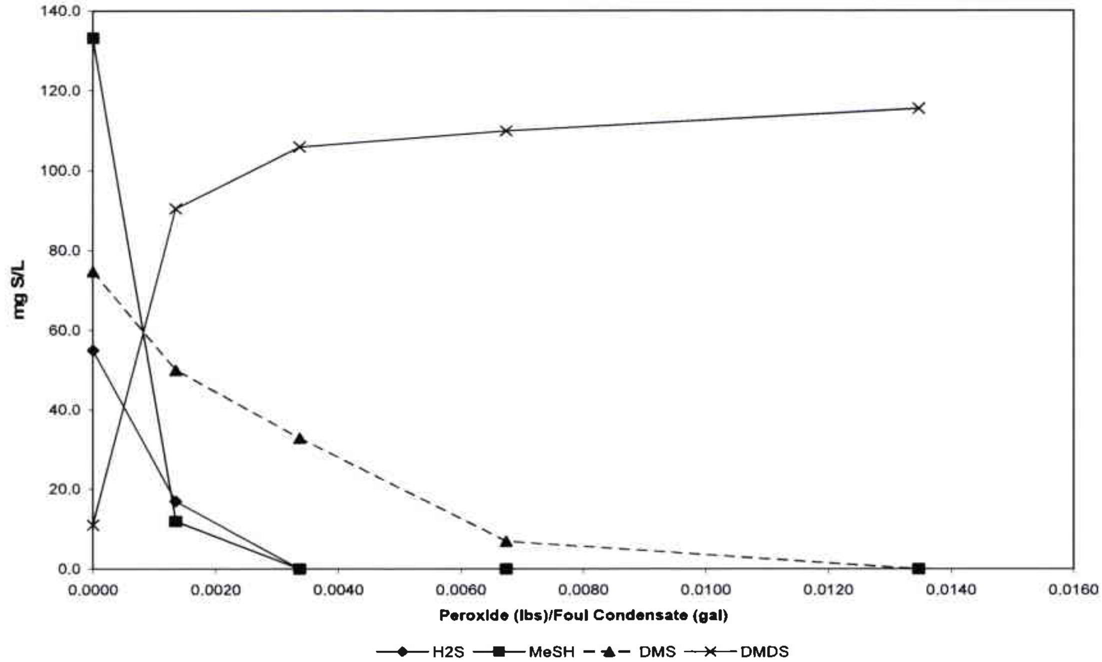


Figure 5.6 Hydrogen Peroxide Dose-Response Curve for Treatment of Foul Condensates

Following the bench studies, a mill trial was conducted over a five day period. H_2O_2 was added to the foul condensate tank (pH 9.0 to 9.3) at a rate of 1 gallon (100% H_2O_2) to every 500 gallons of condensate, which is equivalent to 2.8 g H_2O_2/L of foul condensate. This addition point provided a retention time of ~30 minutes prior to the WWTP. The trial resulted in overall average reductions in sulfide, MeSH, and DMS of 38.8, 64.6, and -3.9%, respectively (Table 5.1). The level of DMDS increased (probably due to oxidation of MeSH to DMDS) during the addition but reportedly did not affect overall odor from the WWTP (NCASI files). The mill continues to feed H_2O_2 to the foul condensate and has reported a reduction in odor at the WWTP.

Table 5.1 Percent Reduction in Hydrogen Sulfide, Methyl Mercaptan, and Dimethyl Sulfide during a Peroxide Addition Trial Conducted in a Foul Condensate

Day of Study	H_2S	MeSH	DMS
1	26.1	67.3	-20.8
2	68.3	74.7	16.5
3	38.1	57.0	1.9
4	36.4	60.0	2.6
5	25.3	63.8	-19.5
Average	38.8	64.6	-3.86

WASTEWATER TREATMENT PLANT – SUPPORTING INFORMATION
BASELINE ACTUAL EMISSIONS

May/July 2022 Baseline Emissions Calculations
H_2S, TRS Compounds, and VOC
New-Indy Catawba - Catawba, SC

		Method: GC/SCD Reduced Sulfur Analysis (Average)			
Sample Date	**Sample Location**	**ALS H2S, ppb**	**ALS DMDS, ppb**	**ALS DMS, ppb**	**ALS MMC, ppb**
2021/2022	Avg. ASB Influent (2021 and 2022)	252	86.78	199	2.60
5/17/2022	Foul Condensate (prior to H_2O_2)	105,667	6,633	14,667	8,267
	Predicted % Reduction from H_2O_2	0.99	MMC converted into DMDS	0.90	0.99
	Foul Condensate (after H_2O_2)	1,057	14,647	1,467	82.67
7/19/2022	Foul Condensate (prior to H_2O_2)	58,333	5,633	5,400	3,900
	Predicted % Reduction from H_2O_2	0.99	MMC converted into DMDS	0.90	0.99
	Foul Condensate (after H_2O_2)	583	9,414	540	39.00
7/20/2022	Foul Condensate (prior to H_2O_2)	76,200	6,932	7,140	7,393
	Predicted % Reduction from H_2O_2	0.99	MMC converted into DMDS	0.90	0.99
	Foul Condensate (after H_2O_2)	762	14,099	714	73.93
7/21/2022	Foul Condensate (prior to H_2O_2)	62,500	8,967	9,200	6,533
	Predicted % Reduction from H_2O_2	0.99	MMC converted into DMDS	0.90	0.99
	Foul Condensate (after H_2O_2)	625	15,300	920	65.33
		ALS H2S, ppm	**ALS DMDS, ppm**	**ALS DMS, ppm**	**ALS MMC, ppm**
Flow Weight Average Loading Calculation	Avg. Foul Condensate Concentration (after peroxide)	0.76	13.36	0.91	0.07
	Avg. ASB Inlet Concentration	0.25	0.09	0.20	2.60E-03
	Avg. Hardpipe Flow, MGD	0.34	0.34	0.34	0.34
	Avg. ASB Inlet Flow, MGD	23.96	23.96	23.96	23.96
	Total Flow	24.30	24.30	24.30	24.30
	Flow Weight. Avg. Loading (ppm)	**0.2593**	**0.2712**	**0.2088**	**0.0035**
Results and Emissions Factors Calculation	**H2SSIM/WATER9 Results**	**H2S, g/s**	**DMDS, g/s**	**DMS, g/s**	**MMC, g/s**
	ASB Zone 1	Multiple H2SSIM runs.	0.10	0.15	2.74E-03
	ASB Zone 2		1.43E-03	3.05E-03	4.63E-05
	ASB Zone 3		2.57E-05	1.01E-04	1.43E-06
	Total ASB		**0.10**	**0.16**	**2.78E-03**
	Baseline Emissions Factor 2200 ODTP/day	**H2S, lb/ODTP**	**DMDS, lb/ODTP**	**DMS, lb/ODTP**	**MMC, lb/ODTP**
	Baseline Emissions Factor	**1.51E-02**	**1.14E-02**	**1.85E-02**	**3.28E-04**

Type of unit is

1 Total water added at the unit (l/s)	50	0
2 Area of openings at unit (cm2)		50
3 Radius of drop pipe (cm)		5
4 Drop length to conduit (cm)		61
5 Humidity of inlet air (%)		40
6 Temperature of air (C)		25
7 Drain air velocity (ft/min)		84
8 manhole air velocity (ft/min)		128
9 Conduit air velocity (ft/min)		66
10 Wind speed (cm/s at 10 m)		447
11 distance to next unit (cm)		500
12 slope of underflow conduit		.015
13 friction factor liquid		.016
14 friction factor gas		.006
15 radius of underflow conduit (cm)		12
16 Underflow T (C)		25
17 oscillation cycle time (min)		5
18 design collection velocities (ft/s)		2
19 design branch line fraction full		.4

Type of unit is

8 HL partition flag=1, adjust for sorption	0
9 unit recycle convergence number	200
10 oil molecular weight	0
11 oil density (g/cc)	0
12 NaUT 1=municipal 2=industrial 3=turb.	0
13 NaUT 1=mass tr. 2=equil	0
14 parts biomass per 1000 parts COD	
15 oil water partition method 0=owpc	
16 use UNIFAC aqueous data base =1	
17 specify mass transfer for unit, =1	
18 Use biomass for unit option, =1	
19 biogrowth Monod half concentration ppm	

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment
Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\BAE\TRS\WATER9\ASB V5 3/14/2023 2:17:21 PM 19:17:08
COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment

1 Description of unit	11	ASB Zone 1
2 Wastewater temperature (C)		34.08
3 length of aeration unit (m)		295
4 width of aeration unit (m)		295
5 depth of aeration unit (m)		1.4
6 Area of agitation (each aerator,m2)		135
7 Total number of agitators in the unit		31
8 Power of agitation (each aerator,HP)		75
9 Impeller diameter (cm)		49.53
10 Impeller rotation (RPM)		1200
11 Agitator mechanical efficiency		0.83
12 aerator effectiveness, alpha		0.83
13 if there is plug flow, enter 1		0
14 Overall biorate (mg/g bio-hr)		19
15 Aeration air flow (m3/s)		0
16 active biomass, aeration (g/l)		0.3
17 If covered, then enter 1		0
18 special input		0
19 pH (enter 0 for no pH adjustment)		7.04

Properties of DIMETHYL DISULFIDE at 34.1 deg.C (93.3 deg.F)

hl= 0.001714 atm-m3/mol   vp= 45.945 mmHg (0.88868 psia)
95.2 y/x
0.068011 g/L gas per g/L liquid
Temperature adjustment factor = 1.046 ^(T-25), deg. C
kl= 0. L/g-hr   dl= 1.041e-05 cm2/s dv= 0.088022 cm2/s
Compound flow rate from inlet water is 0.26179 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 31.792 hr.
____Biomass production________________
The biomass production rate is 0.mg/hr. (0. mg/L)
The fraction dissolved solids converted is 0. .
The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 237.766.
kl is estimated as 5.971e-06 m/s.
kg is estimated as 0.005598 m/s. Model: 2
kg is estimated as 0.005598 m/s. Model: 2
The Schmidt number is 1.70412.
The friction velocity is 37.398 m/s
kg is estimated as 0.012927 m/s. Model: 3
________Agitated surface__________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.11564 m/s.
kl (agitated)is estimated as 0.017486 m/s.
The specified and growth biomass is 0.3 g/L.
The effective KL (surface + diffused air) is 2.753e-04 m/s.
The effective stripping time (surface + diffused air) is 84.752 minutes. (1.41254 hrs.)
The pump mixing time is 5 x the pumping recirculaion time, 0. min.
The ratio of the mixing to the striping (surface + diffused air) is 0.
The mean residence time is 1907.493 min. (31.792 hr.)
The ratio of the pump mixing to the residence time is 0.

KG aerated (m/s)	0.11781
KL aerated (m/s)	0.017486
KL OVERALL AERATED (m/s)	0.005609
KG quiescent (m/s)	0.005703
KL quiescent (m/s)	5.971e-06
KL OVERALL QUIESCENT (m/s)	5.883e-06
KL OVERALL (m/s)	2.753e-04
air stripping time constant (min)	84.752
FRACTION SURFACE VOLATILIZED	0.36432
FRACTION SUBMERGED VOLATILIZED	0.
TOTAL FRACTION VOLATILIZED	0.36432
FRACTION BIOLOGICALLY REMOVED	0.61949
FRACTION ABSORBED	0.
TOTAL AIR EMISSIONS (g/s)	0.095374
(Mg/year)	3.00772
EMISSION FACTOR (g/cm2-s)	1.096e-10
UNIT EXIT CONCENTRATION (ppmw)	0.003981

DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream
Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\BAE\TRS\WATER9\ASB V5 3/14/2023 2:17:21 PM 19:17:08
COMPOUND: DIMETHYL DISULFIDE

Type of unit is system exit stream
1 Description of unit   12   def.system exit st

TOTAL AIR EMISSIONS (g/s)   0.

```
                  (Mg/year)                 0.
   EMISSION FACTOR  (g/cm2-s)               1.096e-10
   UNIT EXIT CONCENTRATION (ppmw)           6.079e-06
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper
  Permitting\Emissions\WWTP\BAE\TRS\WATER9\ASB V5 3/14/2023 2:17:21 PM  19:17:08
COMPOUND: DIMETHYL DISULFIDE

Type of unit is open hub drain
1 Description of unit                       13    default open hub d
2 Underflow T (C)                                 43.89
3 Total water added at the unit (l/s)             0
4 Area of openings at unit (cm2)                  50
5 Radius of drop pipe (cm)                        5
6 Drop length to conduit (cm)                     61
7 Open surface=1                                  1
8 Subsurface entrance=1                           0
9 subsurface exit =1                              0
10 radius of underflow conduit (cm)               12
11 distance to next unit (cm)                     500
12 slope of underflow conduit                     0.015
16 velocity air at drain opening (ft/min)         84
17 municipal waste in conduit =1                  0
18 Assume equilibrium in unit, =1                 0
19 pH  (enter 0 for no pH adjustment)             8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1064.53 l/s.
   Weight fraction down is  2.712E-07
   Gas concentration in  0 mol fraction.
   Gas flow  1064.53 L/s
   Weight fraction out at base of drop is  2.45916666343852E-07
   fraction transferred in the drain drop from hub is .093228
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.093228
   fraction loss in unit                    0.
   fraction loss in line run                0.
   component upstream of unit, g/s          0.
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             3.134e-19
   mol fract. headspace vent base           6.978e-06
   headspace flow out vent (cc/s)           -1.065e+06
   headspace flow down line (cc/s)          1.065e+06
   KG surface (m/s)                         1860.422
   KL surface (m/s)                         6.37e-09
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.2887
   total component into unit, g/s           0.26179
   TOTAL AIR EMISSIONS  (g/s)               0.026915
                  (Mg/year)                 0.84879
   EMISSION FACTOR  (g/cm2-s)               1.096e-10
   UNIT EXIT CONCENTRATION (ppmw)           0.24592
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper
  Permitting\Emissions\WWTP\BAE\TRS\WATER9\ASB V5 3/14/2023 2:17:21 PM  19:17:08
COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment
1 Description of unit                       17    ASB Zone 3
```

```
2 Wastewater temperature   (C)                      30.01
3 length of aeration unit (m)                       376
4 width of aeration unit (m)                        188
5 depth of aeration unit (m)                        0.91
6 Area of agitation (each aerator,m2)               135
7 Total number of agitators in the unit             6
8 Power of agitation (each aerator,HP)              75
9 Impeller diameter (cm)                            49.53
10 Impeller rotation (RPM)                          1200
11 Agitator mechanical efficiency                   0.83
12 aerator effectiveness, alpha                     0.83
13 if there is plug flow, enter 1                   0
14 Overall biorate (mg/g bio-hr)                    19
15 Aeration air flow (m3/s)                         0
16 active biomass, aeration (g/l)                   0.3
17 If covered, then enter 1                         0
18 special input                                    0
19 pH  (enter 0 for no pH adjustment)               7.42

Properties of DIMETHYL DISULFIDE at 30. deg.C (86. deg.F)
   hl= 0.00141 atm-m3/mol      vp= 37.814 mmHg (0.7314 psia)
       78.352 y/x
       0.056726 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.027e-05 cm2/s  dv= 0.085991 cm2/s
Compound flow rate from inlet water is 1.411e-04 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 16.785 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 5.918e-06 m/s.
kg is estimated as 0.005575 m/s.  Model: 2
kg is estimated as 0.005575 m/s.  Model: 2
The Schmidt number is 1.74436.
The friction velocity is 37.398 m/s
kg is estimated as 0.012742 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.1143 m/s.
kl (agitated)is estimated as 0.015772 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 5.972e-05 m/s.
 The effective stripping time (surface + diffused air) is 253.944 minutes. (4.2324
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1007.112 min. (16.785 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                           0.11644
   KL aerated (m/s)                           0.015772
   KL OVERALL AERATED (m/s)                   0.004711
   KG quiescent (m/s)                         0.005679
   KL quiescent (m/s)                         5.918e-06
   KL OVERALL QUIESCENT (m/s)                 5.813e-06
   KL OVERALL (m/s)                           5.972e-05
   air stripping time constant (min)          253.944
```

```
   FRACTION SURFACE VOLATILIZED            0.18189
   FRACTION SUBMERGED VOLATILIZED          0.
   TOTAL FRACTION VOLATILIZED              0.18189
   FRACTION BIOLOGICALLY REMOVED           0.77225
   FRACTION ABSORBED                       0.
   TOTAL AIR EMISSIONS  (g/s)              2.567e-05
                    (Mg/year)              8.094e-04
   EMISSION FACTOR  (g/cm2-s)              3.631e-14
   UNIT EXIT CONCENTRATION (ppmw)          6.079e-06
DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper
  Permitting\Emissions\WWTP\BAE\TRS\WATER9\ASB V5 3/14/2023 2:17:21 PM  19:17:08
COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment
1 Description of unit                       18    ASB Zone 2
2 Wastewater temperature   (C)                    32.08
3 length of aeration unit (m)                     368
4 width of aeration unit (m)                      184
5 depth of aeration unit (m)                      0.97
6 Area of agitation (each aerator,m2)             135
7 Total number of agitators in the unit           15
8 Power of agitation (each aerator,HP)            75
9 Impeller diameter (cm)                          49.53
10 Impeller rotation (RPM)                        1200
11 Agitator mechanical efficiency                 0.83
12 aerator effectiveness, alpha                   0.83
13 if there is plug flow, enter 1                 0
14 Overall biorate (mg/g bio-hr)                  19
15 Aeration air flow (m3/s)                       0
16 active biomass, aeration (g/l)                 0.3
17 If covered, then enter 1                       0
18 special input                                  0
19 pH  (enter 0 for no pH adjustment)             7.24

Properties of DIMETHYL DISULFIDE at 32.1 deg.C (89.7 deg.F)
   hl= 0.001558 atm-m3/mol      vp= 41.785 mmHg (0.80821 psia)
       86.579 y/x
       0.062258 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.034e-05 cm2/s  dv= 0.087022 cm2/s
Compound flow rate from inlet water is 0.004238 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 17.139 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 5.945e-06 m/s.
kg is estimated as 0.005633 m/s.  Model: 2
kg is estimated as 0.005633 m/s.  Model: 2
The Schmidt number is 1.72371.
The friction velocity is 37.398 m/s
kg is estimated as 0.012836 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
```

```
kg (agitated)is estimated as 0.11498 m/s.
kl (agitated)is estimated as 0.016622 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 1.598e-04 m/s.
 The effective stripping time (surface + diffused air) is 101.198 minutes.
 (1.68663 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1028.32 min. (17.139 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                          0.11714
   KL aerated (m/s)                          0.016622
   KL OVERALL AERATED (m/s)                  0.005152
   KG quiescent (m/s)                        0.005738
   KL quiescent (m/s)                        5.945e-06
   KL OVERALL QUIESCENT (m/s)                5.85e-06
   KL OVERALL (m/s)                          1.598e-04
   air stripping time constant (min)         101.198
   FRACTION SURFACE VOLATILIZED              0.33837
   FRACTION SUBMERGED VOLATILIZED            0.
   TOTAL FRACTION VOLATILIZED                0.33837
   FRACTION BIOLOGICALLY REMOVED             0.62833
   FRACTION ABSORBED                         0.
   TOTAL AIR EMISSIONS  (g/s)                0.001434
                     (Mg/year)               0.045218
   EMISSION FACTOR  (g/cm2-s)                2.118e-12
   UNIT EXIT CONCENTRATION (ppmw)            1.326e-04
```

Type of unit is

1 Total water added at the unit (l/s)	50	0
2 Area of openings at unit (cm2)		50
3 Radius of drop pipe (cm)		5
4 Drop length to conduit (cm)		61
5 Humidity of inlet air (%)		40
6 Temperature of air (C)		25
7 Drain air velocity (ft/min)		84
8 manhole air velocity (ft/min)		128
9 Conduit air velocity (ft/min)		66
10 Wind speed (cm/s at 10 m)		447
11 distance to next unit (cm)		500
12 slope of underflow conduit		.015
13 friction factor liquid		.016
14 friction factor gas		.006
15 radius of underflow conduit (cm)		12
16 Underflow T (C)		25
17 oscillation cycle time (min)		5
18 design collection velocities (ft/s)		2
19 design branch line fraction full		.4

Type of unit is

8 HL partition flag=1, adjust for sorption	0
9 unit recycle convergence number	200
10 oil molecular weight	0
11 oil density (g/cc)	0
12 NaUT 1=municipal 2=industrial 3=turb.	0
13 NaUT 1=mass tr. 2=equil	0
14 parts biomass per 1000 parts COD	
15 oil water partition method 0=owpc	
16 use UNIFAC aqueous data base =1	
17 specify mass transfer for unit, =1	
18 Use biomass for unit option, =1	
19 biogrowth Monod half concentration ppm	

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment
Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\BAE\TRS\WATER9\ASB V5 3/14/2023 2:17:21 PM 19:18:13
COMPOUND: DIMETHYL SULFIDE (DMS)

Type of unit is aerated biotreatment

1 Description of unit	11	ASB Zone 1
2 Wastewater temperature (C)		34.08
3 length of aeration unit (m)		295
4 width of aeration unit (m)		295
5 depth of aeration unit (m)		1.4
6 Area of agitation (each aerator,m2)		135
7 Total number of agitators in the unit		31
8 Power of agitation (each aerator,HP)		75
9 Impeller diameter (cm)		49.53
10 Impeller rotation (RPM)		1200
11 Agitator mechanical efficiency		0.83
12 aerator effectiveness, alpha		0.83
13 if there is plug flow, enter 1		0
14 Overall biorate (mg/g bio-hr)		19
15 Aeration air flow (m3/s)		0
16 active biomass, aeration (g/l)		0.3
17 If covered, then enter 1		0
18 special input		0
19 pH (enter 0 for no pH adjustment)		7.04

Properties of DIMETHYL SULFIDE (DMS) at 34.1 deg.C (93.3 deg.F)

```
    hl= 0.002924 atm-m3/mol      vp= 704.653 mmHg (13.629 psia)
        162.463 y/x
        0.11606 g/L gas per g/L liquid
    Temperature adjustment factor = 1.046 ^(T-25), deg. C
    kl= 0. L/g-hr          dl= 1.504e-05 cm2/s  dv= 0.14765 cm2/s
Compound flow rate from inlet water is 0.19189 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 31.792 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 237.766.
kl is estimated as 7.634e-06 m/s.
kg is estimated as 0.007917 m/s.  Model: 2
kg is estimated as 0.007917 m/s.  Model: 2
The Schmidt number is 1.01591.
The friction velocity is 37.398 m/s
kg is estimated as 0.017873 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.14978 m/s.
kl (agitated)is estimated as 0.021024 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 4.77e-04 m/s.
 The effective stripping time (surface + diffused air) is 48.915 minutes. (0.81526
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1907.493 min. (31.792 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                        0.15258
   KL aerated (m/s)                        0.021024
   KL OVERALL AERATED (m/s)                0.009769
   KG quiescent (m/s)                      0.008066
   KL quiescent (m/s)                      7.634e-06
   KL OVERALL QUIESCENT (m/s)              7.574e-06
   KL OVERALL (m/s)                        4.77e-04
   air stripping time constant (min)       48.915
   FRACTION SURFACE VOLATILIZED            0.80226
   FRACTION SUBMERGED VOLATILIZED          0.
   TOTAL FRACTION VOLATILIZED              0.80226
   FRACTION BIOLOGICALLY REMOVED           0.17717
   FRACTION ABSORBED                       0.
   TOTAL AIR EMISSIONS  (g/s)              0.15394
                    (Mg/year)              4.85471
   EMISSION FACTOR  (g/cm2-s)              1.769e-10
   UNIT EXIT CONCENTRATION (ppmw)          0.003708
DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper
  Permitting\Emissions\WWTP\BAE\TRS\WATER9\ASB V5 3/14/2023 2:17:21 PM  19:18:13
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is system exit stream
1 Description of unit                     12    def.system exit st

   TOTAL AIR EMISSIONS  (g/s)              0.
```

```
                  (Mg/year)                  0.
   EMISSION FACTOR  (g/cm2-s)                1.769e-10
   UNIT EXIT CONCENTRATION (ppmw)            1.362e-05
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper
  Permitting\Emissions\WWTP\BAE\TRS\WATER9\ASB V5 3/14/2023 2:17:21 PM  19:18:13
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is open hub drain
1 Description of unit                        13    default open hub d
2 Underflow T (C)                                  43.89
3 Total water added at the unit (l/s)              0
4 Area of openings at unit (cm2)                   50
5 Radius of drop pipe (cm)                         5
6 Drop length to conduit (cm)                      61
7 Open surface=1                                   1
8 Subsurface entrance=1                            0
9 subsurface exit =1                               0
10 radius of underflow conduit (cm)                12
11 distance to next unit (cm)                      500
12 slope of underflow conduit                      0.015
16 velocity air at drain opening (ft/min)          84
17 municipal waste in conduit =1                   0
18 Assume equilibrium in unit, =1                  0
19 pH  (enter 0 for no pH adjustment)              8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1064.53 l/s.
   Weight fraction down is  2.088E-07
   Gas concentration in  0 mol fraction.
   Gas flow  1064.53 L/s
   Weight fraction out at base of drop is  1.80253671574623E-07
   fraction transferred in the drain drop from hub is .136716
   fraction loss in waste1 drop to hub       0.
   fraction loss in waste2 drop to hub       0.
   fraction loss in waste3 drop to hub       0.
   fraction loss in collection hub drop      0.13672
   fraction loss in unit                     0.
   fraction loss in line run                 0.
   component upstream of unit, g/s           0.
   mol fract. headspace upstream (y)         0.
   headspace at conduit discharge, y         0.
   headspace end of conduit (y)              4.509e-19
   mol fract. headspace vent base            1.195e-05
   headspace flow out vent (cc/s)            -1.065e+06
   headspace flow down line (cc/s)           1.065e+06
   KG surface (m/s)                          2626.947
   KL surface (m/s)                          8.245e-09
   flow of waste down hub (l/s)              0.
   component flow in waste into unit (g/s)   0.22227
   total component into unit, g/s            0.19189
   TOTAL AIR EMISSIONS  (g/s)                0.030388
                  (Mg/year)                  0.95833
   EMISSION FACTOR  (g/cm2-s)                1.769e-10
   UNIT EXIT CONCENTRATION (ppmw)            0.18025
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper
  Permitting\Emissions\WWTP\BAE\TRS\WATER9\ASB V5 3/14/2023 2:17:21 PM  19:18:13
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is aerated biotreatment
1 Description of unit                        17    ASB Zone 3
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```
2 Wastewater temperature   (C)                       30.01
3 length of aeration unit (m)                        376
4 width of aeration unit (m)                         188
5 depth of aeration unit (m)                         0.91
6 Area of agitation (each aerator,m2)                135
7 Total number of agitators in the unit              6
8 Power of agitation (each aerator,HP)               75
9 Impeller diameter (cm)                             49.53
10 Impeller rotation (RPM)                           1200
11 Agitator mechanical efficiency                    0.83
12 aerator effectiveness, alpha                      0.83
13 if there is plug flow, enter 1                    0
14 Overall biorate (mg/g bio-hr)                     19
15 Aeration air flow (m3/s)                          0
16 active biomass, aeration (g/l)                    0.3
17 If covered, then enter 1                          0
18 special input                                     0
19 pH  (enter 0 for no pH adjustment)                7.42

Properties of DIMETHYL SULFIDE  (DMS) at 30. deg.C (86. deg.F)
   hl= 0.002519 atm-m3/mol      vp= 606.985 mmHg (11.74 psia)
       139.945 y/x
       0.10132 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.485e-05 cm2/s  dv= 0.14425 cm2/s
Compound flow rate from inlet water is 1.708e-04 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 16.785 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 7.566e-06 m/s.
kg is estimated as 0.007884 m/s.  Model: 2
kg is estimated as 0.007884 m/s.  Model: 2
The Schmidt number is 1.03989.
The friction velocity is 37.398 m/s
kg is estimated as 0.017611 m/s.  Model: 3
________Agitated surface__________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.14804 m/s.
kl (agitated)is estimated as 0.018962 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 1.053e-04 m/s.
 The effective stripping time (surface + diffused air) is 144.073 minutes.
 (2.40122 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1007.112 min. (16.785 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                          0.15081
   KL aerated (m/s)                          0.018962
   KL OVERALL AERATED (m/s)                  0.00854
   KG quiescent (m/s)                        0.008032
   KL quiescent (m/s)                        7.566e-06
   KL OVERALL QUIESCENT (m/s)                7.497e-06
   KL OVERALL (m/s)                          1.053e-04
   air stripping time constant (min)         144.073
```

```
   FRACTION SURFACE VOLATILIZED              0.59355
   FRACTION SUBMERGED VOLATILIZED            0.
   TOTAL FRACTION VOLATILIZED                0.59355
   FRACTION BIOLOGICALLY REMOVED             0.32154
   FRACTION ABSORBED                         0.
   TOTAL AIR EMISSIONS  (g/s)                1.014e-04
                     (Mg/year)               0.003197
   EMISSION FACTOR  (g/cm2-s)                1.434e-13
   UNIT EXIT CONCENTRATION (ppmw)            1.362e-05
DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper
  Permitting\Emissions\WWTP\BAE\TRS\WATER9\ASB V5 3/14/2023 2:17:21 PM  19:18:13
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is aerated biotreatment
1 Description of unit                       18    ASB Zone 2
2 Wastewater temperature   (C)                    32.08
3 length of aeration unit (m)                     368
4 width of aeration unit (m)                      184
5 depth of aeration unit (m)                      0.97
6 Area of agitation (each aerator,m2)             135
7 Total number of agitators in the unit           15
8 Power of agitation (each aerator,HP)            75
9 Impeller diameter (cm)                          49.53
10 Impeller rotation (RPM)                        1200
11 Agitator mechanical efficiency                 0.83
12 aerator effectiveness, alpha                   0.83
13 if there is plug flow, enter 1                 0
14 Overall biorate (mg/g bio-hr)                  19
15 Aeration air flow (m3/s)                       0
16 active biomass, aeration (g/l)                 0.3
17 If covered, then enter 1                       0
18 special input                                  0
19 pH  (enter 0 for no pH adjustment)             7.24

Properties of DIMETHYL SULFIDE  (DMS) at 32.1 deg.C (89.7 deg.F)
   hl= 0.002719 atm-m3/mol      vp= 655.201 mmHg (12.673 psia)
       151.062 y/x
       0.10863 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.495e-05 cm2/s  dv= 0.14597 cm2/s
Compound flow rate from inlet water is 0.003948 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 17.139 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 7.6e-06 m/s.
kg is estimated as 0.007966 m/s.  Model: 2
kg is estimated as 0.007966 m/s.  Model: 2
The Schmidt number is 1.02758.
The friction velocity is 37.398 m/s
kg is estimated as 0.017744 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
```

```
kg (agitated)is estimated as 0.14892 m/s.
kl (agitated)is estimated as 0.019984 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 2.809e-04 m/s.
 The effective stripping time (surface + diffused air) is 57.552 minutes. (0.9592
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1028.32 min. (17.139 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                        0.15171
   KL aerated (m/s)                        0.019984
   KL OVERALL AERATED (m/s)                0.009148
   KG quiescent (m/s)                      0.008115
   KL quiescent (m/s)                      7.6e-06
   KL OVERALL QUIESCENT (m/s)              7.537e-06
   KL OVERALL (m/s)                        2.809e-04
   air stripping time constant (min)       57.552
   FRACTION SURFACE VOLATILIZED            0.77311
   FRACTION SUBMERGED VOLATILIZED          0.
   TOTAL FRACTION VOLATILIZED              0.77311
   FRACTION BIOLOGICALLY REMOVED           0.18362
   FRACTION ABSORBED                       0.
   TOTAL AIR EMISSIONS  (g/s)              0.003052
                     (Mg/year)             0.096247
   EMISSION FACTOR  (g/cm2-s)              4.507e-12
   UNIT EXIT CONCENTRATION (ppmw)          1.605e-04
```

Type of unit is

1 Total water added at the unit (l/s)	50	0
2 Area of openings at unit (cm2)		50
3 Radius of drop pipe (cm)		5
4 Drop length to conduit (cm)		61
5 Humidity of inlet air (%)		40
6 Temperature of air (C)		25
7 Drain air velocity (ft/min)		84
8 manhole air velocity (ft/min)		128
9 Conduit air velocity (ft/min)		66
10 Wind speed (cm/s at 10 m)		447
11 distance to next unit (cm)		500
12 slope of underflow conduit		.015
13 friction factor liquid		.016
14 friction factor gas		.006
15 radius of underflow conduit (cm)		12
16 Underflow T (C)		25
17 oscillation cycle time (min)		5
18 design collection velocities (ft/s)		2
19 design branch line fraction full		.4

Type of unit is

8 HL partition flag=1, adjust for sorption	0
9 unit recycle convergence number	200
10 oil molecular weight	0
11 oil density (g/cc)	0
12 NaUT 1=municipal 2=industrial 3=turb.	0
13 NaUT 1=mass tr. 2=equil	0
14 parts biomass per 1000 parts COD	
15 oil water partition method 0=owpc	
16 use UNIFAC aqueous data base =1	
17 specify mass transfer for unit, =1	
18 Use biomass for unit option, =1	
19 biogrowth Monod half concentration ppm	

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment
Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\BAE\TRS\WATER9\ASB V5 3/14/2023 2:17:21 PM 19:18:53
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment

1 Description of unit	11	ASB Zone 1
2 Wastewater temperature (C)		34.08
3 length of aeration unit (m)		295
4 width of aeration unit (m)		295
5 depth of aeration unit (m)		1.4
6 Area of agitation (each aerator,m2)		135
7 Total number of agitators in the unit		31
8 Power of agitation (each aerator,HP)		75
9 Impeller diameter (cm)		49.53
10 Impeller rotation (RPM)		1200
11 Agitator mechanical efficiency		0.83
12 aerator effectiveness, alpha		0.83
13 if there is plug flow, enter 1		0
14 Overall biorate (mg/g bio-hr)		19
15 Aeration air flow (m3/s)		0
16 active biomass, aeration (g/l)		0.3
17 If covered, then enter 1		0
18 special input		0
19 pH (enter 0 for no pH adjustment)		7.04

Properties of METHANETHIOL(methyl mercaptan) at 34.1 deg.C (93.3 deg.F)

```
   hl= 0.004158 atm-m3/mol      vp= 2272.142 mmHg (43.948 psia)
       230.99 y/x
       0.16502 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.525e-05 cm2/s  dv= 0.23702 cm2/s
Compound flow rate from inlet water is 0.003078 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 31.792 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 237.766.
kl is estimated as 7.703e-06 m/s.
kg is estimated as 0.010871 m/s.  Model: 2
kg is estimated as 0.010871 m/s.  Model: 2
The Schmidt number is 0.63285.
The friction velocity is 37.398 m/s
kg is estimated as 0.024173 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.18977 m/s.
kl (agitated)is estimated as 0.021167 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 6.265e-04 m/s.
 The effective stripping time (surface + diffused air) is 37.242 minutes. (0.62071 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1907.493 min. (31.792 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                         0.19332
   KL aerated (m/s)                         0.021167
   KL OVERALL AERATED (m/s)                 0.012876
   KG quiescent (m/s)                       0.011075
   KL quiescent (m/s)                       7.703e-06
   KL OVERALL QUIESCENT (m/s)               7.672e-06
   KL OVERALL (m/s)                         6.265e-04
   air stripping time constant (min)        37.242
   FRACTION SURFACE VOLATILIZED             0.88891
   FRACTION SUBMERGED VOLATILIZED           0.
   TOTAL FRACTION VOLATILIZED               0.88891
   FRACTION BIOLOGICALLY REMOVED            0.093739
   FRACTION ABSORBED                        0.
   TOTAL AIR EMISSIONS  (g/s)               0.002736
                    (Mg/year)               0.086272
   EMISSION FACTOR  (g/cm2-s)               3.144e-12
   UNIT EXIT CONCENTRATION (ppmw)           5.017e-05
DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\BAE\TRS\WATER9\ASB V5 3/14/2023 2:17:21 PM  19:18:53
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is system exit stream
1 Description of unit                     12    def.system exit st

   TOTAL AIR EMISSIONS  (g/s)               0.
```

(Mg/year) 0.
EMISSION FACTOR (g/cm2-s) 3.144e-12
UNIT EXIT CONCENTRATION (ppmw) 1.458e-07
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain
Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\BAE\TRS\WATER9\ASB V5 3/14/2023 2:17:21 PM 19:18:53
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is open hub drain

1 Description of unit	13	default open hub d
2 Underflow T (C)		43.89
3 Total water added at the unit (l/s)		0
4 Area of openings at unit (cm2)		50
5 Radius of drop pipe (cm)		5
6 Drop length to conduit (cm)		61
7 Open surface=1		1
8 Subsurface entrance=1		0
9 subsurface exit =1		0
10 radius of underflow conduit (cm)		12
11 distance to next unit (cm)		500
12 slope of underflow conduit		0.015
16 velocity air at drain opening (ft/min)		84
17 municipal waste in conduit =1		0
18 Assume equilibrium in unit, =1		0
19 pH (enter 0 for no pH adjustment)		8.9

Equilibrium partitioning in drain drop hub is assumed.
Total drain flow is 1064.53 l/s.
Weight fraction down is 3.5E-09
Gas concentration in 0 mol fraction.
Gas flow 1064.53 L/s
Weight fraction out at base of drop is 2.89099406807993E-09
fraction transferred in the drain drop from hub is .174002

fraction loss in waste1 drop to hub	0.
fraction loss in waste2 drop to hub	0.
fraction loss in waste3 drop to hub	0.
fraction loss in collection hub drop	0.174
fraction loss in unit	0.
fraction loss in line run	0.
component upstream of unit, g/s	0.
mol fract. headspace upstream (y)	0.
headspace at conduit discharge, y	0.
headspace end of conduit (y)	9.429e-21
mol fract. headspace vent base	3.292e-07
headspace flow out vent (cc/s)	-1.065e+06
headspace flow down line (cc/s)	1.065e+06
KG surface (m/s)	3602.086
KL surface (m/s)	8.324e-09
flow of waste down hub (l/s)	0.
component flow in waste into unit (g/s)	0.003726
total component into unit, g/s	0.003078
TOTAL AIR EMISSIONS (g/s)	6.483e-04
(Mg/year)	0.020445
EMISSION FACTOR (g/cm2-s)	3.144e-12
UNIT EXIT CONCENTRATION (ppmw)	0.002891

DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment
Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\BAE\TRS\WATER9\ASB V5 3/14/2023 2:17:21 PM 19:18:53
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment
1 Description of unit 17 ASB Zone 3

```
2 Wastewater temperature   (C)                   30.01
3 length of aeration unit (m)                    376
4 width of aeration unit (m)                     188
5 depth of aeration unit (m)                     0.91
6 Area of agitation (each aerator,m2)            135
7 Total number of agitators in the unit          6
8 Power of agitation (each aerator,HP)           75
9 Impeller diameter (cm)                         49.53
10 Impeller rotation (RPM)                       1200
11 Agitator mechanical efficiency                0.83
12 aerator effectiveness, alpha                  0.83
13 if there is plug flow, enter 1                0
14 Overall biorate (mg/g bio-hr)                 19
15 Aeration air flow (m3/s)                      0
16 active biomass, aeration (g/l)                0.3
17 If covered, then enter 1                      0
18 special input                                 0
19 pH  (enter 0 for no pH adjustment)            7.42

Properties of METHANETHIOL(methyl mercaptan) at 30. deg.C (86. deg.F)
   hl= 0.003687 atm-m3/mol      vp= 2014.774 mmHg (38.97 psia)
       204.826 y/x
       0.14829 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.505e-05 cm2/s  dv= 0.23155 cm2/s
Compound flow rate from inlet water is 1.957e-06 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 16.785 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 7.635e-06 m/s.
kg is estimated as 0.010826 m/s.  Model: 2
kg is estimated as 0.010826 m/s.  Model: 2
The Schmidt number is 0.64779.
The friction velocity is 37.398 m/s
kg is estimated as 0.023814 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.18756 m/s.
kl (agitated)is estimated as 0.019092 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 1.391e-04 m/s.
 The effective stripping time (surface + diffused air) is 109.038 minutes.
 (1.81731 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1007.112 min. (16.785 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                         0.19108
   KL aerated (m/s)                         0.019092
   KL OVERALL AERATED (m/s)                 0.011483
   KG quiescent (m/s)                       0.011029
   KL quiescent (m/s)                       7.635e-06
   KL OVERALL QUIESCENT (m/s)               7.6e-06
   KL OVERALL (m/s)                         1.391e-04
   air stripping time constant (min)        109.038
```

```
   FRACTION SURFACE VOLATILIZED            0.7324
   FRACTION SUBMERGED VOLATILIZED          0.
   TOTAL FRACTION VOLATILIZED              0.7324
   FRACTION BIOLOGICALLY REMOVED           0.1883
   FRACTION ABSORBED                       0.
   TOTAL AIR EMISSIONS  (g/s)              1.433e-06
                     (Mg/year)             4.52e-05
   EMISSION FACTOR  (g/cm2-s)              2.028e-15
   UNIT EXIT CONCENTRATION (ppmw)          1.458e-07
DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper
  Permitting\Emissions\WWTP\BAE\TRS\WATER9\ASB V5 3/14/2023 2:17:21 PM  19:18:53
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment
1 Description of unit                       18    ASB Zone 2
2 Wastewater temperature   (C)                    32.08
3 length of aeration unit (m)                     368
4 width of aeration unit (m)                      184
5 depth of aeration unit (m)                      0.97
6 Area of agitation (each aerator,m2)             135
7 Total number of agitators in the unit           15
8 Power of agitation (each aerator,HP)            75
9 Impeller diameter (cm)                          49.53
10 Impeller rotation (RPM)                        1200
11 Agitator mechanical efficiency                 0.83
12 aerator effectiveness, alpha                   0.83
13 if there is plug flow, enter 1                 0
14 Overall biorate (mg/g bio-hr)                  19
15 Aeration air flow (m3/s)                       0
16 active biomass, aeration (g/l)                 0.3
17 If covered, then enter 1                       0
18 special input                                  0
19 pH  (enter 0 for no pH adjustment)             7.24

Properties of METHANETHIOL(methyl mercaptan) at 32.1 deg.C (89.7 deg.F)
   hl= 0.003921 atm-m3/mol      vp= 2142.771 mmHg (41.446 psia)
       217.838 y/x
       0.15664 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.515e-05 cm2/s  dv= 0.23433 cm2/s
Compound flow rate from inlet water is 5.341e-05 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 17.139 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 7.67e-06 m/s.
kg is estimated as 0.010938 m/s.  Model: 2
kg is estimated as 0.010938 m/s.  Model: 2
The Schmidt number is 0.64013.
The friction velocity is 37.398 m/s
kg is estimated as 0.023996 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
```

```
kg (agitated)is estimated as 0.18868 m/s.
kl (agitated)is estimated as 0.020121 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 3.715e-04 m/s.
 The effective stripping time (surface + diffused air) is 43.518 minutes. (0.72529
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1028.32 min. (17.139 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                         0.19222
   KL aerated (m/s)                         0.020121
   KL OVERALL AERATED (m/s)                 0.012174
   KG quiescent (m/s)                       0.011143
   KL quiescent (m/s)                       7.67e-06
   KL OVERALL QUIESCENT (m/s)               7.637e-06
   KL OVERALL (m/s)                         3.715e-04
   air stripping time constant (min)        43.518
   FRACTION SURFACE VOLATILIZED             0.86584
   FRACTION SUBMERGED VOLATILIZED           0.
   TOTAL FRACTION VOLATILIZED               0.86584
   FRACTION BIOLOGICALLY REMOVED            0.097514
   FRACTION ABSORBED                        0.
   TOTAL AIR EMISSIONS  (g/s)               4.625e-05
                    (Mg/year)               0.001458
   EMISSION FACTOR  (g/cm2-s)               6.83e-14
   UNIT EXIT CONCENTRATION (ppmw)           1.838e-06
```

BAE H2S Factor
Summary of H2SSIM Inputs and Outputs

H2SSIM Inputs Windspeed: 3.55 mph **H2SSIM Outputs**

5/17/2022

	Zone 1	Zone 2	Zone 3
DO	1.57	4.63	4.66
Temp	87.52	83.91	80.19
pH	6.77	7.19	7.44
Length	968	1208	1235
Width	968	604	617
Aerators	31	15	6
Total HP	2325	1125	450

	Main Inlet	Hardpipe	Units
Flow	25.11	0.35	MGD
Total Sulfide	0.060	1.06	mg/L
Sulfate	390	390	mg/L

	Zone 1	Zone 2	Zone 3	Total ASB	
H2S g/s	0.07	0.02	0.02	**0.111**	g/s
				1723	ODTP
				0.012	lb/ODTP

7/19/2022

	Zone 1	Zone 2	Zone 3
DO	1.57	4.63	4.66
Temp	96.27	93.37	89.26
pH	7.17	7.37	7.48
Length	968	1208	1235
Width	968	604	617
Aerators	31	15	6

	Main Inlet	Hardpipe	Units
Flow	25.32	0.42	MGD
Total Sulfide	0.921	0.583	mg/L
Sulfate	390	390	mg/L

	Zone 1	Zone 2	Zone 3	Total ASB	
H2S g/s	0.09	0.03	0.02	**0.144**	g/s
				1900	ODTP
				0.014	lb/ODTP

7/20/2022

	Zone 1	Zone 2	Zone 3
DO	1.57	4.63	4.66
Temp	94.80	91.27	87.57
pH	7.10	7.22	7.39
Length	968	1208	1235
Width	968	604	617
Aerators	31	15	6

	Main Inlet	Hardpipe	Units
Flow	25.48	0.39	MGD
Total Sulfide	0.053	0.762	mg/L
Sulfate	390	390	mg/L

	Zone 1	Zone 2	Zone 3	Total ASB	
H2S g/s	0.06	0.03	0.02	**0.111**	g/s
				1900	ODTP
				0.011	lb/ODTP
				0.01	

7/21/2022

	Zone 1	Zone 2	Zone 3
DO	1.57	4.63	4.66
Temp	94.76	90.42	87.08
pH	7.10	7.19	7.35
Length	968	1208	1235
Width	968	604	617
Aerators	31	15	6

	Main Inlet	Hardpipe	Units
Flow	19.93	0.19	MGD
Total Sulfide	0.094	0.625	mg/L
Sulfate	390	390	mg/L

	Zone 1	Zone 2	Zone 3	Total ASB	
H2S g/s	0.06	0.03	0.02	**0.111**	g/s
				940	ODTP
				0.022	lb/ODTP

*DO are based on average of all DO readings from 2021 and 2022 Subpart S performance testing.

AVG: **0.015** lb/ODTP

NCASI WASTEWATER HYDROGEN SULFIDE EMISSIONS SIMULATOR (H2SSIM)
Version 1.3

5/17/2022

Data Type 1. Site Identification

Company Name	New-Indy
Facility Name	Catawba SC
Basin Name	ASB

Data Type 2. Model Zone Information

Number of Zones	3
Zone Location of Hardpipe	1
Type of Basin	ASB

Data Type 3. Load Characteristics

Loading Characteristics	Main Influent	Hardpipe	Units
Flow	25.11	0.35	MGD
Total Sulfide	0.06	1.057	mg/L
Sulfate	390	390	mg/L

Data Type 4. Atmospheric Conditions

Windspeed	3.55	mph
Ambient Temperature	79	F

Data Type 5. Zone Physical and Chemical Conditions

Zone Condition	Zone 1	Zone 2	Zone 3	Zone 4	Units
Dissolved Oxygen	1.571780303	4.6275	4.659734848		mg/L
Temperature	87.52	83.91	80.19		F
pH	6.77	7.19	7.44		s.u.
Redox Condition	Aerobic	Aerobic	Aerobic	Aerobic	
Length	968	1208	1235		feet
Width	968	604	617		feet
Depth	4.5	3.2	3		feet
Mixing	Moderat	Modera	Moderat		
Number of Aerators	31	15	6		
Total Horsepower	2325	1125	450		HP
Impellor Size	1.625	1.625	1.625		feet
Impellor RPM	1200	1200	1200		RPM
Diffused Air Flow	0	0	0		cms
Weir Height	0	0	0		feet

Model Controls

Run H2SSIM

View Parameters

Clear Input Sheet

H2SSIM Results

5/17/2022

Basin Emissions		Units
Total Emissions (H_2S)	0.111	gms/s
Total Emissions (H_2S)	7726.8	lbs/yr
Total Emissions (H_2S)	3.9	tons/yr
Total Emissions (H_2S)	3.5	tonnes/yr
Emission Flux (H_2S)	15.5	gms/m^2 yr

Zone Emissions	Zone 1	Zone 2	Zone 3	Zone 4	Units
Zone Emissions (H_2S)	0.07	0.02	0.02		gms/s
Zone Emissions (H_2S)	4978.9	1486.3	1261.7		lbs/yr
Emission Flux (H_2S)	25.9	9.9	8.1		gms/m^2 yr
Liquid Conc. (Total Sulfide)	0.003	0.001	0.000		mg/L
Liquid Sulfide Load (lbs/yr)	34.400	6.200	5.200		lbs/yr

Percent Inlet Sulfide Removed	-35.4%

Current Parameters	
kgen	0.25
ThetaGen	1.06
KDO	0.05
KSO4	10
kanox	0.006
ThetaOx	1.05
m	1
n	0.2
MLVSS	272.2
O_2 Transfer Coeff.	2
alpha 1	0.83
alpha 2	0.6

NCASI WASTEWATER HYDROGEN SULFIDE EMISSIONS SIMULATOR (H2SSIM)
Version 1.3

7/19/2022

Data Type 1. Site Identification

Company Name	New-Indy
Facility Name	Catawba SC
Basin Name	ASB

Data Type 2. Model Zone Information

Number of Zones	3
Zone Location of Hardpipe	1
Type of Basin	ASB

Data Type 3. Load Characteristics

Loading Characteristics	Main Influent	Hardpipe	Units
Flow	25.32	0.42	MGD
Total Sulfide	0.921	0.583	mg/L
Sulfate	390	390	mg/L

Data Type 4. Atmospheric Conditions

Windspeed	3.55	mph
Ambient Temperature	79	F

Data Type 5. Zone Physical and Chemical Conditions

Zone Condition	Zone 1	Zone 2	Zone 3	Zone 4	Units
Dissolved Oxygen	1.571780303	4.6275	4.659734848		mg/L
Temperature	96.27	93.37	89.26		F
pH	7.17	7.37	7.48		s.u.
Redox Condition	Aerobic	Aerobic	Aerobic	Aerobic	
Length	968	1208	1235		feet
Width	968	604	617		feet
Depth	4.5	3.2	3		feet
Mixing	Moderat	Moderat	Moderat		
Number of Aerators	31	15	6		
Total Horsepower	2325	1125	450		HP
Impellor Size	1.625	1.625	1.625		feet
Impellor RPM	1200	1200	1200		RPM
Diffused Air Flow	0	0	0		cms
Weir Height	0	0	0		feet

Model Controls

Run H2SSIM

View Parameters

Clear Input Sheet

H2SSIM Results 7/19/2022

Basin Emissions		Units
Total Emissions (H_2S)	0.145	gms/s
Total Emissions (H_2S)	10050.3	lbs/yr
Total Emissions (H_2S)	5.0	tons/yr
Total Emissions (H_2S)	4.6	tonnes/yr
Emission Flux (H_2S)	20.2	gms/m^2 yr

Zone Emissions	Zone 1	Zone 2	Zone 3	Zone 4	Units
Zone Emissions (H_2S)	0.09	0.03	0.02		gms/s
Zone Emissions (H_2S)	6430.8	1936.5	1683.0		lbs/yr
Emission Flux (H_2S)	33.5	13.0	10.8		gms/m^2 yr
Liquid Conc. (Total Sulfide)	0.005	0.000	0.000		mg/L
Liquid Sulfide Load (lbs/yr)	60.200	6.100	5.400		lbs/yr

Percent Inlet Sulfide Removed	86.0%

Current Parameters	
kgen	0.25
ThetaGen	1.06
KDO	0.05
KSO4	10
kanox	0.006
ThetaOx	1.05
m	1
n	0.2
MLVSS	272.2
O_2 Transfer Coeff.	2
alpha 1	0.83
alpha 2	0.6

NCASI WASTEWATER HYDROGEN SULFIDE EMISSIONS SIMULATOR (H2SSIM)

Version 1.3

7/20/2022

Data Type 1. Site Identification

Company Name	New-Indy
Facility Name	Catawba SC
Basin Name	ASB

Data Type 2. Model Zone Information

Number of Zones	3
Zone Location of Hardpipe	1
Type of Basin	ASB

Data Type 3. Load Characteristics

Loading Characteristics	Main Influent	Hardpipe	Units
Flow	25.48	0.39	MGD
Total Sulfide	0.053	0.762	mg/L
Sulfate	390	390	mg/L

Data Type 4. Atmospheric Conditions

Windspeed	3.55	mph
Ambient Temperature	79	F

Data Type 5. Zone Physical and Chemical Conditions

Zone Condition	Zone 1	Zone 2	Zone 3	Zone 4	Units
Dissolved Oxygen	1.571780303	4.6275	4.659734848		mg/L
Temperature	94.8	91.27	87.57		F
pH	7.1	7.22	7.39		s.u.
Redox Condition	Aerobic	Aerobic	Aerobic	Aerobic	
Length	968	1208	1235		feet
Width	968	604	617		feet
Depth	4.5	3.2	3		feet
Mixing	Moderat	Moderat	Moderat		
Number of Aerators	31	15	6		
Total Horsepower	2325	1125	450		HP
Impellor Size	1.625	1.625	1.625		feet
Impellor RPM	1200	1200	1200		RPM
Diffused Air Flow	0	0	0		cms
Weir Height	0	0	0		feet

Model Controls

Run H2SSIM

View Parameters

Clear Input Sheet

H2SSIM Results

7/20/2022

Basin Emissions		Units
Total Emissions (H_2S)	0.111	gms/s
Total Emissions (H_2S)	7721.2	lbs/yr
Total Emissions (H_2S)	3.9	tons/yr
Total Emissions (H_2S)	3.5	tonnes/yr
Emission Flux (H_2S)	15.5	gms/m^2 yr

Zone Emissions	Zone 1	Zone 2	Zone 3	Zone 4	Units
Zone Emissions (H_2S)	0.06	0.03	0.02		gms/s
Zone Emissions (H_2S)	4266.3	1852.9	1602.0		lbs/yr
Emission Flux (H_2S)	22.2	12.4	10.3		gms/m^2 yr
Liquid Conc. (Total Sulfide)	0.002	0.001	0.000		mg/L
Liquid Sulfide Load (lbs/yr)	26.800	6.300	5.600		lbs/yr

Percent Inlet Sulfide Removed	-54.1%

Current Parameters	
kgen	0.25
ThetaGen	1.06
KDO	0.05
KSO4	10
kanox	0.006
ThetaOx	1.05
m	1
n	0.2
MLVSS	272.2
O_2 Transfer Coeff.	2
alpha 1	0.83
alpha 2	0.6

NCASI WASTEWATER HYDROGEN SULFIDE EMISSIONS SIMULATOR (H2SSIM)
Version 1.3

7/21/2022

Data Type 1. Site Identification

Company Name	New-Indy
Facility Name	Catawba SC
Basin Name	ASB

Data Type 2. Model Zone Information

Number of Zones	3
Zone Location of Hardpipe	1
Type of Basin	ASB

Data Type 3. Load Characteristics

Loading Characteristics	Main Influent	Hardpipe	Units
Flow	19.93	0.19	MGD
Total Sulfide	0.094	0.625	mg/L
Sulfate	390	390	mg/L

Data Type 4. Atmospheric Conditions

Windspeed	3.55	mph
Ambient Temperature	79	F

Data Type 5. Zone Physical and Chemical Conditions

Zone Condition	Zone 1	Zone 2	Zone 3	Zone 4	Units
Dissolved Oxygen	1.571780303	4.6275	4.659734848		mg/L
Temperature	94.76	90.42	87.08		F
pH	7.1	7.19	7.35		s.u.
Redox Condition	Aerobic	Aerobic	Aerobic	Aerobic	
Length	968	1208	1235		feet
Width	968	604	617		feet
Depth	4.5	3.2	3		feet
Mixing	Moderat	Moderat	Moderat		
Number of Aerators	31	15	6		
Total Horsepower	2325	1125	450		HP
Impellor Size	1.625	1.625	1.625		feet
Impellor RPM	1200	1200	1200		RPM
Diffused Air Flow	0	0	0		cms
Weir Height	0	0	0		feet

Model Controls

Run H2SSIM

View Parameters

Clear Input Sheet

H2SSIM Results

7/21/2022

Basin Emissions		Units
Total Emissions (H_2S)	0.111	gms/s
Total Emissions (H_2S)	7700.8	lbs/yr
Total Emissions (H_2S)	3.9	tons/yr
Total Emissions (H_2S)	3.5	tonnes/yr
Emission Flux (H_2S)	15.5	gms/m^2 yr

Zone Emissions	Zone 1	Zone 2	Zone 3	Zone 4	Units
Zone Emissions (H_2S)	0.06	0.03	0.02		gms/s
Zone Emissions (H_2S)	4305.7	1814.2	1580.9		lbs/yr
Emission Flux (H_2S)	22.4	12.1	10.1		gms/m^2 yr
Liquid Conc. (Total Sulfide)	0.002	0.001	0.000		mg/L
Liquid Sulfide Load (lbs/yr)	21.300	5.000	4.400		lbs/yr

Percent Inlet Sulfide Removed	-27.1%

Current Parameters	
kgen	0.25
ThetaGen	1.06
KDO	0.05
KSO4	10
kanox	0.006
ThetaOx	1.05
m	1
n	0.2
MLVSS	272.2
O_2 Transfer Coeff.	2
alpha 1	0.83
alpha 2	0.6

Baseline Methanol Emissions Factor

Date of Subpart S Performance Testing	Air Stripping* g/s	Pulp Production	Methanol Emissions Factor lb/ODTP
7/9/2021	14.10	1694	1.59
7/10/2021	11.58	1609	1.37
7/11/2021	8.71	1356	1.22
10/26/2021	15.17	1523	1.90
10/27/2021	12.03	1463	1.57
10/28/2021	13.31	1675	1.51
10/29/2021	12.16	1749	1.32
2/14/2022	8.69	1612	1.03
2/15/2022	8.96	1441	1.18
2/16/2022	10.15	1424	1.36
5/4/2022	0.50	2090	0.05
5/5/2022	1.54	1954	0.15
5/6/2022	1.03	2121	0.09
8/9/2022	1.60	2104	0.15
8/10/2022	1.78	1987	0.17
8/11/2022	1.33	1631	0.15
9/27/2022	1.60	1602	0.19
9/28/2022	1.78	1816	0.19
9/29/2022	1.33	1944	0.13
10/18/2022	0.89	1609	0.11
10/19/2022	0.33	1610	0.04
10/20/2022	0.19	1738	0.02

1.50 lb/ODTP, 2021 average
0.33 lb/ODTP, 2022 average
0.92 lb/ODTP, BAE Factor

*Air Stripping (g/s) for each day of Subpart S performance testing in 2021 and 2022 are from the NCASI Form XIII calculations provided in the performance test reports.

WASTEWATER TREATMENT PLANT – SUPPORTING INFORMATION
PROJECTED ACTUAL EMISSIONS

New Stripper Scenario - Projected Actual Emissions

H_2S, TRS Compounds, and VOC

New-Indy Catawba - Catawba, SC

Concentration Loadings	**H2S, ppm**	**DMDS, ppm**	**DMS, ppm**	**MMC, ppm**
No Hardpipe flow (foul or stripped)	N/A	N/A	N/A	N/A
ASB Influent (Wastewater)	0.25	0.09	0.20	0.0026
Flow Weighted Loading:	0.25	0.09	0.20	2.60E-03
WATER9 Results	**H2S, g/s**	**DMDS, g/s**	**DMS, g/s**	**MMC, g/s**
ASB Zone 1	0.07	0.03	0.15	2.13E-03
ASB Zone 2	0.03	5.03E-04	3.19E-03	3.77E-05
ASB Zone 3	0.02	9.42E-06	1.11E-04	1.22E-06
Total ASB	**0.12**	**0.03**	**0.16**	**2.17E-03**
PAE Emissions Factors	**H2S, lb/ODTP**	**DMDS, lb/ODTP**	**DMS, lb/ODTP**	**MMC, lb/ODTP**
Total ASB	**1.03E-02**	**2.81E-03**	**1.36E-02**	**1.88E-04**

Hardpipe Flow (Foul or Stripped Condensate)	0	MGD
Post-Project ASB Influent Flow:	25.48	MGD
Total ASB Flow:	25.48	MGD
Total ASB Flow:	1116.47	L/s
Pulp Production	2200	ODTP/day

	MW
H2S	34
DMDS	94
DMS	62
MMC	48

Type of unit is

1	Total water added at the unit (l/s)	50	0
2	Area of openings at unit (cm2)		50
3	Radius of drop pipe (cm)		5
4	Drop length to conduit (cm)		61
5	Humidity of inlet air (%)		40
6	Temperature of air (C)		25
7	Drain air velocity (ft/min)		84
8	manhole air velocity (ft/min)		128
9	Conduit air velocity (ft/min)		66
10	Wind speed (cm/s at 10 m)		447
11	distance to next unit (cm)		500
12	slope of underflow conduit		.015
13	friction factor liquid		.016
14	friction factor gas		.006
15	radius of underflow conduit (cm)		12
16	Underflow T (C)		25
17	oscillation cycle time (min)		5
18	design collection velocities (ft/s)		2
19	design branch line fraction full		.4

Type of unit is

8	HL partition flag=1, adjust for sorption	0
9	unit recycle convergence number	200
10	oil molecular weight	0
11	oil density (g/cc)	0
12	NaUT 1=municipal 2=industrial 3=turb.	0
13	NaUT 1=mass tr. 2=equil	0
14	parts biomass per 1000 parts COD	
15	oil water partition method 0=owpc	
16	use UNIFAC aqueous data base =1	
17	specify mass transfer for unit, =1	
18	Use biomass for unit option, =1	
19	biogrowth Monod half concentration ppm	

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment
Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\PAE\New Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM 19:27:50
COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment

1	Description of unit	11	ASB Zone 1
2	Wastewater temperature (C)		34.08
3	length of aeration unit (m)		295
4	width of aeration unit (m)		295
5	depth of aeration unit (m)		1.4
6	Area of agitation (each aerator,m2)		135
7	Total number of agitators in the unit		31
8	Power of agitation (each aerator,HP)		75
9	Impeller diameter (cm)		49.53
10	Impeller rotation (RPM)		1200
11	Agitator mechanical efficiency		0.83
12	aerator effectiveness, alpha		0.83
13	if there is plug flow, enter 1		0
14	Overall biorate (mg/g bio-hr)		19
15	Aeration air flow (m3/s)		0
16	active biomass, aeration (g/l)		0.3
17	If covered, then enter 1		0
18	special input		0
19	pH (enter 0 for no pH adjustment)		7.04

Properties of DIMETHYL DISULFIDE at 34.1 deg.C (93.3 deg.F)

```
   hl= 0.001714 atm-m3/mol      vp= 45.945 mmHg (0.88868 psia)
       95.2 y/x
       0.068011 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.041e-05 cm2/s  dv= 0.088022 cm2/s
Compound flow rate from inlet water is 0.087838 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 30.325 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 237.766.
kl is estimated as 5.971e-06 m/s.
kg is estimated as 0.005598 m/s.  Model: 2
kg is estimated as 0.005598 m/s.  Model: 2
The Schmidt number is 1.70412.
The friction velocity is 37.398 m/s
kg is estimated as 0.012927 m/s.  Model: 3
________Agitated surface__________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.11564 m/s.
kl (agitated)is estimated as 0.017486 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 2.753e-04 m/s.
 The effective stripping time (surface + diffused air) is 84.752 minutes. (1.41254
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1819.519 min. (30.325 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                        0.11781
   KL aerated (m/s)                        0.017486
   KL OVERALL AERATED (m/s)                0.005609
   KG quiescent (m/s)                      0.005703
   KL quiescent (m/s)                      5.971e-06
   KL OVERALL QUIESCENT (m/s)              5.883e-06
   KL OVERALL (m/s)                        2.753e-04
   air stripping time constant (min)       84.752
   FRACTION SURFACE VOLATILIZED            0.36393
   FRACTION SUBMERGED VOLATILIZED          0.
   TOTAL FRACTION VOLATILIZED              0.36393
   FRACTION BIOLOGICALLY REMOVED           0.61912
   FRACTION ABSORBED                       0.
   TOTAL AIR EMISSIONS  (g/s)              0.031967
                    (Mg/year)              1.00811
   EMISSION FACTOR  (g/cm2-s)              3.673e-11
   UNIT EXIT CONCENTRATION (ppmw)          0.001334
DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\PAE\New
  Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:27:50
COMPOUND: DIMETHYL DISULFIDE

Type of unit is system exit stream
1 Description of unit                     12    def.system exit st

   TOTAL AIR EMISSIONS  (g/s)              0.
```

```
                  (Mg/year)                0.
   EMISSION FACTOR  (g/cm2-s)              3.673e-11
   UNIT EXIT CONCENTRATION (ppmw)          2.231e-06
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\PAE\New
  Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:27:50
COMPOUND: DIMETHYL DISULFIDE

Type of unit is open hub drain
1 Description of unit                        13    default open hub d
2 Underflow T (C)                                  43.89
3 Total water added at the unit (l/s)              0
4 Area of openings at unit (cm2)                   50
5 Radius of drop pipe (cm)                         5
6 Drop length to conduit (cm)                      61
7 Open surface=1                                   1
8 Subsurface entrance=1                            0
9 subsurface exit =1                               0
10 radius of underflow conduit (cm)                12
11 distance to next unit (cm)                      500
12 slope of underflow conduit                      0.015
16 velocity air at drain opening (ft/min)          84
17 municipal waste in conduit =1                   0
18 Assume equilibrium in unit, =1                  0
19 pH  (enter 0 for no pH adjustment)              8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1116 l/s.
   Weight fraction down is  8.680001E-08
   Gas concentration in  0 mol fraction.
   Gas flow  1116 L/s
   Weight fraction out at base of drop is  7.87078550837274E-08
   fraction transferred in the drain drop from hub is .093228
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.093228
   fraction loss in unit                    0.
   fraction loss in line run                0.
   component upstream of unit, g/s          0.
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             9.876e-20
   mol fract. headspace vent base           2.233e-06
   headspace flow out vent (cc/s)           -1.116e+06
   headspace flow down line (cc/s)          1.116e+06
   KG surface (m/s)                         1932.406
   KL surface (m/s)                         6.575e-09
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.096869
   total component into unit, g/s           0.087838
   TOTAL AIR EMISSIONS  (g/s)               0.009031
                  (Mg/year)                 0.2848
   EMISSION FACTOR  (g/cm2-s)               3.673e-11
   UNIT EXIT CONCENTRATION (ppmw)           0.078708
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\PAE\New
  Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:27:50
COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment
1 Description of unit                        17    ASB Zone 3
```

```
2 Wastewater temperature   (C)                    30.01
3 length of aeration unit (m)                     376
4 width of aeration unit (m)                      188
5 depth of aeration unit (m)                      0.91
6 Area of agitation (each aerator,m2)             135
7 Total number of agitators in the unit           6
8 Power of agitation (each aerator,HP)            75
9 Impeller diameter (cm)                          49.53
10 Impeller rotation (RPM)                        1200
11 Agitator mechanical efficiency                 0.83
12 aerator effectiveness, alpha                   0.83
13 if there is plug flow, enter 1                 0
14 Overall biorate (mg/g bio-hr)                  19
15 Aeration air flow (m3/s)                       0
16 active biomass, aeration (g/l)                 0.3
17 If covered, then enter 1                       0
18 special input                                  0
19 pH  (enter 0 for no pH adjustment)             7.42

Properties of DIMETHYL DISULFIDE at 30. deg.C (86. deg.F)
   hl= 0.00141 atm-m3/mol      vp= 37.814 mmHg (0.7314 psia)
       78.352 y/x
       0.056726 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.027e-05 cm2/s  dv= 0.085991 cm2/s
Compound flow rate from inlet water is 5.19e-05 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 16.011 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 5.918e-06 m/s.
kg is estimated as 0.005575 m/s.  Model: 2
kg is estimated as 0.005575 m/s.  Model: 2
The Schmidt number is 1.74436.
The friction velocity is 37.398 m/s
kg is estimated as 0.012742 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.1143 m/s.
kl (agitated)is estimated as 0.015772 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 5.972e-05 m/s.
 The effective stripping time (surface + diffused air) is 253.944 minutes. (4.2324
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 960.664 min. (16.011 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                          0.11644
   KL aerated (m/s)                          0.015772
   KL OVERALL AERATED (m/s)                  0.004711
   KG quiescent (m/s)                        0.005679
   KL quiescent (m/s)                        5.918e-06
   KL OVERALL QUIESCENT (m/s)                5.813e-06
   KL OVERALL (m/s)                          5.972e-05
   air stripping time constant (min)         253.944
```

```
   FRACTION SURFACE VOLATILIZED            0.18149
   FRACTION SUBMERGED VOLATILIZED          0.
   TOTAL FRACTION VOLATILIZED              0.18149
   FRACTION BIOLOGICALLY REMOVED           0.77054
   FRACTION ABSORBED                       0.
   TOTAL AIR EMISSIONS  (g/s)              9.419e-06
                    (Mg/year)              2.97e-04
   EMISSION FACTOR  (g/cm2-s)              1.332e-14
   UNIT EXIT CONCENTRATION (ppmw)          2.231e-06
DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\PAE\New
  Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:27:50
COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment
1 Description of unit                     18    ASB Zone 2
2 Wastewater temperature   (C)                  32.08
3 length of aeration unit (m)                   368
4 width of aeration unit (m)                    184
5 depth of aeration unit (m)                    0.97
6 Area of agitation (each aerator,m2)           135
7 Total number of agitators in the unit         15
8 Power of agitation (each aerator,HP)          75
9 Impeller diameter (cm)                        49.53
10 Impeller rotation (RPM)                      1200
11 Agitator mechanical efficiency               0.83
12 aerator effectiveness, alpha                 0.83
13 if there is plug flow, enter 1               0
14 Overall biorate (mg/g bio-hr)                19
15 Aeration air flow (m3/s)                     0
16 active biomass, aeration (g/l)               0.3
17 If covered, then enter 1                     0
18 special input                                0
19 pH  (enter 0 for no pH adjustment)           7.24

Properties of DIMETHYL DISULFIDE at 32.1 deg.C (89.7 deg.F)
   hl= 0.001558 atm-m3/mol      vp= 41.785 mmHg (0.80821 psia)
       86.579 y/x
       0.062258 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.034e-05 cm2/s  dv= 0.087022 cm2/s
Compound flow rate from inlet water is 0.001489 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 16.348 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 5.945e-06 m/s.
kg is estimated as 0.005633 m/s.  Model: 2
kg is estimated as 0.005633 m/s.  Model: 2
The Schmidt number is 1.72371.
The friction velocity is 37.398 m/s
kg is estimated as 0.012836 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
```

```
kg (agitated)is estimated as 0.11498 m/s.
kl (agitated)is estimated as 0.016622 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 1.598e-04 m/s.
 The effective stripping time (surface + diffused air) is 101.198 minutes.
 (1.68663 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 980.894 min. (16.348 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                        0.11714
   KL aerated (m/s)                        0.016622
   KL OVERALL AERATED (m/s)                0.005152
   KG quiescent (m/s)                      0.005738
   KL quiescent (m/s)                      5.945e-06
   KL OVERALL QUIESCENT (m/s)              5.85e-06
   KL OVERALL (m/s)                        1.598e-04
   air stripping time constant (min)       101.198
   FRACTION SURFACE VOLATILIZED            0.33782
   FRACTION SUBMERGED VOLATILIZED          0.
   TOTAL FRACTION VOLATILIZED              0.33782
   FRACTION BIOLOGICALLY REMOVED           0.62732
   FRACTION ABSORBED                       0.
   TOTAL AIR EMISSIONS  (g/s)              5.03e-04
                    (Mg/year)              0.015863
   EMISSION FACTOR  (g/cm2-s)              7.429e-13
   UNIT EXIT CONCENTRATION (ppmw)          4.65e-05
```

```
Type of unit is
1 Total water added at the unit (l/s)      50     0
2 Area of openings at unit (cm2)                  50
3 Radius of drop pipe (cm)                        5
4 Drop length to conduit (cm)                     61
5 Humidity of inlet air (%)                       40
6 Temperature of air (C)                          25
7 Drain air velocity (ft/min)                     84
8 manhole air velocity (ft/min)                   128
9 Conduit air velocity (ft/min)                   66
10 Wind speed (cm/s at 10 m)                      447
11 distance to next unit (cm)                     500
12 slope of underflow conduit                     .015
13 friction factor liquid                         .016
14 friction factor gas                            .006
15 radius of underflow conduit (cm)               12
16 Underflow T (C)                                25
17 oscillation cycle time (min)                   5
18 design collection velocities  (ft/s)           2
19 design branch line fraction full               .4

Type of unit is
8 HL partition flag=1, adjust for sorption        0
9 unit recycle convergence number                 200
10 oil molecular weight                           0
11 oil density  (g/cc)                            0
12 NaUT 1=municipal 2=industrial  3=turb.         0
13 NaUT 1=mass tr. 2=equil                        0
14 parts biomass per 1000 parts COD
15 oil water partition method 0=owpc
16 use UNIFAC aqueous data base =1
17 specify mass transfer for unit, =1
18 Use biomass for unit option, =1
19 biogrowth Monod half concentration ppm

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\PAE\New
  Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:28:26
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is aerated biotreatment
1 Description of unit                      11    ASB Zone 1
2 Wastewater temperature   (C)                   34.08
3 length of aeration unit (m)                    295
4 width of aeration unit (m)                     295
5 depth of aeration unit (m)                     1.4
6 Area of agitation (each aerator,m2)            135
7 Total number of agitators in the unit          31
8 Power of agitation (each aerator,HP)           75
9 Impeller diameter (cm)                         49.53
10 Impeller rotation (RPM)                       1200
11 Agitator mechanical efficiency                0.83
12 aerator effectiveness, alpha                  0.83
13 if there is plug flow, enter 1                0
14 Overall biorate (mg/g bio-hr)                 19
15 Aeration air flow (m3/s)                      0
16 active biomass, aeration (g/l)                0.3
17 If covered, then enter 1                      0
18 special input                                 0
19 pH  (enter 0 for no pH adjustment)            7.04

Properties of DIMETHYL SULFIDE  (DMS) at 34.1 deg.C (93.3 deg.F)
```

```
   hl= 0.002924 atm-m3/mol      vp= 704.653 mmHg (13.629 psia)
       162.463 y/x
       0.11606 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.504e-05 cm2/s  dv= 0.14765 cm2/s
Compound flow rate from inlet water is 0.19163 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 30.325 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 237.766.
kl is estimated as 7.634e-06 m/s.
kg is estimated as 0.007917 m/s.  Model: 2
kg is estimated as 0.007917 m/s.  Model: 2
The Schmidt number is 1.01591.
The friction velocity is 37.398 m/s
kg is estimated as 0.017873 m/s.  Model: 3
________Agitated surface__________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.14978 m/s.
kl (agitated)is estimated as 0.021024 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 4.77e-04 m/s.
 The effective stripping time (surface + diffused air) is 48.915 minutes. (0.81526
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1819.519 min. (30.325 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                        0.15258
   KL aerated (m/s)                        0.021024
   KL OVERALL AERATED (m/s)                0.009769
   KG quiescent (m/s)                      0.008066
   KL quiescent (m/s)                      7.634e-06
   KL OVERALL QUIESCENT (m/s)              7.574e-06
   KL OVERALL (m/s)                        4.77e-04
   air stripping time constant (min)       48.915
   FRACTION SURFACE VOLATILIZED            0.80146
   FRACTION SUBMERGED VOLATILIZED          0.
   TOTAL FRACTION VOLATILIZED              0.80146
   FRACTION BIOLOGICALLY REMOVED           0.17699
   FRACTION ABSORBED                       0.
   TOTAL AIR EMISSIONS  (g/s)              0.15358
                     (Mg/year)             4.84331
   EMISSION FACTOR  (g/cm2-s)              1.765e-10
   UNIT EXIT CONCENTRATION (ppmw)          0.0037
DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\PAE\New
  Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:28:26
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is system exit stream
1 Description of unit                     12    def.system exit st

   TOTAL AIR EMISSIONS  (g/s)              0.
```

```
                  (Mg/year)             0.
   EMISSION FACTOR  (g/cm2-s)           1.765e-10
   UNIT EXIT CONCENTRATION (ppmw)       1.485e-05
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\PAE\New
  Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:28:26
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is open hub drain
1 Description of unit                        13    default open hub d
2 Underflow T (C)                                  43.89
3 Total water added at the unit (l/s)              0
4 Area of openings at unit (cm2)                   50
5 Radius of drop pipe (cm)                         5
6 Drop length to conduit (cm)                      61
7 Open surface=1                                   1
8 Subsurface entrance=1                            0
9 subsurface exit =1                               0
10 radius of underflow conduit (cm)                12
11 distance to next unit (cm)                      500
12 slope of underflow conduit                      0.015
16 velocity air at drain opening (ft/min)          84
17 municipal waste in conduit =1                   0
18 Assume equilibrium in unit, =1                  0
19 pH  (enter 0 for no pH adjustment)              8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1116 l/s.
   Weight fraction down is  1.989E-07
   Gas concentration in  0 mol fraction.
   Gas flow  1116 L/s
   Weight fraction out at base of drop is  1.71707119336225E-07
   fraction transferred in the drain drop from hub is .136716
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.13672
   fraction loss in unit                    0.
   fraction loss in line run                0.
   component upstream of unit, g/s          0.
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             4.229e-19
   mol fract. headspace vent base           1.138e-05
   headspace flow out vent (cc/s)           -1.116e+06
   headspace flow down line (cc/s)          1.116e+06
   KG surface (m/s)                         2728.591
   KL surface (m/s)                         8.51e-09
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.22197
   total component into unit, g/s           0.19163
   TOTAL AIR EMISSIONS  (g/s)               0.030347
                  (Mg/year)                 0.95703
   EMISSION FACTOR  (g/cm2-s)               1.765e-10
   UNIT EXIT CONCENTRATION (ppmw)           0.17171
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\PAE\New
  Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:28:26
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is aerated biotreatment
1 Description of unit                        17    ASB Zone 3
```

```
2 Wastewater temperature   (C)                      30.01
3 length of aeration unit (m)                       376
4 width of aeration unit (m)                        188
5 depth of aeration unit (m)                        0.91
6 Area of agitation (each aerator,m2)               135
7 Total number of agitators in the unit             6
8 Power of agitation (each aerator,HP)              75
9 Impeller diameter (cm)                            49.53
10 Impeller rotation (RPM)                          1200
11 Agitator mechanical efficiency                   0.83
12 aerator effectiveness, alpha                     0.83
13 if there is plug flow, enter 1                   0
14 Overall biorate (mg/g bio-hr)                    19
15 Aeration air flow (m3/s)                         0
16 active biomass, aeration (g/l)                   0.3
17 If covered, then enter 1                         0
18 special input                                    0
19 pH  (enter 0 for no pH adjustment)               7.42

Properties of DIMETHYL SULFIDE  (DMS) at 30. deg.C (86. deg.F)
   hl= 0.002519 atm-m3/mol      vp= 606.985 mmHg (11.74 psia)
       139.945 y/x
       0.10132 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.485e-05 cm2/s  dv= 0.14425 cm2/s
Compound flow rate from inlet water is 1.869e-04 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 16.011 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 7.566e-06 m/s.
kg is estimated as 0.007884 m/s.  Model: 2
kg is estimated as 0.007884 m/s.  Model: 2
The Schmidt number is 1.03989.
The friction velocity is 37.398 m/s
kg is estimated as 0.017611 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.14804 m/s.
kl (agitated)is estimated as 0.018962 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 1.053e-04 m/s.
 The effective stripping time (surface + diffused air) is 144.073 minutes.
 (2.40122 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 960.664 min. (16.011 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                           0.15081
   KL aerated (m/s)                           0.018962
   KL OVERALL AERATED (m/s)                   0.00854
   KG quiescent (m/s)                         0.008032
   KL quiescent (m/s)                         7.566e-06
   KL OVERALL QUIESCENT (m/s)                 7.497e-06
   KL OVERALL (m/s)                           1.053e-04
   air stripping time constant (min)          144.073
```

```
   FRACTION SURFACE VOLATILIZED             0.59112
   FRACTION SUBMERGED VOLATILIZED           0.
   TOTAL FRACTION VOLATILIZED               0.59112
   FRACTION BIOLOGICALLY REMOVED            0.32022
   FRACTION ABSORBED                        0.
   TOTAL AIR EMISSIONS  (g/s)               1.105e-04
                     (Mg/year)              0.003484
   EMISSION FACTOR  (g/cm2-s)               1.563e-13
   UNIT EXIT CONCENTRATION (ppmw)           1.485e-05
DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\PAE\New
  Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:28:26
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is aerated biotreatment
1 Description of unit                      18    ASB Zone 2
2 Wastewater temperature   (C)                   32.08
3 length of aeration unit (m)                    368
4 width of aeration unit (m)                     184
5 depth of aeration unit (m)                     0.97
6 Area of agitation (each aerator,m2)            135
7 Total number of agitators in the unit          15
8 Power of agitation (each aerator,HP)           75
9 Impeller diameter (cm)                         49.53
10 Impeller rotation (RPM)                       1200
11 Agitator mechanical efficiency                0.83
12 aerator effectiveness, alpha                  0.83
13 if there is plug flow, enter 1                0
14 Overall biorate (mg/g bio-hr)                 19
15 Aeration air flow (m3/s)                      0
16 active biomass, aeration (g/l)                0.3
17 If covered, then enter 1                      0
18 special input                                 0
19 pH  (enter 0 for no pH adjustment)            7.24

Properties of DIMETHYL SULFIDE  (DMS) at 32.1 deg.C (89.7 deg.F)
   hl= 0.002719 atm-m3/mol      vp= 655.201 mmHg (12.673 psia)
       151.062 y/x
       0.10863 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.495e-05 cm2/s  dv= 0.14597 cm2/s
Compound flow rate from inlet water is 0.004129 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 16.348 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 7.6e-06 m/s.
kg is estimated as 0.007966 m/s.  Model: 2
kg is estimated as 0.007966 m/s.  Model: 2
The Schmidt number is 1.02758.
The friction velocity is 37.398 m/s
kg is estimated as 0.017744 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
```

```
kg (agitated)is estimated as 0.14892 m/s.
kl (agitated)is estimated as 0.019984 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 2.809e-04 m/s.
 The effective stripping time (surface + diffused air) is 57.552 minutes. (0.9592
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 980.894 min. (16.348 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                         0.15171
   KL aerated (m/s)                         0.019984
   KL OVERALL AERATED (m/s)                 0.009148
   KG quiescent (m/s)                       0.008115
   KL quiescent (m/s)                       7.6e-06
   KL OVERALL QUIESCENT (m/s)               7.537e-06
   KL OVERALL (m/s)                         2.809e-04
   air stripping time constant (min)        57.552
   FRACTION SURFACE VOLATILIZED             0.7715
   FRACTION SUBMERGED VOLATILIZED           0.
   TOTAL FRACTION VOLATILIZED               0.7715
   FRACTION BIOLOGICALLY REMOVED            0.18324
   FRACTION ABSORBED                        0.
   TOTAL AIR EMISSIONS  (g/s)               0.003185
                     (Mg/year)              0.10045
   EMISSION FACTOR  (g/cm2-s)               4.704e-12
   UNIT EXIT CONCENTRATION (ppmw)           1.675e-04
```

Type of unit is

1 Total water added at the unit (l/s)	50	0
2 Area of openings at unit (cm2)		50
3 Radius of drop pipe (cm)		5
4 Drop length to conduit (cm)		61
5 Humidity of inlet air (%)		40
6 Temperature of air (C)		25
7 Drain air velocity (ft/min)		84
8 manhole air velocity (ft/min)		128
9 Conduit air velocity (ft/min)		66
10 Wind speed (cm/s at 10 m)		447
11 distance to next unit (cm)		500
12 slope of underflow conduit		.015
13 friction factor liquid		.016
14 friction factor gas		.006
15 radius of underflow conduit (cm)		12
16 Underflow T (C)		25
17 oscillation cycle time (min)		5
18 design collection velocities (ft/s)		2
19 design branch line fraction full		.4

Type of unit is

8 HL partition flag=1, adjust for sorption	0
9 unit recycle convergence number	200
10 oil molecular weight	0
11 oil density (g/cc)	0
12 NaUT 1=municipal 2=industrial 3=turb.	0
13 NaUT 1=mass tr. 2=equil	0
14 parts biomass per 1000 parts COD	
15 oil water partition method 0=owpc	
16 use UNIFAC aqueous data base =1	
17 specify mass transfer for unit, =1	
18 Use biomass for unit option, =1	
19 biogrowth Monod half concentration ppm	

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment
Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\PAE\New Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM 19:28:58
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment

1 Description of unit	11	ASB Zone 1
2 Wastewater temperature (C)		34.08
3 length of aeration unit (m)		295
4 width of aeration unit (m)		295
5 depth of aeration unit (m)		1.4
6 Area of agitation (each aerator,m2)		135
7 Total number of agitators in the unit		31
8 Power of agitation (each aerator,HP)		75
9 Impeller diameter (cm)		49.53
10 Impeller rotation (RPM)		1200
11 Agitator mechanical efficiency		0.83
12 aerator effectiveness, alpha		0.83
13 if there is plug flow, enter 1		0
14 Overall biorate (mg/g bio-hr)		19
15 Aeration air flow (m3/s)		0
16 active biomass, aeration (g/l)		0.3
17 If covered, then enter 1		0
18 special input		0
19 pH (enter 0 for no pH adjustment)		7.04

Properties of METHANETHIOL(methyl mercaptan) at 34.1 deg.C (93.3 deg.F)

```
   hl= 0.004158 atm-m3/mol      vp= 2272.142 mmHg (43.948 psia)
       230.99 y/x
       0.16502 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.525e-05 cm2/s  dv= 0.23702 cm2/s
Compound flow rate from inlet water is 0.002397 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 30.325 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 237.766.
kl is estimated as 7.703e-06 m/s.
kg is estimated as 0.010871 m/s.  Model: 2
kg is estimated as 0.010871 m/s.  Model: 2
The Schmidt number is 0.63285.
The friction velocity is 37.398 m/s
kg is estimated as 0.024173 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.18977 m/s.
kl (agitated)is estimated as 0.021167 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 6.265e-04 m/s.
 The effective stripping time (surface + diffused air) is 37.242 minutes. (0.62071
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1819.519 min. (30.325 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                         0.19332
   KL aerated (m/s)                         0.021167
   KL OVERALL AERATED (m/s)                 0.012876
   KG quiescent (m/s)                       0.011075
   KL quiescent (m/s)                       7.703e-06
   KL OVERALL QUIESCENT (m/s)               7.672e-06
   KL OVERALL (m/s)                         6.265e-04
   air stripping time constant (min)        37.242
   FRACTION SURFACE VOLATILIZED             0.88816
   FRACTION SUBMERGED VOLATILIZED           0.
   TOTAL FRACTION VOLATILIZED               0.88816
   FRACTION BIOLOGICALLY REMOVED            0.09366
   FRACTION ABSORBED                        0.
   TOTAL AIR EMISSIONS  (g/s)               0.002129
                     (Mg/year)              0.06713
   EMISSION FACTOR  (g/cm2-s)               2.446e-12
   UNIT EXIT CONCENTRATION (ppmw)           3.904e-05
DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\PAE\New
  Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:28:58
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is system exit stream
1 Description of unit                      12    def.system exit st

   TOTAL AIR EMISSIONS  (g/s)               0.
```

```
                  (Mg/year)                 0.
   EMISSION FACTOR  (g/cm2-s)               2.446e-12
   UNIT EXIT CONCENTRATION (ppmw)           1.24e-07
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\PAE\New
  Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:28:58
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is open hub drain
1 Description of unit                       13     default open hub d
2 Underflow T (C)                                  43.89
3 Total water added at the unit (l/s)              0
4 Area of openings at unit (cm2)                   50
5 Radius of drop pipe (cm)                         5
6 Drop length to conduit (cm)                      61
7 Open surface=1                                   1
8 Subsurface entrance=1                            0
9 subsurface exit =1                               0
10 radius of underflow conduit (cm)                12
11 distance to next unit (cm)                      500
12 slope of underflow conduit                      0.015
16 velocity air at drain opening (ft/min)          84
17 municipal waste in conduit =1                   0
18 Assume equilibrium in unit, =1                  0
19 pH  (enter 0 for no pH adjustment)              8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1116 l/s.
   Weight fraction down is  2.6E-09
   Gas concentration in  0 mol fraction.
   Gas flow  1116 L/s
   Weight fraction out at base of drop is  2.14759568570224E-09
   fraction transferred in the drain drop from hub is .174002
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.174
   fraction loss in unit                    0.
   fraction loss in line run                0.
   component upstream of unit, g/s          0.
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             6.896e-21
   mol fract. headspace vent base           2.445e-07
   headspace flow out vent (cc/s)           -1.116e+06
   headspace flow down line (cc/s)          1.116e+06
   KG surface (m/s)                         3741.46
   KL surface (m/s)                         8.591e-09
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.002902
   total component into unit, g/s           0.002397
   TOTAL AIR EMISSIONS  (g/s)               5.049e-04
                  (Mg/year)                 0.015922
   EMISSION FACTOR  (g/cm2-s)               2.446e-12
   UNIT EXIT CONCENTRATION (ppmw)           0.002148
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\PAE\New
  Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:28:58
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment
1 Description of unit                       17     ASB Zone 3
```

```
2 Wastewater temperature   (C)                        30.01
3 length of aeration unit (m)                         376
4 width of aeration unit (m)                          188
5 depth of aeration unit (m)                          0.91
6 Area of agitation (each aerator,m2)                 135
7 Total number of agitators in the unit               6
8 Power of agitation (each aerator,HP)                75
9 Impeller diameter (cm)                              49.53
10 Impeller rotation (RPM)                            1200
11 Agitator mechanical efficiency                     0.83
12 aerator effectiveness, alpha                       0.83
13 if there is plug flow, enter 1                     0
14 Overall biorate (mg/g bio-hr)                      19
15 Aeration air flow (m3/s)                           0
16 active biomass, aeration (g/l)                     0.3
17 If covered, then enter 1                           0
18 special input                                      0
19 pH  (enter 0 for no pH adjustment)                 7.42

Properties of METHANETHIOL(methyl mercaptan) at 30. deg.C (86. deg.F)
   hl= 0.003687 atm-m3/mol      vp= 2014.774 mmHg (38.97 psia)
       204.826 y/x
       0.14829 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.505e-05 cm2/s  dv= 0.23155 cm2/s
Compound flow rate from inlet water is 1.671e-06 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 16.011 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 7.635e-06 m/s.
kg is estimated as 0.010826 m/s.  Model: 2
kg is estimated as 0.010826 m/s.  Model: 2
The Schmidt number is 0.64779.
The friction velocity is 37.398 m/s
kg is estimated as 0.023814 m/s.  Model: 3
________Agitated surface__________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.18756 m/s.
kl (agitated)is estimated as 0.019092 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 1.391e-04 m/s.
 The effective stripping time (surface + diffused air) is 109.038 minutes.
 (1.81731 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 960.664 min. (16.011 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                          0.19108
   KL aerated (m/s)                          0.019092
   KL OVERALL AERATED (m/s)                  0.011483
   KG quiescent (m/s)                        0.011029
   KL quiescent (m/s)                        7.635e-06
   KL OVERALL QUIESCENT (m/s)                7.6e-06
   KL OVERALL (m/s)                          1.391e-04
   air stripping time constant (min)         109.038
```

```
   FRACTION SURFACE VOLATILIZED              0.7296
   FRACTION SUBMERGED VOLATILIZED            0.
   TOTAL FRACTION VOLATILIZED                0.7296
   FRACTION BIOLOGICALLY REMOVED             0.18759
   FRACTION ABSORBED                         0.
   TOTAL AIR EMISSIONS  (g/s)                1.219e-06
                     (Mg/year)               3.844e-05
   EMISSION FACTOR  (g/cm2-s)                1.724e-15
   UNIT EXIT CONCENTRATION (ppmw)            1.24e-07
DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\PAE\New
  Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:28:58
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment
1 Description of unit                       18    ASB Zone 2
2 Wastewater temperature    (C)                   32.08
3 length of aeration unit (m)                     368
4 width of aeration unit (m)                      184
5 depth of aeration unit (m)                      0.97
6 Area of agitation (each aerator,m2)             135
7 Total number of agitators in the unit           15
8 Power of agitation (each aerator,HP)            75
9 Impeller diameter (cm)                          49.53
10 Impeller rotation (RPM)                        1200
11 Agitator mechanical efficiency                 0.83
12 aerator effectiveness, alpha                   0.83
13 if there is plug flow, enter 1                 0
14 Overall biorate (mg/g bio-hr)                  19
15 Aeration air flow (m3/s)                       0
16 active biomass, aeration (g/l)                 0.3
17 If covered, then enter 1                       0
18 special input                                  0
19 pH  (enter 0 for no pH adjustment)             7.24

Properties of METHANETHIOL(methyl mercaptan) at 32.1 deg.C (89.7 deg.F)
   hl= 0.003921 atm-m3/mol      vp= 2142.771 mmHg (41.446 psia)
       217.838 y/x
       0.15664 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.515e-05 cm2/s  dv= 0.23433 cm2/s
Compound flow rate from inlet water is 4.357e-05 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 16.348 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 7.67e-06 m/s.
kg is estimated as 0.010938 m/s.  Model: 2
kg is estimated as 0.010938 m/s.  Model: 2
The Schmidt number is 0.64013.
The friction velocity is 37.398 m/s
kg is estimated as 0.023996 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
```

```
kg (agitated)is estimated as 0.18868 m/s.
kl (agitated)is estimated as 0.020121 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 3.715e-04 m/s.
 The effective stripping time (surface + diffused air) is 43.518 minutes. (0.72529
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 980.894 min. (16.348 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                         0.19222
   KL aerated (m/s)                         0.020121
   KL OVERALL AERATED (m/s)                 0.012174
   KG quiescent (m/s)                       0.011143
   KL quiescent (m/s)                       7.67e-06
   KL OVERALL QUIESCENT (m/s)               7.637e-06
   KL OVERALL (m/s)                         3.715e-04
   air stripping time constant (min)        43.518
   FRACTION SURFACE VOLATILIZED             0.86431
   FRACTION SUBMERGED VOLATILIZED           0.
   TOTAL FRACTION VOLATILIZED               0.86431
   FRACTION BIOLOGICALLY REMOVED            0.097342
   FRACTION ABSORBED                        0.
   TOTAL AIR EMISSIONS  (g/s)               3.766e-05
                     (Mg/year)              0.001188
   EMISSION FACTOR  (g/cm2-s)               5.562e-14
   UNIT EXIT CONCENTRATION (ppmw)           1.497e-06
```

Backup Stripper Scenario - Projected Actual Emissions

H_2S, TRS Compounds, and VOC

New-Indy Catawba - Catawba, SC

Concentration Loadings	**H2S, ppm**	**DMDS, ppm**	**DMS, ppm**	**MMC, ppm**
Design Foul Condensate Loadings to Backup Stripper	147	15.00	17.00	16.00
Backup Stripper TRS Removal Efficiency	0.98	0.98	0.98	0.98
Stripped Condensate to Hardpipe	2.93	0.30	0.34	0.32
Avg. ASB Inlet (2021 and 2022)	0.25	0.09	0.20	0.0026
Flow Weighted Loading:	0.38	0.10	0.21	0.02
WATER9 Results	**H2S, g/s**	**DMDS, g/s**	**DMS, g/s**	**MMC, g/s**
ASB Zone 1	0.08	0.04	0.17	0.01
ASB Zone 2	0.03	6.14E-04	3.60E-03	2.73E-04
ASB Zone 3	0.02	1.20E-05	1.31E-04	9.23E-06
Total ASB	**0.13**	**0.04**	**0.17**	**0.02**
PAE Emissions Factors	**H2S, lb/ODTP**	**DMDS, lb/ODTP**	**DMS, lb/ODTP**	**MMC, lb/ODTP**
Total ASB	**1.09E-02**	**3.28E-03**	**1.47E-02**	**1.30E-03**

Post-Project Stripped Condensate Flow:	850	gpm
Post-Project Stripped Condensate Flow:	1.22	MGD
Post-Project ASB Influent Flow:	25.48	MGD
Total ASB Flow:	26.71	MGD
Total ASB Flow:	1170	L/s
Pulp Production	2200	ODTP/day

	MW
H2S	34
DMDS	94
DMS	62
MMC	48

Type of unit is

1 Total water added at the unit (l/s)	50	0
2 Area of openings at unit (cm2)		50
3 Radius of drop pipe (cm)		5
4 Drop length to conduit (cm)		61
5 Humidity of inlet air (%)		40
6 Temperature of air (C)		25
7 Drain air velocity (ft/min)		84
8 manhole air velocity (ft/min)		128
9 Conduit air velocity (ft/min)		66
10 Wind speed (cm/s at 10 m)		447
11 distance to next unit (cm)		500
12 slope of underflow conduit		.015
13 friction factor liquid		.016
14 friction factor gas		.006
15 radius of underflow conduit (cm)		12
16 Underflow T (C)		25
17 oscillation cycle time (min)		5
18 design collection velocities (ft/s)		2
19 design branch line fraction full		.4

Type of unit is

8 HL partition flag=1, adjust for sorption	0
9 unit recycle convergence number	200
10 oil molecular weight	0
11 oil density (g/cc)	0
12 NaUT 1=municipal 2=industrial 3=turb.	0
13 NaUT 1=mass tr. 2=equil	0
14 parts biomass per 1000 parts COD	
15 oil water partition method 0=owpc	
16 use UNIFAC aqueous data base =1	
17 specify mass transfer for unit, =1	
18 Use biomass for unit option, =1	
19 biogrowth Monod half concentration ppm	

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment
Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\PAE\Old Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM 11:39:37
COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment

1 Description of unit	11	ASB Zone 1
2 Wastewater temperature (C)		34.08
3 length of aeration unit (m)		295
4 width of aeration unit (m)		295
5 depth of aeration unit (m)		1.4
6 Area of agitation (each aerator,m2)		135
7 Total number of agitators in the unit		31
8 Power of agitation (each aerator,HP)		75
9 Impeller diameter (cm)		49.53
10 Impeller rotation (RPM)		1200
11 Agitator mechanical efficiency		0.83
12 aerator effectiveness, alpha		0.83
13 if there is plug flow, enter 1		0
14 Overall biorate (mg/g bio-hr)		19
15 Aeration air flow (m3/s)		0
16 active biomass, aeration (g/l)		0.3
17 If covered, then enter 1		0
18 special input		0
19 pH (enter 0 for no pH adjustment)		7.04

Properties of DIMETHYL DISULFIDE at 34.1 deg.C (93.3 deg.F)

hl= 0.001714 atm-m3/mol   vp= 45.945 mmHg (0.88868 psia)
95.2 y/x
0.068011 g/L gas per g/L liquid
Temperature adjustment factor = 1.046 ^(T-25), deg. C
kl= 0. L/g-hr   dl= 1.041e-05 cm2/s dv= 0.088022 cm2/s
Compound flow rate from inlet water is 0.10249 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 28.926 hr.
____Biomass production________________
The biomass production rate is 0.mg/hr. (0. mg/L)
The fraction dissolved solids converted is 0. .
The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 237.766.
kl is estimated as 5.971e-06 m/s.
kg is estimated as 0.005598 m/s. Model: 2
kg is estimated as 0.005598 m/s. Model: 2
The Schmidt number is 1.70412.
The friction velocity is 37.398 m/s
kg is estimated as 0.012927 m/s. Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.11564 m/s.
kl (agitated)is estimated as 0.017486 m/s.
The specified and growth biomass is 0.3 g/L.
The effective KL (surface + diffused air) is 2.753e-04 m/s.
The effective stripping time (surface + diffused air) is 84.752 minutes. (1.41254 hrs.)
The pump mixing time is 5 x the pumping recirculaion time, 0. min.
The ratio of the mixing to the striping (surface + diffused air) is 0.
The mean residence time is 1735.541 min. (28.926 hr.)
The ratio of the pump mixing to the residence time is 0.

KG aerated (m/s)	0.11781
KL aerated (m/s)	0.017486
KL OVERALL AERATED (m/s)	0.005609
KG quiescent (m/s)	0.005703
KL quiescent (m/s)	5.971e-06
KL OVERALL QUIESCENT (m/s)	5.883e-06
KL OVERALL (m/s)	2.753e-04
air stripping time constant (min)	84.752
FRACTION SURFACE VOLATILIZED	0.36364
FRACTION SUBMERGED VOLATILIZED	0.
TOTAL FRACTION VOLATILIZED	0.36364
FRACTION BIOLOGICALLY REMOVED	0.6186
FRACTION ABSORBED	0.
TOTAL AIR EMISSIONS (g/s)	0.037268
(Mg/year)	1.17529
EMISSION FACTOR (g/cm2-s)	4.282e-11
UNIT EXIT CONCENTRATION (ppmw)	0.001555

DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream
Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\PAE\Old Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM 11:39:37
COMPOUND: DIMETHYL DISULFIDE

Type of unit is system exit stream
1 Description of unit   12   def.system exit st

TOTAL AIR EMISSIONS (g/s)   0.

```
                    (Mg/year)              0.
    EMISSION FACTOR  (g/cm2-s)             4.282e-11
    UNIT EXIT CONCENTRATION (ppmw)         2.847e-06
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\PAE\Old
  Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM  11:39:37
COMPOUND: DIMETHYL DISULFIDE

Type of unit is open hub drain
1 Description of unit                      13    default open hub d
2 Underflow T (C)                                43.89
3 Total water added at the unit (l/s)            0
4 Area of openings at unit (cm2)                 50
5 Radius of drop pipe (cm)                       5
6 Drop length to conduit (cm)                    61
7 Open surface=1                                 1
8 Subsurface entrance=1                          0
9 subsurface exit =1                             0
10 radius of underflow conduit (cm)              12
11 distance to next unit (cm)                    500
12 slope of underflow conduit                    0.015
16 velocity air at drain opening (ft/min)        84
17 municipal waste in conduit =1                 0
18 Assume equilibrium in unit, =1                0
19 pH  (enter 0 for no pH adjustment)            8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1170 l/s.
   Weight fraction down is  9.66E-08
   Gas concentration in  0 mol fraction.
   Gas flow  1170 L/s
   Weight fraction out at base of drop is  8.7594214355091E-08
   fraction transferred in the drain drop from hub is .093228
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.093228
   fraction loss in unit                    0.
   fraction loss in line run                -7.27e-08
   component upstream of unit, g/s          0.
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             1.082e-19
   mol fract. headspace vent base           2.486e-06
   headspace flow out vent (cc/s)           -1.17e+06
   headspace flow down line (cc/s)          1.17e+06
   KG surface (m/s)                         2007.233
   KL surface (m/s)                         6.787e-09
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.11302
   total component into unit, g/s           0.10249
   TOTAL AIR EMISSIONS  (g/s)               0.010537
                    (Mg/year)               0.33229
   EMISSION FACTOR  (g/cm2-s)               4.282e-11
   UNIT EXIT CONCENTRATION (ppmw)           0.087594
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\PAE\Old
  Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM  11:39:37
COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment
1 Description of unit                      17    ASB Zone 3
```

```
2 Wastewater temperature   (C)                    30.01
3 length of aeration unit (m)                     376
4 width of aeration unit (m)                      188
5 depth of aeration unit (m)                      0.91
6 Area of agitation (each aerator,m2)             135
7 Total number of agitators in the unit           6
8 Power of agitation (each aerator,HP)            75
9 Impeller diameter (cm)                          49.53
10 Impeller rotation (RPM)                        1200
11 Agitator mechanical efficiency                 0.83
12 aerator effectiveness, alpha                   0.83
13 if there is plug flow, enter 1                 0
14 Overall biorate (mg/g bio-hr)                  19
15 Aeration air flow (m3/s)                       0
16 active biomass, aeration (g/l)                 0.3
17 If covered, then enter 1                       0
18 special input                                  0
19 pH  (enter 0 for no pH adjustment)             7.42

Properties of DIMETHYL DISULFIDE at 30. deg.C (86. deg.F)
   hl= 0.00141 atm-m3/mol      vp= 37.814 mmHg (0.7314 psia)
       78.352 y/x
       0.056726 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.027e-05 cm2/s  dv= 0.085991 cm2/s
Compound flow rate from inlet water is 6.639e-05 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.272 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 5.918e-06 m/s.
kg is estimated as 0.005575 m/s.  Model: 2
kg is estimated as 0.005575 m/s.  Model: 2
The Schmidt number is 1.74436.
The friction velocity is 37.398 m/s
kg is estimated as 0.012742 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.1143 m/s.
kl (agitated)is estimated as 0.015772 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 5.972e-05 m/s.
 The effective stripping time (surface + diffused air) is 253.944 minutes. (4.2324
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 916.326 min. (15.272 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                         0.11644
   KL aerated (m/s)                         0.015772
   KL OVERALL AERATED (m/s)                 0.004711
   KG quiescent (m/s)                       0.005679
   KL quiescent (m/s)                       5.918e-06
   KL OVERALL QUIESCENT (m/s)               5.813e-06
   KL OVERALL (m/s)                         5.972e-05
   air stripping time constant (min)        253.944
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```
   FRACTION SURFACE VOLATILIZED              0.18107
   FRACTION SUBMERGED VOLATILIZED            0.
   TOTAL FRACTION VOLATILIZED                0.18107
   FRACTION BIOLOGICALLY REMOVED             0.76875
   FRACTION ABSORBED                         0.
   TOTAL AIR EMISSIONS  (g/s)                1.202e-05
                    (Mg/year)                3.791e-04
   EMISSION FACTOR  (g/cm2-s)                1.7e-14
   UNIT EXIT CONCENTRATION (ppmw)            2.847e-06
DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\PAE\Old
  Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM  11:39:37
COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment
1 Description of unit                         18    ASB Zone 2
2 Wastewater temperature   (C)                      32.08
3 length of aeration unit (m)                       368
4 width of aeration unit (m)                        184
5 depth of aeration unit (m)                        0.97
6 Area of agitation (each aerator,m2)               135
7 Total number of agitators in the unit             15
8 Power of agitation (each aerator,HP)              75
9 Impeller diameter (cm)                            49.53
10 Impeller rotation (RPM)                          1200
11 Agitator mechanical efficiency                   0.83
12 aerator effectiveness, alpha                     0.83
13 if there is plug flow, enter 1                   0
14 Overall biorate (mg/g bio-hr)                    19
15 Aeration air flow (m3/s)                         0
16 active biomass, aeration (g/l)                   0.3
17 If covered, then enter 1                         0
18 special input                                    0
19 pH  (enter 0 for no pH adjustment)               7.24

Properties of DIMETHYL DISULFIDE at 32.1 deg.C (89.7 deg.F)
   hl= 0.001558 atm-m3/mol      vp= 41.785 mmHg (0.80821 psia)
       86.579 y/x
       0.062258 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.034e-05 cm2/s  dv= 0.087022 cm2/s
Compound flow rate from inlet water is 0.00182 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.594 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 5.945e-06 m/s.
kg is estimated as 0.005633 m/s.  Model: 2
kg is estimated as 0.005633 m/s.  Model: 2
The Schmidt number is 1.72371.
The friction velocity is 37.398 m/s
kg is estimated as 0.012836 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
```

```
kg (agitated)is estimated as 0.11498 m/s.
kl (agitated)is estimated as 0.016622 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 1.598e-04 m/s.
 The effective stripping time (surface + diffused air) is 101.198 minutes.
 (1.68663 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 935.622 min. (15.594 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                         0.11714
   KL aerated (m/s)                         0.016622
   KL OVERALL AERATED (m/s)                 0.005152
   KG quiescent (m/s)                       0.005738
   KL quiescent (m/s)                       5.945e-06
   KL OVERALL QUIESCENT (m/s)               5.85e-06
   KL OVERALL (m/s)                         1.598e-04
   air stripping time constant (min)        101.198
   FRACTION SURFACE VOLATILIZED             0.33725
   FRACTION SUBMERGED VOLATILIZED           0.
   TOTAL FRACTION VOLATILIZED               0.33725
   FRACTION BIOLOGICALLY REMOVED            0.62627
   FRACTION ABSORBED                        0.
   TOTAL AIR EMISSIONS  (g/s)               6.138e-04
                     (Mg/year)              0.019356
   EMISSION FACTOR  (g/cm2-s)               9.065e-13
   UNIT EXIT CONCENTRATION (ppmw)           5.674e-05
```

```
Type of unit is
1 Total water added at the unit (l/s)      50     0
2 Area of openings at unit (cm2)                  50
3 Radius of drop pipe (cm)                        5
4 Drop length to conduit (cm)                     61
5 Humidity of inlet air (%)                       40
6 Temperature of air (C)                          25
7 Drain air velocity (ft/min)                     84
8 manhole air velocity (ft/min)                   128
9 Conduit air velocity (ft/min)                   66
10 Wind speed (cm/s at 10 m)                      447
11 distance to next unit (cm)                     500
12 slope of underflow conduit                     .015
13 friction factor liquid                         .016
14 friction factor gas                            .006
15 radius of underflow conduit (cm)               12
16 Underflow T (C)                                25
17 oscillation cycle time (min)                   5
18 design collection velocities  (ft/s)           2
19 design branch line fraction full               .4

Type of unit is
8 HL partition flag=1, adjust for sorption        0
9 unit recycle convergence number                 200
10 oil molecular weight                           0
11 oil density  (g/cc)                            0
12 NaUT 1=municipal 2=industrial  3=turb.         0
13 NaUT 1=mass tr. 2=equil                        0
14 parts biomass per 1000 parts COD
15 oil water partition method 0=owpc
16 use UNIFAC aqueous data base =1
17 specify mass transfer for unit, =1
18 Use biomass for unit option, =1
19 biogrowth Monod half concentration ppm

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\PAE\Old
  Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM  19:24:18
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is aerated biotreatment
1 Description of unit                      11    ASB Zone 1
2 Wastewater temperature   (C)                   34.08
3 length of aeration unit (m)                    295
4 width of aeration unit (m)                     295
5 depth of aeration unit (m)                     1.4
6 Area of agitation (each aerator,m2)            135
7 Total number of agitators in the unit          31
8 Power of agitation (each aerator,HP)           75
9 Impeller diameter (cm)                         49.53
10 Impeller rotation (RPM)                       1200
11 Agitator mechanical efficiency                0.83
12 aerator effectiveness, alpha                  0.83
13 if there is plug flow, enter 1                0
14 Overall biorate (mg/g bio-hr)                 19
15 Aeration air flow (m3/s)                      0
16 active biomass, aeration (g/l)                0.3
17 If covered, then enter 1                      0
18 special input                                 0
19 pH  (enter 0 for no pH adjustment)            7.04

Properties of DIMETHYL SULFIDE  (DMS) at 34.1 deg.C (93.3 deg.F)
```

```
   hl= 0.002924 atm-m3/mol      vp= 704.653 mmHg (13.629 psia)
       162.463 y/x
       0.11606 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.504e-05 cm2/s  dv= 0.14765 cm2/s
Compound flow rate from inlet water is 0.20746 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 28.926 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 237.766.
kl is estimated as 7.634e-06 m/s.
kg is estimated as 0.007917 m/s.  Model: 2
kg is estimated as 0.007917 m/s.  Model: 2
The Schmidt number is 1.01591.
The friction velocity is 37.398 m/s
kg is estimated as 0.017873 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.14978 m/s.
kl (agitated)is estimated as 0.021024 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 4.77e-04 m/s.
 The effective stripping time (surface + diffused air) is 48.915 minutes. (0.81526 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1735.541 min. (28.926 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                        0.15258
   KL aerated (m/s)                        0.021024
   KL OVERALL AERATED (m/s)                0.009769
   KG quiescent (m/s)                      0.008066
   KL quiescent (m/s)                      7.634e-06
   KL OVERALL QUIESCENT (m/s)              7.574e-06
   KL OVERALL (m/s)                        4.77e-04
   air stripping time constant (min)       48.915
   FRACTION SURFACE VOLATILIZED            0.80063
   FRACTION SUBMERGED VOLATILIZED          0.
   TOTAL FRACTION VOLATILIZED              0.80063
   FRACTION BIOLOGICALLY REMOVED           0.17681
   FRACTION ABSORBED                       0.
   TOTAL AIR EMISSIONS  (g/s)              0.1661
                     (Mg/year)             5.23815
   EMISSION FACTOR  (g/cm2-s)              1.909e-10
   UNIT EXIT CONCENTRATION (ppmw)          0.004001
DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\PAE\Old Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM  19:24:18
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is system exit stream
1 Description of unit                     12    def.system exit st

   TOTAL AIR EMISSIONS  (g/s)              0.
```

```
                  (Mg/year)              0.
   EMISSION FACTOR  (g/cm2-s)            1.909e-10
   UNIT EXIT CONCENTRATION (ppmw)        1.753e-05
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\PAE\Old
  Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM  19:24:18
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is open hub drain
1 Description of unit                      13    default open hub d
2 Underflow T (C)                                43.89
3 Total water added at the unit (l/s)            0
4 Area of openings at unit (cm2)                 50
5 Radius of drop pipe (cm)                       5
6 Drop length to conduit (cm)                    61
7 Open surface=1                                 1
8 Subsurface entrance=1                          0
9 subsurface exit =1                             0
10 radius of underflow conduit (cm)              12
11 distance to next unit (cm)                    500
12 slope of underflow conduit                    0.015
16 velocity air at drain opening (ft/min)        84
17 municipal waste in conduit =1                 0
18 Assume equilibrium in unit, =1                0
19 pH  (enter 0 for no pH adjustment)            8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1170 l/s.
   Weight fraction down is  2.054E-07
   Gas concentration in  0 mol fraction.
   Gas flow  1170 L/s
   Weight fraction out at base of drop is  1.77318497496617E-07
   fraction transferred in the drain drop from hub is .136716
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.13672
   fraction loss in unit                    0.
   fraction loss in line run                0.
   component upstream of unit, g/s          0.
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             4.299e-19
   mol fract. headspace vent base           1.175e-05
   headspace flow out vent (cc/s)           -1.17e+06
   headspace flow down line (cc/s)          1.17e+06
   KG surface (m/s)                         2834.248
   KL surface (m/s)                         8.784e-09
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.24032
   total component into unit, g/s           0.20746
   TOTAL AIR EMISSIONS  (g/s)               0.032855
                  (Mg/year)                 1.03613
   EMISSION FACTOR  (g/cm2-s)               1.909e-10
   UNIT EXIT CONCENTRATION (ppmw)           0.17732
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\PAE\Old
  Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM  19:24:18
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is aerated biotreatment
1 Description of unit                      17    ASB Zone 3
```

```
2 Wastewater temperature   (C)                     30.01
3 length of aeration unit (m)                      376
4 width of aeration unit (m)                       188
5 depth of aeration unit (m)                       0.91
6 Area of agitation (each aerator,m2)              135
7 Total number of agitators in the unit            6
8 Power of agitation (each aerator,HP)             75
9 Impeller diameter (cm)                           49.53
10 Impeller rotation (RPM)                         1200
11 Agitator mechanical efficiency                  0.83
12 aerator effectiveness, alpha                    0.83
13 if there is plug flow, enter 1                  0
14 Overall biorate (mg/g bio-hr)                   19
15 Aeration air flow (m3/s)                        0
16 active biomass, aeration (g/l)                  0.3
17 If covered, then enter 1                        0
18 special input                                   0
19 pH  (enter 0 for no pH adjustment)              7.42

Properties of DIMETHYL SULFIDE  (DMS) at 30. deg.C (86. deg.F)
   hl= 0.002519 atm-m3/mol      vp= 606.985 mmHg (11.74 psia)
       139.945 y/x
       0.10132 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.485e-05 cm2/s  dv= 0.14425 cm2/s
Compound flow rate from inlet water is 2.217e-04 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.272 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 7.566e-06 m/s.
kg is estimated as 0.007884 m/s.  Model: 2
kg is estimated as 0.007884 m/s.  Model: 2
The Schmidt number is 1.03989.
The friction velocity is 37.398 m/s
kg is estimated as 0.017611 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.14804 m/s.
kl (agitated)is estimated as 0.018962 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 1.053e-04 m/s.
 The effective stripping time (surface + diffused air) is 144.073 minutes.
 (2.40122 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 916.326 min. (15.272 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                          0.15081
   KL aerated (m/s)                          0.018962
   KL OVERALL AERATED (m/s)                  0.00854
   KG quiescent (m/s)                        0.008032
   KL quiescent (m/s)                        7.566e-06
   KL OVERALL QUIESCENT (m/s)                7.497e-06
   KL OVERALL (m/s)                          1.053e-04
   air stripping time constant (min)         144.073
```

```
   FRACTION SURFACE VOLATILIZED             0.5886
   FRACTION SUBMERGED VOLATILIZED           0.
   TOTAL FRACTION VOLATILIZED               0.5886
   FRACTION BIOLOGICALLY REMOVED            0.31886
   FRACTION ABSORBED                        0.
   TOTAL AIR EMISSIONS  (g/s)               1.305e-04
                     (Mg/year)              0.004115
   EMISSION FACTOR  (g/cm2-s)               1.846e-13
   UNIT EXIT CONCENTRATION (ppmw)           1.753e-05
DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\PAE\Old
  Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM  19:24:18
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is aerated biotreatment
1 Description of unit                       18    ASB Zone 2
2 Wastewater temperature   (C)                    32.08
3 length of aeration unit (m)                     368
4 width of aeration unit (m)                      184
5 depth of aeration unit (m)                      0.97
6 Area of agitation (each aerator,m2)             135
7 Total number of agitators in the unit           15
8 Power of agitation (each aerator,HP)            75
9 Impeller diameter (cm)                          49.53
10 Impeller rotation (RPM)                        1200
11 Agitator mechanical efficiency                 0.83
12 aerator effectiveness, alpha                   0.83
13 if there is plug flow, enter 1                 0
14 Overall biorate (mg/g bio-hr)                  19
15 Aeration air flow (m3/s)                       0
16 active biomass, aeration (g/l)                 0.3
17 If covered, then enter 1                       0
18 special input                                  0
19 pH  (enter 0 for no pH adjustment)             7.24

Properties of DIMETHYL SULFIDE  (DMS) at 32.1 deg.C (89.7 deg.F)
   hl= 0.002719 atm-m3/mol      vp= 655.201 mmHg (12.673 psia)
       151.062 y/x
       0.10863 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.495e-05 cm2/s  dv= 0.14597 cm2/s
Compound flow rate from inlet water is 0.004681 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.594 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 7.6e-06 m/s.
kg is estimated as 0.007966 m/s.  Model: 2
kg is estimated as 0.007966 m/s.  Model: 2
The Schmidt number is 1.02758.
The friction velocity is 37.398 m/s
kg is estimated as 0.017744 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
```

```
kg (agitated)is estimated as 0.14892 m/s.
kl (agitated)is estimated as 0.019984 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 2.809e-04 m/s.
 The effective stripping time (surface + diffused air) is 57.552 minutes. (0.9592
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 935.622 min. (15.594 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                         0.15171
   KL aerated (m/s)                         0.019984
   KL OVERALL AERATED (m/s)                 0.009148
   KG quiescent (m/s)                       0.008115
   KL quiescent (m/s)                       7.6e-06
   KL OVERALL QUIESCENT (m/s)               7.537e-06
   KL OVERALL (m/s)                         2.809e-04
   air stripping time constant (min)        57.552
   FRACTION SURFACE VOLATILIZED             0.76981
   FRACTION SUBMERGED VOLATILIZED           0.
   TOTAL FRACTION VOLATILIZED               0.76981
   FRACTION BIOLOGICALLY REMOVED            0.18284
   FRACTION ABSORBED                        0.
   TOTAL AIR EMISSIONS  (g/s)               0.003604
                     (Mg/year)              0.11365
   EMISSION FACTOR  (g/cm2-s)               5.322e-12
   UNIT EXIT CONCENTRATION (ppmw)           1.895e-04
```

Type of unit is

1 Total water added at the unit (l/s)	50	0
2 Area of openings at unit (cm2)		50
3 Radius of drop pipe (cm)		5
4 Drop length to conduit (cm)		61
5 Humidity of inlet air (%)		40
6 Temperature of air (C)		25
7 Drain air velocity (ft/min)		84
8 manhole air velocity (ft/min)		128
9 Conduit air velocity (ft/min)		66
10 Wind speed (cm/s at 10 m)		447
11 distance to next unit (cm)		500
12 slope of underflow conduit		.015
13 friction factor liquid		.016
14 friction factor gas		.006
15 radius of underflow conduit (cm)		12
16 Underflow T (C)		25
17 oscillation cycle time (min)		5
18 design collection velocities (ft/s)		2
19 design branch line fraction full		.4

Type of unit is

8 HL partition flag=1, adjust for sorption	0
9 unit recycle convergence number	200
10 oil molecular weight	0
11 oil density (g/cc)	0
12 NaUT 1=municipal 2=industrial 3=turb.	0
13 NaUT 1=mass tr. 2=equil	0
14 parts biomass per 1000 parts COD	
15 oil water partition method 0=owpc	
16 use UNIFAC aqueous data base =1	
17 specify mass transfer for unit, =1	
18 Use biomass for unit option, =1	
19 biogrowth Monod half concentration ppm	

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment
Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\PAE\Old Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM 19:25:00
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment

1 Description of unit	11	ASB Zone 1
2 Wastewater temperature (C)		34.08
3 length of aeration unit (m)		295
4 width of aeration unit (m)		295
5 depth of aeration unit (m)		1.4
6 Area of agitation (each aerator,m2)		135
7 Total number of agitators in the unit		31
8 Power of agitation (each aerator,HP)		75
9 Impeller diameter (cm)		49.53
10 Impeller rotation (RPM)		1200
11 Agitator mechanical efficiency		0.83
12 aerator effectiveness, alpha		0.83
13 if there is plug flow, enter 1		0
14 Overall biorate (mg/g bio-hr)		19
15 Aeration air flow (m3/s)		0
16 active biomass, aeration (g/l)		0.3
17 If covered, then enter 1		0
18 special input		0
19 pH (enter 0 for no pH adjustment)		7.04

Properties of METHANETHIOL(methyl mercaptan) at 34.1 deg.C (93.3 deg.F)

```
      hl= 0.004158 atm-m3/mol      vp= 2272.142 mmHg (43.948 psia)
          230.99 y/x
          0.16502 g/L gas per g/L liquid
      Temperature adjustment factor = 1.046 ^(T-25), deg. C
      kl= 0. L/g-hr          dl= 1.525e-05 cm2/s  dv= 0.23702 cm2/s
   Compound flow rate from inlet water is 0.016622 g/s.
   Compound flow rate from inlet vent is 0. g/s.
   Compound flow rate from inlet duct is 0. g/s.
   Submerged aeration rate from inlet vent is 0. m3/s.
   Total submerged aeration is 0. m3/s.
   The residence time in the unit is 28.926 hr.
   ____Biomass production________________
       The biomass production rate is 0.mg/hr. (0. mg/L)
       The fraction dissolved solids converted is 0. .
       The estimated biomass exit concentration is 0. mg/L.
   ________Quiescent wind shear surface___Springer_
   The fetch to depth ratio is 237.766.
   kl is estimated as 7.703e-06 m/s.
   kg is estimated as 0.010871 m/s.  Model: 2
   kg is estimated as 0.010871 m/s.  Model: 2
   The Schmidt number is 0.63285.
   The friction velocity is 37.398 m/s
   kg is estimated as 0.024173 m/s.  Model: 3
   ________Agitated surface___________________
   The rotation speed is 125.654 radians per second.
   The rotation factor NRW is 2.052e+06.
   The power number NPR is 7.881e-04.
   The rotation factor NFR is 797.027.
   kg (agitated)is estimated as 0.18977 m/s.
   kl (agitated)is estimated as 0.021167 m/s.
       The specified and growth biomass is 0.3 g/L.
    The effective KL (surface + diffused air) is 6.265e-04 m/s.
    The effective stripping time (surface + diffused air) is 37.242 minutes. (0.62071
    hrs.)
    The pump mixing time is 5 x the pumping recirculaion time, 0. min.
    The ratio of the mixing to the striping (surface + diffused air) is 0.
    The mean residence time is 1735.541 min. (28.926 hr.)
    The ratio of the pump mixing to the residence time is 0.
      KG aerated (m/s)                          0.19332
      KL aerated (m/s)                          0.021167
      KL OVERALL AERATED (m/s)                  0.012876
      KG quiescent (m/s)                        0.011075
      KL quiescent (m/s)                        7.703e-06
      KL OVERALL QUIESCENT (m/s)                7.672e-06
      KL OVERALL (m/s)                          6.265e-04
      air stripping time constant (min)         37.242
      FRACTION SURFACE VOLATILIZED              0.88738
      FRACTION SUBMERGED VOLATILIZED            0.
      TOTAL FRACTION VOLATILIZED                0.88738
      FRACTION BIOLOGICALLY REMOVED             0.093577
      FRACTION ABSORBED                         0.
      TOTAL AIR EMISSIONS  (g/s)                0.01475
                        (Mg/year)               0.46517
      EMISSION FACTOR  (g/cm2-s)                1.695e-11
      UNIT EXIT CONCENTRATION (ppmw)            2.705e-04
   DETAILED CALCULATIONS at Unit 12 def.system exit st
   Type: system exit stream
     Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
     Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\PAE\Old
     Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM  19:25:00
   COMPOUND: METHANETHIOL(methyl mercaptan)

   Type of unit is system exit stream
   1 Description of unit                      12    def.system exit st

      TOTAL AIR EMISSIONS  (g/s)                0.
```

```
                    (Mg/year)                    0.
   EMISSION FACTOR  (g/cm2-s)                    1.695e-11
   UNIT EXIT CONCENTRATION (ppmw)                9.387e-07
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\PAE\Old
  Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM  19:25:00
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is open hub drain
1 Description of unit                           13    default open hub d
2 Underflow T (C)                                     43.89
3 Total water added at the unit (l/s)                 0
4 Area of openings at unit (cm2)                      50
5 Radius of drop pipe (cm)                            5
6 Drop length to conduit (cm)                         61
7 Open surface=1                                      1
8 Subsurface entrance=1                               0
9 subsurface exit =1                                  0
10 radius of underflow conduit (cm)                   12
11 distance to next unit (cm)                         500
12 slope of underflow conduit                         0.015
16 velocity air at drain opening (ft/min)             84
17 municipal waste in conduit =1                      0
18 Assume equilibrium in unit, =1                     0
19 pH  (enter 0 for no pH adjustment)                 8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1170 l/s.
   Weight fraction down is  1.72E-08
   Gas concentration in  0 mol fraction.
   Gas flow  1170 L/s
   Weight fraction out at base of drop is  1.42071711698917E-08
   fraction transferred in the drain drop from hub is .174002
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.174
   fraction loss in unit                    0.
   fraction loss in line run                0.
   component upstream of unit, g/s          0.
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             4.491e-20
   mol fract. headspace vent base           1.618e-06
   headspace flow out vent (cc/s)           -1.17e+06
   headspace flow down line (cc/s)          1.17e+06
   KG surface (m/s)                         3886.338
   KL surface (m/s)                         8.868e-09
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.020124
   total component into unit, g/s           0.016622
   TOTAL AIR EMISSIONS  (g/s)               0.003502
                    (Mg/year)               0.11043
   EMISSION FACTOR  (g/cm2-s)               1.695e-11
   UNIT EXIT CONCENTRATION (ppmw)           0.014207
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\PAE\Old
  Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM  19:25:00
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment
1 Description of unit                           17    ASB Zone 3
```

```
2 Wastewater temperature   (C)                   30.01
3 length of aeration unit (m)                    376
4 width of aeration unit (m)                     188
5 depth of aeration unit (m)                     0.91
6 Area of agitation (each aerator,m2)            135
7 Total number of agitators in the unit          6
8 Power of agitation (each aerator,HP)           75
9 Impeller diameter (cm)                         49.53
10 Impeller rotation (RPM)                       1200
11 Agitator mechanical efficiency                0.83
12 aerator effectiveness, alpha                  0.83
13 if there is plug flow, enter 1                0
14 Overall biorate (mg/g bio-hr)                 19
15 Aeration air flow (m3/s)                      0
16 active biomass, aeration (g/l)                0.3
17 If covered, then enter 1                      0
18 special input                                 0
19 pH  (enter 0 for no pH adjustment)            7.42

Properties of METHANETHIOL(methyl mercaptan) at 30. deg.C (86. deg.F)
   hl= 0.003687 atm-m3/mol      vp= 2014.774 mmHg (38.97 psia)
       204.826 y/x
       0.14829 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.505e-05 cm2/s  dv= 0.23155 cm2/s
Compound flow rate from inlet water is 1.27e-05 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.272 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 7.635e-06 m/s.
kg is estimated as 0.010826 m/s.  Model: 2
kg is estimated as 0.010826 m/s.  Model: 2
The Schmidt number is 0.64779.
The friction velocity is 37.398 m/s
kg is estimated as 0.023814 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.18756 m/s.
kl (agitated)is estimated as 0.019092 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 1.391e-04 m/s.
 The effective stripping time (surface + diffused air) is 109.038 minutes.
 (1.81731 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 916.326 min. (15.272 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                          0.19108
   KL aerated (m/s)                          0.019092
   KL OVERALL AERATED (m/s)                  0.011483
   KG quiescent (m/s)                        0.011029
   KL quiescent (m/s)                        7.635e-06
   KL OVERALL QUIESCENT (m/s)                7.6e-06
   KL OVERALL (m/s)                          1.391e-04
   air stripping time constant (min)         109.038
```

```
   FRACTION SURFACE VOLATILIZED              0.72669
   FRACTION SUBMERGED VOLATILIZED            0.
   TOTAL FRACTION VOLATILIZED                0.72669
   FRACTION BIOLOGICALLY REMOVED             0.18684
   FRACTION ABSORBED                         0.
   TOTAL AIR EMISSIONS  (g/s)                9.23e-06
                     (Mg/year)               2.911e-04
   EMISSION FACTOR  (g/cm2-s)                1.306e-14
   UNIT EXIT CONCENTRATION (ppmw)            9.387e-07
DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\PAE\Old
  Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM  19:25:00
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment
1 Description of unit                       18    ASB Zone 2
2 Wastewater temperature   (C)                    32.08
3 length of aeration unit (m)                     368
4 width of aeration unit (m)                      184
5 depth of aeration unit (m)                      0.97
6 Area of agitation (each aerator,m2)             135
7 Total number of agitators in the unit           15
8 Power of agitation (each aerator,HP)            75
9 Impeller diameter (cm)                          49.53
10 Impeller rotation (RPM)                        1200
11 Agitator mechanical efficiency                 0.83
12 aerator effectiveness, alpha                   0.83
13 if there is plug flow, enter 1                 0
14 Overall biorate (mg/g bio-hr)                  19
15 Aeration air flow (m3/s)                       0
16 active biomass, aeration (g/l)                 0.3
17 If covered, then enter 1                       0
18 special input                                  0
19 pH  (enter 0 for no pH adjustment)             7.24

Properties of METHANETHIOL(methyl mercaptan) at 32.1 deg.C (89.7 deg.F)
   hl= 0.003921 atm-m3/mol      vp= 2142.771 mmHg (41.446 psia)
       217.838 y/x
       0.15664 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.515e-05 cm2/s  dv= 0.23433 cm2/s
Compound flow rate from inlet water is 3.165e-04 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.594 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 7.67e-06 m/s.
kg is estimated as 0.010938 m/s.  Model: 2
kg is estimated as 0.010938 m/s.  Model: 2
The Schmidt number is 0.64013.
The friction velocity is 37.398 m/s
kg is estimated as 0.023996 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
```

```
kg (agitated)is estimated as 0.18868 m/s.
kl (agitated)is estimated as 0.020121 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 3.715e-04 m/s.
 The effective stripping time (surface + diffused air) is 43.518 minutes. (0.72529
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 935.622 min. (15.594 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                        0.19222
   KL aerated (m/s)                        0.020121
   KL OVERALL AERATED (m/s)                0.012174
   KG quiescent (m/s)                      0.011143
   KL quiescent (m/s)                      7.67e-06
   KL OVERALL QUIESCENT (m/s)              7.637e-06
   KL OVERALL (m/s)                        3.715e-04
   air stripping time constant (min)       43.518
   FRACTION SURFACE VOLATILIZED            0.86271
   FRACTION SUBMERGED VOLATILIZED          0.
   TOTAL FRACTION VOLATILIZED              0.86271
   FRACTION BIOLOGICALLY REMOVED           0.097161
   FRACTION ABSORBED                       0.
   TOTAL AIR EMISSIONS  (g/s)              2.731e-04
                     (Mg/year)             0.008611
   EMISSION FACTOR  (g/cm2-s)              4.033e-13
   UNIT EXIT CONCENTRATION (ppmw)          1.086e-05
```

No Stripper Scenario - Projected Actual Emissions

H_2S, TRS Compounds, and VOC

New-Indy Catawba - Catawba, SC

Concentration Loadings	**H2S, ppm**	**DMDS, ppm**	**DMS, ppm**	**MMC, ppm**
Design Foul Condensate Loadings (prior to H2O2)	147	15.00	17.00	16.00
Predicted % Reduction from H_2O_2	0.99	MMC converted into DMDS	0.90	0.99
Foul Condensate (after H_2O_2)	1.47	30.51	1.70	0.16
Avg. ASB Inlet (2021 and 2022)	0.25	0.09	0.20	0.0026
Flow Weighted Loading:	0.31	1.48	0.27	9.82E-03
H2SSIM/WATER9 Results	**H2S, g/s**	**DMDS, g/s**	**DMS, g/s**	**MMC, g/s**
ASB Zone 1	0.08	0.57	0.22	8.40E-03
ASB Zone 2	0.03	9.43E-03	4.70E-03	1.56E-04
ASB Zone 3	0.02	1.85E-04	1.70E-04	5.26E-06
Total ASB	**0.12**	**0.58**	**0.22**	**8.56E-03**
PAE Emissions Factors	**H2S, lb/ODTP**	**DMDS, lb/ODTP**	**DMS, lb/ODTP**	**MMC, lb/ODTP**
Total ASB	**1.06E-02**	**5.04E-02**	**1.92E-02**	**7.42E-04**

Post-Project Foul Condensate Flow:	850	gpm
Post-Project Foul Condensate Flow:	1.22	MGD
Post-Project ASB Influent Flow:	25.48	MGD
Total ASB Flow:	26.71	MGD
Total ASB Flow:	1170	L/s
Pulp Production	2200	ODTP/day

	MW
H2S	34
DMDS	94
DMS	62
MMC	48

```
Type of unit is
1 Total water added at the unit (l/s)      50     0
2 Area of openings at unit (cm2)                  50
3 Radius of drop pipe (cm)                        5
4 Drop length to conduit (cm)                     61
5 Humidity of inlet air (%)                       40
6 Temperature of air (C)                          25
7 Drain air velocity (ft/min)                     84
8 manhole air velocity (ft/min)                   128
9 Conduit air velocity (ft/min)                   66
10 Wind speed (cm/s at 10 m)                      447
11 distance to next unit (cm)                     500
12 slope of underflow conduit                     .015
13 friction factor liquid                         .016
14 friction factor gas                            .006
15 radius of underflow conduit (cm)               12
16 Underflow T (C)                                25
17 oscillation cycle time (min)                   5
18 design collection velocities  (ft/s)           2
19 design branch line fraction full               .4

Type of unit is
8 HL partition flag=1, adjust for sorption        0
9 unit recycle convergence number                 200
10 oil molecular weight                           0
11 oil density  (g/cc)                            0
12 NaUT 1=municipal 2=industrial  3=turb.         0
13 NaUT 1=mass tr. 2=equil                        0
14 parts biomass per 1000 parts COD
15 oil water partition method 0=owpc
16 use UNIFAC aqueous data base =1
17 specify mass transfer for unit, =1
18 Use biomass for unit option, =1
19 biogrowth Monod half concentration ppm

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper
  Permitting\Emissions\WWTP\PAE\Hardpipe Scenario\ASB Hardpipe Scenario V7
  3/16/2023 1:47:24 PM  19:20:20
COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment
1 Description of unit                      11    ASB Zone 1
2 Wastewater temperature   (C)                   34.08
3 length of aeration unit (m)                    295
4 width of aeration unit (m)                     295
5 depth of aeration unit (m)                     1.4
6 Area of agitation (each aerator,m2)            135
7 Total number of agitators in the unit          31
8 Power of agitation (each aerator,HP)           75
9 Impeller diameter (cm)                         49.53
10 Impeller rotation (RPM)                       1200
11 Agitator mechanical efficiency                0.83
12 aerator effectiveness, alpha                  0.83
13 if there is plug flow, enter 1                0
14 Overall biorate (mg/g bio-hr)                 19
15 Aeration air flow (m3/s)                      0
16 active biomass, aeration (g/l)                0.3
17 If covered, then enter 1                      0
18 special input                                 0
19 pH  (enter 0 for no pH adjustment)            7.04
```

```
Properties of DIMETHYL DISULFIDE at 34.1 deg.C (93.3 deg.F)
   hl= 0.001714 atm-m3/mol      vp= 45.945 mmHg (0.88868 psia)
       95.2 y/x
       0.068011 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.041e-05 cm2/s  dv= 0.088022 cm2/s
Compound flow rate from inlet water is 1.57133 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 28.926 hr.
    Biomass production
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
        Quiescent wind shear surface   Springer
The fetch to depth ratio is 237.766.
kl is estimated as 5.971e-06 m/s.
kg is estimated as 0.005598 m/s.  Model: 2
kg is estimated as 0.005598 m/s.  Model: 2
The Schmidt number is 1.70412.
The friction velocity is 37.398 m/s
kg is estimated as 0.012927 m/s.  Model: 3
        Agitated surface
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.11564 m/s.
kl (agitated)is estimated as 0.017486 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 2.753e-04 m/s.
 The effective stripping time (surface + diffused air) is 84.752 minutes. (1.41254
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1735.541 min. (28.926 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                          0.11781
   KL aerated (m/s)                          0.017486
   KL OVERALL AERATED (m/s)                  0.005609
   KG quiescent (m/s)                        0.005703
   KL quiescent (m/s)                        5.971e-06
   KL OVERALL QUIESCENT (m/s)                5.883e-06
   KL OVERALL (m/s)                          2.753e-04
   air stripping time constant (min)         84.752
   FRACTION SURFACE VOLATILIZED              0.36452
   FRACTION SUBMERGED VOLATILIZED            0.
   TOTAL FRACTION VOLATILIZED                0.36452
   FRACTION BIOLOGICALLY REMOVED             0.61768
   FRACTION ABSORBED                         0.
   TOTAL AIR EMISSIONS  (g/s)                0.57278
                        (Mg/year)            18.063
   EMISSION FACTOR  (g/cm2-s)                6.582e-10
   UNIT EXIT CONCENTRATION (ppmw)            0.023907
DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper
  Permitting\Emissions\WWTP\PAE\Hardpipe Scenario\ASB Hardpipe Scenario V7
  3/16/2023 1:47:24 PM  19:20:20
COMPOUND: DIMETHYL DISULFIDE

Type of unit is system exit stream
1 Description of unit                      12    def.system exit st
```

```
   TOTAL AIR EMISSIONS  (g/s)              0.
                    (Mg/year)              0.
   EMISSION FACTOR  (g/cm2-s)              6.582e-10
   UNIT EXIT CONCENTRATION (ppmw)          4.376e-05
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper
  Permitting\Emissions\WWTP\PAE\Hardpipe Scenario\ASB Hardpipe Scenario V7
  3/16/2023 1:47:24 PM  19:20:20
COMPOUND: DIMETHYL DISULFIDE

Type of unit is open hub drain
1 Description of unit                        13    default open hub d
2 Underflow T (C)                                  43.89
3 Total water added at the unit (l/s)              0
4 Area of openings at unit (cm2)                   50
5 Radius of drop pipe (cm)                         5
6 Drop length to conduit (cm)                      61
7 Open surface=1                                   1
8 Subsurface entrance=1                            0
9 subsurface exit =1                               0
10 radius of underflow conduit (cm)                12
11 distance to next unit (cm)                      500
12 slope of underflow conduit                      0.015
16 velocity air at drain opening (ft/min)          84
17 municipal waste in conduit =1                   0
18 Assume equilibrium in unit, =1                  0
19 pH  (enter 0 for no pH adjustment)              8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1170 l/s.
   Weight fraction down is  1.4811E-06
   Gas concentration in  0 mol fraction.
   Gas flow  1170 L/s
   Weight fraction out at base of drop is  1.3430203399053E-06
   fraction transferred in the drain drop from hub is .093228
   fraction loss in waste1 drop to hub     0.
   fraction loss in waste2 drop to hub     0.
   fraction loss in waste3 drop to hub     0.
   fraction loss in collection hub drop    0.093228
   fraction loss in unit                   0.
   fraction loss in line run               0.
   component upstream of unit, g/s         0.
   mol fract. headspace upstream (y)       0.
   headspace at conduit discharge, y       0.
   headspace end of conduit (y)            1.659e-18
   mol fract. headspace vent base          3.811e-05
   headspace flow out vent (cc/s)          -1.17e+06
   headspace flow down line (cc/s)         1.17e+06
   KG surface (m/s)                        2007.233
   KL surface (m/s)                        6.787e-09
   flow of waste down hub (l/s)            0.
   component flow in waste into unit (g/s)  1.73289
   total component into unit, g/s          1.57133
   TOTAL AIR EMISSIONS  (g/s)              0.16155
                    (Mg/year)              5.09474
   EMISSION FACTOR  (g/cm2-s)              6.582e-10
   UNIT EXIT CONCENTRATION (ppmw)          1.34302
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper
  Permitting\Emissions\WWTP\PAE\Hardpipe Scenario\ASB Hardpipe Scenario V7
  3/16/2023 1:47:24 PM  19:20:20
```

```
COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment
1 Description of unit                        17    ASB Zone 3
2 Wastewater temperature   (C)                     30.01
3 length of aeration unit (m)                      376
4 width of aeration unit (m)                       188
5 depth of aeration unit (m)                       0.91
6 Area of agitation (each aerator,m2)              135
7 Total number of agitators in the unit            6
8 Power of agitation (each aerator,HP)             75
9 Impeller diameter (cm)                           49.53
10 Impeller rotation (RPM)                         1200
11 Agitator mechanical efficiency                  0.83
12 aerator effectiveness, alpha                    0.83
13 if there is plug flow, enter 1                  0
14 Overall biorate (mg/g bio-hr)                   19
15 Aeration air flow (m3/s)                        0
16 active biomass, aeration (g/l)                  0.3
17 If covered, then enter 1                        0
18 special input                                   0
19 pH  (enter 0 for no pH adjustment)              7.42

Properties of DIMETHYL DISULFIDE at 30. deg.C (86. deg.F)
   hl= 0.00141 atm-m3/mol      vp= 37.814 mmHg (0.7314 psia)
       78.352 y/x
       0.056726 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.027e-05 cm2/s  dv= 0.085991 cm2/s
Compound flow rate from inlet water is 0.00102 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.272 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 5.918e-06 m/s.
kg is estimated as 0.005575 m/s.  Model: 2
kg is estimated as 0.005575 m/s.  Model: 2
The Schmidt number is 1.74436.
The friction velocity is 37.398 m/s
kg is estimated as 0.012742 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.1143 m/s.
kl (agitated)is estimated as 0.015772 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 5.972e-05 m/s.
 The effective stripping time (surface + diffused air) is 253.944 minutes. (4.2324
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 916.326 min. (15.272 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                             0.11644
   KL aerated (m/s)                             0.015772
   KL OVERALL AERATED (m/s)                     0.004711
   KG quiescent (m/s)                           0.005679
```

```
   KL quiescent (m/s)                      5.918e-06
   KL OVERALL QUIESCENT (m/s)              5.813e-06
   KL OVERALL (m/s)                        5.972e-05
   air stripping time constant (min)       253.944
   FRACTION SURFACE VOLATILIZED            0.18107
   FRACTION SUBMERGED VOLATILIZED          0.
   TOTAL FRACTION VOLATILIZED              0.18107
   FRACTION BIOLOGICALLY REMOVED           0.76875
   FRACTION ABSORBED                       0.
   TOTAL AIR EMISSIONS  (g/s)              1.848e-04
                     (Mg/year)             0.005827
   EMISSION FACTOR  (g/cm2-s)              2.614e-13
   UNIT EXIT CONCENTRATION (ppmw)          4.376e-05
DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper
  Permitting\Emissions\WWTP\PAE\Hardpipe Scenario\ASB Hardpipe Scenario V7
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COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment
1 Description of unit                         18    ASB Zone 2
2 Wastewater temperature    (C)                     32.08
3 length of aeration unit (m)                       368
4 width of aeration unit (m)                        184
5 depth of aeration unit (m)                        0.97
6 Area of agitation (each aerator,m2)               135
7 Total number of agitators in the unit             15
8 Power of agitation (each aerator,HP)              75
9 Impeller diameter (cm)                            49.53
10 Impeller rotation (RPM)                          1200
11 Agitator mechanical efficiency                   0.83
12 aerator effectiveness, alpha                     0.83
13 if there is plug flow, enter 1                   0
14 Overall biorate (mg/g bio-hr)                    19
15 Aeration air flow (m3/s)                         0
16 active biomass, aeration (g/l)                   0.3
17 If covered, then enter 1                         0
18 special input                                    0
19 pH  (enter 0 for no pH adjustment)               7.24

Properties of DIMETHYL DISULFIDE at 32.1 deg.C (89.7 deg.F)
   hl= 0.001558 atm-m3/mol      vp= 41.785 mmHg (0.80821 psia)
       86.579 y/x
       0.062258 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.034e-05 cm2/s  dv= 0.087022 cm2/s
Compound flow rate from inlet water is 0.027971 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.594 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 5.945e-06 m/s.
kg is estimated as 0.005633 m/s.  Model: 2
kg is estimated as 0.005633 m/s.  Model: 2
The Schmidt number is 1.72371.
The friction velocity is 37.398 m/s
kg is estimated as 0.012836 m/s.  Model: 3
```

```
        ________Agitated surface___________________
        The rotation speed is 125.654 radians per second.
        The rotation factor NRW is 2.052e+06.
        The power number NPR is 7.881e-04.
        The rotation factor NFR is 797.027.
        kg (agitated)is estimated as 0.11498 m/s.
        kl (agitated)is estimated as 0.016622 m/s.
            The specified and growth biomass is 0.3 g/L.
         The effective KL (surface + diffused air) is 1.598e-04 m/s.
         The effective stripping time (surface + diffused air) is 101.198 minutes.
         (1.68663 hrs.)
         The pump mixing time is 5 x the pumping recirculaion time, 0. min.
         The ratio of the mixing to the striping (surface + diffused air) is 0.
         The mean residence time is 935.622 min. (15.594 hr.)
         The ratio of the pump mixing to the residence time is 0.
           KG aerated (m/s)                        0.11714
           KL aerated (m/s)                        0.016622
           KL OVERALL AERATED (m/s)                0.005152
           KG quiescent (m/s)                      0.005738
           KL quiescent (m/s)                      5.945e-06
           KL OVERALL QUIESCENT (m/s)              5.85e-06
           KL OVERALL (m/s)                        1.598e-04
           air stripping time constant (min)       101.198
           FRACTION SURFACE VOLATILIZED            0.33728
           FRACTION SUBMERGED VOLATILIZED          0.
           TOTAL FRACTION VOLATILIZED              0.33728
           FRACTION BIOLOGICALLY REMOVED           0.62623
           FRACTION ABSORBED                       0.
           TOTAL AIR EMISSIONS  (g/s)              0.009434
                             (Mg/year)             0.29751
           EMISSION FACTOR  (g/cm2-s)              1.393e-11
           UNIT EXIT CONCENTRATION (ppmw)          8.721e-04
```

```
Type of unit is
1 Total water added at the unit (l/s)      50     0
2 Area of openings at unit (cm2)                  50
3 Radius of drop pipe (cm)                        5
4 Drop length to conduit (cm)                     61
5 Humidity of inlet air (%)                       40
6 Temperature of air (C)                          25
7 Drain air velocity (ft/min)                     84
8 manhole air velocity (ft/min)                   128
9 Conduit air velocity (ft/min)                   66
10 Wind speed (cm/s at 10 m)                      447
11 distance to next unit (cm)                     500
12 slope of underflow conduit                     .015
13 friction factor liquid                         .016
14 friction factor gas                            .006
15 radius of underflow conduit (cm)               12
16 Underflow T (C)                                25
17 oscillation cycle time (min)                   5
18 design collection velocities  (ft/s)           2
19 design branch line fraction full               .4

Type of unit is
8 HL partition flag=1, adjust for sorption        0
9 unit recycle convergence number                 200
10 oil molecular weight                           0
11 oil density  (g/cc)                            0
12 NaUT 1=municipal 2=industrial  3=turb.         0
13 NaUT 1=mass tr. 2=equil                        0
14 parts biomass per 1000 parts COD
15 oil water partition method 0=owpc
16 use UNIFAC aqueous data base =1
17 specify mass transfer for unit, =1
18 Use biomass for unit option, =1
19 biogrowth Monod half concentration ppm

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper
  Permitting\Emissions\WWTP\PAE\Hardpipe Scenario\ASB Hardpipe Scenario V7
  3/16/2023 1:47:24 PM  19:21:06
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is aerated biotreatment
1 Description of unit                      11    ASB Zone 1
2 Wastewater temperature   (C)                   34.08
3 length of aeration unit (m)                    295
4 width of aeration unit (m)                     295
5 depth of aeration unit (m)                     1.4
6 Area of agitation (each aerator,m2)            135
7 Total number of agitators in the unit          31
8 Power of agitation (each aerator,HP)           75
9 Impeller diameter (cm)                         49.53
10 Impeller rotation (RPM)                       1200
11 Agitator mechanical efficiency                0.83
12 aerator effectiveness, alpha                  0.83
13 if there is plug flow, enter 1                0
14 Overall biorate (mg/g bio-hr)                 19
15 Aeration air flow (m3/s)                      0
16 active biomass, aeration (g/l)                0.3
17 If covered, then enter 1                      0
18 special input                                 0
19 pH  (enter 0 for no pH adjustment)            7.04
```

```
Properties of DIMETHYL SULFIDE  (DMS) at 34.1 deg.C (93.3 deg.F)
   hl= 0.002924 atm-m3/mol      vp= 704.653 mmHg (13.629 psia)
       162.463 y/x
       0.11606 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr           dl= 1.504e-05 cm2/s  dv= 0.14765 cm2/s
Compound flow rate from inlet water is 0.27039 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 28.926 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 237.766.
kl is estimated as 7.634e-06 m/s.
kg is estimated as 0.007917 m/s.  Model: 2
kg is estimated as 0.007917 m/s.  Model: 2
The Schmidt number is 1.01591.
The friction velocity is 37.398 m/s
kg is estimated as 0.017873 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.14978 m/s.
kl (agitated)is estimated as 0.021024 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 4.77e-04 m/s.
 The effective stripping time (surface + diffused air) is 48.915 minutes. (0.81526
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1735.541 min. (28.926 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                         0.15258
   KL aerated (m/s)                         0.021024
   KL OVERALL AERATED (m/s)                 0.009769
   KG quiescent  (m/s)                      0.008066
   KL quiescent  (m/s)                      7.634e-06
   KL OVERALL QUIESCENT (m/s)               7.574e-06
   KL OVERALL  (m/s)                        4.77e-04
   air stripping time constant (min)        48.915
   FRACTION SURFACE VOLATILIZED             0.80064
   FRACTION SUBMERGED VOLATILIZED           0.
   TOTAL FRACTION VOLATILIZED               0.80064
   FRACTION BIOLOGICALLY REMOVED            0.1768
   FRACTION ABSORBED                        0.
   TOTAL AIR EMISSIONS  (g/s)               0.21648
                  (Mg/year)                 6.82699
   EMISSION FACTOR  (g/cm2-s)               2.488e-10
   UNIT EXIT CONCENTRATION (ppmw)           0.005215
DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper
  Permitting\Emissions\WWTP\PAE\Hardpipe Scenario\ASB Hardpipe Scenario V7
  3/16/2023 1:47:24 PM  19:21:06
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is system exit stream
1 Description of unit                     12    def.system exit st
```

```
   TOTAL AIR EMISSIONS  (g/s)             0.
                  (Mg/year)               0.
   EMISSION FACTOR  (g/cm2-s)             2.488e-10
   UNIT EXIT CONCENTRATION (ppmw)         2.285e-05
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper
  Permitting\Emissions\WWTP\PAE\Hardpipe Scenario\ASB Hardpipe Scenario V7
  3/16/2023 1:47:24 PM  19:21:06
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is open hub drain
1 Description of unit                     13    default open hub d
2 Underflow T (C)                               43.89
3 Total water added at the unit (l/s)           0
4 Area of openings at unit (cm2)                50
5 Radius of drop pipe (cm)                      5
6 Drop length to conduit (cm)                   61
7 Open surface=1                                1
8 Subsurface entrance=1                         0
9 subsurface exit =1                            0
10 radius of underflow conduit (cm)             12
11 distance to next unit (cm)                   500
12 slope of underflow conduit                   0.015
16 velocity air at drain opening (ft/min)       84
17 municipal waste in conduit =1                0
18 Assume equilibrium in unit, =1               0
19 pH  (enter 0 for no pH adjustment)           8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1170 l/s.
   Weight fraction down is  2.677E-07
   Gas concentration in  0 mol fraction.
   Gas flow  1170 L/s
   Weight fraction out at base of drop is  2.31101058606837E-07
   fraction transferred in the drain drop from hub is .136716
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.13672
   fraction loss in unit                    0.
   fraction loss in line run                0.
   component upstream of unit, g/s          0.
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             5.603e-19
   mol fract. headspace vent base           1.532e-05
   headspace flow out vent (cc/s)           -1.17e+06
   headspace flow down line (cc/s)          1.17e+06
   KG surface (m/s)                         2834.248
   KL surface (m/s)                         8.784e-09
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.31321
   total component into unit, g/s           0.27039
   TOTAL AIR EMISSIONS  (g/s)               0.042821
                  (Mg/year)                 1.3504
   EMISSION FACTOR  (g/cm2-s)               2.488e-10
   UNIT EXIT CONCENTRATION (ppmw)           0.2311
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper
  Permitting\Emissions\WWTP\PAE\Hardpipe Scenario\ASB Hardpipe Scenario V7
  3/16/2023 1:47:24 PM  19:21:06
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```
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is aerated biotreatment
1 Description of unit                             17    ASB Zone 3
2 Wastewater temperature   (C)                          30.01
3 length of aeration unit (m)                           376
4 width of aeration unit (m)                            188
5 depth of aeration unit (m)                            0.91
6 Area of agitation (each aerator,m2)                   135
7 Total number of agitators in the unit                 6
8 Power of agitation (each aerator,HP)                  75
9 Impeller diameter (cm)                                49.53
10 Impeller rotation (RPM)                              1200
11 Agitator mechanical efficiency                       0.83
12 aerator effectiveness, alpha                         0.83
13 if there is plug flow, enter 1                       0
14 Overall biorate (mg/g bio-hr)                        19
15 Aeration air flow (m3/s)                             0
16 active biomass, aeration (g/l)                       0.3
17 If covered, then enter 1                             0
18 special input                                        0
19 pH  (enter 0 for no pH adjustment)                   7.42

Properties of DIMETHYL SULFIDE  (DMS) at 30. deg.C (86. deg.F)
   hl= 0.002519 atm-m3/mol       vp= 606.985 mmHg (11.74 psia)
       139.945 y/x
       0.10132 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr           dl= 1.485e-05 cm2/s  dv= 0.14425 cm2/s
Compound flow rate from inlet water is 2.889e-04 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.272 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 7.566e-06 m/s.
kg is estimated as 0.007884 m/s.  Model: 2
kg is estimated as 0.007884 m/s.  Model: 2
The Schmidt number is 1.03989.
The friction velocity is 37.398 m/s
kg is estimated as 0.017611 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.14804 m/s.
kl (agitated)is estimated as 0.018962 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 1.053e-04 m/s.
 The effective stripping time (surface + diffused air) is 144.073 minutes.
 (2.40122 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 916.326 min. (15.272 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                          0.15081
   KL aerated (m/s)                          0.018962
   KL OVERALL AERATED (m/s)                  0.00854
   KG quiescent (m/s)                        0.008032
```

```
   KL quiescent (m/s)                        7.566e-06
   KL OVERALL QUIESCENT (m/s)                7.497e-06
   KL OVERALL (m/s)                          1.053e-04
   air stripping time constant (min)         144.073
   FRACTION SURFACE VOLATILIZED              0.5886
   FRACTION SUBMERGED VOLATILIZED            0.
   TOTAL FRACTION VOLATILIZED                0.5886
   FRACTION BIOLOGICALLY REMOVED             0.31886
   FRACTION ABSORBED                         0.
   TOTAL AIR EMISSIONS  (g/s)                1.701e-04
                     (Mg/year)               0.005363
   EMISSION FACTOR  (g/cm2-s)                2.406e-13
   UNIT EXIT CONCENTRATION (ppmw)            2.285e-05
DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper
  Permitting\Emissions\WWTP\PAE\Hardpipe Scenario\ASB Hardpipe Scenario V7
  3/16/2023 1:47:24 PM  19:21:06
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is aerated biotreatment
1 Description of unit                          18    ASB Zone 2
2 Wastewater temperature   (C)                      32.08
3 length of aeration unit (m)                       368
4 width of aeration unit (m)                        184
5 depth of aeration unit (m)                        0.97
6 Area of agitation (each aerator,m2)               135
7 Total number of agitators in the unit             15
8 Power of agitation (each aerator,HP)              75
9 Impeller diameter (cm)                            49.53
10 Impeller rotation (RPM)                          1200
11 Agitator mechanical efficiency                   0.83
12 aerator effectiveness, alpha                     0.83
13 if there is plug flow, enter 1                   0
14 Overall biorate (mg/g bio-hr)                    19
15 Aeration air flow (m3/s)                         0
16 active biomass, aeration (g/l)                   0.3
17 If covered, then enter 1                         0
18 special input                                    0
19 pH  (enter 0 for no pH adjustment)               7.24

Properties of DIMETHYL SULFIDE  (DMS) at 32.1 deg.C (89.7 deg.F)
   hl= 0.002719 atm-m3/mol      vp= 655.201 mmHg (12.673 psia)
       151.062 y/x
       0.10863 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.495e-05 cm2/s  dv= 0.14597 cm2/s
Compound flow rate from inlet water is 0.006101 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.594 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 7.6e-06 m/s.
kg is estimated as 0.007966 m/s.  Model: 2
kg is estimated as 0.007966 m/s.  Model: 2
The Schmidt number is 1.02758.
The friction velocity is 37.398 m/s
kg is estimated as 0.017744 m/s.  Model: 3
```

```
        ________Agitated surface___________________
       The rotation speed is 125.654 radians per second.
       The rotation factor NRW is 2.052e+06.
       The power number NPR is 7.881e-04.
       The rotation factor NFR is 797.027.
       kg (agitated)is estimated as 0.14892 m/s.
       kl (agitated)is estimated as 0.019984 m/s.
           The specified and growth biomass is 0.3 g/L.
        The effective KL (surface + diffused air) is 2.809e-04 m/s.
        The effective stripping time (surface + diffused air) is 57.552 minutes. (0.9592
        hrs.)
        The pump mixing time is 5 x the pumping recirculaion time, 0. min.
        The ratio of the mixing to the striping (surface + diffused air) is 0.
        The mean residence time is 935.622 min. (15.594 hr.)
        The ratio of the pump mixing to the residence time is 0.
          KG aerated (m/s)                        0.15171
          KL aerated (m/s)                        0.019984
          KL OVERALL AERATED (m/s)                0.009148
          KG quiescent (m/s)                      0.008115
          KL quiescent (m/s)                      7.6e-06
          KL OVERALL QUIESCENT (m/s)              7.537e-06
          KL OVERALL (m/s)                        2.809e-04
          air stripping time constant (min)       57.552
          FRACTION SURFACE VOLATILIZED            0.76981
          FRACTION SUBMERGED VOLATILIZED          0.
          TOTAL FRACTION VOLATILIZED              0.76981
          FRACTION BIOLOGICALLY REMOVED           0.18284
          FRACTION ABSORBED                       0.
          TOTAL AIR EMISSIONS  (g/s)              0.004697
                             (Mg/year)            0.14812
          EMISSION FACTOR  (g/cm2-s)              6.937e-12
          UNIT EXIT CONCENTRATION (ppmw)          2.469e-04
```

Type of unit is

1 Total water added at the unit (l/s)	50	0
2 Area of openings at unit (cm2)		50
3 Radius of drop pipe (cm)		5
4 Drop length to conduit (cm)		61
5 Humidity of inlet air (%)		40
6 Temperature of air (C)		25
7 Drain air velocity (ft/min)		84
8 manhole air velocity (ft/min)		128
9 Conduit air velocity (ft/min)		66
10 Wind speed (cm/s at 10 m)		447
11 distance to next unit (cm)		500
12 slope of underflow conduit		.015
13 friction factor liquid		.016
14 friction factor gas		.006
15 radius of underflow conduit (cm)		12
16 Underflow T (C)		25
17 oscillation cycle time (min)		5
18 design collection velocities (ft/s)		2
19 design branch line fraction full		.4

Type of unit is

8 HL partition flag=1, adjust for sorption	0
9 unit recycle convergence number	200
10 oil molecular weight	0
11 oil density (g/cc)	0
12 NaUT 1=municipal 2=industrial 3=turb.	0
13 NaUT 1=mass tr. 2=equil	0
14 parts biomass per 1000 parts COD	
15 oil water partition method 0=owpc	
16 use UNIFAC aqueous data base =1	
17 specify mass transfer for unit, =1	
18 Use biomass for unit option, =1	
19 biogrowth Monod half concentration ppm	

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment
Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\PAE\Hardpipe Scenario\ASB Hardpipe Scenario V7 3/16/2023 1:47:24 PM 19:21:41
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment

1 Description of unit	11	ASB Zone 1
2 Wastewater temperature (C)		34.08
3 length of aeration unit (m)		295
4 width of aeration unit (m)		295
5 depth of aeration unit (m)		1.4
6 Area of agitation (each aerator,m2)		135
7 Total number of agitators in the unit		31
8 Power of agitation (each aerator,HP)		75
9 Impeller diameter (cm)		49.53
10 Impeller rotation (RPM)		1200
11 Agitator mechanical efficiency		0.83
12 aerator effectiveness, alpha		0.83
13 if there is plug flow, enter 1		0
14 Overall biorate (mg/g bio-hr)		19
15 Aeration air flow (m3/s)		0
16 active biomass, aeration (g/l)		0.3
17 If covered, then enter 1		0
18 special input		0
19 pH (enter 0 for no pH adjustment)		7.04

```
Properties of METHANETHIOL(methyl mercaptan) at 34.1 deg.C (93.3 deg.F)
   hl= 0.004158 atm-m3/mol      vp= 2272.142 mmHg (43.948 psia)
       230.99 y/x
       0.16502 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.525e-05 cm2/s  dv= 0.23702 cm2/s
Compound flow rate from inlet water is 0.009471 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 28.926 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 237.766.
kl is estimated as 7.703e-06 m/s.
kg is estimated as 0.010871 m/s.  Model: 2
kg is estimated as 0.010871 m/s.  Model: 2
The Schmidt number is 0.63285.
The friction velocity is 37.398 m/s
kg is estimated as 0.024173 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.18977 m/s.
kl (agitated)is estimated as 0.021167 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 6.265e-04 m/s.
 The effective stripping time (surface + diffused air) is 37.242 minutes. (0.62071
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1735.541 min. (28.926 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                        0.19332
   KL aerated (m/s)                        0.021167
   KL OVERALL AERATED (m/s)                0.012876
   KG quiescent (m/s)                      0.011075
   KL quiescent (m/s)                      7.703e-06
   KL OVERALL QUIESCENT (m/s)              7.672e-06
   KL OVERALL (m/s)                        6.265e-04
   air stripping time constant (min)       37.242
   FRACTION SURFACE VOLATILIZED            0.88738
   FRACTION SUBMERGED VOLATILIZED          0.
   TOTAL FRACTION VOLATILIZED              0.88738
   FRACTION BIOLOGICALLY REMOVED           0.093578
   FRACTION ABSORBED                       0.
   TOTAL AIR EMISSIONS  (g/s)              0.008404
                    (Mg/year)              0.26504
   EMISSION FACTOR  (g/cm2-s)              9.657e-12
   UNIT EXIT CONCENTRATION (ppmw)          1.541e-04
DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper
  Permitting\Emissions\WWTP\PAE\Hardpipe Scenario\ASB Hardpipe Scenario V7
  3/16/2023 1:47:24 PM  19:21:41
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is system exit stream
1 Description of unit                  12    def.system exit st
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```
    TOTAL AIR EMISSIONS  (g/s)                0.
                      (Mg/year)               0.
    EMISSION FACTOR  (g/cm2-s)                9.657e-12
    UNIT EXIT CONCENTRATION (ppmw)            5.348e-07
 DETAILED CALCULATIONS at Unit 13 default open hub d
 Type: open hub drain
   Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
   Poe Privileged and Confidential\New Stripper
   Permitting\Emissions\WWTP\PAE\Hardpipe Scenario\ASB Hardpipe Scenario V7
   3/16/2023 1:47:24 PM  19:21:41
 COMPOUND: METHANETHIOL(methyl mercaptan)

 Type of unit is open hub drain
 1 Description of unit                        13    default open hub d
 2 Underflow T (C)                                  43.89
 3 Total water added at the unit (l/s)              0
 4 Area of openings at unit (cm2)                   50
 5 Radius of drop pipe (cm)                         5
 6 Drop length to conduit (cm)                      61
 7 Open surface=1                                   1
 8 Subsurface entrance=1                            0
 9 subsurface exit =1                               0
 10 radius of underflow conduit (cm)                12
 11 distance to next unit (cm)                      500
 12 slope of underflow conduit                      0.015
 16 velocity air at drain opening (ft/min)          84
 17 municipal waste in conduit =1                   0
 18 Assume equilibrium in unit, =1                  0
 19 pH  (enter 0 for no pH adjustment)              8.9

  Equilibrium partitioning in drain drop hub is assumed.
    Total drain flow is  1170 l/s.
    Weight fraction down is  9.8E-09
    Gas concentration in  0 mol fraction.
    Gas flow  1170 L/s
    Weight fraction out at base of drop is  8.09478308097639E-09
    fraction transferred in the drain drop from hub is .174002
    fraction loss in waste1 drop to hub       0.
    fraction loss in waste2 drop to hub       0.
    fraction loss in waste3 drop to hub       0.
    fraction loss in collection hub drop      0.174
    fraction loss in unit                     0.
    fraction loss in line run                 0.
    component upstream of unit, g/s           0.
    mol fract. headspace upstream (y)         0.
    headspace at conduit discharge, y         0.
    headspace end of conduit (y)              2.559e-20
    mol fract. headspace vent base            9.217e-07
    headspace flow out vent (cc/s)            -1.17e+06
    headspace flow down line (cc/s)           1.17e+06
    KG surface (m/s)                          3886.338
    KL surface (m/s)                          8.868e-09
    flow of waste down hub (l/s)              0.
    component flow in waste into unit (g/s)   0.011466
    total component into unit, g/s            0.009471
    TOTAL AIR EMISSIONS  (g/s)                0.001995
                      (Mg/year)               0.062918
    EMISSION FACTOR  (g/cm2-s)                9.657e-12
    UNIT EXIT CONCENTRATION (ppmw)            0.008095
 DETAILED CALCULATIONS at Unit 17 ASB Zone 3
 Type: aerated biotreatment
   Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
   Poe Privileged and Confidential\New Stripper
   Permitting\Emissions\WWTP\PAE\Hardpipe Scenario\ASB Hardpipe Scenario V7
   3/16/2023 1:47:24 PM  19:21:41
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COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment
1 Description of unit                         17    ASB Zone 3
2 Wastewater temperature    (C)                     30.01
3 length of aeration unit (m)                       376
4 width of aeration unit (m)                        188
5 depth of aeration unit (m)                        0.91
6 Area of agitation (each aerator,m2)               135
7 Total number of agitators in the unit             6
8 Power of agitation (each aerator,HP)              75
9 Impeller diameter (cm)                            49.53
10 Impeller rotation (RPM)                          1200
11 Agitator mechanical efficiency                   0.83
12 aerator effectiveness, alpha                     0.83
13 if there is plug flow, enter 1                   0
14 Overall biorate (mg/g bio-hr)                    19
15 Aeration air flow (m3/s)                         0
16 active biomass, aeration (g/l)                   0.3
17 If covered, then enter 1                         0
18 special input                                    0
19 pH  (enter 0 for no pH adjustment)               7.42

Properties of METHANETHIOL(methyl mercaptan) at 30. deg.C (86. deg.F)
   hl= 0.003687 atm-m3/mol       vp= 2014.774 mmHg (38.97 psia)
       204.826 y/x
       0.14829 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.505e-05 cm2/s  dv= 0.23155 cm2/s
Compound flow rate from inlet water is 7.237e-06 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.272 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 7.635e-06 m/s.
kg is estimated as 0.010826 m/s.  Model: 2
kg is estimated as 0.010826 m/s.  Model: 2
The Schmidt number is 0.64779.
The friction velocity is 37.398 m/s
kg is estimated as 0.023814 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.18756 m/s.
kl (agitated)is estimated as 0.019092 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 1.391e-04 m/s.
 The effective stripping time (surface + diffused air) is 109.038 minutes.
 (1.81731 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 916.326 min. (15.272 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                            0.19108
   KL aerated (m/s)                            0.019092
   KL OVERALL AERATED (m/s)                    0.011483
   KG quiescent (m/s)                          0.011029
```

```
    KL quiescent (m/s)                          7.635e-06
    KL OVERALL QUIESCENT (m/s)                  7.6e-06
    KL OVERALL (m/s)                            1.391e-04
    air stripping time constant (min)           109.038
    FRACTION SURFACE VOLATILIZED                0.72669
    FRACTION SUBMERGED VOLATILIZED              0.
    TOTAL FRACTION VOLATILIZED                  0.72669
    FRACTION BIOLOGICALLY REMOVED               0.18684
    FRACTION ABSORBED                           0.
    TOTAL AIR EMISSIONS  (g/s)                  5.259e-06
                      (Mg/year)                 1.658e-04
    EMISSION FACTOR  (g/cm2-s)                  7.439e-15
    UNIT EXIT CONCENTRATION (ppmw)              5.348e-07
DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper
  Permitting\Emissions\WWTP\PAE\Hardpipe Scenario\ASB Hardpipe Scenario V7
  3/16/2023 1:47:24 PM  19:21:41
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment
1 Description of unit                          18    ASB Zone 2
2 Wastewater temperature   (C)                       32.08
3 length of aeration unit (m)                        368
4 width of aeration unit (m)                         184
5 depth of aeration unit (m)                         0.97
6 Area of agitation (each aerator,m2)                135
7 Total number of agitators in the unit              15
8 Power of agitation (each aerator,HP)               75
9 Impeller diameter (cm)                             49.53
10 Impeller rotation (RPM)                           1200
11 Agitator mechanical efficiency                    0.83
12 aerator effectiveness, alpha                      0.83
13 if there is plug flow, enter 1                    0
14 Overall biorate (mg/g bio-hr)                     19
15 Aeration air flow (m3/s)                          0
16 active biomass, aeration (g/l)                    0.3
17 If covered, then enter 1                          0
18 special input                                     0
19 pH  (enter 0 for no pH adjustment)                7.24

Properties of METHANETHIOL(methyl mercaptan) at 32.1 deg.C (89.7 deg.F)
   hl= 0.003921 atm-m3/mol      vp= 2142.771 mmHg (41.446 psia)
       217.838 y/x
       0.15664 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.515e-05 cm2/s  dv= 0.23433 cm2/s
Compound flow rate from inlet water is 1.803e-04 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.594 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 7.67e-06 m/s.
kg is estimated as 0.010938 m/s.  Model: 2
kg is estimated as 0.010938 m/s.  Model: 2
The Schmidt number is 0.64013.
The friction velocity is 37.398 m/s
kg is estimated as 0.023996 m/s.  Model: 3
```

```
_______Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.18868 m/s.
kl (agitated)is estimated as 0.020121 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 3.715e-04 m/s.
 The effective stripping time (surface + diffused air) is 43.518 minutes. (0.72529 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 935.622 min. (15.594 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                         0.19222
   KL aerated (m/s)                         0.020121
   KL OVERALL AERATED (m/s)                 0.012174
   KG quiescent (m/s)                       0.011143
   KL quiescent (m/s)                       7.67e-06
   KL OVERALL QUIESCENT (m/s)               7.637e-06
   KL OVERALL (m/s)                         3.715e-04
   air stripping time constant (min)        43.518
   FRACTION SURFACE VOLATILIZED             0.86271
   FRACTION SUBMERGED VOLATILIZED           0.
   TOTAL FRACTION VOLATILIZED               0.86271
   FRACTION BIOLOGICALLY REMOVED            0.097161
   FRACTION ABSORBED                        0.
   TOTAL AIR EMISSIONS  (g/s)               1.556e-04
                      (Mg/year)             0.004907
   EMISSION FACTOR  (g/cm2-s)               2.298e-13
   UNIT EXIT CONCENTRATION (ppmw)           6.185e-06
```

PAE H2S Factor
Summary of H2SSIM Inputs and Outputs

PAE - No Stripper Scenario	Zone 1	Zone 2	Zone 3
DO	1.57	4.63	4.66
Temp	93.34	89.74	86.02
pH	7.04	7.24	7.42
Length	968	1208	1235
Width	968	604	617
Aerators	31	15	6

	Main Inlet	Hardpipe	Units
Flow	25.48	1.22	MGD
Total Sulfide	0.252	1.47	mg/L
Sulfate	390	390	mg/L

	Zone 1	Zone 2	Zone 3	Total ASB	
H2S g/s	0.08	0.03	0.02	0.122	g/s
				2200	ODTP/day
				1.06E-02	lb/ODTP

PAE - Backup Stripper	Zone 1	Zone 2	Zone 3
DO	1.57	4.63	4.66
Temp	93.34	89.74	86.02
pH	7.04	7.24	7.42
Length	968	1208	1235
Width	968	604	617
Aerators	31	15	6

	Main Inlet	Hardpipe	Units
Flow	25.48	1.22	MGD
Total Sulfide	0.252	2.93	mg/L
Sulfate	390	390	mg/L

	Zone 1	Zone 2	Zone 3	Total ASB	
H2S g/s	0.08	0.03	0.02	0.126	g/s
				2200	ODTP/day
				1.09E-02	lb/ODTP

PAE - New Stripper	Zone 1	Zone 2	Zone 3
DO	1.57	4.63	4.66
Temp	93.34	89.74	86.02
pH	7.04	7.24	7.42
Length	968	1208	1235
Width	968	604	617
Aerators	31	15	6

	Main Inlet	Hardpipe	Units
Flow	25.48	0.00	MGD
Total Sulfide	0.252	0.00	mg/L
Sulfate	390	390	mg/L

	Zone 1	Zone 2	Zone 3	Total ASB	
H2S g/s	0.07	0.03	0.02	0.119	
				2200	ODTP/day
				1.03E-02	lb/ODTP

*DO are based on average of all DO readings from 2021 and 2022 Subpart S performance testing.

NCASI WASTEWATER HYDROGEN SULFIDE EMISSIONS SIMULATOR (H2SSIM)
Version 1.3

New Stripper Scenario

Data Type 1. Site Identification

Company Name	New-Indy
Facility Name	Catawba SC
Basin Name	ASB

Data Type 2. Model Zone Information

Number of Zones	3
Zone Location of Hardpipe	1
Type of Basin	ASB

Data Type 3. Load Characteristics

Loading Characteristics	Main Influent	Hardpipe	Units
Flow	25.48		MGD
Total Sulfide	0.252		mg/L
Sulfate	390	390	mg/L

Data Type 4. Atmospheric Conditions

Windspeed	3.55	mph
Ambient Temperature	79	F

Data Type 5. Zone Physical and Chemical Conditions

Zone Condition	Zone 1	Zone 2	Zone 3	Zone 4	Units
Dissolved Oxygen	1.57	4.63	4.66		mg/L
Temperature	93.34	89.74	86.02		F
pH	7.04	7.24	7.42		s.u.
Redox Condition	Aerobic	Aerobic	Aerobic	Aerobic	
Length	968	1208	1235		feet
Width	968	604	617		feet
Depth	4.5	3.2	3		feet
Mixing	Moderat	Moderat	Moderat		
Number of Aerators	31	15	6		
Total Horsepower	2325	1125	450		HP
Impellor Size	1.625	1.625	1.625		feet
Impellor RPM	1200	1200	1200		RPM
Diffused Air Flow	0	0	0		cms
Weir Height	0	0	0		feet

Model Controls

Run H2SSIM

View Parameters

Clear Input Sheet

H2SSIM Results

New Stripper Scenario

Basin Emissions		Units
Total Emissions (H_2S)	0.119	gms/s
Total Emissions (H_2S)	8271.8	lbs/yr
Total Emissions (H_2S)	4.1	tons/yr
Total Emissions (H_2S)	3.8	tonnes/yr
Emission Flux (H_2S)	16.6	gms/m^2 yr

Zone Emissions	Zone 1	Zone 2	Zone 3	Zone 4	Units
Zone Emissions (H_2S)	0.07	0.03	0.02		gms/s
Zone Emissions (H_2S)	4987.3	1762.5	1522.0		lbs/yr
Emission Flux (H_2S)	26.0	11.8	9.8		gms/m^2 yr
Liquid Conc. (Total Sulfide)	0.003	0.001	0.000		mg/L
Liquid Sulfide Load (lbs/yr)	36.300	6.200	5.400		lbs/yr

Percent Inlet Sulfide Removed	57.7%

Current Parameters	
kgen	0.25
ThetaGen	1.06
KDO	0.05
KSO4	10
kanox	0.006
ThetaOx	1.05
m	1
n	0.2
MLVSS	272.2
O_2 Transfer Coeff.	2
alpha 1	0.83
alpha 2	0.6

NCASI WASTEWATER HYDROGEN SULFIDE EMISSIONS SIMULATOR (H2SSIM)
Version 1.3

Backup Stripper Scenario

Data Type 1. Site Identification

Company Name	New-Indy
Facility Name	Catawba SC
Basin Name	ASB

Data Type 2. Model Zone Information

Number of Zones	3
Zone Location of Hardpipe	1
Type of Basin	ASB

Data Type 3. Load Characteristics

Loading Characteristics	Main Influent	Hardpipe	Units
Flow	25.48	1.22	MGD
Total Sulfide	0.252	2.93	mg/L
Sulfate	390	390	mg/L

Data Type 4. Atmospheric Conditions

Windspeed	3.55	mph
Ambient Temperature	79	F

Data Type 5. Zone Physical and Chemical Conditions

Zone Condition	Zone 1	Zone 2	Zone 3	Zone 4	Units
Dissolved Oxygen	1.57	4.63	4.66		mg/L
Temperature	93.34	89.74	86.02		F
pH	7.04	7.24	7.42		s.u.
Redox Condition	Aerobic	Aerobic	Aerobic	Aerobic	
Length	968	1208	1235		feet
Width	968	604	617		feet
Depth	4.5	3.2	3		feet
Mixing	Moderat	Moderat	Moderat		
Number of Aerators	31	15	6		
Total Horsepower	2325	1125	450		HP
Impellor Size	1.625	1.625	1.625		feet
Impellor RPM	1200	1200	1200		RPM
Diffused Air Flow	0	0	0		cms
Weir Height	0	0	0		feet

Model Controls

Run H2SSIM

View Parameters

Clear Input Sheet

H2SSIM Results

Backup Stripper Scenario

Basin Emissions		Units
Total Emissions (H_2S)	0.126	gms/s
Total Emissions (H_2S)	8765.3	lbs/yr
Total Emissions (H_2S)	4.4	tons/yr
Total Emissions (H_2S)	4.0	tonnes/yr
Emission Flux (H_2S)	17.6	gms/m^2 yr

Zone Emissions	Zone 1	Zone 2	Zone 3	Zone 4	Units
Zone Emissions (H_2S)	0.08	0.03	0.02		gms/s
Zone Emissions (H_2S)	5479.5	1763.8	1521.9		lbs/yr
Emission Flux (H_2S)	28.6	11.8	9.8		gms/m^2 yr
Liquid Conc. (Total Sulfide)	0.004	0.001	0.000		mg/L
Liquid Sulfide Load (lbs/yr)	45.000	6.500	5.700		lbs/yr

Percent Inlet Sulfide Removed	71.2%

Current Parameters	
kgen	0.25
ThetaGen	1.06
KDO	0.05
KSO4	10
kanox	0.006
ThetaOx	1.05
m	1
n	0.2
MLVSS	272.2
O_2 Transfer Coeff.	2
alpha 1	0.83
alpha 2	0.6

NCASI WASTEWATER HYDROGEN SULFIDE EMISSIONS SIMULATOR (H2SSIM)
Version 1.3

No Stripper Scenario

Data Type 1. Site Identification

Company Name	New-Indy
Facility Name	Catawba SC
Basin Name	ASB

Data Type 2. Model Zone Information

Number of Zones	3
Zone Location of Hardpipe	1
Type of Basin	ASB

Data Type 3. Load Characteristics

Loading Characteristics	Main Influent	Hardpipe	Units
Flow	25.48	1.22	MGD
Total Sulfide	0.252	1.47	mg/L
Sulfate	390	390	mg/L

Data Type 4. Atmospheric Conditions

Windspeed	3.55	mph
Ambient Temperature	79	F

Data Type 5. Zone Physical and Chemical Conditions

Zone Condition	Zone 1	Zone 2	Zone 3	Zone 4	Units
Dissolved Oxygen	1.57	4.63	4.66		mg/L
Temperature	93.34	89.74	86.02		F
pH	7.04	7.24	7.42		s.u.
Redox Condition	Aerobic	Aerobic	Aerobic	Aerobic	
Length	968	1208	1235		feet
Width	968	604	617		feet
Depth	4.5	3.2	3		feet
Mixing	Moderat	Moderat	Moderat		
Number of Aerators	31	15	6		
Total Horsepower	2325	1125	450		HP
Impellor Size	1.625	1.625	1.625		feet
Impellor RPM	1200	1200	1200		RPM
Diffused Air Flow	0	0	0		cms
Weir Height	0	0	0		feet

Model Controls

Run H2SSIM

View Parameters

Clear Input Sheet

H2SSIM Results

No Stripper Scenario

Basin Emissions		Units
Total Emissions (H_2S)	0.123	gms/s
Total Emissions (H_2S)	8518.1	lbs/yr
Total Emissions (H_2S)	4.3	tons/yr
Total Emissions (H_2S)	3.9	tonnes/yr
Emission Flux (H_2S)	17.1	gms/m^2 yr

Zone Emissions	Zone 1	Zone 2	Zone 3	Zone 4	Units
Zone Emissions (H_2S)	0.08	0.03	0.02		gms/s
Zone Emissions (H_2S)	5232.9	1763.2	1521.9		lbs/yr
Emission Flux (H_2S)	27.3	11.8	9.8		gms/m^2 yr
Liquid Conc. (Total Sulfide)	0.003	0.001	0.000		mg/L
Liquid Sulfide Load (lbs/yr)	41.500	6.500	5.700		lbs/yr

Percent Inlet Sulfide Removed	65.9%

Current Parameters	
kgen	0.25
ThetaGen	1.06
KDO	0.05
KSO4	10
kanox	0.006
ThetaOx	1.05
m	1
n	0.2
MLVSS	272.2
O_2 Transfer Coeff.	2
alpha 1	0.83
alpha 2	0.6

Methanol PAE Emissions Factors

Methanol PAE Scenarios	Hardpipe ppm	Hardpipe Flow, MGD	Air Stripping g/s	Pulp Production	Methanol Emissions Factor lb/ODTP
New Stripper	N/A	N/A	3.47	2200	0.30
Backup Stripper	2095	1.22	17.63	2200	1.53
No Stripper	3809	1.22	26.69	2200	2.31

Design MeOH:	**1620**	lb/hr
	16	lb/ODT

APPENDIX C FORMS - CALCULATING FRACTION BIODEGRADED

Data Date: PAE - New Stripper Scenario

Instructions: Enter data in green shaded sections of this page of this spreadsheet only.

I. BIOTREATMENT UNIT DESCRIPTION

	Units	Zone 1	Zone 2	Zone 3
Number of 75 HP Aerators	#	31	15	6
Number of 100 HP Aerators	#	0	0	0
Total Horsepower	HP	2325	1125	450
Temperature	C	35.4	33.5	31.3
Length	ft	968	1,208	1,235
Width	ft	968	604	617
Average Depth	ft	4.5	3.2	3
Aerator Rotation	rpm	1200	1200	1200
Agitation Area per 75 HP aerator	ft2	1452	1452	1452
Agitation Area per 100 HP aerator	ft2	2206	2206	2206
Impellor Diameter	in	19.5	19.5	19.5

II. OVERALL PARAMS - individual flows

	Flow MGD	MeOH mg/L	
Inlet Stream **	25.48	60.0	AVG ASB Inlet, 2021 and 2022
Condensate Stream	0.0	0	
Outlet	25.5	5.1	AVG ASB Effluent, 2021 and 2022

** *except condensate flow*

NA - individual flow/conc data not available

II. OVERALL PARAMS - total flows

	Flow m3/sec	Flow MGD	MeOH mg/L
Influent Concentration		25.5	60.0
Effluent Concentration			5.10
Wind Speed	mph		3.8

III. HAP DATA

Methanol

	Units	Inlet	Average Zone Concentration Zone 1	Zone 2	Zone 3	Detect Limit
Conc.	mg/L	60.0	7.4	5.4	3.2	0.5
Temp.	F		95.7	92.3	88.3	
			12%	9%	5%	

Expected zone concentration reductions similar to 2022 data.
No Hardpipe Stream

IV. RESULTS

fbio - Methanol	%
Fraction biodegraded	86.3
Fraction air emissions	5.2
Fraction remaining in unit effluent	8.5

APPENDIX C FORMS - CALCULATING FRACTION BIODEGRADED
PARAMETERS FOR CALCULATING MASS TRANSFER COEFIICIENTS

Data Date: PAE - New Stripper Scenario

	Diff in Water cm2/s	Diff in Air cm2/s	Henry's Law atm-m3/mol	Equil. Ratio (Hc) or (Keq) m3 liq to m3 gas	MW g/mol	ScG	Antoine Eqtn b	Antoine Eqtn c
Methanol	1.64E-05	0.150	5.19E-06	2.12E-04	32.0	1.006	1474	229.13
Acetaldehyde	1.41E-05	0.124	8.77E-05	3.58E-03	45.1	1.216	1600	291.8
MEK	9.80E-06	0.081	1.30E-04	5.31E-03	72.1	1.867	1305	229.27

General

	Units	Value	Name
viscosity of air	g/cm-s	0.000181	va
viscosity of water	g/cm-s	0.002	vw
density of air	g/cm3	0.0012	da
density of water	g/cm3	1	dw
MW of air	g/mol	29	Mwa
MW of water	g/mol	18	MWw
Diff of O2 in H2O	cm2/s	2.40E-05	DO2w
grav const.	lb-ft/s2/lb	32.17	g
R	atm-m3/mol K	8.21E-05	R_
Aerator Motor Eff	fraction	0.85	AerEff
O2 Trans Correct		0.83	Beta
Wind Speed	m/s	1.69	U
Diff of Ether	m/s	8.50E-06	Dether
O2 Trans	lb O2/HP-h	3	J

TURBULENT
KL Params

		Zone 1	Zone 2	Zone 3
	w	126.3	126.3	126.3
	Re	2.07E+06	2.07E+06	2.07E+06
	Pl	35063	35063	35063
	Power Number, p	7.92E-04	7.92E-04	7.92E-04
	Fr	8.06E+02	8.06E+02	8.06E+02
	Total TurbArea (ft2)	45012	21780	8712
	Total TurbArea (m2)	4181.6	2023.4	809.3
	Frac. Agitated (by surface aerators)	0.048	0.030	0.011
	QUIESCENT			
	Depth	1.37	0.98	0.92
	SurfArea (ft2)	937472	729750	762343
	SurfArea (m2)	87208.33	67885.00	70916.98
	F/D Ratio	243	301	328
These Parameters are used when F/D < 14 **AND** U > 3.25 m/s	ScL - Methanol	NA	NA	NA
	ScL - Acetaldehyde	NA	NA	NA
	ScL - MEK	NA	NA	NA
	U* (Friction Velocity)	NA	NA	NA
	DIFFUSED			
	Air flow, cfm	0	0	0
	Air flow, m3/s	0.000	0.000	0.000

APPENDIX C FORMS - CALCULATING FRACTION BIODEGRADED

Calculating Mass Transfer Coefficient KL for Various Zones

Data Date: **PAE - New Stripper Scenario**

Surface Aeration												
		Turbulent Area			Quiescient Area							
						kL, m/s						
							U10 > 3.25					
	Temp Adj H	kG m/s	kL m/s	KL turb m/s	kG m/s	U10 < 3.25	F/D<14	14<F/D<51.2	F/D>51.2	kL m/s	KL quisc m/s	KL overall m/s
Zone1												
Methanol	8.77E-06	1.55E-01	2.27E-02	5.37E-05	3.82E-03	4.31E-06	NA	3.38E-06	1.16E-06	4.31E-06	1.01E-06	3.54E-06
Zone 2												
Methanol	7.99E-06	1.55E-01	2.17E-02	4.92E-05	3.88E-03	4.31E-06	NA	4.06E-06	1.16E-06	4.31E-06	9.57E-07	2.40E-06
Zone 3												
Methanol	7.16E-06	1.55E-01	2.06E-02	4.44E-05	3.87E-03	4.31E-06	NA	4.37E-06	1.16E-06	4.31E-06	8.82E-07	1.38E-06

FORM XIII. DATA FORM FOR THE ESTIMATION OF MULTIPLE ZONE BIODEGRADATION FROM UNIT CONCENTRATIONS

Data Date: PAE - New Stripper Scenario

NAME OF THE FACILITY		
COMPOUND for site specific biorate determination		**Methanol**
Number of zones in the biological treatment unit	1	
VOLUME of full-scale system (cubic meters)	2	250372.98
Average DEPTH of the full-scale system (meters)	3	1.0878333
FLOW RATE of wastewater to the unit (m3/s)	4	1.116
FLOW RATE of condensate to the unit (m3/s)	5	0.000
Total wastewater flowrate - (including condensates) (m3/s)	5-A	1.116
ESTIMATE OF KL (m/s)	6	*see table*
Concentration in the wastewater treated in the unit (mg/L)	7	60
Concentration in the condensates (mg/L)	8	0
Concentration in wastewater (total - inc. cond) in (mg/L)	8-A	60
Concentration in the effluent (mg/L)	9	5.0982378

TOTAL INLET FLOW (m3/s) line 4 plus the number on line 5 (or 5-A)	10	1.116	
TOTAL RESIDENCE TIME (s) line 2 divided by line 10.	11	224279	2.60 days
TOTAL AREA OF IMPOUNDMENT (m2) line 2 divided by line 3	12	230157	

Lines 13 through 15 Not Used

Zone Number	Concentration for zone, Ci (mg/L)	Area of the zone, A (m2)	Estimate of KL in the zone (m/s)	AIR STRIPPING KL A Ci (g/s)	
1	7.38608521	87091.1501	3.54365E-06	2.2795	0.308621
2	5.393164807	67793.7816	2.39719E-06	0.8765	0.162515
3	3.166816433	70821.6825	1.37942E-06	0.309	0.097693
4					
5					
6					
TOTALS - sum for each zone.	15	225706.614	16	3.47	

Removal by air stripping (g/s). Line 16.	17	3.47
Loading in effluent (g/s). Line 9 times line 10.	18	5.69
Total loading (g/s). {(line 5*line 8)+(line 4*line 7)} or {line 5-A*line 8-A}.	19	67.0
Removal by biodegradation (g/s) Line 19 minus (line 17 + line 18).	20	57.8
Fraction biodegraded: Divide line 20 by line 19.	21	0.863
Fraction air emissions: Divide line 17 by line 19.	22	0.052
Fraction remaining in unit effluent. Divide line 18 by 19.	23	0.085

APPENDIX C FORMS - CALCULATING FRACTION BIODEGRADED

Data Date: PAE - Old Stripper Scenario

Instructions: Enter data in green shaded sections of this page of this spreadsheet only.

I. BIOTREATMENT UNIT DESCRIPTION

	Units	Zone 1	Zone 2	Zone 3
Number of 75 HP Aerators	#	31	15	6
Number of 100 HP Aerators	#	0	0	0
Total Horsepower	HP	2325	1125	450
Temperature	C	35.4	33.5	31.3
Length	ft	968	1,208	1,235
Width	ft	968	604	617
Average Depth	ft	4.5	3.2	3
Aerator Rotation	rpm	1200	1200	1200
Agitation Area per 75 HP aerator	ft2	1452	1452	1452
Agitation Area per 100 HP aerator	ft2	2206	2206	2206
Impellor Diameter	in	19.5	19.5	19.5

II. OVERALL PARAMS - Individual flows

	Flow MGD	MeOH mg/L
Inlet Stream **	25.48	59.5
Condensate Stream	1.2	2,095
Outlet	26.7	5.1

** *except condensate flow*

NA - individual flow/conc data not available

II. OVERALL PARAMS - total flows

	Flow m3/sec	Flow MGD	MeOH mg/L
Influent Concentration		26.7	152.8
Effluent Concentration			5.10
Wind Speed	mph		3.8

III. HAP DATA

Methanol — **Average Zone Concentration**

	Units	Inlet	Zone 1	Zone 2	Zone 3	Detect Limit
Conc.	mg/L	152.8	41.9	24.2	7.6	0.5
Temp.	F		95.7	92.3	88.3	

	Zone 1	Zone 2	Zone 3
Avg. 2021/2022 Zone Reductions	27%	16%	5%

IV. RESULTS

fbio - Methanol	%
Fraction biodegraded	86.8
Fraction air emissions	9.9
Fraction remaining in unit effluent	3.3

APPENDIX C FORMS - CALCULATING FRACTION BIODEGRADED
PARAMETERS FOR CALCULATING MASS TRANSFER COEFIICIENTS

Data Date: PAE - Old Stripper Scenario

	Diff in Water cm2/s	Diff in Air cm2/s	Henry's Law atm-m3/mol	Equil. Ratio (Hc) or (Keq) m3 liq to m3 gas	MW g/mol	ScG	Antoine Eqtn b	Antoine Eqtn c
Methanol	1.64E-05	0.150	5.19E-06	2.12E-04	32.0	1.006	1474	229.13
Acetaldehyde	1.41E-05	0.124	8.77E-05	3.58E-03	45.1	1.216	1600	291.8
MEK	9.80E-06	0.081	1.30E-04	5.31E-03	72.1	1.867	1305	229.27

General

	Units	Value	Name
viscosity of air	g/cm-s	0.000181	va
viscosity of water	g/cm-s	0.002	vw
density of air	g/cm3	0.0012	da
density of water	g/cm3	1	dw
MW of air	g/mol	29	Mwa
MW of water	g/mol	18	MWw
Diff of O2 in H2O	cm2/s	2.40E-05	DO2w
grav const.	lb-ft/s2/lb	32.17	g
R	atm-m3/mol K	8.21E-05	R_
Aerator Motor Eff	fraction	0.85	AerEff
O2 Trans Correct		0.83	Beta
Wind Speed	m/s	1.69	U
Diff of Ether	m/s	8.50E-06	Dether
O2 Trans	lb O2/HP-h	3	J

TURBULENT
KL Params

	Zone 1	Zone 2	Zone 3
w	126.3	126.3	126.3
Re	2.07E+06	2.07E+06	2.07E+06
Pl	35063	35063	35063
Power Number, p	7.92E-04	7.92E-04	7.92E-04
Fr	8.06E+02	8.06E+02	8.06E+02
Total TurbArea (ft2)	45012	21780	8712
Total TurbArea (m2)	4181.6	2023.4	809.3
Frac. Agitated (by surface aerators)	0.048	0.030	0.011
QUIESCENT			
Depth	1.37	0.98	0.92
SurfArea (ft2)	937472	729750	762343
SurfArea (m2)	87208.33	67885.00	70916.98
F/D Ratio	243	301	328
ScL - Methanol	NA	NA	NA
ScL - Acetaldehyde	NA	NA	NA
ScL - MEK	NA	NA	NA
U* (Friction Velocity)	NA	NA	NA
DIFFUSED			
Air flow, cfm	0	0	0
Air flow, m3/s	0.000	0.000	0.000

These Parameters are used when F/D < 14 **AND** U > 3.25 m/s

APPENDIX C FORMS - CALCULATING FRACTION BIODEGRADED

Calculating Mass Transfer Coefficient KL for Various Zones

Data Date: **PAE - Old Stripper Scenario**

Surface Aeration													
		Turbulent Area			Quiescient Area								
						kL, m/s							
	Temp Adj H	kG m/s	kL m/s	KL turb m/s	kG m/s	U10 < 3.25	U10 > 3.25 F/D<14	U10 > 3.25 14<F/D<51.2	U10 > 3.25 F/D>51.2	kL m/s	KL quisc m/s	KL overall m/s
Zone1 Methanol	8.77E-06	1.55E-01	2.27E-02	5.37E-05	3.82E-03	4.31E-06	NA	3.38E-06	1.16E-06	4.31E-06	1.01E-06	3.54E-06
Zone 2 Methanol	7.99E-06	1.55E-01	2.17E-02	4.92E-05	3.88E-03	4.31E-06	NA	4.06E-06	1.16E-06	4.31E-06	9.57E-07	2.40E-06
Zone 3 Methanol	7.16E-06	1.55E-01	2.06E-02	4.44E-05	3.87E-03	4.31E-06	NA	4.37E-06	1.16E-06	4.31E-06	8.82E-07	1.38E-06

FORM XIII. DATA FORM FOR THE ESTIMATION OF MULTIPLE ZONE BIODEGRADATION FROM UNIT CONCENTRATIONS

Data Date: PAE - Old Stripper Scenario

NAME OF THE FACILITY		
COMPOUND for site specific biorate determination		**Methanol**
Number of zones in the biological treatment unit	1	
VOLUME of full-scale system (cubic meters)	2	250372.98
Average DEPTH of the full-scale system (meters)	3	1.0878333
FLOW RATE of wastewater to the unit (m3/s)	4	1.116
FLOW RATE of condensate to the unit (m3/s)	5	0.054
Total wastewater flowrate - (including condensates) (m3/s)	5-A	1.170
ESTIMATE OF KL (m/s)	6	*see table*
Concentration in the wastewater treated in the unit (mg/L)	7	59.511413
Concentration in the condensates (mg/L)	8	2094.7948
Concentration in wastewater (total - inc. cond) in (mg/L)	8-A	152.79058
Concentration in the effluent (mg/L)	9	5.0982378

TOTAL INLET FLOW (m3/s) line 4 plus the number on line 5 (or 5-A)	10	1.170	
TOTAL RESIDENCE TIME (s) line 2 divided by line 10.	11	214000	2.48 days
TOTAL AREA OF IMPOUNDMENT (m2) line 2 divided by line 3	12	230157	

Lines 13 through 15 Not Used

Zone Number	Concentration for zone, Ci (mg/L)	Area of the zone, A (m2)	Estimate of KL in the zone (m/s)		AIR STRIPPING KL A Ci (g/s)	
1	41.94854003	87091.1501	3.54365E-06		12.9462	0.308621
2	24.242506	67793.7816	2.39719E-06		3.9398	0.162515
3	7.579459633	70821.6825	1.37942E-06		0.740	0.097693
4						
5						
6						
TOTALS - sum for each zone.	15	225706.614		16	17.63	

Removal by air stripping (g/s). Line 16.	17	17.63
Loading in effluent (g/s). Line 9 times line 10.	18	5.96
Total loading (g/s). {(line 5*line 8)+(line 4*line 7)} or {line 5-A*line 8-A}.	19	178.8
Removal by biodegradation (g/s) Line 19 minus (line 17 + line 18).	20	155.2
Fraction biodegraded: Divide line 20 by line 19.	21	0.868
Fraction air emissions: Divide line 17 by line 19.	22	0.099
Fraction remaining in unit effluent. Divide line 18 by 19.	23	0.033

APPENDIX C FORMS - CALCULATING FRACTION BIODEGRADED

Data Date: PAE - No Stripper

Instructions: Enter data in green shaded sections of this page of this spreadsheet only.

I. BIOTREATMENT UNIT DESCRIPTION

	Units	Zone 1	Zone 2	Zone 3
Number of 75 HP Aerators	#	31	15	6
Number of 100 HP Aerators	#	0	0	0
Total Horsepower	HP	2325	1125	450
Temperature	C	35.4	33.5	31.3
Length	ft	968	1,208	1,235
Width	ft	968	604	617
Average Depth	ft	4.5	3.2	3
Aerator Rotation	rpm	1200	1200	1200
Agitation Area per 75 HP aerator	ft2	1452	1452	1452
Agitation Area per 100 HP aerator	ft2	2206	2206	2206
Impellor Diameter	in	19.5	19.5	19.5

II. OVERALL PARAMS - individual flows

	Flow MGD	MeOH mg/L
Inlet Stream **	25.48	59.5
Condensate Stream	1.2	3,809
Outlet	26.7	5.1

*** except condensate flow*

NA - individual flow/conc data not available

II. OVERALL PARAMS - total flows

		Flow m3/sec	Flow MGD	MeOH mg/L
Influent Concentration			26.7	231.3
Effluent Concentration				5.09824
Wind Speed	mph			3.8

III. HAP DATA

Methanol

	Units	Inlet	Average Zone Concentration Zone 1	Zone 2	Zone 3	Detect Limit
Conc.	mg/L	231.3	63.5	36.7	11.5	0.5
Temp.	F		95.7	92.3	88.3	

	Zone 1	Zone 2	Zone 3
Avg. 2021/2022 Zone Reductions	27%	16%	5%

IV. RESULTS

fbio - Methanol	%
Fraction biodegraded	[redacted]
Fraction air emissions	9.9
Fraction remaining in unit effluent	2.2

APPENDIX C FORMS - CALCULATING FRACTION BIODEGRADED
PARAMETERS FOR CALCULATING MASS TRANSFER COEFIICIENTS

Data Date: PAE - No Stripper

	Diff in Water cm2/s	Diff in Air cm2/s	Henry's Law atm-m3/mol	Equil. Ratio (Hc) or (Keq) m3 liq to m3 gas	MW g/mol	ScG	Antoine Eqtn b	Antoine Eqtn c
Methanol	1.64E-05	0.150	5.19E-06	2.12E-04	32.0	1.006	1474	229.13
Acetaldehyde	1.41E-05	0.124	8.77E-05	3.58E-03	45.1	1.216	1600	291.8
MEK	9.80E-06	0.081	1.30E-04	5.31E-03	72.1	1.867	1305	229.27

General

	Units	Value	Name
viscosity of air	g/cm-s	0.000181	va
viscosity of water	g/cm-s	0.002	vw
density of air	g/cm3	0.0012	da
density of water	g/cm3	1	dw
MW of air	g/mol	29	Mwa
MW of water	g/mol	18	MWw
Diff of O2 in H2O	cm2/s	2.40E-05	DO2w
grav const.	lb-ft/s2/lb	32.17	g
R	atm-m3/mol K	8.21E-05	R_
Aerator Motor Eff	fraction	0.85	AerEff
O2 Trans Correct		0.83	Beta
Wind Speed	m/s	1.69	U
Diff of Ether	m/s	8.50E-06	Dether
O2 Trans	lb O2/HP-h	3	J

TURBULENT
KL Params

		Zone 1	Zone 2	Zone 3
	w	126.3	126.3	126.3
	Re	2.07E+06	2.07E+06	2.07E+06
	PI	35063	35063	35063
	Power Number, p	7.92E-04	7.92E-04	7.92E-04
	Fr	8.06E+02	8.06E+02	8.06E+02
	Total TurbArea (ft2)	45012	21780	8712
	Total TurbArea (m2)	4181.6	2023.4	809.3
	Frac. Agitated (by surface aerators)	0.048	0.030	0.011
	QUIESCENT			
	Depth	1.37	0.98	0.92
	SurfArea (ft2)	937472	729750	762343
	SurfArea (m2)	87208.33	67885.00	70916.98
	F/D Ratio	243	301	328
These Parameters are used when F/D < 14 **AND** U > 3.25 m/s	ScL - Methanol	NA	NA	NA
	ScL - Acetaldehyde	NA	NA	NA
	ScL - MEK	NA	NA	NA
	U* (Friction Velocity)	NA	NA	NA
	DIFFUSED			
	Air flow, cfm	0	0	0
	Air flow, m3/s	0.000	0.000	0.000

APPENDIX C FORMS - CALCULATING FRACTION BIODEGRADED

Calculating Mass Transfer Coefficient KL for Various Zones

Data Date: PAE - No Stripper

	Surface Aeration											
		Turbulent Area			Quiescent Area							
						kL, m/s						
	Temp Adj H	kG m/s	kL m/s	KL turb m/s	kG m/s	U10 < 3.25	U10 > 3.25 F/D<14	U10 > 3.25 14<F/D<51.2	U10 > 3.25 F/D>51.2	kL m/s	KL quisc m/s	KL overall m/s
Zone1 Methanol	8.77E-06	1.55E-01	2.27E-02	5.37E-05	3.82E-03	4.31E-06	NA	3.38E-06	1.16E-06	4.31E-06	1.01E-06	3.54E-06
Zone 2 Methanol	7.99E-06	1.55E-01	2.17E-02	4.92E-05	3.88E-03	4.31E-06	NA	4.06E-06	1.16E-06	4.31E-06	9.57E-07	2.40E-06
Zone 3 Methanol	7.16E-06	1.55E-01	2.06E-02	4.44E-05	3.87E-03	4.31E-06	NA	4.37E-06	1.16E-06	4.31E-06	8.82E-07	1.38E-06

FORM XIII. DATA FORM FOR THE ESTIMATION OF MULTIPLE ZONE BIODEGRADATION FROM UNIT CONCENTRATIONS

Data Date: PAE - No Stripper

NAME OF THE FACILITY		
COMPOUND for site specific biorate determination		**Methanol**
Number of zones in the biological treatment unit	1	
VOLUME of full-scale system (cubic meters)	2	250372.98
Average DEPTH of the full-scale system (meters)	3	1.0878333
FLOW RATE of wastewater to the unit (m3/s)	4	1.116
FLOW RATE of condensate to the unit (m3/s)	5	0.054
Total wastewater flowrate - (including condensates) (m3/s)	5-A	1.170
ESTIMATE OF KL (m/s)	6	*see table*
Concentration in the wastewater treated in the unit (mg/L)	7	59.511413
Concentration in the condensates (mg/L)	8	3808.7177
Concentration in wastewater (total - inc. cond) in (mg/L)	8-A	231.34146
Concentration in the effluent (mg/L)	9	5.0982378

TOTAL INLET FLOW (m3/s) line 4 plus the number on line 5 (or 5-A)	10	1.170	
TOTAL RESIDENCE TIME (s) line 2 divided by line 10.	11	214000	2.48 days
TOTAL AREA OF IMPOUNDMENT (m2) line 2 divided by line 3	12	230157	

Lines 13 through 15 Not Used

Zone Number	Concentration for zone, Ci (mg/L)	Area of the zone, A (m2)	Estimate of KL in the zone (m/s)		AIR STRIPPING KL A Ci (g/s)	
1	63.5146271	87091.1501	3.54365E-06		19.6019	0.308621
2	36.70577636	67793.7816	2.39719E-06		5.9652	0.162515
3	11.47612174	70821.6825	1.37942E-06		1.121	0.097693
4						
5						
6						
TOTALS - sum for each zone.	15	225706.614		16	26.69	

Removal by air stripping (g/s). Line 16.	17	26.69
Loading in effluent (g/s). Line 9 times line 10.	18	5.96
Total loading (g/s). {(line 5*line 8)+(line 4*line 7)} or {line 5-A*line 8-A}.	19	270.7
Removal by biodegradation (g/s) Line 19 minus (line 17 + line 18).	20	238.0
Fraction biodegraded: Divide line 20 by line 19.	21	0.879
Fraction air emissions: Divide line 17 by line 19.	22	0.099
Fraction remaining in unit effluent. Divide line 18 by 19.	23	0.022

APPENDIX C - AIR DISPERSION MODELING DOCUMENTATION

Appendix C – Supporting Modeling Information

New-Indy Catawba LLC (New-Indy Catawba) is submitting our updated ambient air dispersion modeling analysis for the proposed modification to the current foul condensate treatment system at the Mill, in support of the New Condensate Stripper Construction Permit Application (Application). The modification will install a new foul condensate stripper (new steam stripper) and demote the existing steam stripper (existing steam stripper) strictly to backup operation during periods of downtime experienced by the new steam stripper. In support of the Application, New-Indy Catawba has conducted an ambient air dispersion modeling analysis of hydrogen sulfide (H_2S), methyl mercaptan (MMC), and total reduced sulfur (TRS) and is providing additional information regarding the analysis below. The modeling files will be submitted to the South Carolina Department of Health and Environmental Control (SCDHEC) electronically.

Background

On May 7, 2021, SCDHEC issued *an Order to Correct Undesirable Level of Contaminants* (Order) to New-Indy Catawba. Paragraph 5 of the Order required New-Indy to conduct a facility-wide air dispersion modeling analysis for sulfur dioxide (SO_2), H_2S, and TRS. New-Indy submitted an analysis for these pollutants in August 2021. In response to comments from SCDHEC and the United States Environmental Protection Agency (U.S. EPA), an updated analysis was submitted in October 2021. SCDHEC made an additional request for the emissions of each TRS constituent for each emission point that had been previously modeled as part of the Order. SCHDEC used this information, which was provided to SCDHEC on June 30, 2022, to conduct a modeling analysis for MMC to address community concerns and to update H_2S and TRS modeling.

On September 26, 2022, SCDHEC concluded its modeling analysis. During the course of updating the modeling, SCDHEC identified a small number of anomalously high modeled concentrations at a few, isolated receptors. SCDHEC and U.S. EPA reviewed the source of the anomalously high concentrations and concluded they were a result of a bug in the AERMOD (American Meteorological Society/EPA Regulatory Model) code triggered by rare combinations of meteorological and topographic conditions. For the New-Indy Catawba modeling, SCDHEC concluded that only the 1-hour averaging period results from the DITCH2 modeled source were affected. SCDHEC implemented an alternate characterization methodology for the DITCH2 source by reorganizing the order of vertices of the source in the modeling, which eliminated the trigger for the model code bug. U.S. EPA Region 4 concurred that the alternate characterization was appropriate for the analysis.

As mandated by Item V of Appendix A of the November 16, 2022, Consent Decree Civil No. 0:21-cv-02053-SAL, United States of America v. New Indy Catawba, LLC (EPA Consent Decree), New-Indy Catawba must install, maintain, and operate a containment system to prevent any uncontrolled black liquor overflows or releases from reaching the Mill's Aeration Stabilization Basin (ASB). To meet this requirement, New-Indy Catawba submitted a construction permit application (Application) to add the Black Liquor Storage Tank Secondary Containment (Equipment ID 2490) system to the Mill.

On February 13, 2023, New-Indy Catawba received the following email from SCDHEC:

> *As was touched-upon in the recent pre-application meeting for the stripper project, we request that a modeling analysis be submitted to account for facility-wide increases of hydrogen sulfide, methyl mercaptan and total reduced sulfur (TRS - modeled as H2S) as a result of the addition of a secondary containment tank for black liquor storage at the facility.*
>
> *The modeled emissions and stack parameters should reflect those used in the 9/26/2022 modeling conducted by DHEC as part of the Order to Correct Undesirable Level of Air*

Contaminants (dated 5/7/2021). Both 24 hour and 1 hour averaging periods should be used, consistent with the previous modeling.

On February 15, 2023, SCDHEC provided the AERMOD files used in their September 26, 2022 modeling to ALL4 LLC (ALL4), who is conducting air dispersion modeling on behalf of New-Indy Catawba. As directed by SCDHEC, ALL4 used the SCDHEC-provided modeling, including the reorganized DITCH2 characterization only for the 1-hour analysis of H_2S, as the basis for modeling the addition of a secondary containment tank for black liquor storage.

Facility-wide modeling of H2S, MMC, and TRS was conducted using the emissions rates, source parameters, meteorology, and receptor network provided by SCDHEC, with the exception of the additional secondary containment tank (Source ID NEWSPLTK) and associated structure (Structure ID NEWSPLTK). New-Indy Catawba has not reviewed the emissions rates provided in any of the SCDHEC modeling files and makes no claims, promises, or guarantees about their accuracy, completeness, or adequacy. Results of the air dispersion modeling analysis, which demonstrate that ambient concentrations are below the relevant standards for H_2S, MMC, and TRS for each averaging period, were provided to SCDHEC on March 8, 2023.

Air Dispersion Modeling for the New Condensate Stripper

To comply with Part I of Appendix A of the EPA Consent Decree, New-Indy Catawba will install a new steam stripper to treat all foul condensate. During periods when the new steam stripper is offline, foul condensate will be routed to the existing steam stripper where TRS compounds will be stripped. Peroxide addition to the stripped foul condensate in the Hardpipe will take place prior to discharging the treated pulping condensates to the ASB.

Facility-wide modeling of H_2S, MMC, and TRS was conducted using the source parameters, meteorology, and receptor network provided by SCDHEC, with the exception of the additional secondary containment tank (Source ID NEWSPLTK) and associated structure (Structure ID NEWSPLTK) that were included in the March 8, 2023 modeling submitted to SCDHEC. New-Indy Catawba used the maximum actual emissions rates as submitted in the October 2021 analysis (for H_2S and TRS) and corresponding MMC emissions rates, with the exception of the additional secondary containment tank and the ASB. Emissions rates from the March 8, 2023 analysis were used for the secondary containment tank and refined emissions reflecting the new steam stripper operation and foul condensate flow for the ASB. Results of the air dispersion modeling analysis demonstrate that ambient concentrations are below the relevant standards for H_2S, MMC, and TRS for each averaging period.

2023 New Steam Stripper Application

Pollutant	Standard[a]	Averaging Period[b]	Modeled Concentration (µg/m³)	UTM Easting (m)	UTM Northing (m)	Rank[a]	Standard[a](c)(d) (µg/m³)
H_2S	MAAC	24-hour	14.83	511,348.28	3,856,641.25	1st High	140
	EPA Action Level	30-minute	67.00	511,298.99	3,856,643.04	1-hour 1st High	837
MMM	MAAC	24-hour	9.40	510,115.55	3,856,041.31	1st High	10
	EPA Action Level	30-minute	47.99	510,209.41	3,856,039.95	1-hour 1st High	57,000
TRS	MAAC	24-hour	70.67	511,249.70	3,856,644.83	1st High	140
	EPA Action Level	30-minute	385.32	510,143.86	3,855,999.18	1-hour 1st High	837

(a) https://scdhec.gov/sites/default/files/media/document/BAQ_SC%20Modeling%20Guidelines_10.15.18_revised%204.15.19.pdf.

(b) 30-minute averaging period to be compared against maximum 1-hour modeled concentration, per DHEC October 6, 2021 request.

(c) TRS does not have a SC Standard - compare to H_2S.

(d) Methyl Mercaptan does not have an established AEGL-1 value due to insufficient data. Comparison of modeled concentrations are to the 30-minute AEGL-2 value for MMC only.

Buckner, Katharine

From: Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Sent: Friday, March 31, 2023 2:16 PM
To: Buckner, Katharine
Cc: Pete Cleveland; Golden, Rebecca; Hardee, Christopher; McCaslin, Steven
Subject: RE: Draft PSD Applicability Calculations - Foul Condensate Stripper Project
Attachments: Emissions References.pdf; Responses to DHEC (3-30-23).docx

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***

Katharine
Good afternoon. Please find the attached responses to the questions below. Have a good weekend.

From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Wednesday, March 22, 2023 8:52 AM
To: Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Cc: Pete Cleveland <pete.cleveland@new-indycb.com>; Golden, Rebecca <RebeccaG@thekraftgroup.com>; Hardee, Christopher <hardeecd@dhec.sc.gov>; McCaslin, Steven <mccaslsd@dhec.sc.gov>
Subject: RE: Draft PSD Applicability Calculations - Foul Condensate Stripper Project

Hello Bob,

I have quickly reviewed the draft PSD analysis and calculations. I have some comments for you. Since there was such a short amount time to review and submit comments on the abbreviated draft analysis, you can address these comments separately from the application that is due on March 23, 2023. Some of these may already be addressed in the application so provide the specific location where the item is addressed in the application. Also, please send the electronic version of the emission calculations.

1. Please provide a narrative on the emission calculations that details the assumptions made, etc.
2. In the projected actual emissions, what is the basis for the operating time percentage of the new stripper, the backup stripper, and the time both strippers are offline?
3. Please provide complete reference citations for "Title V" and "Columbia" such as page number of the application, etc. Also, provide the complete AP-42 citations to include Chapter, Table, and any pertinent information to pinpoint the emission factor used. For information from stack tests used in the emission calculations, provide the date of the test and whether it is a Department approved test. If the stack test was performed at another facility, please provide the complete stack test report so the results can be reviewed for use as an emission factor. Where the H2SSIM/WATER9 programs were used, please provide the inputs and outputs for all.
4. Will the new stripper have its own steam generating system or will steam be supplied by the boilers? If steam will be provided by the boilers, please provide the steam balance for estimating the portion going to the new stripper and backup stripper.
5. How will the methanol be added to the Recovery Furnaces? Will a storage tank be needed for the methanol generated? Were emissions accounted for it in the PSD analysis? Is the condensed methanol further purified?
6. Please provide a detailed diagram of the foul condensate stripper system to at least show the liquid flows and the gaseous flows.
7. Was the 10% annual capacity factor for fossil fuels taken into account in the projected actual emissions for the Recovery Furnaces?
8. What happens to the scrubbing liquid from the LVHS caustic scrubber? Is this this the existing scrubber or will a new one be installed?

9. During the baseline period, where you operating in compliance? If not, how were any limits accounted for in the baseline calculations?
10. Provide the vendor guarantee/certification for the emission factors supplied by the vendor.
11. For Footnote E, why was data from the entire baseline period not used in the PSD analysis.

Please provide responses by Friday, March 31, 2023.

Thank you,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

Office: (803) 898-3213
bucknekk@dhec.sc.gov

S.C. Dept. of Health & Environmental Control
2600 Bull Street
Columbia, SC 29201

Connect: www.scdhec.gov Facebook Twitter

From: Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Sent: Friday, March 17, 2023 11:37 AM
To: Buckner, Katharine <bucknekk@dhec.sc.gov>; Hardee, Christopher <hardeecd@dhec.sc.gov>; McCaslin, Steven <mccaslsd@dhec.sc.gov>
Cc: Pete Cleveland <pete.cleveland@new-indycb.com>; Golden, Rebecca <RebeccaG@thekraftgroup.com>
Subject: Draft PSD Applicability Calculations - Foul Condensate Stripper Project

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***

Katharine
Please find attached the draft calculations for the New Indy foul condensate stripper project. I have also placed a copy in a Fedex package. A full application will be submitted by March 23, 2023. Let me know if you have questions.

NOTICE: This message and any attachments are solely for the intended recipient and may contain confidential or privileged information. If you are not the intended recipient, you are hereby notified that any review, dissemination, distribution or duplication of this message and any attachments is prohibited. If you have received this communication in error, please notify us by reply email and immediately and permanently delete this message and any attachments. Email transmission may not be secure and could contain errors. We accept no liability for any damage caused by any virus transmitted by this email. Please do not send to us by email any information containing personally identifiable information without appropriate encryption. Thank you.

Responses in Blue

1. Please provide a narrative on the emission calculations that details the assumptions made, etc.
   A narrative was submitted with the permit application submitted March 23, 2023. Emissions calculations are discussed in Section 3.2.2.3.
2. In the projected actual emissions, what is the basis for the operating time percentage of the new stripper, the backup stripper, and the time both strippers are offline?
   The PSD calculations were very conservative and assumed "worst case scenarios" based on best engineering judgement. In practice, we expect the new low pressure stripper to be in operation greater than 90%. The worst case scenario of 90% new stripper operation is also consistent with §63.446(g).
3. Please provide complete reference citations for "Title V" and "Columbia" such as page number of the application, etc. Also, provide the complete AP-42 citations to include Chapter, Table, and any pertinent information to pinpoint the emission factor used. For information from stack tests used in the emission calculations, provide the date of the test and whether it is a Department approved test. If the stack test was performed at another facility, please provide the complete stack test report so the results can be reviewed for use as an emission factor. Where the H2SSIM/WATER9 programs were used, please provide the inputs and outputs for all.
   Stack tests performed at another facility were not used. H2SSIM and WATER9 inputs and outputs are located starting on page B-26 of Appendix B of the permit application submitted March 23, 2023. Please see attached tables for more detailed citations for other emissions factors.
4. Will the new stripper have its own steam generating system or will steam be supplied by the boilers? If steam will be provided by the boilers, please provide the steam balance for estimating the portion going to the new stripper and backup stripper.
   Steam will be provided by the boilers. Emissions from generating steam required for the new stripper and backup stripper are based on preliminary design information from the vendors. The final steam balance for the project has not been developed.
5. How will the methanol be added to the Recovery Furnaces? Will a storage tank be needed for the methanol generated? Were emissions accounted for it in the PSD analysis? Is the condensed methanol further purified?
   The methanol will be added to the recovery furnace black liquor feed per BLRBAC standards. Emissions from SRL methanol combustion in the recovery furnace are addressed in Section 3.2.2.3. A process tank for the methanol is proposed in the application on page 1-1 and throughout the application. The methanol tank will vent to the NCG system, which was accounted for in the analysis in Section 3.2.2.3 as the total NCG collection system. The condensed methanol will not be further purified.
6. Was the 10% annual capacity factor for fossil fuels taken into account in the projected actual emissions for the Recovery Furnaces?
   The annual capacity factor was evaluated, and there is no impact to the 10% annual capacity factor. The LVHC ignitor (1 MMBtu/hr) is approximately 0.1% of the total heat input capacity of the recovery furnace. Emissions from the LVHC ignitor are included in the emissions calculation tables in Appendix B.
7. What happens to the scrubbing liquid from the LVHS caustic scrubber? Is this this the existing scrubber or will a new one be installed?
   When the LVHC NCG's are being burned in the recovery boiler the existing LVHC scrubber will not be utilized, as explained on page 3-18 of the submitted permit application. The gases will be taken to the recovery boiler before the LVHC scrubber. When the backup combustion source is

used (combination boiler no. 1 or 2), the gases will go through the existing LVHC scrubber. The scrubbing liquid will be returned to the liquor cycle, consistent with current operation.

8. During the baseline period, where you operating in compliance? If not, how were any limits accounted for in the baseline calculations?
   Yes. Note our baseline emissions for SO_2 are based on the October 2021 performance test.
9. Provide the vendor guarantee/certification for the emission factors supplied by the vendor.
   The treatment efficiencies presented in Section 3.2.2.3 and Appendix B are based on preliminary design information. Documentation can be supplied once the vendor is selected.
10. For Footnote E, why was data from the entire baseline period not used in the PSD analysis.
    Steam data for the existing steam stripper (Backup Stripper) was based on January 1 – December 16, 2022, which was readily available at the time the permit application was developed.

SO2 EMISSIONS REFERENCES

Stripper Operating Scenario	Operating Configuration	Controls		SO2 Emissions Factor		Sulfur Capture[C]	SO2 Emissions	
			UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)								
Backup Stripper SOG[A]	NA	SOG to CB1/CB2	ADTP/day	1.06	October 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	63.1	252.5
LVHC Collection System	NA	LVHC to CB1/CB2	ADTP/day	1.97	October 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	117.0	512.4
Backup Stripper Steam[A]	Natural Gas[B,E]	NA	mmBtu/hr	6.00E-04	AP-42 Table 1.4-2.	NA	0.02	0.1
Backup Stripper Steam[A]	No. 6 Oil[B,E]	NA	mmBtu/hr	2.20E+00	AP-42 Table 1.3-1. 2.1% Sulfur Content.	NA	61.9	5.2
SO2 BASELINE ACTUAL EMISSIONS (BAE)								**770.2**
PROJECTED ACTUAL EMISSIONS								
New Stripper Online	SRL Online	SRL Methanol to RF2/3[G]	ADTP/day	0.56	Vendor / Preliminary Design Information	99%	0.6	2.4
New Stripper Online	SRL Online	SRL LVHC to RF3[G]	ADTP/day	0.84	Vendor / Preliminary Design Information	99%	0.9	2.7
New Stripper Online	SRL Online	SRL LVHC to CB1/CB2[G]	ADTP/day	0.84	Vendor / Preliminary Design Information	50%	47.2	44.2
New Stripper Online	SRL Offline	SOG to CB1/CB2	ADTP/day	1.40	Vendor / Preliminary Design Information	0%	157.4	31.0
Backup Stripper Online	NA	SOG to CB1/CB2	ADTP/day	1.40	Vendor / Preliminary Design Information	0%	157.4	55.1
No Stripper Online	Foul Condensate to Hard Pipe	Hydrogen Peroxide Addition	NA	NA	NA	NA	NA	NA
LVHC Collection System	NA	LVHC to RF3	ADTP/day	5.25	October 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. Pre-control emissions based on LVHC scrubber efficiency (50%) and estimated bark ash sulfur capture (20%) from 2012 stack test.	99%	5.9	19.4
LVHC Collection System	NA	LVHC to CB1/CB2	ADTP/day	5.25	October 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. Pre-control emissions based on LVHC scrubber efficiency (50%) and estimated bark ash sulfur capture (20%) from 2012 stack test.	50%	295.2	323.3
Recovery Furnace #3 LVHC Ignitor	Natural Gas[I]	NA	mmBtu/hr	6.00E-04	AP-42 Table 1.4-2.	NA	0.00	0.0
New Stripper Steam - Natural Gas	Natural Gas[D,F]	NA	mmBtu/hr	6.00E-04	AP-42 Table 1.4-2.	NA	0.06	0.2
New Stripper Steam - No. 6 Oil	No. 6 Oil[D,F]	NA	mmBtu/hr	2.20E+00	AP-42 Table 1.3-1. 2.1% Sulfur Content.	NA	202.9	147.2
Backup Stripper Steam - Natural Gas	Natural Gas[D,F]	NA	mmBtu/hr	6.00E-04	AP-42 Table 1.4-2.	NA	0.02	0.004
Backup Stripper Steam - No. 6 Oil	No. 6 Oil[D,F]	NA	mmBtu/hr	2.20E+00	AP-42 Table 1.3-1. 2.1% Sulfur Content.	NA	53.1	3.4
SO2 PROJECTED ACTUAL EMISSIONS (PAE)								**628.84**
NET EMISSIONS CHANGE (PAE - BAE)								
NET EMISSIONS CHANGE (PAE - BAE)								**-141.35**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boiliers No. 1 and No. 2 during baseline.

C - Sulfur capture in recovery furnace >99, sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Actual steam usage January 1 - December 16, 2022.

F - Projected steam usage at 850 gpm from vendor.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

H2SO4 EMISSIONS REFERENCES

Stripper Operating Scenario	Operating Configuration	Controls	H2SO4 Emissions Factor lb/ADTP	H2SO4 Emissions Factor Reference	Sulfur Capture %	H2SO4 Emissions lb/hr	H2SO4 Emissions tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)							
LVHC Collection System	NA	LVHC to CB1/CB2	4.93E-03	NCASI Technical Bulletin 858, Table 10	NA	0.3	1.3
H2SO4 BASELINE ACTUAL EMISSIONS (BAE)							**1.3**
PROJECTED ACTUAL EMISSIONS							
LVHC Collection System	NA	LVHC to RF3	4.93E-03	NCASI Technical Bulletin 858, Table 10	NA	0.55	1.82
LVHC Collection System	NA	LVHC to CB1/CB2	4.93E-03	NCASI Technical Bulletin 858, Table 10	NA	0.55	0.61
H2SO4 PROJECTED ACTUAL EMISSIONS (PAE)							**2.43**
NET EMISSIONS CHANGE (PAE - BAE)							
NET EMISSIONS CHANGE (PAE - BAE)							**1.15**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boiliers No. 1 and No. 2 during baseline.

C - Sulfur capture in recovery furnace >99, sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Actual steam usage January 1 - December 16, 2022.

F - Projected steam usage at 850 gpm from vendor.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

NOX EMISSIONS REFERENCES

Stripper Operating Scenario	Operating Configuration	Controls	UOM	NOX Emissions Factor lb/UOM	NOX Emissions Factor Reference	Ammonia Increase[C] %	NOX Emissions lb/hr	NOX Emissions tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)								
Backup Stripper SOG[A]	NA	SOG to CB1/CB2	ADTP/day	0.415	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	24.7	98.7
Backup Stripper Steam[A]	Natural Gas[B,E]	NA	mmBtu/hr	2.80E-01	AP-42 Table 1.4-2.	NA	8.3	32.4
Backup Stripper Steam[A]	No. 6 Oil[B,E]	NA	mmBtu/hr	3.13E-01	AP-42 Table 1.3-1.	NA	8.8	0.7
NOX BASELINE ACTUAL EMISSIONS								**131.8**
PROJECTED ACTUAL EMISSIONS								
New Stripper Online	SRL Online	SRL Methanol to RF2/3[G]	TBLS/day	1.500	NCASI Technical Bulletin 884, Table 4.12.	1.0%	1.8	6.7
New Stripper Online	SRL Online	SRL LVHC to RF3[G]	TBLS/day	1.500	NCASI Technical Bulletin 884, Table 4.12.	1.0%	0.2	0.6
New Stripper Online	SRL Online	SRL LVHC to CB1/CB2[G]	ADTP/day	0.415	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	4.7	4.4
New Stripper Online	SRL Offline	SOG to CB1/CB2	ADTP/day	0.415	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	46.7	9.2
Backup Stripper Online	NA	SOG to CB1/CB2	ADTP/day	0.415	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	46.7	16.4
No Stripper Online	Foul Condensate to Hard Pipe	Hydrogen Peroxide Addition	NA	NA	NA	NA	NA	NA
Recovery Furnace #3 LVHC Ignitor	Natural Gas[I]	NA	mmBtu/hr	2.80E-01	AP-42 Table 1.4-2.	NA	0.3	0.1
New Stripper Steam - Natural Gas	Natural Gas[D,F]	NA	mmBtu/hr	2.80E-01	AP-42 Table 1.4-2.	NA	27.1	87.2
New Stripper Steam - No. 6 Oil	No. 6 Oil[D,F]	NA	mmBtu/hr	3.13E-01	AP-42 Table 1.3-1.	NA	28.9	20.9
Backup Stripper Steam - Natural Gas	Natural Gas[D,F]	NA	mmBtu/hr	2.80E-01	AP-42 Table 1.4-2.	NA	7.1	2.0
Backup Stripper Steam - No. 6 Oil	No. 6 Oil[D,F]	NA	mmBtu/hr	3.13E-01	AP-42 Table 1.3-1.	NA	7.5	0.5
NOX PROJECTED ACTUAL EMISSIONS								**147.9**
NET EMISSIONS CHANGE (PAE - BAE)								
PAE - BAE								**16.1**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Ammonia input to recovery furnace increases >1% (methanol input limited to 1% of black liquor input by BLRBAC).

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Actual steam usage January 1 - December 16, 2022.

F - Projected steam usage at 850 gpm from vendor design.

G - >90% of methanol condensed and burned in recovery furnace, < 10% of methanol vented into LVHC System.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

CO EMISSIONS REFERENCES

				CO Emissions Factor		CO Control	CO Emissions	
Stripper Operating Scenario	**Operating Configuration**	**Controls**	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)								
Backup Stripper SOG[A]	NA	SOG to CB1/CB2	ADTP/day	0.0728	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	4.3	17.3
Backup Stripper Steam[A]	Natural Gas[B]	NA	mmBtu/hr	8.40E-02	AP-42 Table 1.4-2.	NA	2.5	9.7
Backup Stripper Steam[A]	No. 6 Oil[B]	NA	mmBtu/hr	3.33E-02	AP-42 Table 1.3-1.	NA	0.9	0.1
CO BASELINE ACTUAL EMISSIONS								**27.1**
PROJECTED ACTUAL EMISSIONS								
New Stripper Online	SRL Online	SRL Methanol to RF2/3	NA	NA	NA	NA	NA	NA
New Stripper Online	SRL Online	SRL LVHC to RF3	ADTP/day	0.0728	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	8.2	23.0
New Stripper Online	SRL Online	SRL LVHC to CB1/CB2	ADTP/day	0.0728	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	8.2	7.7
New Stripper Online	SRL Offline	SOG to CB1/CB2	ADTP/day	0.0728	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	8.2	1.6
Backup Stripper Online	NA	SOG to CB1/CB2	ADTP/day	0.0728	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	8.2	2.9
No Stripper Online	Foul Condensate to Hard Pipe	Hydrogen Peroxide Addition	NA	NA	NA	NA	NA	NA
Recovery Furnace #3 LVHC Ignitor	Natural Gas[I]	NA	mmBtu/hr	8.40E-02	AP-42 Table 1.4-2.	NA	0.1	0.0
New Stripper Steam - Natural Gas	Natural Gas[D]	NA	mmBtu/hr	8.40E-02	AP-42 Table 1.4-2.	NA	8.1	26.2
New Stripper Steam - No. 6 Oil	No. 6 Oil[D]	NA	mmBtu/hr	3.33E-02	AP-42 Table 1.3-1.	NA	3.1	2.2
Backup Stripper Steam - Natural Gas	Natural Gas[D]	NA	mmBtu/hr	8.40E-02	AP-42 Table 1.4-2.	NA	2.1	0.6
Backup Stripper Steam - No. 6 Oil	No. 6 Oil[D]	NA	mmBtu/hr	3.33E-02	AP-42 Table 1.3-1.	NA	0.8	0.1
CO PROJECTED ACTUAL EMISSIONS								**64.2**
NET EMISSIONS CHANGE (PAE - BAE)								
PAE - BAE								**37.1**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - reserved.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Actual steam usage January 1 - December 16, 2022.

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

VOC EMISSIONS REFERENCES

Stripper Operating Scenario	Operating Configuration	Controls	VOC Emissions Factor			Removal[C]	VOC Emissions	
			UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)								
Backup Stripper SOG[A]	NA	LVHC to CB1/CB2	ADTP/day	4.37	Average daily methanol stripped based on daily Subpart S compliance.	98.0%	5.19	20.78
Aerated Stabilization Basin (ASB)	Foul Condensate to Hard Pipe	NA	ADTP/day	8.73E-01	WATER9 Inputs and Outputs Provided.	NA	51.88	227.21
LVHC Collection System	NA	LVHC to CB1/CB2	ADTP/day	3.10E-03	July 2019 Project Columbia Application. Page C-3 for Total LVHC Emissions.	NA	0.18	0.81
Backup Stripper Steam[A]	Natural Gas[B]	NA	mmBtu/hr	5.39E-03	AP-42 Table 1.4-2.	NA	0.2	0.6
Backup Stripper Steam[A]	No. 6 Oil[B]	NA	mmBtu/hr	1.87E-03	AP-42 Table 1.3-3. NMTOC for no. 6 oil.	NA	0.1	0.0
VOC BASELINE ACTUAL EMISSIONS								**249.43**
PROJECTED ACTUAL EMISSIONS								
New Stripper Online	SRL Online	SRL Methanol to RF2/3[G]	ADTP/day	14.40	Vendor / Preliminary Design Information	99.9%	1.62	6.07
New Stripper Online	SRL Online	SRL LVHC to RF3[G]	ADTP/day	1.60	Vendor / Preliminary Design Information	98%	3.60	10.11
New Stripper Online	SRL Online	SRL LVHC to CB1/CB2[G]	ADTP/day	1.60	Vendor / Preliminary Design Information	98%	3.60	3.37
New Stripper Online	SRL Offline	SOG to CB1/CB2	ADTP/day	16.00	Vendor / Preliminary Design Information	98%	36.00	7.10
Backup Stripper Online	NA	SOG to CB1/CB2	ADTP/day	16.00	Vendor / Preliminary Design Information	98%	36.00	12.61
ASB - New Stripper Online	No Foul Condensate to Hard Pipe	NA	ADTP/day	0.29	WATER9 Inputs and Outputs Provided.	NA	32.40	127.72
ASB - Backup Stripper Online	TRS Stripped From Foul Condensate	NA	ADTP/day	1.42	WATER9 Inputs and Outputs Provided.	NA	159.98	56.06
ASB - No Stripper Online	Foul Condensate to Hard Pipe	NA	ADTP/day	2.20	WATER9 Inputs and Outputs Provided.	NA	247.05	21.64
LVHC Collection System	NA	LVHC to RF3	ADTP/day	3.10E-03	July 2019 Project Columbia Application. Page C-3 for Total LVHC Emissions.	NA	0.35	1.15
LVHC Collection System	NA	LVHC to CB1/CB2	ADTP/day	3.10E-03	July 2019 Project Columbia Application. Page C-3 for Total LVHC Emissions.	NA	0.35	0.38
Recovery Furnace #3 LVHC Ignitor	Natural Gas[I]	NA	mmBtu/hr	5.39E-03	AP-42 Table 1.4-2.	NA	0.0	0.0
New Stripper Steam - Natural Gas	Natural Gas[D]	NA	mmBtu/hr	5.39E-03	AP-42 Table 1.4-2.	NA	0.5	1.7
New Stripper Steam - No. 6 Oil	No. 6 Oil[D]	NA	mmBtu/hr	1.87E-03	AP-42 Table 1.3-3. NMTOC for no. 6 oil.	NA	0.2	0.1
Backup Stripper Steam - Natural Gas	Natural Gas[D]	NA	mmBtu/hr	5.39E-03	AP-42 Table 1.4-2.	NA	0.1	0.0
Backup Stripper Steam - No. 6 Oil	No. 6 Oil[D]	NA	mmBtu/hr	1.87E-03	AP-42 Table 1.3-3. NMTOC for no. 6 oil.	NA	0.0	0.0
VOC PROJECTED ACTUAL EMISSIONS								**248.05**
NET EMISSIONS CHANGE (PAE - BAE)								
PAE - BAE								**-1.38**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - VOC destruction >98% in vapor phase, 99.9% in liquid phase.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Actual steam usage January 1 - December 16, 2022.

F - Projected steam usage at 850 gpm from vendor design.

G - >90% of methanol condensed and burned in recovery furnace, < 10% of methanol vented into LVHC System.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

TRS EMISSIONS REFERENCES

Stripper Operating Scenario	Operating Configuration	Controls	UOM	TRS Emissions Factor lb/UOM	TRS Emissions Factor Reference	Sulfur Capture[C] %	TRS Emissions lb/hr	TRS Emissions tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)								
Backup Stripper SOG[A]	NA	LVHC to CB1/CB2	ADTP/day	2.88E-03	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	0.17	0.68
Aerated Stabilization Basin (ASB)	NA	NA	ADTP/day	4.08E-02	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	2.42	10.61
LVHC Collection System	NA	LVHC to CB1/CB2	ADTP/day	8.01E-03	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	0.48	2.09
TRS BASELINE ACTUAL EMISSIONS								**13.38**
PROJECTED ACTUAL EMISSIONS								
New Stripper Online	SRL Online	SRL Methanol to RF2/3[G,H]	ADTP/day	0.33	Vendor / Preliminary Design Information	99.9%	0.04	0.14
New Stripper Online	SRL Online	SRL LVHC to RF3[G,H]	ADTP/day	0.49	Vendor / Preliminary Design Information	99.9%	0.05	0.15
New Stripper Online	SRL Online	SRL LVHC to CB1/CB2[G]	ADTP/day	0.49	Vendor / Preliminary Design Information	99%	0.55	0.51
New Stripper Online	SRL Offline	SOG to CB1/CB2	ADTP/day	0.81	Vendor / Preliminary Design Information	99%	0.91	0.18
Backup Stripper Online	NA	SOG to CB1/CB2	ADTP/day	0.81	Vendor / Preliminary Design Information	99%	0.91	0.32
ASB - New Stripper Online	No Foul Condensate to Hard Pipe	NA	ADTP/day	2.42E-02	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	2.72	10.74
ASB - Backup Stripper Online	TRS Stripped From Foul Condensate	NA	ADTP/day	2.72E-02	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	3.06	1.07
ASB - No Stripper Online	Foul Condensate to Hard Pipe	Hydrogen Peroxide Addition	ADTP/day	7.28E-02	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	8.19	0.72
LVHC Collection System	NA	LVHC to RF3	ADTP/day	1.75E+00	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. Pre-control emissions based on LVHC scrubber efficiency (50%) and estimated 99% combustion efficiency in combination boilers.	99.9%	0.20	0.65
LVHC Collection System	NA	LVHC to CB1/CB2	ADTP/day	8.76E-03	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. DHEC Approved Test.	NA	0.99	1.08
TRS PROJECTED ACTUAL EMISSIONS								**15.56**
NET EMISSIONS CHANGE (PAE - BAE)								
PAE - BAE								**2.18**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Sulfur capture in recovery furnace >99.9% (see note H), sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Actual steam usage January 1 - December 16, 2022.

F - Projected steam usage at 850 gpm from vendor design.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - Recovery Furnace captures 99% of sulfur and converts 99% of remaining uncaptured sulfur.

H2S EMISSIONS REFERENCES

Stripper Operating Scenario	Operating Configuration	Controls	UOM	H2S Emissions Factor lb/UOM	Reference	Sulfur Capture[C] %	H2S Emissions lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)								
Backup Stripper SOG[A]	NA	LVHC to CB1/CB2	ADTP/day	4.13E-04	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	0.02	0.10
Aerated Stabilization Basin (ASB)	Foul Condensate to Hard Pipe	Hydrogen Peroxide Addition	ADTP/day	1.36E-02	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	0.81	3.54
LVHC Collection System	NA	LVHC to CB1/CB2	ADTP/day	5.03E-04	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	0.03	0.13
H2S BASELINE ACTUAL EMISSIONS								**3.77**
PROJECTED ACTUAL EMISSIONS								
New Stripper Online	SRL Online	SRL Methanol to RF2/3[G,H]	ADTP/day	0.24	Vendor / Preliminary Design Information	99.9%	0.03	0.10
New Stripper Online	SRL Online	SRL LVHC to RF3[G,H]	ADTP/day	0.37	Vendor / Preliminary Design Information	99.9%	0.04	0.12
New Stripper Online	SRL Online	SRL LVHC to CB1/CB2[G]	ADTP/day	0.37	Vendor / Preliminary Design Information	99%	0.41	0.39
New Stripper Online	SRL Offline	SOG to CB1/CB2	ADTP/day	0.61	Vendor / Preliminary Design Information	99%	0.69	0.14
Backup Stripper Online	NA	SOG to CB1/CB2	ADTP/day	0.61	Vendor / Preliminary Design Information	99%	0.69	0.24
ASB - New Stripper Online	No Foul Condensate to Hard Pipe	NA	ADTP/day	9.27E-03	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	1.04	4.11
ASB - Backup Stripper Online	H2S Stripped From Foul Condensate	NA	ADTP/day	9.81E-03	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	1.10	0.39
ASB - No Stripper Online	Foul Condensate to Hard Pipe	Hydrogen Peroxide Addition	ADTP/day	9.54E-03	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	1.07	0.09
LVHC Collection System	NA	LVHC to RF3	ADTP/day	1.17E-01	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. Pre-control emissions based on LVHC scrubber efficiency (50%) and estimated 99% combustion efficiency in combination boilers.	99.9%	0.01	0.04
LVHC Collection System	NA	LVHC to CB1/CB2	ADTP/day	5.87E-04	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. DHEC Approved Test.	NA	0.07	0.07
H2S PROJECTED ACTUAL EMISSIONS								**5.69**
NET EMISSIONS CHANGE (PAE - BAE)								
PAE - BAE								**1.92**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Sulfur capture in recovery furnace >99.9% (see note H), sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Actual steam usage January 1 - December 16, 2022.

F - Projected steam usage at 850 gpm from vendor design.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - Recovery Furnace captures 99% of sulfur and converts 99% of remaining uncaptured sulfur.

PM EMISSIONS REFERENCES

Stripper Operating Scenario	Operating Configuration	UOM	PM Emissions Factor lb/UOM	PM Emissions Factor Reference	PM Control %	PM Emissions lb/hr	PM Emissions tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)							
Backup Stripper Steam[A]	Natural Gas[B]	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.9
Backup Stripper Steam[A]	No. 6 Oil[B]	mmBtu/hr	1.61E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	4.5	0.4
PM BASELINE ACTUAL EMISSIONS							**1.3**
PROJECTED ACTUAL EMISSIONS							
Recovery Furnace #3 LVHC Ignitor	Natural Gas[I]	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	7.60E-03	3.74E-03
New Stripper Steam - Natural Gas	Natural Gas[D]	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.7	2.4
New Stripper Steam - No. 6 Oil	No. 6 Oil[D]	mmBtu/hr	1.61E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	14.8	10.8
Backup Stripper Steam - Natural Gas	Natural Gas[D]	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.1
Backup Stripper Steam - No. 6 Oil	No. 6 Oil[D]	mmBtu/hr	1.61E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	3.9	0.3
PM PROJECTED ACTUAL EMISSIONS							**13.4**
NET EMISSIONS CHANGE (PAE - BAE)							
PAE - BAE							**12.2**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - reserved.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Actual steam usage January 1 - December 16, 2022.

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

PM10 EMISSIONS REFERENCES

Stripper Operating Scenario	Operating Configuration	UOM	PM10 Emissions Factor lb/UOM	PM10 Emissions Factor Reference	PM10 Control %	PM10 Emissions lb/hr	PM10 Emissions tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)							
Backup Stripper Steam[A]	Natural Gas[B]	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.9
Backup Stripper Steam[A]	No. 6 Oil[B]	mmBtu/hr	1.17E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	3.3	0.3
PM10 BASELINE ACTUAL EMISSIONS							**1.2**
PROJECTED ACTUAL EMISSIONS							
Recovery Furnace #3 LVHC Ignitor	Natural Gas[I]	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	7.60E-03	3.74E-03
New Stripper Steam - Natural Gas	Natural Gas[D]	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.7	2.4
New Stripper Steam - No. 6 Oil	No. 6 Oil[D]	mmBtu/hr	1.17E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	10.8	7.8
Backup Stripper Steam - Natural Gas	Natural Gas[D]	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.1
Backup Stripper Steam - No. 6 Oil	No. 6 Oil[D]	mmBtu/hr	1.17E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	2.8	0.2
PM10 PROJECTED ACTUAL EMISSIONS							**10.4**
NET EMISSIONS CHANGE (PAE - BAE)							
PAE - BAE							**9.3**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - reserved.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Actual steam usage January 1 - December 16, 2022.

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

PM2.5 EMISSIONS REFERENCES

Stripper Operating Scenario	Operating Configuration	UOM	PM2.5 Emissions Factor lb/UOM	PM2.5 Emissions Factor Reference	PM2.5 Control %	PM2.5 Emissions lb/hr	PM2.5 Emissions tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)							
Backup Stripper Steam[A]	Natural Gas[B]	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.9
Backup Stripper Steam[A]	No. 6 Oil[B]	mmBtu/hr	8.80E-02	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	2.5	0.2
PM2.5 BASELINE ACTUAL EMISSIONS							**1.1**
PROJECTED ACTUAL EMISSIONS							
Recovery Furnace #3 LVHC Ignitor	Natural Gas[I]	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	7.60E-03	3.74E-03
New Stripper Steam - Natural Gas	Natural Gas[D]	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.7	2.4
New Stripper Steam - No. 6 Oil	No. 6 Oil[D]	mmBtu/hr	8.80E-02	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	8.1	5.9
Backup Stripper Steam - Natural Gas	Natural Gas[D]	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.1
Backup Stripper Steam - No. 6 Oil	No. 6 Oil[D]	mmBtu/hr	8.80E-02	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	2.1	0.1
PM2.5 PROJECTED ACTUAL EMISSIONS							**8.4**
NET EMISSIONS CHANGE (PAE - BAE)							
PAE - BAE							**7.4**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - reserved.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Actual steam usage January 1 - December 16, 2022.

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

LEAD EMISSIONS REFERENCES

Stripper Operating Scenario	Operating Configuration	UOM	Lead Emissions Factor lb/UOM	Lead Emissions Factor Reference	Lead Control %	Lead Emissions lb/hr	Lead Emissions tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)							
Backup Stripper Steam[A]	Natural Gas[B]	mmBtu/hr	5.00E-07	AP-42 Table 1.4-2.	NA	1.48E-05	5.78E-05
Backup Stripper Steam[A]	No. 6 Oil[B]	mmBtu/hr	2.80E-05	U.S. EPA document "Estimating Air Toxic Emissions from Coal and Oil Combustion Sources" [EPA-450/2-89-001] for Uncontrolled Residual Oil-fired Utility Boilers (Table 4-1)	NA	7.87E-04	6.63E-05
LEAD BASELINE ACTUAL EMISSIONS							**1.24E-04**
PROJECTED ACTUAL EMISSIONS							
Recovery Furnace #3 LVHC Ignitor	Natural Gas[I]	mmBtu/hr	5.00E-07	AP-42 Table 1.4-2.	NA	5.00E-07	2.46E-07
New Stripper Steam - Natural Gas	Natural Gas[D]	mmBtu/hr	5.00E-07	AP-42 Table 1.4-2.	NA	4.84E-05	1.56E-04
New Stripper Steam - No. 6 Oil	No. 6 Oil[D]	mmBtu/hr	2.80E-05	U.S. EPA document "Estimating Air Toxic Emissions from Coal and Oil Combustion Sources" [EPA-450/2-89-001] for Uncontrolled Residual Oil-fired Utility Boilers (Table 4-1)	NA	2.58E-03	1.87E-03
Backup Stripper Steam - Natural Gas	Natural Gas[D]	mmBtu/hr	5.00E-07	AP-42 Table 1.4-2.	NA	1.27E-05	3.62E-06
Backup Stripper Steam - No. 6 Oil	No. 6 Oil[D]	mmBtu/hr	2.80E-05	U.S. EPA document "Estimating Air Toxic Emissions from Coal and Oil Combustion Sources" [EPA-450/2-89-001] for Uncontrolled Residual Oil-fired Utility Boilers (Table 4-1)	NA	6.75E-04	4.35E-05
LEAD PROJECTED ACTUAL EMISSIONS							**2.08E-03**
NET EMISSIONS CHANGE (PAE - BAE)							
PAE - BAE							**1.95E-03**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - reserved.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Actual steam usage January 1 - December 16, 2022.

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

CO2 EMISSIONS REFERENCES

Stripper Operating Scenario	Operating Configuration	UOM	CO2 Emissions Factor lb/UOM	CO2 Emissions Factor Reference	CO2 Control %	CO2 Emissions lb/hr	CO2 Emissions tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)							
Backup Stripper Steam[A]	Natural Gas[B]	mmBtu/hr	1.17E+02	40 CFR Part 98, Table C-1	NA	3,448.9	13,512
Backup Stripper Steam[A]	No. 6 Oil[B]	mmBtu/hr	1.66E+02	40 CFR Part 98, Table C-1	NA	4,655.3	392
CO2 BASELINE ACTUAL EMISSIONS							**13,904**
PROJECTED ACTUAL EMISSIONS							
Recovery Furnace #3 LVHC Ignitor	Natural Gas[I]	mmBtu/hr	1.17E+02	40 CFR Part 98, Table C-1	NA	116.9	58
New Stripper Steam - Natural Gas	Natural Gas[D]	mmBtu/hr	1.17E+02	40 CFR Part 98, Table C-1	NA	11,313.5	36,392
New Stripper Steam - No. 6 Oil	No. 6 Oil[D]	mmBtu/hr	1.66E+02	40 CFR Part 98, Table C-1	NA	15,270.9	11,076
Backup Stripper Steam - Natural Gas	Natural Gas[D]	mmBtu/hr	1.17E+02	40 CFR Part 98, Table C-1	NA	2,958.3	846
Backup Stripper Steam - No. 6 Oil	No. 6 Oil[D]	mmBtu/hr	1.66E+02	40 CFR Part 98, Table C-1	NA	3,993.0	257
CO2 PROJECTED ACTUAL EMISSIONS							**48,629**
NET EMISSIONS CHANGE (PAE - BAE)							
PAE - BAE							**34,725**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - reserved.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Actual steam usage January 1 - December 16, 2022.

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

Buckner, Katharine

From:	Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Sent:	Wednesday, April 5, 2023 3:43 PM
To:	Buckner, Katharine
Cc:	Hardee, Christopher
Subject:	RE: confidential page in stripper app

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***

Katharine
Good afternoon. There is nothing in the application that is confidential. As you surmised, the "confidential" marking was just part of a file name. The box marked "no" to indicate confidentiality is correct. Have a good Easter.

From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Tuesday, April 4, 2023 11:53 AM
To: Tourville, Bob <Bob.Tourville@new-indycb.com>
Cc: Hardee, Christopher <hardeecd@dhec.sc.gov>
Subject: RE: confidential page in stripper app

External Email

Hey Bob,
I checked the app for other possible confidential information. The word "confidential" appears throughout the WATER9 results, beginning on page B-28. It appears to be just a filename. Please comment if the Water9 information should be treated as confidential along with page B-17. If so, please send a public version of the application as soon as possible with a cover letter indicating the original app should be treated as confidential.

Also, the box on the application form to indicate if confidential information is enclosed in the app was marked "no", page 2 of 9.

Thanks,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

Office: (803) 898-3213
bucknekk@dhec.sc.gov

S.C. Dept. of Health & Environmental Control
2600 Bull Street
Columbia, SC 29201

Connect: www.scdhec.gov Facebook Twitter

From: Buckner, Katharine
Sent: Tuesday, April 4, 2023 11:43 AM
To: Robert Tourville <BOB.TOURVILLE@NEW-INDYCB.COM>
Cc: Hardee, Christopher <hardeecd@dhec.sc.gov>
Subject: confidential page in stripper app

Hey Bob,

There is a page marked confidential in the stripper application. It is B-17. Is this supposed to be confidential? Confidential information is supposed to be submitted under separate cover and clearly marked and separated from public versions of applications.

Please let me know.

Thanks,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

Office: (803) 898-3213
bucknekk@dhec.sc.gov

S.C. Dept. of Health & Environmental Control
2600 Bull Street
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Buckner, Katharine

From: Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Sent: Tuesday, April 4, 2023 3:41 PM
To: Buckner, Katharine
Subject: RE: Xcel sheet for new stripper app
Attachments: FINAL Emissions Calculations (3-22-23).xlsx

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***

Katharine
Here you go. Working answers to your other questions.

From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Tuesday, April 4, 2023 2:00 PM
To: Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Subject: Xcel sheet for new stripper app

External Email

Hey Bob,
Can you please send the Xcel spreadsheets for the new stripper app so that I can verify the calculations and emission rates?

Thank you,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

Office: (803) 898-3213
bucknekk@dhec.sc.gov

S.C. Dept. of Health & Environmental Control
2600 Bull Street
Columbia, SC 29201

Connect: www.scdhec.gov Facebook Twitter

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NEW-INDY CATAWBA MILL STRIPPER PROJECT

Stripper Operating Scenario	Operating Time %	Operating Time hrs
New Stripper Online	90%	7,884.0
Backup Stripper Online	8%	700.8
No Stripper Online	2%	175.2

LVHC Control Operating Scenario	Operating Time %	Operating Time hrs
RF3 Available for LVHC	75%	6,570.0
LVHC to CB1/CB2	25%	2,190.0

Summary of PSD Applicability
(tons/year)

Pollutant[A]	PM	PM_{10}	$PM_{2.5}$	NO_X	SO_2	CO	H2SO4	TRS	VOC	Pb	H_2S	Total CO_2e
Baseline Actual Emissions	1.26	1.16	1.09	132	770	27.1	1.28	13.4	249	1.24E-04	3.77	13,904
Projected Actual Emissions	13.4	10.4	8.45	148	629	64.2	2.43	15.6	248	2.08E-03	5.69	48,629
Net Emissions Changes (PAE - BAE)	12.2	9.28	7.36	16.1	-141.35	37.1	1.15	2.18	-1.4	1.95E-03	1.92	34,725
PSD Significant Emissions Rates	**25**	**15**	**10**	**40**	**40**	**100**	**7**	**10**	**40**	**0.6**	**10**	**75,000**
PSD Significant?	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**

A - HF is not emitted from new, modified, or affected emissions units.

SO2 EMISSIONS CALCULATIONS

Stripper Operating Scenario	Stripper Scenario Operating Time %	Stripper Scenario Operating Time hrs	Operating Configuration	Operating Configuration Time %	Operating Configuration Time hrs	Controls	Controls Operating Time %	Controls Operating Time hrs	Production Rate Value	Production Rate UOM	SO2 Emissions Factor lb/UOM	SO2 Emissions Factor Reference	Sulfur Capture[C] %	SO2 Emissions lb/hr	SO2 Emissions tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100%	8,004.0	SOG to CB1/CB2	100.0%	8,004.0	1,426	ADTP/day	1.06	Stack Test	NA	63.1	252.5
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,426	ADTP/day	1.97	Stack Test	NA	117.0	512.4
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B,E]	97.9%	7,835.7	NA	100.0%	7,835.7	29.5	mmBtu/hr	6.00E-04	AP-42	NA	0.02	0.1
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B,E]	2.1%	168.3	NA	100.0%	168.3	28.1	mmBtu/hr	2.20E+00	AP-42	NA	61.9	5.2
SO2 BASELINE ACTUAL EMISSIONS (BAE)															**770.2**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90.0%	7,884.0	SRL Online	95%	7,489.8	SRL Methanol to RF2/3[G]	100.0%	7,489.8	2,700	ADTP/day	0.56	Vendor	99%	0.6	2.4
New Stripper Online	90.0%	7,884.0	SRL Online	95%	7,489.8	SRL LVHC to RF3[G]	75.0%	5,617.4	2,700	ADTP/day	0.84	Vendor	99%	0.9	2.7
New Stripper Online	90.0%	7,884.0	SRL Online	95%	7,489.8	SRL LVHC to CB1/CB2[G]	25.0%	1,872.5	2,700	ADTP/day	0.84	Vendor	50%	47.2	44.2
New Stripper Online	90.0%	7,884.0	SRL Offline	5%	394.2	SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	1.40	Vendor	0%	157.4	31.0
Backup Stripper Online	8.0%	700.8	NA	100%	700.8	SOG to CB1/CB2	100.0%	700.8	2,700	ADTP/day	1.40	Vendor	0%	157.4	55.1
No Stripper Online	2.0%	175.2	Foul Condensate to Hard Pipe	100%	175.2	Hydrogen Peroxide Addition	100.0%	175.2	NA	NA	NA	NA	NA	NA	NA
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	5.25	Stack Test	99%	5.9	19.4
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	5.25	Stack Test	50%	295.2	323.3
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5	NA	100.0%	985.5	1.0	mmBtu/hr	6.00E-04	AP-42	NA	0.00	0.0
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D,F]	81.6%	6,433.3	NA	100.0%	6,433.3	96.8	mmBtu/hr	6.00E-04	AP-42	NA	0.06	0.2
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D,F]	18.4%	1,450.7	NA	100.0%	1,450.7	92.2	mmBtu/hr	2.20E+00	AP-42	NA	202.9	147.2
Backup Stripper Steam - Natural Gas	8.0%	700.8	Natural Gas[D,F]	81.6%	571.9	NA	100.0%	571.9	25.3	mmBtu/hr	6.00E-04	AP-42	NA	0.02	0.004
Backup Stripper Steam - No. 6 Oil	8.0%	700.8	No. 6 Oil[D,F]	18.4%	128.9	NA	100.0%	128.9	24.1	mmBtu/hr	2.20E+00	AP-42	NA	53.1	3.4
SO2 PROJECTED ACTUAL EMISSIONS (PAE)															**628.84**
NET EMISSIONS CHANGE (PAE - BAE)															
NET EMISSIONS CHANGE (PAE - BAE)															**-141.35**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Sulfur capture in recovery furnace >99, sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Actual steam usage January 1 - December 16, 2022.

F - Projected steam usage at 850 gpm from vendor.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

				Foul UNCTRL lb/ADTP	Methanol[G] UNCTRL lb/ADTP	LVHC[G] UNCTRL lb/ADTP
TRS as S		MW	AHL	0.70	0.28	0.42
sulfur	S	32.065				
sulfur dioxide	SO_2	64.064		1.40	0.56	0.84

H2SO4 EMISSIONS CALCULATIONS

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		H2SO4 Emissions Factor		Sulfur Capture	H2SO4 Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/ADTP	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,426	ADTP/day	4.93E-03	NCASI Technical Bulletin 858, Table 10	NA	0.3	1.3
H2SO4 BASELINE ACTUAL EMISSIONS (BAE)															**1.3**
PROJECTED ACTUAL EMISSIONS															
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	4.93E-03	NCASI Technical Bulletin 858, Table 10	NA	0.55	1.82
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	4.93E-03	NCASI Technical Bulletin 858, Table 10	NA	0.55	0.61
H2SO4 PROJECTED ACTUAL EMISSIONS (PAE)															**2.43**
NET EMISSIONS CHANGE (PAE - BAE)															
NET EMISSIONS CHANGE (PAE - BAE)															**1.15**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boiliers No. 1 and No. 2 during baseline.

C - Sulfur capture in recovery furnace >99, sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Actual steam usage January 1 - December 16, 2022.

F - Projected steam usage at 850 gpm from vendor.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

NOX EMISSIONS CALCULATIONS

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		NOX Emissions Factor		Ammonia Increase[C]	NOX Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	SOG to CB1/CB2	100%	8,004.0	1,426	ADTP/day	0.415	Columbia	NA	24.7	98.7
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B,E]	97.9%	7,835.7	NA	100%	7,835.7	29.5	mmBtu/hr	2.80E-01	AP-42	NA	8.3	32.4
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B,E]	2.1%	168.3	NA	100%	168.3	28.1	mmBtu/hr	3.13E-01	AP-42	NA	8.8	0.7
NOX BASELINE ACTUAL EMISSIONS															**131.8**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3[G]	100%	7,489.8	2,852	TBLS/day	1.500	Title V	1.0%	1.8	6.7
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3[G]	75%	5,617.4	316.9	TBLS/day	1.500	Title V	1.0%	0.2	0.6
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2[G]	25%	1,872.5	270.0	ADTP/day	0.415	Columbia	NA	4.7	4.4
New Stripper Online	90%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100%	394.2	2,700	ADTP/day	0.415	Columbia	NA	46.7	9.2
Backup Stripper Online	8%	700.8	NA	100.0%	700.8	SOG to CB1/CB2	100%	700.8	2,700	ADTP/day	0.415	Columbia	NA	46.7	16.4
No Stripper Online	2%	175.2	Foul Condensate to Hard Pipe	100.0%	175.2	Hydrogen Peroxide Addition	100%	175.2	NA	NA	NA	NA	NA	NA	NA
Recovery Furnace #3 LVHC Ignitor	75%	6,570.0	Natural Gas[I]	15.0%	985.5	NA	100%	985.5	1.0	mmBtu/hr	2.80E-01	AP-42	NA	0.3	0.1
New Stripper Steam - Natural Gas	90%	7,884.0	Natural Gas[D,F]	81.6%	6,433.3	NA	100%	6,433.3	96.8	mmBtu/hr	2.80E-01	AP-42	NA	27.1	87.2
New Stripper Steam - No. 6 Oil	90%	7,884.0	No. 6 Oil[D,F]	18.4%	1,450.7	NA	100%	1,450.7	92.2	mmBtu/hr	3.13E-01	AP-42	NA	28.9	20.9
Backup Stripper Steam - Natural Gas	8%	700.8	Natural Gas[D,F]	81.6%	571.9	NA	100%	571.9	25.3	mmBtu/hr	2.80E-01	AP-42	NA	7.1	2.0
Backup Stripper Steam - No. 6 Oil	8%	700.8	No. 6 Oil[D,F]	18.4%	128.9	NA	100%	128.9	24.1	mmBtu/hr	3.13E-01	AP-42	NA	7.5	0.5
NOX PROJECTED ACTUAL EMISSIONS															**147.9**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**16.1**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Ammonia input to recovery furnace increases >1% (methanol input limited to 1% of black liquor input by BLRBAC).

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Actual steam usage January 1 - December 16, 2022.

F - Projected steam usage at 850 gpm from vendor design.

G - >90% of methanol condensed and burned in recovery furnace, < 10% of methanol vented into LVHC System.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

CO EMISSIONS CALCULATIONS

	Stripper Scenario Operating Time			Operating Configuration Time			Controls Operating Time		Production Rate		CO Emissions Factor		CO Control	CO Emissions	
Stripper Operating Scenario	%	hrs	**Operating Configuration**	%	hrs	**Controls**	%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	SOG to CB1/CB2	100.0%	8,004.0	1,426	ADTP/day	0.0728	Columbia	NA	4.3	17.3
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7	NA	100.0%	7,835.7	29.5	mmBtu/hr	8.40E-02	AP-42	NA	2.5	9.7
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3	NA	100.0%	168.3	28.1	mmBtu/hr	3.33E-02	AP-42	NA	0.9	0.1
CO BASELINE ACTUAL EMISSIONS															**27.1**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3	100.0%	7,489.8	NA	NA	NA	NA	NA	NA	NA
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3	75%	5,617.4	2,700	ADTP/day	0.0728	Columbia	NA	8.2	23.0
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2	25%	1,872.5	2,700	ADTP/day	0.0728	Columbia	NA	8.2	7.7
New Stripper Online	90%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	0.0728	Columbia	NA	8.2	1.6
Backup Stripper Online	8%	700.8	NA	100.0%	700.8	SOG to CB1/CB2	100.0%	700.8	2,700	ADTP/day	0.0728	Columbia	NA	8.2	2.9
No Stripper Online	2%	175.2	Foul Condensate to Hard Pipe	100.0%	175.2	Hydrogen Peroxide Addition	100.0%	175.2	NA	NA	NA	NA	NA	NA	NA
Recovery Furnace #3 LVHC Ignitor	75%	6,570.0	Natural Gas[I]	15.0%	985.5	NA	100.0%	985.5	1.0	mmBtu/hr	8.40E-02	AP-42	NA	0.1	0.0
New Stripper Steam - Natural Gas	90%	7,884.0	Natural Gas[D]	81.6%	6,433.3	NA	100.0%	6,433.3	96.8	mmBtu/hr	8.40E-02	AP-42	NA	8.1	26.2
New Stripper Steam - No. 6 Oil	90%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7	NA	100.0%	1,450.7	92.2	mmBtu/hr	3.33E-02	AP-42	NA	3.1	2.2
Backup Stripper Steam - Natural Gas	8%	700.8	Natural Gas[D]	81.6%	571.9	NA	100.0%	571.9	25.3	mmBtu/hr	8.40E-02	AP-42	NA	2.1	0.6
Backup Stripper Steam - No. 6 Oil	8%	700.8	No. 6 Oil[D]	18.4%	128.9	NA	100.0%	128.9	24.1	mmBtu/hr	3.33E-02	AP-42	NA	0.8	0.1
CO PROJECTED ACTUAL EMISSIONS															**64.2**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**37.1**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - reserved.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Actual steam usage January 1 - December 16, 2022.

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

VOC EMISSIONS CALCULATIONS

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		VOC Emissions Factor		Removal[C]	VOC Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	LVHC to CB1/CB2	100.0%	8,004.0	1,426	ADTP/day	4.37	Stripped	98.0%	5.19	20.78
Aerated Stabilization Basin (ASB)	100.0%	8,760.0	Foul Condensate to Hard Pipe	100.0%	8,760.0	NA	100.0%	8,760.0	1,426	ADTP/day	8.73E-01	WATER9	NA	51.88	227.21
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,426	ADTP/day	3.10E-03	Columbia	NA	0.18	0.81
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7	NA	100.0%	7,835.7	29.5	mmBtu/hr	5.39E-03	AP-42	NA	0.2	0.6
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3	NA	100.0%	168.3	28.1	mmBtu/hr	1.87E-03	AP-42	NA	0.1	0.0
VOC BASELINE ACTUAL EMISSIONS															**249.43**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3[G]	100%	7,489.8	2,700	ADTP/day	14.40	Vendor	99.9%	1.62	6.07
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3[G]	75%	5,617.4	2,700	ADTP/day	1.60	Vendor	98%	3.60	10.11
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2[G]	25%	1,872.5	2,700	ADTP/day	1.60	Vendor	98%	3.60	3.37
New Stripper Online	90%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100%	394.2	2,700	ADTP/day	16.00	Vendor	98%	36.00	7.10
Backup Stripper Online	8%	700.8	NA	100.0%	700.8	SOG to CB1/CB2	100%	700.8	2,700	ADTP/day	16.00	Vendor	98%	36.00	12.61
ASB - New Stripper Online	90%	7,884.0	No Foul Condensate to Hard Pipe	100.0%	7,884.0	NA	100%	7,884.0	2,700	ADTP/day	0.29	WATER9	NA	32.40	127.72
ASB - Backup Stripper Online	8%	700.8	TRS Stripped From Foul Condensate	100.0%	700.8	NA	100%	700.8	2,700	ADTP/day	1.42	WATER9	NA	159.98	56.06
ASB - No Stripper Online	2%	175.2	Foul Condensate to Hard Pipe	100.0%	175.2	NA	100%	175.2	2,700	ADTP/day	2.20	WATER9	NA	247.05	21.64
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to RF3	75%	6,570.0	2,700	ADTP/day	3.10E-03	Columbia	NA	0.35	1.15
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	25%	2,190.0	2,700	ADTP/day	3.10E-03	Columbia	NA	0.35	0.38
Recovery Furnace #3 LVHC Ignitor	75%	6,570.0	Natural Gas[I]	15.0%	985.5	NA	100%	985.5	1.0	mmBtu/hr	5.39E-03	AP-42	NA	0.0	0.0
New Stripper Steam - Natural Gas	90%	7,884.0	Natural Gas[D]	81.6%	6,433.3	NA	100%	6,433.3	96.8	mmBtu/hr	5.39E-03	AP-42	NA	0.5	1.7
New Stripper Steam - No. 6 Oil	90%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7	NA	100%	1,450.7	92.2	mmBtu/hr	1.87E-03	AP-42	NA	0.2	0.1
Backup Stripper Steam - Natural Gas	8%	700.8	Natural Gas[D]	81.6%	571.9	NA	100%	571.9	25.3	mmBtu/hr	5.39E-03	AP-42	NA	0.1	0.0
Backup Stripper Steam - No. 6 Oil	8%	700.8	No. 6 Oil[D]	18.4%	128.9	NA	100%	128.9	24.1	mmBtu/hr	1.87E-03	AP-42	NA	0.0	0.0
VOC PROJECTED ACTUAL EMISSIONS															**248.05**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**-1.38**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - VOC destruction >98% in vapor phase, 99.9% in liquid phase.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Actual steam usage January 1 - December 16, 2022.

F - Projected steam usage at 850 gpm from vendor design.

G - >90% of methanol condensed and burned in recovery furnace, < 10% of methanol vented into LVHC System.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

TRS EMISSIONS CALCULATIONS

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		TRS Emissions Factor		Sulfur Capture[C]	TRS Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	LVHC to CB1/CB2	100.0%	8,004.0	1,426	ADTP/day	2.88E-03	Stack test	NA	0.17	0.68
Aerated Stabilization Basin (ASB)	100.0%	8,760.0	NA	100.0%	8,760.0	NA	100.0%	8,760.0	1,426	ADTP/day	4.08E-02	H2SSIM/WATER9	NA	2.42	10.61
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,426	ADTP/day	8.01E-03	Stack test	NA	0.48	2.09
TRS BASELINE ACTUAL EMISSIONS															**13.38**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3[G,H]	100.0%	7,489.8	2,700	ADTP/day	0.33	Vendor	99.9%	0.04	0.14
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3[G,H]	75.0%	5,617.4	2,700	ADTP/day	0.49	Vendor	99.9%	0.05	0.15
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2[G]	25.0%	1,872.5	2,700	ADTP/day	0.49	Vendor	99%	0.55	0.51
New Stripper Online	90.0%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	0.81	Vendor	99%	0.91	0.18
Backup Stripper Online	8.0%	700.8	NA	100.0%	700.8	SOG to CB1/CB2	100.0%	700.8	2,700	ADTP/day	0.81	Vendor	99%	0.91	0.32
ASB - New Stripper Online	90.0%	7,884.0	No Foul Condensate to Hard Pipe	100.0%	7,884.0	NA	100.0%	7,884.0	2,700	ADTP/day	2.42E-02	H2SSIM/WATER9	NA	2.72	10.74
ASB - Backup Stripper Online	8.0%	700.8	TRS Stripped From Foul Condensate	100.0%	700.8	NA	100.0%	700.8	2,700	ADTP/day	2.72E-02	H2SSIM/WATER9	NA	3.06	1.07
ASB - No Stripper Online	2.0%	175.2	Foul Condensate to Hard Pipe	100.0%	175.2	Hydrogen Peroxide Addition	100.0%	175.2	2,700	ADTP/day	7.28E-02	H2SSIM/WATER9	NA	8.19	0.72
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	1.75E+00	Stack test	99.9%	0.20	0.65
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	8.76E-03	Stack test	NA	0.99	1.08
TRS PROJECTED ACTUAL EMISSIONS															**15.56**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**2.18**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Sulfur capture in recovery furnace >99.9% (see note H), sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Actual steam usage January 1 - December 16, 2022.

F - Projected steam usage at 850 gpm from vendor design.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - Recovery Furnace captures 99% of sulfur and converts 99% of remaining uncaptured sulfur.

					Foul UNCTRL lb/ADTP	Methanol[G] UNCTRL lb/ADTP	LVHC[G] UNCTRL lb/ADTP
TRS as S		MW		AHL	0.70	0.28	0.42
sulfur	S	32.065					
hydrogen sulfide	H_2S	34.081	82.3%		0.61	0.24	0.37
methyl mercaptan	CH_4S	48.107	6.4%		0.07	0.03	0.04
dimethyl sulfide	C_2H_6S	62.134	5.2%		0.07	0.03	0.04
dimethyl disulfide	$C_2H_6S_2$	94.199	6.1%		0.06	0.03	0.04
TRS as TRS	TRS				0.81	0.33	0.49

H2S EMISSIONS CALCULATIONS

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		H2S Emissions Factor		Sulfur Capture[C]	H2S Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	LVHC to CB1/CB2	100.0%	8,004.0	1,426	ADTP/day	4.13E-04	Stack test	NA	0.02	0.10
Aerated Stabilization Basin (ASB)	100.0%	8,760.0	Foul Condensate to Hard Pipe	100.0%	8,760.0	Hydrogen Peroxide Addition	100.0%	8,760.0	1,426	ADTP/day	1.36E-02	H2SSIM	NA	0.81	3.54
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,426	ADTP/day	5.03E-04	Stack test	NA	0.03	0.13
H2S BASELINE ACTUAL EMISSIONS															**3.77**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3[G,H]	100.0%	7,489.8	2,700	ADTP/day	0.24	Vendor	99.9%	0.03	0.10
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3[G,H]	75.0%	5,617.4	2,700	ADTP/day	0.37	Vendor	99.9%	0.04	0.12
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2[G]	25.0%	1,872.5	2,700	ADTP/day	0.37	Vendor	99%	0.41	0.39
New Stripper Online	90.0%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	0.61	Vendor	99%	0.69	0.14
Backup Stripper Online	8.0%	700.8	NA	100.0%	700.8	SOG to CB1/CB2	100.0%	700.8	2,700	ADTP/day	0.61	Vendor	99%	0.69	0.24
ASB - New Stripper Online	90.0%	7,884.0	No Foul Condensate to Hard Pipe	100.0%	7,884.0	NA	100.0%	7,884.0	2,700	ADTP/day	9.27E-03	H2SSIM	NA	1.04	4.11
ASB - Backup Stripper Online	8.0%	700.8	H2S Stripped From Foul Condensate	100.0%	700.8	NA	100.0%	700.8	2,700	ADTP/day	9.81E-03	H2SSIM	NA	1.10	0.39
ASB - No Stripper Online	2.0%	175.2	Foul Condensate to Hard Pipe	100.0%	175.2	Hydrogen Peroxide Addition	100.0%	175.2	2,700	ADTP/day	9.54E-03	H2SSIM	NA	1.07	0.09
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	1.17E-01	Stack test	99.9%	0.01	0.04
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	5.87E-04	Stack test	NA	0.07	0.07
H2S PROJECTED ACTUAL EMISSIONS															**5.69**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**1.92**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Sulfur capture in recovery furnace >99.9% (see note H), sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Actual steam usage January 1 - December 16, 2022.

F - Projected steam usage at 850 gpm from vendor design.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - Recovery Furnace captures 99% of sulfur and converts 99% of remaining uncaptured sulfur.

		MW			Foul UNCTRL lb/ADTP	Methanol[G] UNCTRL lb/ADTP	LVHC[G] UNCTRL lb/ADTP
TRS as S				AHL	0.70	0.28	0.42
sulfur	S	32.065					
hydrogen sulfide	H_2S	34.081	82.3%		0.61	0.24	0.37
methyl mercaptan	CH_4S	48.107	6.4%		0.07	0.03	0.04
dimethyl sulfide	C_2H_6S	62.134	5.2%		0.07	0.03	0.04
dimethyl disulfide	$C_2H_6S_2$	94.199	6.1%		0.06	0.03	0.04
TRS as TRS	TRS				0.81	0.33	0.49

PM EMISSIONS CALCULATIONS

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		PM Emissions Factor		PM Control	PM Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	29.5	mmBtu/hr	7.60E-03	AP-42	NA	0.2	0.9
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	28.1	mmBtu/hr	1.61E-01	AP-42	NA	4.5	0.4
PM BASELINE ACTUAL EMISSIONS															**1.3**
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	7.60E-03	AP-42	NA	7.60E-03	3.74E-03
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	7.60E-03	AP-42	NA	0.7	2.4
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	1.61E-01	AP-42	NA	14.8	10.8
Backup Stripper Steam - Natural Gas	8.0%	700.8	Natural Gas[D]	81.6%	571.9		100.0%	571.9	25.3	mmBtu/hr	7.60E-03	AP-42	NA	0.2	0.1
Backup Stripper Steam - No. 6 Oil	8.0%	700.8	No. 6 Oil[D]	18.4%	128.9		100.0%	128.9	24.1	mmBtu/hr	1.61E-01	AP-42	NA	3.9	0.3
PM PROJECTED ACTUAL EMISSIONS															**13.4**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**12.2**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - reserved.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Actual steam usage January 1 - December 16, 2022.

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

PM10 EMISSIONS CALCULATIONS

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		PM10 Emissions Factor		PM10 Control	PM10 Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	29.5	mmBtu/hr	7.60E-03	AP-42	NA	0.2	0.9
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	28.1	mmBtu/hr	1.17E-01	AP-42	NA	3.3	0.3
PM10 BASELINE ACTUAL EMISSIONS															**1.2**
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	7.60E-03	AP-42	NA	7.60E-03	3.74E-03
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	7.60E-03	AP-42	NA	0.7	2.4
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	1.17E-01	AP-42	NA	10.8	7.8
Backup Stripper Steam - Natural Gas	8.0%	700.8	Natural Gas[D]	81.6%	571.9		100.0%	571.9	25.3	mmBtu/hr	7.60E-03	AP-42	NA	0.2	0.1
Backup Stripper Steam - No. 6 Oil	8.0%	700.8	No. 6 Oil[D]	18.4%	128.9		100.0%	128.9	24.1	mmBtu/hr	1.17E-01	AP-42	NA	2.8	0.2
PM10 PROJECTED ACTUAL EMISSIONS															**10.4**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**9.3**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - reserved.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Actual steam usage January 1 - December 16, 2022.

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

PM2.5 EMISSIONS CALCULATIONS

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		PM2.5 Emissions Factor		PM2.5 Control	PM2.5 Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	29.5	mmBtu/hr	7.60E-03	AP-42	NA	0.2	0.9
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	28.1	mmBtu/hr	8.80E-02	AP-42	NA	2.5	0.2
PM2.5 BASELINE ACTUAL EMISSIONS															**1.1**
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	7.60E-03	AP-42	NA	7.60E-03	3.74E-03
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	7.60E-03	AP-42	NA	0.7	2.4
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	8.80E-02	AP-42	NA	8.1	5.9
Backup Stripper Steam - Natural Gas	8.0%	700.8	Natural Gas[D]	81.6%	571.9		100.0%	571.9	25.3	mmBtu/hr	7.60E-03	AP-42	NA	0.2	0.1
Backup Stripper Steam - No. 6 Oil	8.0%	700.8	No. 6 Oil[D]	18.4%	128.9		100.0%	128.9	24.1	mmBtu/hr	8.80E-02	AP-42	NA	2.1	0.1
PM2.5 PROJECTED ACTUAL EMISSIONS															**8.4**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**7.4**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - reserved.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Actual steam usage January 1 - December 16, 2022.

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

LEAD EMISSIONS CALCULATIONS

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		Lead Emissions Factor		Lead Control	Lead Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	29.5	mmBtu/hr	5.00E-07	AP-42	NA	1.48E-05	5.78E-05
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	28.1	mmBtu/hr	2.80E-05	AP-42	NA	7.87E-04	6.63E-05
LEAD BASELINE ACTUAL EMISSIONS															**1.24E-04**
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	5.00E-07	AP-42	NA	5.00E-07	2.46E-07
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	5.00E-07	AP-42	NA	4.84E-05	1.56E-04
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	2.80E-05	AP-42	NA	2.58E-03	1.87E-03
Backup Stripper Steam - Natural Gas	8.0%	700.8	Natural Gas[D]	81.6%	571.9		100.0%	571.9	25.3	mmBtu/hr	5.00E-07	AP-42	NA	1.27E-05	3.62E-06
Backup Stripper Steam - No. 6 Oil	8.0%	700.8	No. 6 Oil[D]	18.4%	128.9		100.0%	128.9	24.1	mmBtu/hr	2.80E-05	AP-42	NA	6.75E-04	4.35E-05
LEAD PROJECTED ACTUAL EMISSIONS															**2.08E-03**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**1.95E-03**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - reserved.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Actual steam usage January 1 - December 16, 2022.

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

CO2 EMISSIONS CALCULATIONS

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		CO2 Emissions Factor		CO2 Control	CO2 Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	29.5	mmBtu/hr	1.17E+02	AP-42	NA	3,448.9	13,512
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	28.1	mmBtu/hr	1.66E+02	AP-42	NA	4,655.3	392
CO2 BASELINE ACTUAL EMISSIONS															**13,904**
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	1.17E+02	AP-42	NA	116.9	58
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	1.17E+02	AP-42	NA	11,313.5	36,392
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	1.66E+02	AP-42	NA	15,270.9	11,076
Backup Stripper Steam - Natural Gas	8.0%	700.8	Natural Gas[D]	81.6%	571.9		100.0%	571.9	25.3	mmBtu/hr	1.17E+02	AP-42	NA	2,958.3	846
Backup Stripper Steam - No. 6 Oil	8.0%	700.8	No. 6 Oil[D]	18.4%	128.9		100.0%	128.9	24.1	mmBtu/hr	1.66E+02	AP-42	NA	3,993.0	257
CO2 PROJECTED ACTUAL EMISSIONS															**48,629**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**34,725**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - reserved.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Actual steam usage January 1 - December 16, 2022.

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

SUMMARY OF ASB EMISSIONS FACTORS

Scenario	ASB Emissions Factors (lb/ODTP)						
	H_2S	DMDS	DMS	MMC	Methanol	VOC[A]	TRS[B]
Baseline Actual Emissions	0.0151	0.0114	0.0185	3.28E-04	0.92	0.97	0.0453
New Stripper Scenario	0.0103	0.0028	0.0136	1.88E-04	0.30	0.32	0.0269
Backup Stripper Scenario	0.0109	0.0033	0.0147	1.30E-03	1.53	1.58	0.0302
No Stripper Scenario	0.0106	0.0504	0.0192	7.42E-04	2.31	2.44	0.0809

A - Includes VOC TRS compounds, methanol, acetaldehyde, methyl ethyl ketone, and propionaldehyde.

B - TRS as compounds

Stripper Inlet Foul Condensate - Table 2-17 (Weston report dated October 2, 2021, Work Order No. 15730.001.008)

		Concentration (ppm)				
Date	**Sample Time**	**Hydrogen Sulfide**	**Methyl Mercaptan**	**Dimethyl Sulfide**	**Dimethyl Disulfide**	**Total TRS**
6/24/2021	15:10	130	14	16	13	173
6/24/2021	15:10	140	14	16	17	187
6/24/2021	17:00	140	17	18	14	189
6/24/2021	18:45	150	19	18	16	203
6/25/2021	10:35	130	12	12	11	165
6/25/2021	12:05	120	10	12	9.6	151.6
6/25/2021	13:45	190	22	22	23	257
Average of all data		142.9	15.4	16.3	14.8	189.4
Max of 6/24 or 6/25		146.7	16.0	17.0	15.0	194.7

		MW	
H2S	Hydrogen Sulfide	34.08	g/mol
Ch4S	Methyl Mercaptan	48.11	g/mol
C2H6S	Dimethyl Sulfide	62.13	g/mol
C2H6S2	Dimethyl Disulfide	94.20	g/mol
S	Sulfur	32.07	g/mol

Convert compound to equivalent S (ppm)

Hydrogen Sulfide	Methyl Mercaptan	Dimethyl Sulfide	Dimethyl Disulfide
138.0	10.7	8.8	10.2
82.3%	6.4%	5.2%	6.1%

S (ppm)	168	Maximum feed to stripper (AHL)
Lb S/gallon FC	1.40E-03	
Lb S/hr @850 gpm	71.3	
Lb S/ADTP (@2200 ODTP)[a]	0.70	

[a] Conservative Lb S/ADTP emissions factor using 2200 ODTP (2200 ODTP * ADTP/0.9 ODTP = 2444.4 ADTP) Emissions factor is representative of the lower end of the range of pulp production at the maximum steam stripper design of 850 gpm. Calculations are scaled to 2700 ADTP to represent worst case emissions.

Assumption
1. Assume no losses in feed tank
2. Assume 98% efficiency of S across stripper therefore 0.69 # S/ADTP in SOG

CONFIDENTIAL TAB M - New-Indy Catawba Monthly Production

Month	Kraft Mill ADTP	Combination Boiler No. 1 Natural Gas mmBtu	Combination Boiler No. 2 Natural Gas mmBtu	Total Natural Gas mmBtu	Combination Boiler No. 1 No. 6 Fuel Oil gallons	Combination Boiler No. 2 No. 6 Fuel Oil gallons	Total No. 6 Fuel Oil gallons	Total No. 6 Fuel Oil mmBtu		
Mar-21	42,474	61,175	99,507	160,683	0	2,057	2,057	309	1,370	
Apr-21	43,075	41,363	75,012	116,376	0	0	0	0	1,436	
May-21	46,962	38,834	63,467	102,301	0	0	0	0	1,515	
Jun-21	42,867	1,909	59,909	61,818	0	1,199	1,199	180	1,429	
Jul-21	49,371	67,565	55,824	123,389	3	97	100	15	1,593	
Aug-21	44,614	33,863	32,461	66,325	0	0	0	0	1,439	
Sep-21	40,177	40,779	41,811	82,590	86	0	86	13	1,339	
Oct-21	47,234	69,732	75,498	145,230	0	0	0	0	1,524	
Nov-21	39,185	60,664	80,397	141,061	0	0	0	0	1,306	
Dec-21	38,734	62,931	60,176	123,107	0	0	0	0	1,249	
Jan-22	43,690	84,088	82,251	166,339	69,200	66,720	135,920	20,388	1,409	
Feb-22	37,736	57,764	75,924	133,688	27,042	370	27,412	4,112	1,348	
Mar-22	43,944	62,423	82,083	144,506	335	0	335	50	1,418	
Apr-22	40,046	44,634	62,835	107,469	0	0	0	0	1,335	
May-22	38,896	39,982	73,918	113,900	0	0	0	0	1,255	
Jun-22	23,184	43,071	89,239	132,310	2,238	0	2,238	336	773	
Jul-22	39,890	64,532	86,134	150,666	0	0	0	0	1,287	
Aug-22	53,396	48,067	73,591	121,658	0	0	0	0	1,722	
Sep-22	45,044	60,782	65,899	126,681	24	0	24	4	1,501	
Oct-22	47,517	70,539	89,760	160,299	0	0	0	0	1,533	
Nov-22	40,133	82,534	114,164	196,698	0	0	0	0	1,338	
Dec-22	33,859	101,466	95,023	196,490	170,076	0	170,076	25,511	1,092	
Jan-23	35,464	95,982	92,733	188,715	102,558	0	102,558	15,384	1,144	1,041,075
Feb-23	39,276	78,431	96,813	175,244	21,626	53	21,679	3,252	1,403	520,537
Total	996,766			3,237,544				69,553		
Annual Average	498,383									
				97.9%				2.1%		

October 2021 SO2 Testing - Weston

	Combination Boiler No. 1 Stack			Combination Boiler No. 2	
	NCG+SOG	NCG	SOG	NCG+SOG	NCG
ODTP/hr	77.3	79.0		91.1	92.9
ADTP/hr	85.9	87.8		101.2	103.2
lb SO2/hr	342.8	230.7		380.9	309.9
lb SO2/ADTP	3.99	2.63	1.36	3.76	3.00

	Controlled Emissions		Sulfur Capture		Uncontrolle
	Average	Maximum	Bark Ash[C]	LVHC Scrubber	Average
	lb SO2/ADTP	lb SO2/ADTP	%	%	lb SO2/ADTP
SOG	1.06	1.36	20%	NA	1.33
NCG	2.82	3.00			
LVHC[A,B]	1.97	2.10	20%	50%	4.92
HVLC[A,B]	0.85	0.90	20%	NA	1.06

A - NCG gases include LVHC gases and HVLC gases.

B - NCG gases split using ratio of controlled SO2 emissions from LVHC (1.10 lb SO2/ADTP) and HVLC (

C - Estimated sulfur capture based on 2012 stack test (NCASI data suggests ~32% capture).

TABLE 2-2
NO. 1 COMBINATION BOILER
CONDITION 1: NCG AND SOG GASES
SUMMARY OF SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	10/13/21	10/13/21	10/13/21	----
Time Began	0844	1029	1206	----
Time Ended	0944	1129	1306	----
Stack Gas Data				
Temperature, °F	430	435	438	434
Velocity, ft/sec	64	63	63	63
Moisture, %	17	17	17	17
CO_2 Concentration, %	8.8	9.0	8.6	8.8
O_2 Concentration, %	10.5	10.5	10.8	10.6
VFR, x 10^5 dscfm	1.46	1.45	1.44	1.45
Sulfur Dioxide				
Concentration, ppm	280	227	204	237
Emission Rate, lb/hr	407.4	328.3	292.6	342.8

TABLE 2-3
NO. 1 COMBINATION BOILER
CONDITION 2: NCG GASES ONLY
SUMMARY OF SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	10/13/21	10/13/21	10/13/21	----
Time Began	1407	1544	1714	----
Time Ended	1507	1644	1814	----
Stack Gas Data				
Temperature, °F	447	450	444	447
Velocity, ft/sec	61	62	63	62
Moisture, %	17	18	16	17
CO_2 Concentration, %	9.6	9.9	8.9	9.5
O_2 Concentration, %	10.1	9.8	10.7	10.2
VFR, x 10^5 dscfm	1.37	1.39	1.43	1.40
Sulfur Dioxide				
Concentration, ppm	140	176	180	165
Emission Rate, lb/hr	191.3	243.6	257.0	230.7

Combination Boiler #1

Condition 1: With NCGs, with SOGs
13-Oct-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	Pulp KAPPA
1	0844	262.3	29.9	126.9	1.23	40	10.9	511	230	1407	1103	10851	77.3	82.7
2	1029	266.3	33.0	109.1	1.23	40	10.9	505	213	1409	1200	10885	77.3	85.7
3	1206	257.2	32.6	100.4	1.23	40	10.9	504	2	1443	1206	10963	77.3	84.8
Average:		261.9	31.8	112.1	1.23	40	10.9	507	148	1420	1170	10900	77.3	84.4

Condition 2: With NCGs, without SOGs
13-Oct-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	Pulp KAPPA
1	1407	267.7	34.0	102.0	1.23	40	10.9	506	2	1416	[redacted]	11071	79.0	83.9
2	1544	272.9	34.8	101.3	1.23	40	10.9	504	252	1414	[redacted]	10976	79.0	81.6
3	1714	256.9	30.05	115.96	1.23	40	10.9	505	183	1430	[redacted]	11061	79.0	80.3
Average:		265.8	33.0	106.4	1.23	40	10.9	505	146	1420	[redacted]	11036	79.0	81.9

TABLE 2-4
NO. 2 COMBINATION BOILER
CONDITION 1: NCG AND SOG GASES
SUMMARY OF SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	10/14/21	10/14/21	10/14/21	----
Time Began	0830	1026	1222	----
Time Ended	0930	1126	1322	----
Stack Gas Data				
Temperature, °F	463	477	465	469
Velocity, ft/sec	63	68	61	64
Moisture, %	17	19	16	17
CO_2 Concentration, %	8.2	9.5	7.5	8.4
O_2 Concentration, %	10.8	10.1	11.5	10.8
VFR, x 10^5 dscfm	1.40	1.43	1.35	1.39
Sulfur Dioxide				
Concentration, ppm	275	262	286	274
Emission Rate, lb/hr	383.7	373.7	385.4	380.9

TABLE 2-5
NO. 2 COMBINATION BOILER
CONDITION 2: NCG GASES ONLY
SUMMARY OF SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	10/14/21	10/14/21	10/14/21	----
Time Began	1410	1547	1725	----
Time Ended	1510	1647	1825	----
Stack Gas Data				
Temperature, °F	457	461	460	459
Velocity, ft/sec	59	59	58	59
Moisture, %	15	15	15	15
CO_2 Concentration, %	7.2	7.6	7.0	7.3
O_2 Concentration, %	11.9	11.2	11.7	11.6
VFR, x 10^5 dscfm	1.33	1.33	1.33	1.33
Sulfur Dioxide				
Concentration, ppm	235	234	232	234
Emission Rate, lb/hr	311.3	311.0	307.4	309.9

Combination Boiler #2

Condition 1: With NCGs, with SOGs
14-Oct-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	Pulp KAPPA
1	0830	241	29.8	188.7	1.23	40	10.9	505	209	1409	1203	11071	91.1	94.5
2	1026	251	46.3	115.6	1.23	40	10.9	504	200	1420	1179	11160	91.1	88.2
3	1222	211	25.4	171.4	1.23	40	10.9	505	199	1429	1157	11090	91.1	80.7
Average:		234	33.8	158.6	1.23	40	10.9	505	203	1419	1180	11107	91.1	87.8

Condition 2: With NCGs, without SOGs
14-Oct-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	Pulp KAPPA
1	1410	198	21.7	174.8	1.23	40	10.9	505	209	1438	[redacted]	11109	92.9	78.8
2	1547	218	35.4	206.4	1.23	40	10.9	505	224	1435		11060	92.9	78.7
3	1725	214	49.6	220.6	0.65	40	10.9	505	262	1453		10977	92.9	79.3
Average:		210	35.6	200.6	1.04	40	10.9	505	232	1442		11049	92.9	

June 2021 TRS_H2S Testing - Weston

TRS as TRS	Combination Boiler No. 1 Stack			Combination Boiler No. 2 Stack		
	NCG+SOG	NCG	SOG	NCG+SOG	NCG	SOG
ODTP/hr	55.9	76.0		88.3	85.2	
ADTP/hr	62.1	84.4		98.1	94.7	
lb TRS (as H2S)/hr	0.75	0.68		0.85	0.92	
lb TRS (as TRS)/hr	1.07	0.97		1.22	1.32	
lb TRS (as TRS)/ADTP	1.73E-02	1.15E-02	5.75E-03	1.24E-02	1.39E-02	-1.51E-03

H2S	Combination Boiler No. 1 Stack			Combination Boiler No. 2 Stack		
	NCG+SOG	NCG	SOG	NCG+SOG	NCG	SOG
ODTP/hr	55.9	76.0		88.3	85.2	
ADTP/hr	62.1	84.4		98.1	94.7	
lb H2S/hr	0.07	0.05		0.07	0.04	
lb H2S/ADTP	1.13E-03	5.92E-04	5.35E-04	7.13E-04	4.23E-04	2.91E-04

	Controlled Emissions		Sulfur Conversion		Uncontrolled Emissions	
	Average	Maximum	Combustion	LVHC Scrubber	Average	Maximum
TRS as TRS	lb TRS/ADTP	lb TRS/ADTP	%	%	lb TRS/ADTP	lb TRS/ADTP
SOG[D]	2.88E-03	5.75E-03	99%	NA	0.29	0.58
NCG	1.27E-02	1.39E-02				
LVHC[A,B]	8.01E-03	8.76E-03	99%	50%	1.60	1.75
HVLC[A,B]	4.69E-03	5.13E-03	99%	NA	0.47	0.51

	Controlled Emissions		Sulfur Conversion		Uncontrolled Emissions	
	Average	Maximum	Combustion	LVHC Scrubber	Average	Maximum
H2S	lb H2S/ADTP	lb H2S/ADTP	%	%	lb H2S/ADTP	lb H2S/ADTP
SOG	4.13E-04	5.35E-04	99%	NA	4.13E-02	5.35E-02
NCG	5.07E-04	5.92E-04				
LVHC[A,C]	5.03E-04	5.87E-04	99%	50%	1.01E-01	1.17E-01
HVLC[A,C]	4.45E-06	5.19E-06	99%	NA	4.45E-04	5.19E-04

A - NCG gases include LVHC gases and HVLC gases.

B - NCG gases split using ratio of controlled TRS emissions from LVHC (8.97E-3 lb TRS/ADTP) and HVLC (5.25E-3 lb TRS/ADTP) from Project Columbia Application (July 2019 and April 2020 Addendum - Attachment C).

C - NCG gases split using ratio of controlled H2S emissions from LVHC (3.82E-3 lb H2S/ADTP) and HVLC (3.38E-5 lb H2S/ADTP) from Project Columbia Application (July 2019 and April 2020 Addendum - Attachment C).

D - Combination Boiler No. 2 SOG averaged as zero (0).

			CB1			CB1			CB2			CB2						
TRS as S		MW	NCG+SOG			NCG			NCG+SOG			NCG						
sulfur	S	32.065	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3	AVG		PLC Cross Check back to TRS as H2S	
hydrogen sulfide	H_2S	34.081	0.08	0.07	0.1	0.07	0.07	0.07	0.08	0.08	0.08	0.05	0.05	0.05	0.07	8.0%	0.085742	0.085742
methyl mercaptan	CH_4S	48.107	0.55	0.53	0.49	0.52	0.52	0.53	0.77	0.63	0.64	0.94	0.91	0.69	0.64	72.6%	0.778738	0.55169
dimethyl sulfide	C_2H_6S	62.134	0.16	0.16	0.16	0.16	0.16	0.17	0.08	0.08	0.08	0.08	0.07	0.07	0.12	13.5%	0.144248	0.079121
dimethyl disulfide	$C_2H_6S_2$	94.199	0.07	0.07	0.07	0.07	0.07	0.07	0.04	0.04	0.04	0.03	0.03	0.03	0.05	5.9%	0.06355	0.045984
															0.89	Total TRS	1.072278	0.762538
															84.8%			

10^6 ACFM Flowrate Basis to lb/min													
H_2S	0.007081766	0.006196545	0.008852208	0.006196545	0.006196545	0.006196545	0.007081766	0.007081766	0.007081766	0.004426104	0.004426104	0.004426104	
CH_4S	0.068724286	0.066225221	0.061227091	0.064975688	0.064975688	0.066225221	0.096214	0.078720545	0.079970078	0.117456052	0.113707455	0.08621774	
C_2H_6S	0.025821922	0.025821922	0.025821922	0.025821922	0.025821922	0.027435792	0.012910961	0.012910961	0.012910961	0.012910961	0.011297091	0.011297091	
$C_2H_6S_2$	0.017127091	0.017127091	0.017127091	0.017127091	0.017127091	0.017127091	0.009786909	0.009786909	0.009786909	0.007340182	0.007340182	0.007340182	
TRS as H2S	0.082325532	0.07966987	0.078784649	0.078784649	0.078784649	0.080555091	0.089407299	0.077014208	0.077899429	0.100029948	0.096489065	0.077014208	
TRS as TRS	0.118755065	0.115370779	0.113028312	0.114121247	0.114121247	0.116984649	0.125993636	0.108500182	0.109749714	0.142133299	0.136770831	0.109281117	
Ratio TRS as H2S/TRS a	0.693238074	0.690555015	0.697034647	0.690359171	0.690359171	0.688595396	0.709617575	0.709807177	0.70979163	0.703775603	0.705479846	0.704734816	0.69944568
													1.43

TABLE 2-11
NO. 1 COMBINATION BOILER
CONDITION 1: NCG AND SOG GASES
SUMMARY OF H_2S, TOTAL TRS, AND SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	6/23/21	6/23/21	6/23/21	---
Time Began	1158	1400	1541	---
Time Ended	1258	1500	1641	---
Stack Gas Data				
Temperature, °F	415	418	415	416
Velocity, ft/sec	59	57	57	57
Moisture, %	17	18	16	17
CO_2 Concentration, %	7.8	8.4	7.7	8.0
O_2 Concentration, %	12.1	11.4	12.0	11.8
VFR, x 10^5 dscfm	1.35	1.31	1.33	1.33
Hydrogen Sulfide				
Concentration, ppm	0.09	0.08	0.12	0.10
Emission Rate, lb/hr	0.07	0.06	0.08	0.07
Total Reduced Sulfur				
Concentration, ppm	1.09	1.07	1.03	1.06
Emission Rate, lb/hr	0.78	0.74	0.73	0.75
Sulfur Dioxide				
Concentration, ppm	195	278	344	272
Emission Rate, lb/hr	262.7	362.5	457.4	360.9

TABLE 2-12
NO. 1 COMBINATION BOILER
CONDITION 2: NCG GASES ONLY
SUMMARY OF H_2S, TOTAL TRS, AND SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	6/23/21	6/23/21	6/23/21	---
Time Began	1824	2019	2202	---
Time Ended	1924	2119	2302	---
Stack Gas Data				
Temperature, °F	416	411	415	414
Velocity, ft/sec	56	56	56	56
Moisture, %	16	16	17	17
CO_2 Concentration, %	8.3	7.8	8.1	8.1
O_2 Concentration, %	11.4	11.9	11.6	11.6
VFR, x 10^5 dscfm	1.30	1.31	1.30	1.30
Hydrogen Sulfide				
Concentration, ppm	0.08	0.08	0.08	0.08
Emission Rate, lb/hr	0.05	0.05	0.05	0.05
Total Reduced Sulfur				
Concentration, ppm	0.97	0.98	0.99	0.98
Emission Rate, lb/hr	0.67	0.68	0.68	0.68
Sulfur Dioxide				
Concentration, ppm	313	348	349	337
Emission Rate, lb/hr	404.4	452.9	450.8	436.1

Combination Boiler #1

Condition 1: With NCGs, with SOGs
23-Jun-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	SO_2 Emissions (lbs/hr)	SO_2 Emissions (lbs/ODT Pulp)	TRS Emissions (lbs/hr)
1	1158	208	25.1	80.8	1.37	40	10.9	458	146	1585	621	11575	49.7	262.7	5.29	0.56
2	1400	225	29.3	68.8	1.37	40	10.9	491	152	1595	1219	11048	54.0	362.5	6.71	0.49
3	1541	207	24.8	81.2	1.37	40	10.9	491	45	1578	1136	11009	64.0	457.4	7.15	0.50
Average:		213	26.4	76.9	1.37	40	10.9	480	114	1586	992	11211	55.9	360.9	6.46	0.52

Condition 2: With NCGs, without SOGs
23-Jun-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	SO_2 Emissions (lbs/hr)	SO_2 Emissions (lbs/ODT Pulp)	TRS Emissions (lbs/hr)
1	1824	230	26.3	94.9	1.37	40	10.9	489	123	1587		10515	74.1	404.4	5.46	0.43
2	2019	216	23.7	97.5	1.37	40	10.9	491	184	1593		10377	74.7	452.9	6.06	0.42
3	2202	220	25.2	92.4	1.37	40	10.9	490	152	1570		10573	79.2	450.8	5.69	0.46
Average:		222	25.1	94.9	1.37	40	10.9	490	153	1583		10488	76.0	436.1	5.74	0.44

TABLE 2-13
NO. 2 COMBINATION BOILER
CONDITION 1: NCG AND SOG GASES
SUMMARY OF H_2S, TOTAL TRS, AND SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	6/24/21	6/24/21	6/24/21	----
Time Began	1445	1630	1806	----
Time Ended	1545	1730	1906	----
Stack Gas Data				
Temperature, °F	475	474	479	476
Velocity, ft/sec	69	69	69	69
Moisture, %	14	14	15	14
CO_2 Concentration, %	6.6	6.9	7.3	6.9
O_2 Concentration, %	13.1	12.7	12.3	12.7
VFR, x 10^5 dscfm	1.57	1.56	1.54	1.56
Hydrogen Sulfide				
Concentration, ppm	0.09	0.09	0.09	0.09
Emission Rate, lb/hr	0.07	0.07	0.07	0.07
Total Reduced Sulfur				
Concentration, ppm	1.13	0.97	0.97	1.02
Emission Rate, lb/hr	0.94	0.80	0.80	0.85
Sulfur Dioxide				
Concentration, ppm	324	327	322	324
Emission Rate, lb/hr	508.7	507.2	496.1	504.0

TABLE 2-14
NO. 2 COMBINATION BOILER
CONDITION 2: NCG GASES ONLY
SUMMARY OF H_2S, TOTAL TRS, AND SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	6/25/21	6/25/21	6/25/21	----
Time Began	1000	1135	1315	----
Time Ended	1100	1235	1415	----
Stack Gas Data				
Temperature, °F	468	470	481	473
Velocity, ft/sec	68	69	69	69
Moisture, %	14	14	14	14
CO_2 Concentration, %	6.9	6.8	7.3	7.0
O_2 Concentration, %	12.8	12.7	12.3	12.6
VFR, x 10^5 dscfm	1.56	1.55	1.56	1.56
Hydrogen Sulfide				
Concentration, ppm	0.05	0.05	0.05	0.05
Emission Rate, lb/hr	0.04	0.04	0.04	0.04
Total Reduced Sulfur				
Concentration, ppm	1.22	1.18	0.94	1.11
Emission Rate, lb/hr	1.01	0.97	0.78	0.92
Sulfur Dioxide				
Concentration, ppm	247	245	235	242
Emission Rate, lb/hr	383.2	380.0	366.2	376.4

Combination Boiler #2

Condition 1: With NCGs, with SOGs
24-Jun-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	SO_2 Emissions (lbs/hr)	SO_2 Emissions (lbs/ODT Pulp)	TRS Emissions (lbs/hr)
1	1445	219	39.0	125.3	1.37	40	10.9	491	190	1572	1231	10253	87.8	508.7	5.79	0.77
2	1630	224	31.1	146.4	1.37	40	10.9	490	186	1576	1231	10277	88.6	507.2	5.72	0.63
3	1806	241	33.6	146.4	1.37	40	10.9	490	190	1580	1231	10300	88.6	496.1	5.60	0.63
Average:		228	34.6	139.4	1.37	40	10.9	490	189	1576	1231	10277	88.3	504.0	5.71	0.68

Condition 2: With NCGs, without SOGs
25-Jun-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	SO_2 Emissions (lbs/hr)	SO_2 Emissions (lbs/ODT Pulp)	TRS Emissions (lbs/hr)
1	1000	234	35.7	132.7	1.37	40	10.9	482	155	1579		10475	87.2	383.2	4.39	0.86
2	1135	225	30.8	147.8	1.37	40	10.9	479	252	1573		10425	84.3	380.0	4.51	0.82
3	1315	245	30.6	141.7	1.37	40	10.9	482	97	1571		10500	84.2	366.2	4.35	0.63
Average:		235	32.4	140.7	1.37	40	10.9	481	168	1574		10467	85.2	376.4	4.42	0.77

Buckner, Katharine

From:	Sheryl Watkins <swatkins@all4inc.com>
Sent:	Monday, April 24, 2023 3:23 PM
To:	Buckner, Katharine; Robert Tourville; Steven Moore
Cc:	Hardee, Christopher
Subject:	RE: WATER9 input files
Attachments:	BAE TRS WATER9.zip; BAE VOC WATER9.zip; PAE Hardpipe Scenario WATER9.zip; PAE New Stripper Scenario WATER9.zip; PAE Old Stripper Scenario WATER9.zip

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***

Good afternoon, Katharine. Attached are the WATER9 files that are the underlying basis for the TRS and VOC emissions factors and emissions calculations for the new steam stripper construction permit application submitted to DHEC on March 23, 2023. We have organized them into 5 separate zip files corresponding to the baseline emissions and the projected actual emissions operating scenarios (old stripper, new stripper, and Hardpipe). Let us know if you have any questions or any problems with the files. Thanks!

Sheryl Watkins, PE / Sr. Technical Manager / ATL Office
swatkins@all4inc.com / Direct: 678.293.9428 / Cell: 386.503.0266 / Profile / LinkedIn
www.all4inc.com / Locations / Articles / Podcast / Training
ALL4 // *STRATEGY WITH SOLUTION. PARTNERSHIP WITH A PURPOSE.*

From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Thursday, April 20, 2023 12:35 PM
To: Robert Tourville <BOB.TOURVILLE@NEW-INDYCB.COM>; Steven Moore <smoore@all4inc.com>; Sheryl Watkins <swatkins@all4inc.com>
Cc: Hardee, Christopher <hardeecd@dhec.sc.gov>
Subject: RE: WATER9 input files

Hello Bob,

I was checking on the status of the WATER9 files for Christopher. Will these be coming soon?

Thank you,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

Office: (803) 898-3213
bucknekk@dhec.sc.gov

S.C. Dept. of Health & Environmental Control
2600 Bull Street
Columbia, SC 29201

Connect: www.scdhec.gov Facebook Twitter

From: Buckner, Katharine
Sent: Wednesday, April 12, 2023 11:21 AM
To: Robert Tourville <BOB.TOURVILLE@NEW-INDYCB.COM>; Steve Moore (smoore@all4inc.com) <smoore@all4inc.com>; Sheryl Watkins <swatkins@all4inc.com>
Cc: Hardee, Christopher <hardeecd@dhec.sc.gov>
Subject: WATER9 input files

Hey All,

Christopher would like the WATER9 input files. He said he was able to run the example as seen on EPAs website and felt he would be able to handle the WATER9 input files themselves.

Thank you,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

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Buckner, Katharine

From:	Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Sent:	Monday, May 22, 2023 10:00 AM
To:	Buckner, Katharine
Cc:	Pete Cleveland; Hardee, Christopher
Subject:	Stripper Application Comments
Attachments:	2440-0005.RE-comments on stripper app 3 (5-17-23) (003).docx; Attachment A (5-22-23).pdf; 2440-0005.RE-comments on stripper app 1 (5-18-23) (003).docx

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Katharine
Please find the response to the questions on the stripper application. Let me know if you have any additional questions.

Bob

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SCDHEC BAQ comments/questions for New-Indy (2440-0005) on the new Stripper construction application, sent April 20, 2023
Emission Calculations
Steam balance - When the final steam balance for using the new stripper has been derived, please submit for review, along with revised calculations. The revised steam balance is under development and currently does not include the steam savings projects which are currently being evaluated. The steam savings projects will reduce the incremental steam required for the Project (i.e. operation of the new or existing steam stripper as back up) and thus will reduce the projected actual emissions. The Mill will provide the final steam balance with the updated emissions calculations when available. The conclusions of the emissions calculations are not expected to change. - Please provide the steam balance for the existing operations where the existing stripper is being used. A revised steam balance for baseline is provided with this submittal (Attachment A). The revised analysis includes steam used by the existing stripper for the baseline period (i.e., May 3, 2021 to February 28, 2023). - Please justify why approximately one year of steam data is representative of the 24 consecutive months data that should be used for the baseline actual emissions. Why is a 24 consecutive month average not used? How would the emission calculations be affected if a 24 consecutive month average were used? The Mill will update the baseline actual emissions for operation of the existing stripper during the baseline period (i.e., May 3, 2021 restart of the stripper, to February 28, 2023) with the updated emissions calculations. The conclusions of the emissions calculations are not expected to change.
Current stripper - Please provide a justification why the current stripper should be considered as an existing source rather than a new source. The current stripper was installed in 2000 and is included in the current Title V Operating Permit (No. TV-2440-0005). The current stripper treated foul condensates consistent with bleached papermaking operations until bleached operations ceased on September 5, 2020. The current stripper has been treating foul condensates generated from the post-project Columbia equipment/operations since May 3, 2021, as required by the Consent Order to Correct Undesirable Levels of Air Contaminants. There are no physical modifications planned for the current stripper with the proposed New Condensate Stripper Project ("Project"), although the current stripper will be demoted to operate strictly as a backup to the new condensate stripper and will be operated to process all of the foul condensate, with an expected removal of the total reduced sulfur (TRS) and methanol compounds of 98% and 45%, respectively. Note: Further methanol treatment through biological destruction will be accomplished by routing the stripped condensates to the existing Hardpipe system that discharges the foul condensates below the liquid surface of the existing ASB. Since the existing steam stripper has been in operation since 2000 and was not shutdown for more than 2 years [U.S. Environmental Protection Agency (EPA) presumptive guidance[1]] it is considered

[1] October 9, 1979 Letter from William A. Spratlin, Jr. U.S. EPA Region VII Chief, Air Support Branch Air and Hazardous Materials Division. Note: This guidance has also been upheld in more recent policy letters, with additional guidance on what factors to address if a unit has been shutdown for greater than 2 years but the shutdown was not intended to be permanent.

an "existing source" for the purposes of evaluating prevention of significant deterioration (PSD). Current stripper (Cont.) And include any information on the activities that occurred prior to the stripper being returned to service on May 3, 2021. When ordered by SC DHEC to restart the existing stripper in April 2021, the Mill performed general cleaning and maintenance activities as well as general startup activities (e.g., connections to steam and foul condensate lines) prior to the startup on May 3, 2021. There were no other activities performed between cessation of bleached operations and May 3, 2021.
Vendor specifications - FYI, in the permit it will be required that prior to start of construction the vendor guarantee/certification shall be provided for the design specifications of the new stripper along with the caveats or assumptions on which the guarantees are based. The Mill will provide the information requested/documented in the air construction permit issued for the Project prior to startup of the new condensate stripper.
NOx Fresh Start TAB - Rows 14 and 15, please explain the reason behind splitting the ton BLS rate between the condensed methanol and that vented to the LVHC. The new condensate stripper will be designed to concentrate 90% of the stripped methanol into a liquid called stripper rectified liquid (SRL). The remaining methanol (10%) will pass through the condenser and be vented into the low volume, high concentration (LVHC) System. Ammonia, which is the precursor to NO_X emissions is assumed to follow methanol. The new stripper will operate in SRL mode 95% of the time and when in this mode, the SRL liquid will be combusted 100% of the time in the Nos. 2 and 3 Recovery Furnaces (row 14 - emissions factor is 1.5 lbs NOx/TBLS and using 90% (0.9) of the total TBLS rate). During the SRL operating mode, the LVHC gases from the SRL condenser system, stripper feed tank, and SRL methanol tank will be combusted in the No. 3 Recovery Furnace 75% of the time (row 15 - emissions factor is 1.5 lbs NOx/TBLS and using 10% (0.10) of the total TBLS rate). The remaining 25% of the time, the SRL LVHC will be combusted in the Nos. 1 or 2 Combination Boilers (row 16 - emissions factor is 0.415 lb NOx/air dried tons of pulp (ADTP) and using 10% (0.1) of the total ADTP). Does footnote G explain the reduced production rate used? See response above. The footnote G statement is different from that under the SO2 Fresh Start TAB, where 40% of methanol is condensed and 60% to LVHC. Please explain the difference. The emissions calculation for the generation of NOx from combustion of the SRL and SRL LVHC is explained above (i.e. based on the assumption that the ammonia in the SRL and SRL LVHC will increase NOx emissions no more than 1%). The emissions calculation for the generation of SO2 from combustion of the SRL and SRL LVHC is based on the mass of TRS compounds in the foul condensate and how those compounds are distributed into the SRL (40%) and SRL LVHC (60%) when stripped from the condensate and then condensed. Please note that it is expected that 90% of the methanol in the foul condensates will be concentrated in the SRL, with 10% going to the SRL LVHC. The SRL feed to each recovery furnace is limited to a maximum of 1% of the black liquor feed rate for safety reasons by the Black Liquor Recovery Boiler Advisory Committee (BLRBAC). NCASI examined the impact of burning stripper off gases (SOG) in recovery furnaces (Special Report SR-03, October 2003, Section 7.1) and

concluded introducing SOG below the liquor guns results in no change to NOX emissions. As a conservative assumption, the NOX emissions from the recovery furnaces were assumed to increase by 1% from blending the SRL with the black liquor and introduction the LVHC gases (both of which include ammonia from the SOG) below the liquor guns.
VOC Fresh Start TAB - In the baseline calculations, Row 8, the reference for the emission factor says "Stripped". Please provide the data used, calculations, etc. to arrive at this factor. The emissions factor is the average amount removed by the steam stripper using all the available data at the time the calculations were initially performed (June 23, 2021 through January 28, 2023). The emissions factor will be updated using all available data through February 28, 2023 when revised calculations are provided, but the conclusions are not expected to change. - The natural gas emission factors were derived from the AP-42 factor. But to arrive at the factor in the TAB, the AP-42 factor was divided by 1,020 Btu/scf, which is not consistent with the other tabs – SO_2, NO_x, etc. Those divided the AP-42 factor by 1,000 Btu/scf heat content for natural gas. Although AP-42 provides instruction to convert emissions factors reported in lb/MMscf to lb/mmBtu by dividing by 1,020 mmBtu/mmscf [per footnote a to Tables 1.4-1 and 1.4-2], the Mill has historically converted the AP-42 lb/mmscf factors using 1,000 mmBtu/mmscf since calendar year 2000 or earlier, which is a more conservative approach. The Mill will revise the AP-42 VOC emissions factor to use the 1,000 mmBtu/mmscf conversion. Revised calculations will be provided once all DHEC comments have been received and addressed. The conclusions of the emissions calculations are not expected to change. - The VOC factor for No. 6 fuel oil is for sources between 10-100 mmBtu/hr. The VOC emission factor for sources >100 million Btu/hr should be used to calculate the VOC emission factor used in the TAB. This is consistent with how it was done in the other TABs. The AP-42 VOC emissions factor from Table 1.3-3 for Industrial boilers does not list the size; however, review of the SCC codes listed shows that the 0.28 lb VOC/1000 gal factor applies to industrial boilers <100 mmBtu/hr. There are no VOC emissions factors presented for industrial boilers >100 mmBtu/hr in Table 1.3-3.
Lead Fresh Start TAB - How did you arrive at the emission factor of 2.8E-05 mmBtu/hr? Using Table 1.3-11 in AP-42, the lead factor is 1.51E-03 lb/1000 gal. Converting this using 150,000 Btu/scf (which is consistent with other areas in the calculations), I get 1.01E-05 lb/mmBtu. The lead emissions factor is from the U.S. EPA document "Estimating Air Toxic Emissions from Coal and Oil Combustion Sources" [EPA-450/2-89-001] for Uncontrolled Residual Oil-fired Utility Boilers (Table 4-1). This emissions factor has been used in air emissions inventories and air permit applications since calendar year 2000 or earlier.
CO_2 Fresh Start - The AP-42 factor for CO_2 for natural gas was divided by a heat input of 1,020 Btu/scf. Most of the other combustion calculations divided by 1,000 for the heat content of natural gas. Please fix to be consistent with the other combustion calcs and that of the TV. Similar to the AP-42 VOC factor, the Mill will revise the AP-42 CO_2 emissions factor to use the 1,000 mmBtu/mmscf conversion, consistent with the historical conservative approach. Revised calculations will be provided once all DHEC comments have been received and addressed. The conclusions of the emissions calculations are not expected to change.

- The CO_2 rates calculated (and presented in the PSD analysis table) are for CO_2 and not CO_2e emissions. The CO_2 emissions along with methane and nitrous oxide and including the global warming potential for each will need to be calculated and then totaled in order for these to be CO_2e rates. As the project does not trigger PSD for any new source review (NSR) pollutant, quantification of GHG emissions is not required. We have provided the CO_2 emissions calculations for completeness and do not believe adding methane and nitrous oxide emissions will not change the magnitude of the CO_2e emissions. We will update the PSD summary table to indicate that only CO_2 (and not CO_2e) emissions have been provided.
TRS_H2S Stack Test Factors TAB - The controlled factor derived for SOG, controlled, average (cell B16) was derived by averaging D10 and G10. G10 is a negative value and was treated in the "average" as 0. Why was the D10 value "averaged" (divided by 2) and so half the value used as the factor? Isn't the result in G10 suspect? Why would you not use the entire D10 value? Please explain the reasoning behind this. However, using the "averaged" value is more conservative. The emissions from burning SOG were determined by subtracting the emissions burning NCG only from the emissions burning NCG + SOG. The emissions from NCG were higher than NCG + SOG from Combination Boiler No. 2. The SOG emissions are not expected to be negative, so a value of zero (no impact from SOG from Combination Boiler No. 2) was substituted for the negative result.
Application
PSD Analysis - Provide a discussion on the baseline actual emissions whether any excess emissions and/or any out of compliance emissions occurred. Baseline emission rates are to be adjusted downward for any emissions out of compliance. Please elaborate with the applicable emission limitations, etc. The baseline actual emissions do not include excess emissions and/or any emissions that were out of compliance. Site-specific test data that were used to develop BAE were from approved test data that demonstrated compliance with any applicable air emissions limits. For example, the applicable emissions limit of SO_2 emissions from NCG combustion is 10.1 lb/ADTP. The October 2021 test results used for BAE showed actual emissions of less than 4 lb/ADTP. Also, the TRS, H2S, and MMC data used for BAE was used by DHEC to demonstrate compliance with the MAAC. There are no air emissions limitations on the WWTP.
NSPS Subpart BB and BBa - Under c/p-DF, it was determined that the Digester System, the No. 1 Evaporator System, and the existing Condensate Stripper System were being modified. A modification under NSPS regulations is any physical or operational change to an existing facility which results in an increase in the emission rate… TRS emissions are regulated by Subpart BB and BBa, changes in the method of operation were occurring with increases in emissions. These sources are now subject to NSPS Subpart BBa, not Subpart BB as discussed on pages 3-1 and 3-2 of the application. The limits between the two Subparts are generally the same. Subpart BBa has slightly more rigorous monitoring, recordkeeping, and reporting. The June 2019 Project Columbia construction permit application correctly identified the sources listed above as becoming subject to 40 CFR Part 60, Subpart BBa following the completion of Project Columbia, as specified in c/p-DF.
SC Std No. 4

- FYI, there is no "cut off" date in Std No. 4. Sources which commenced construction prior to Sept 24, 1976 are subject to the TRS requirements in Section XI of SC Std No. 4 regardless if they were modified or reconstructed or become subject to NSPS BB or BBa. Therefore, requirements from this regulation will be included in the construction permit for any of the sources covered under SC Std No. 4. SC Std No. 4 is very similar to NSPS BB and BBa. In addition to the sources listed in the application, we understand that the Nos. 1-2 Evaporators Sets with Concentrators will be subject to Standard No. 4, Section XI requirements for TRS because these sources commenced construction prior to September 24, 1976.
Page 3-16, 2nd paragraph - Why were biomass emissions not estimated in the BAE and PAE scenarios? New-Indy Catawba operates the two recovery furnaces as base-loaded steam generators with the combination boilers handling most swings in steam load. New-Indy Catawba burns all the biomass available in the combination boilers because biomass is the most cost-effective fuel on an MMBtu basis. Additional steam is generated from burning natural gas and No. 6 fuel oil as needed and it was assumed that any steam used in the current/existing stripper and any steam needed to operate the new stripper would be generated from fossil-fuel firing.

SCDHEC BAQ comments/questions for New-Indy (2440-0005)
on the new Stripper construction application, sent May 8, 2023, responses due May 22, 2023

Application

1. The current Title V operating permit lists the current, existing stripper at 800 gpm. Also, the application for the conversion (c/p-DF revision) lists the existing stripper at 800 gpm and the hardpipe at 1,200 gpm. The application for the new stripper lists the existing stripper at 850 gpm and the hardpipe at 850 gpm. Please explain these differences. What is the maximum gpm of foul condensate generated from the processes?
   The new condensate stripper is designed to process 100% of the foul condensate generated at a maximum pulp production of 2,400 to 2,700 ADTP (equivalent to a maximum foul condensate flow of 850 gpm).
2. The latest MACT S reports on condensate collection and treatment show that the current stripper handles 350 gpm of foul condensate with the rest of the foul condensate going to the ASB. When this stripper operates as the backup stripper, what will happen to the rest of the foul condensate (not the stripped condensate from the stripper)? Why are the projected actual emissions when the backup stripper operates using 850 gpm (page B-76)?
   The backup stripper was originally designed for stripping methanol from 800 gpm of foul condensate. Issues with fouling have hampered the ability to continuously operate at the design rate. As a backup operating unit, the existing stripper will operate in "TRS only mode". The stripper will operate at lower effective steam ratios which will allow all the condensate to run through the column. Methanol stripping will be minimal in this mode. Therefore, the stripped condensate will then be pumped to the wastewater treatment cell for further treatment.
3. On page B-130, the "Fraction biodegraded" is blurred or marked out. What is the number supposed to be here?
   Fbio = 87.9 on pg B-130
4. On pages B-122, B-126, and B-130, a wind speed of 3.8 mph is shown. This value is different than that used in the H2SSIM model input/output sheets and that used in the WATER9 models. Should the wind speeds be consistent within each scenario, from model to model?

Wind speed of 3.8 mph was used for the Form XII calculations as a representative value from the July 2021 IPT. Wind speed of 3.55 mph was used for the H2SSIM model based on August 2022 onsite wind speed data to be representative of the May and July 2022 tests. The ambient temperature of 79 F has been the Mill's default value for H2SSIM runs and is based on National Oceanic and Atmospheric Administration (NOAA) data from Greenville-Spartanburg, SC. The difference in wind speed is minor and is not believed to have an impact on the conclusions of the calculations.

The ambient temperature and wind speed in WATER9 are the default values for the model. Per page 187 of the document for air emission models for hazardous waste treatment, storage, and disposal facilities (TSDF) that documents the basis for the WATER9 emissions calculations ("AIR EMISSIONS MODELS FOR WASTE AND WASTEWATER EPA-453/R-94-080A, U.S. EPA Contract No. 68D10118, November 1994"):

> Two meteorological parameters required in the models are temperature and windspeed. The emission estimates are based on a standard temperature of 25 ˚C and a windspeed of 4.47 m/s (10 mi/h). These standard values were evaluated by estimating emissions for windspeed/temperature combinations at actual sites based on their frequency of occurrence. Over a 1-yr period, the results from site-specific data on windspeed and temperature were not significantly different from the results using the standard values. Consequently, the standard

values were judged adequate to estimate annual emissions. For short-term emissions, the actual temperature and windspeed over the short-term interval should be used to avoid underestimating emissions during high-windspeed /high-temperature conditions.

5. On Page B-55, Baseline Methanol Emission Factor – the factor developed, 0.92 lb/ODTP, is from averaging the two averages. Baseline emissions should be based on the 24 month average. I believe the entire column of lb/ODTP should be averaged to arrive at the factor to be used in the calculations for the baseline.
   We believe that the July and October 2021 performance test results and associated air emissions from the aerated stabilization basin (ASB) are representative of the operations and emissions from March 2021 through mid-February 2022 [air emissions presented on page B-55 range from 1.22 to 1.9 lb methanol per oven dried tons of pulp (lb/ODTP)] and the four performance test results in 2022 and associated air emissions from the ASB are representative of operations and emissions from mid-February 2022 through February 2023 emissions (air emissions range from 0.02 to 0.19 lb methanol/ODTP, except for the February 2022 test which ranged from 1.03 to 1.36 lb/ODTP). Therefore, averaging the average of these two periods is representative of the 24-month baseline period for March 2021 through February 2023.
6. Pg B-55, Baseline Methanol Emissions Factor – I understand there were some issues during the August 2022 testing and a re-test was conducted in September 2022. Should the data from the August 2022 testing be included in the calculations for the methanol emission factor?
   Yes, both the August and September 2022 testing at the ASB was representative of normal operations. The required treatment of 6.6 lb hazardous air pollutants (HAP)/ODTP was not met due to low collection and lower than typical methanol removal in the existing condensate stripper.
7. On the Foul Cond Sulfur spreadsheet, duplicate sample results (6/24/2021, 15:10) are reported and used in the calculation. Is it appropriate to include the duplicate?
   Yes, unless the samples are invalidated, protocol is to average and report the original and duplicate sample results.
8. Please provide the data that was used to arrive at the "stripped" VOC emission factor for the baseline scenario. Please point to where it is in the application if I have overlooked it.
   See response to question on VOC Fresh Start tab under comments on stripper application 1.

WATER9 and H2SSIM inputs

9. There is a source called "Open Hub Drain" in the WATER9 results. What is this and why are the emissions from it not counted in with the emission rates from the 3 zones of the ASB?
   The open hub drain is an open drain that discharges into a closed conduit. In this case, the open hub drain is an element of WATER9 used to connect the ASB Inlet stream into the ASB Zone 1.
10. The Backup Stripper Scenario projected actual emissions (pg B-76) lists the stripped condensate flow at 850 gpm. According to the MACT S periodic condensate collection and treatment reports, the backup stripper seems to only handle up to 350 gpm. Please explain why the Backup Stripper Scenario projected actual emissions appears to use 850 gpm. Plus, this is not the same design capacity listed in the TV OP for this stripper.
    See response to Question 2 in this document.
11. Please comment on the changing residence time in the various zones of the ASB for the different projected actual emissions scenarios and the baseline actual emissions scenario. Different residence times were calculated in Form XIII for the existing and no stripper scenarios than those calculated in the WATER9 models.
    The residence times that appear in Form XIII documents are estimated based on the inputs that were determined to be representative, but do not affect the calculations. The Mill believes that the different estimated residence times between WATER9 and Form XIII are of no consequence.

12. The temperatures of the wastewater for the different zones of the ASB are different than those used in the Appendix C Forms – calculating fraction biodegraded, pages B-122, B-126, and B-130.
    Temperatures used in the H2SSIM and WATER9 models were based on data from the May and July 2022 TRS testing to coincide with the concentration data/flows used. The temperatures used in the Form XIII calculations were from the August 2022 Subpart S performance test to representative worst-case temperatures.
13. Page B-114 – PAE H2S Factor, Summary of H2SSIM inputs and outputs, the Backup Stripper scenario shows that 850 gpm (1.22 MGD) goes to the hardpipe. If some of the foul condensate flow is stripped would this amount be reduced that goes to the hardpipe? The MACT S periodic foul condensate treatment reports show the average foul condensate stripped at 350 gpm.
    In the Backup Stripper Scenario, the Mill estimated the stripped condensate flow was equal to the foul condensate flow to the stripper since the TRS concentrations in the stripped condensate were based on the 98% reduction in the foul condensate concentrations. The same flow basis was needed to estimate the reduction in concentrations as a result of stripping TRS in the Backup Stripper. The stripped condensate flow could be different due to steam condensing or mass transfer, but the concentrations would also be affected by the change in flow.
14. July 2021 Initial Performance Test (IPT) results and the Baseline Methanol Emissions Factor, pg B-55 – The air stripping g/s on pg B-55 listed for July 2021 does not seem to match up to those in the Form XIII in the IPT results from July 2021.
    The results of the July 2021 IPT were considered to be the calculations that were updated at DHEC's request as part of the Mill's October 5, 2021 response to comments.
15. Please provide the supporting data for calculating the VOC emissions from acetaldehyde, methyl ethyl ketone, and propionaldehyde.
    See supporting information below. BAE emissions of non-methanol VOC were based on the hardpipe concentrations during 2021 and 2022 Subpart S performance tests that were fairly constant. The non-methanol VOC emissions factor constitutes a very small fraction of the total BAE VOC emissions factor of 0.97 lb/ODTP. For PAE scenarios, non-methanol VOC were scaled by the relationship of the PAE methanol emissions factor each scenario as compared to the BAE methanol emissions factor.

Date of Subpart S Performance Testing	Acetaldehyde, ppm	MEK, ppm	Propionaldehyde, ppm
7/9/2021	24.3	7.7	1.1
7/10/2021	25.3	5.7	4.0
7/11/2021	25.0	6.5	7.0
10/26/2021	25.0	12.3	0.8
10/27/2021	27.5	13.3	1.0
10/28/2021	10.6	6.6	1.2
10/29/2021	15.0	8.6	0.9
2/14/2022	16.7	7.5	0.7
2/15/2022	17.0	9.5	0.6
2/16/2022	15.7	8.6	1.0
5/4/2022	20.7	7.1	1.0

5/5/2022	16.3	7.3	1.0
5/6/2022	15.0	6.8	1.0
8/9/2022	15.3	5.9	0.7
8/10/2022	25.0	7.2	1.1
8/11/2022	20.3	6.0	1.0
9/27/2022	14.3	5.3	0.7
9/28/2022	15.0	5.2	0.7
9/29/2022	18.0	5.6	0.9
10/18/2022	25.0	5.6	1.0
10/19/2022	23.7	5.5	1.1
10/20/2022	23.0	6.6	0.9
AVG ppm:	**19.72**	**7.28**	**1.34**
Lbs into ASB	55.48	20.49	3.78
Fair estimated from WATER9 properties	0.55	0.38	0.43
Lbs emitted	30.73	7.73	1.61
Average Pulp Production during Subpart S testing	1716		
lb/ODTP	**0.018**	**0.005**	**0.001**

Attachment A

Current Stripper Revised Baseline

May 22 Response

Average Actual (5/3/21-2/28/23)

	MLb/hr	Mmbtu/hr	
Steam In	50.0	42.8	(Latent heat of steam at measured pressure)
Steam Out	24.0	21.8	(Latent heat of steam at measured pressure)
		21.1	Steam Used by Existing Stripper in baseline period, MMBtu/hr

Steam

Gage Pressure	Latent Heat (Btu/lb)
57.8	906.4
60	904.9
150	857.6
150.5	857.6

Source: TLV.com/global/US/calulator

Buckner, Katharine

From:	Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Sent:	Monday, May 8, 2023 7:55 AM
To:	Buckner, Katharine
Subject:	RE: Additional comments on new Stripper app
Attachments:	Responses to DHEC (5-5-23) DRAFT.docx

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***

Katharine
Happy Monday. Please find the attached comments to your questions.

From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Wednesday, April 26, 2023 4:13 PM
To: Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Subject: Additional comments on new Stripper app

External Email

Hello Bob,

Attached please find additional comments on the calculations and some discussions in the application. Please provide responses to these comments by May 10, 2023. If you should need additional time, please let me know prior to this date and provide a date when the information will be provided.

Feel free to call or email if you need clarification on anything.

Thank you,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

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SCDHEC BAQ comments/questions for New-Indy (2440-0005)
on the new Stripper construction application, sent April 26, 2023

Application

1. NSPS, Section 60.14: According to NSPS 60.14, a modification is "…any physical or operational change to an existing facility which results in an increase in the emission rate…" of any pollutant to which a standard applies. Please discuss whether the following changes would qualify as a modification or not under NSPS. If so, please detail the applicable regulatory changes that will result.
    a. Combusting the methanol condensate in Nos. 2 and 3 Recovery Furnaces
    b. Combusting the condenser LVHC in No. 3 Recovery Furnace
    c. Addition of the 1.0 million Btu/hr natural gas ignitor in the No. 3 Recovery Furnace
    d. Any other changes that are occurring that are "physical or operational" that increases emissions, please discuss those too.

The modifications or changes in the method of operation noted in items a through c above are not considered modifications for the purposes of evaluating new source performance standards (NSPS) applicability per §60.14(e)(5). The purpose for combustion of the rectified methanol (liquid) in the Nos. 2 and 3 Recovery furnaces, combustion of the low volume high concentration (LVHC) system gases in the No. 3 Recovery Furnace, and installation of the natural gas ignitor in the No. 3 Recovery Furnace is explicitly for the destruction of total reduced sulfur (TRS) and hazardous air pollutant (HAP) emissions for the new condensate stripper system and existing LVHC system gases as required under 40 CFR 60, Subpart BBa and 40 CFR 63, Subpart S.

> §60.14(e) The following shall not, by themselves, be considered modifications under this part:
> (5) The addition or use of any system or device whose primary function is the reduction of air pollutants, except when an emission control system is removed or is replaced by a system which the Administrator determines to be less environmentally beneficial.

The *Consent Oder to Correct Undesirable Levels of Air Contaminants* effective November 23, 2022, requires New-Indy Catawba to control methanol and sulfur compounds from the stripped condensate in the recovery furnaces.

> "New-Indy must install, operate, and maintain a primary stripper that is adequately sized to collect and treat all foul condensate streams in accordance with applicable state and federal air quality regulations. The primary stripper shall use low pressure steam and must be designed for both methanol and sulfur compound removal with the off gases being treated in the recovery boilers to absorb the sulfur compounds in the stripper off gas."

Regarding item d, there are no other physical or operational changes proposed as part of the project that could increase the short-term emissions rates of regulated pollutants under 40 CFR 60, Subpart BBa [i.e., TRS or particulate matter (PM)].

WATER9 and H2SSIM inputs
ASB 2. The dimensions of the ASB are different than that used in the July 2021 model runs. Why? a. Then ASB 225 x 225 meters b. Now 295 x 295 The ASB zone dimensions were updated in 1Q2022 based on updated aerial imaging to represent progress of ongoing removal of solids. The updated zone dimensions were determined to be representative of the ASB during the majority of the baseline period and are also consistent with the Mill's quarterly Subpart S performance test calculations dating back to 1Q2022. Although future solids removal is expected, the Mill would need to perform additional sampling after the solids are removed to determine the emissions impact of a larger surface area and less solids. We believe that use of the 1Q2022 surface area is the most conservative approach for projected emissions with the new stripper (i.e. yields the highest air emissions). Please note that the actual performance test results were utilized for estimating the baseline methanol emissions. 3. The ambient temperature and wind speed used for the model runs of the H2SSIM model for the July 2022 data seems conservative and were also used in the May 2022 model runs. A temperature of 79 F was used and 3.55 mph. Also, the values used in the WATER9 model differ from those used in the H2SSIM model. WATER9 used Temperature of Air (C) of 25 (or 77F) and Wind speed (cm/s at 10 m) of 447 (or 9.91 mph). Please discuss whether these should be the same between the two models, why or why not. In the October 2021 Corrective Action Plan report, a wind speed of 3.79 mph was used in the H2SSIM model. Wind speed of 3.55 mph was used for the H2SSIM model based on August 2022 onsite wind speed data to be representative of the May and July 2022 tests. The ambient temperature of 79 F has been the Mill's default value for H2SSIM runs and is based on National Oceanic and Atmospheric Administration (NOAA) data from Greenville-Spartanburg, SC. The ambient temperature and wind speed in WATER9 are the default values for the model and have not been changed. Per page 187 of the document for air emission models for hazardous waste treatment, storage, and disposal facilities (TSDF) that documents the basis for the WATER9 emissions calculations ("AIR EMISSIONS MODELS FOR WASTE AND WASTEWATER EPA-453/R-94-080A, U.S. EPA Contract No. 68D10118, November 1994"): Two meteorological parameters required in the models are temperature and windspeed. The emission estimates are based on a standard temperature of 25 ˚C and a windspeed of 4.47 m/s (10 mi/h). These standard values were evaluated by estimating emissions for windspeed/temperature combinations at actual sites based on their frequency of occurrence. Over a 1-yr period, the results from site-specific data on windspeed and temperature were not significantly different from the results using the standard values. Consequently, the standard values were judged adequate to estimate annual emissions. For short-term emissions, the actual temperature and windspeed over the short-term interval should be used to avoid underestimating emissions during high-windspeed /high-temperature conditions.

4. Pg B-27 appears to say a production rate of 2200 ODTP/day was used to figure the baseline emission factors. But it appears that the average of the 4 test runs (May 2021, and the 3 in July 2021) were used. Why mention the use of 2200 ODTP/day here? You are correct. 2200 ODTP/day was not used to determine the baseline emissions factors on page B-27. It should not mention 2200 ODTP/day there.
5. Why are emissions from only the ASB being calculated and not the other sources in the Wastewater Treatment Plant? If emissions and such are changing at the ASB, wouldn't it be expected that emissions from the units that follow the ASB to be having changes too that should be accounted for? The project-related emissions increase analysis includes only the new, modified and affected emissions units. There are no new or modified emissions units in the wastewater treatment plant (WWTP) area proposed as part of the project. In addition, the only portions of the WWTP that are affected by the project pertain to those portions whose emissions are impacted by the foul pulping condensates that are introduced into zone 1 of the aerated stabilization basin (ASB) through the Hardpipe. The affected portions of the WWTP whose emissions are impacted by the Hardpipe are zones 1-3 of the ASB where treatment and volatilization occurs. The portions of the WWTP that pertain to the primary wastewater treatment (i.e., mix box, bar screen, primary clarifier, and ditches) and primary sludge treatment (i.e. settling pond), are not impacted by the Hardpipe, since the Hardpipe is introduced downstream of the primary treatment operations. The portions of the WWTP that are post-secondary treatment (i.e., the Holding Pond and the Post-aeration Basin) are not impacted by the Hardpipe since the effluent concentration of the ASB is negligible. The Holding Basin emits small amounts of hydrogen sulfide believed to be generated from anaerobic activity. The post-aeration basin is equipped with carbon adsorption control and also emits small amounts of hydrogen sulfide. Sludge Pond No. 4 emits small amounts of hydrogen sulfide that is generated from anaerobic activity from ASB sludge deposited and stored and is not impacted by the Hardpipe stream.
Emission Calculations spreadsheet
WWTP Factors TAB and TRS TAB 6. The TRS emission factors on the WWTP Factors tab are given in terms of lb/ODTP. On the TRS Tab, this value is converted to lb/ADTP by multiplying by 0.9. Shouldn't it be converted by dividing by 0.9 to get lb/ADTP? ADTP is slightly heavier than ODTP. The value in the TRS tab for lb/ADTP is smaller (aka. lighter) than the lb/ODTP. Please check all your other spreadsheets for this too. Due to the pulp production number being located in the denominator of the emissions factor, multiplying by 0.9 is correct to convert from lb/ODTP to lb/ADTP. See below. On a weight basis, 1 ADTP weighs the same as 1 ODTP, but contains less pulp due to the moisture. Therefore, on a pulp basis, 1 ADTP is equivalent to only 0.9 ODTP. $\frac{lb}{ODT} x \frac{0.9\ ODT}{1\ ADT} = \frac{lb}{ADT}$

Buckner, Katharine

From:	Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Sent:	Friday, May 26, 2023 3:16 PM
To:	Buckner, Katharine
Subject:	Fw: emission spreadsheet
Attachments:	REVISED Emissions Calculations (5-26-23).xlsx

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***

Here you go. Have a good weekend.

From: Caleb Fetner <cfetner@all4inc.com>
Sent: Friday, May 26, 2023 2:27 PM
To: Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Cc: Steven Moore <smoore@all4inc.com>; Sheryl Watkins <swatkins@all4inc.com>
Subject: RE: emission spreadsheet

External Email

Bob, see revised calculations as of today that you can pass along to Katherine.

We think it's important to note that as of 5/26/23, we have revised baseline actual emissions calculations in the following ways (1) baseline pulp production was revised and (2) baseline net steam used by existing steam stripper which resulted in decreases in BAE for all pollutants. At this time, the projected actual emissions estimates for the steam required for the new steam stripper have not been revised, but are expected to decrease due to the original application not accounting for any steam offsets that the Mill is including in the project. Once the final scope of these projects are finalized, the decrease in net steam required by the new steam stripper will result in decreases in PAE emissions.

The 5/26/23 also included revisions to the VOC emissions factors for natural gas (1000 Btu/scf) to be consistent with other tabs.

Caleb

Caleb Fetner / Consulting Engineer
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ALL4 // *STRATEGY WITH SOLUTION. PARTNERSHIP WITH A PURPOSE.*

From: Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Sent: Friday, May 26, 2023 9:19 AM
To: Buckner, Katharine <bucknekk@dhec.sc.gov>
Cc: Caleb Fetner <cfetner@all4inc.com>
Subject: RE: emission spreadsheet

Katharine
I have included Caleb Fetner on this email.

Caleb
Do we have the updated emission spreadsheet ready to send to Katharine?

From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Friday, May 26, 2023 7:45 AM
To: Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Subject: emission spreadsheet

External Email

Hey Bob,
Could you send the updated emissions spreadsheet? I would like to look at it over the weekend to see if there are any more questions.

Thank you. I am off today.

Have a nice holiday weekend,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

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NEW-INDY CATAWBA MILL STRIPPER PROJECT

Stripper Operating Scenario	Operating Time %	Operating Time hrs
New Stripper Online	90%	7,884.0
Backup Stripper Online	8%	700.8
No Stripper Online	2%	175.2

LVHC Control Operating Scenario	Operating Time %	Operating Time hrs
RF3 Available for LVHC	75%	6,570.0
LVHC to CB1/CB2	25%	2,190.0

	Baseline				
Existing Stripper Steam Demand	21.1	MMBtu/hr	was previously	23.9	MMBtu/hr

(Attachment A to May 22 Response to DHEC Comments on App 1)

Summary of PSD Applicability
(tons/year)

Pollutant[(A)]	PM	PM_{10}	$PM_{2.5}$	NO_X	SO_2	CO	H2SO4	TRS	VOC	Pb	H_2S	CO_2
Baseline Actual Emissions	1.11	1.02	0.959	124	737	25.2	1.23	12.8	239	1.10E-04	3.61	12,275
Projected Actual Emissions	13.4	10.4	8.45	148	629	64.2	2.43	15.6	248	2.08E-03	5.69	48,629
Net Emissions Changes (PAE - BAE)	12.3	9.41	7.49	24.2	-108.18	39.0	1.20	2.75	9.4	1.97E-03	2.09	36,354
PSD Significant Emissions Rates	**25**	**15**	**10**	**40**	**40**	**100**	**7**	**10**	**40**	**0.6**	**10**	**75,000**
PSD Significant?	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**

A - HF is not emitted from new, modified, or affected emissions units.

SO2 EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		SO2 Emissions Factor		Sulfur Capture[C]	SO2 Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100%	8,004.0	SOG to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	1.06	October 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	60.4	241.8
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	1.97	October 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	112.0	490.6
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B,E]	97.9%	7,835.7	NA	100.0%	7,835.7	26.0	mmBtu/hr	6.00E-04	AP-42 Table 1.4-2.	NA	0.02	0.1
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B,E]	2.1%	168.3	NA	100.0%	168.3	24.8	mmBtu/hr	2.20E+00	AP-42 Table 1.3-1. 2.1% Sulfur Content.	NA	54.6	4.6
SO2 BASELINE ACTUAL EMISSIONS (BAE)															**737.0**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90.0%	7,884.0	SRL Online	95%	7,489.8	SRL Methanol to RF2/3[G]	100.0%	7,489.8	2,700	ADTP/day	0.56	Vendor / Preliminary Design Information	99%	0.6	2.4
New Stripper Online	90.0%	7,884.0	SRL Online	95%	7,489.8	SRL LVHC to RF3[G]	75.0%	5,617.4	2,700	ADTP/day	0.84	Vendor / Preliminary Design Information	99%	0.9	2.7
New Stripper Online	90.0%	7,884.0	SRL Online	95%	7,489.8	SRL LVHC to CB1/CB2[G]	25.0%	1,872.5	2,700	ADTP/day	0.84	Vendor / Preliminary Design Information	50%	47.2	44.2
New Stripper Online	90.0%	7,884.0	SRL Offline	5%	394.2	SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	1.40	Vendor / Preliminary Design Information	0%	157.4	31.0
Backup Stripper Online	8.0%	700.8	NA	100%	700.8	SOG to CB1/CB2	100.0%	700.8	2,700	ADTP/day	1.40	Vendor / Preliminary Design Information	0%	157.4	55.1
No Stripper Online	2.0%	175.2	Foul Condensate to Hard Pipe	100%	175.2	Hydrogen Peroxide Addition	100.0%	175.2	NA	NA	NA	NA	NA	NA	NA
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	5.25	October 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. Pre-control emissions based on LVHC scrubber efficiency (50%) and estimated bark ash sulfur capture (20%) from 2012 stack test.	99%	5.9	19.4
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	5.25	October 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. Pre-control emissions based on LVHC scrubber efficiency (50%) and estimated bark ash sulfur capture (20%) from 2012 stack test.	50%	295.2	323.3
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5	NA	100.0%	985.5	1.0	mmBtu/hr	6.00E-04	AP-42 Table 1.4-2.	NA	0.00	0.0
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D,F]	81.6%	6,433.3	NA	100.0%	6,433.3	96.8	mmBtu/hr	6.00E-04	AP-42 Table 1.4-2.	NA	0.06	0.2
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D,F]	18.4%	1,450.7	NA	100.0%	1,450.7	92.2	mmBtu/hr	2.20E+00	AP-42 Table 1.3-1. 2.1% Sulfur Content.	NA	202.9	147.2
Backup Stripper Steam - Natural Gas	8.0%	700.8	Natural Gas[D,F]	81.6%	571.9	NA	100.0%	571.9	25.3	mmBtu/hr	6.00E-04	AP-42 Table 1.4-2.	NA	0.02	0.004
Backup Stripper Steam - No. 6 Oil	8.0%	700.8	No. 6 Oil[D,F]	18.4%	128.9	NA	100.0%	128.9	24.1	mmBtu/hr	2.20E+00	AP-42 Table 1.3-1. 2.1% Sulfur Content.	NA	53.1	3.4
SO2 PROJECTED ACTUAL EMISSIONS (PAE)															**628.84**
NET EMISSIONS CHANGE (PAE - BAE)															
NET EMISSIONS CHANGE (PAE - BAE)															**-108.18**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boiliers No. 1 and No. 2 during baseline.

C - Sulfur capture in recovery furnace >99, sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

H2SO4 EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		H2SO4 Emissions Factor		Sulfur Capture	H2SO4 Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/ADTP	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	4.93E-03	NCASI Technical Bulletin 858, Table 10	NA	0.3	1.2
H2SO4 BASELINE ACTUAL EMISSIONS (BAE)															**1.2**
PROJECTED ACTUAL EMISSIONS															
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	4.93E-03	NCASI Technical Bulletin 858, Table 10	NA	0.55	1.82
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	4.93E-03	NCASI Technical Bulletin 858, Table 10	NA	0.55	0.61
H2SO4 PROJECTED ACTUAL EMISSIONS (PAE)															**2.43**
NET EMISSIONS CHANGE (PAE - BAE)															
NET EMISSIONS CHANGE (PAE - BAE)															**1.20**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boiliers No. 1 and No. 2 during baseline.

C - Sulfur capture in recovery furnace >99, sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

NOX EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		NOX Emissions Factor		Ammonia Increase[C]	NOX Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	SOG to CB1/CB2	100%	8,004.0	1,365	ADTP/day	0.415	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	23.6	94.5
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B,E]	97.9%	7,835.7	NA	100%	7,835.7	26.0	mmBtu/hr	2.80E-01	AP-42 Table 1.4-2.	NA	7.3	28.6
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B,E]	2.1%	168.3	NA	100%	168.3	24.8	mmBtu/hr	3.13E-01	AP-42 Table 1.3-1.	NA	7.8	0.7
NOX BASELINE ACTUAL EMISSIONS															**123.7**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3[G]	100%	7,489.8	2,852	TBLS/day	1.500	NCASI Technical Bulletin 884, Table 4.12.	1.0%	1.8	6.7
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3[G]	75%	5,617.4	316.9	TBLS/day	1.500	NCASI Technical Bulletin 884, Table 4.12.	1.0%	0.2	0.6
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2[G]	25%	1,872.5	270.0	ADTP/day	0.415	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	4.7	4.4
New Stripper Online	90%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100%	394.2	2,700	ADTP/day	0.415	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	46.7	9.2
Backup Stripper Online	8%	700.8	NA	100.0%	700.8	SOG to CB1/CB2	100%	700.8	2,700	ADTP/day	0.415	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	46.7	16.4
No Stripper Online	2%	175.2	Foul Condensate to Hard Pipe	100.0%	175.2	Hydrogen Peroxide Addition	100%	175.2	NA	NA	NA	NA	NA	NA	NA
Recovery Furnace #3 LVHC Ignitor	75%	6,570.0	Natural Gas[I]	15.0%	985.5	NA	100%	985.5	1.0	mmBtu/hr	2.80E-01	AP-42 Table 1.4-2.	NA	0.3	0.1
New Stripper Steam - Natural Gas	90%	7,884.0	Natural Gas[D,F]	81.6%	6,433.3	NA	100%	6,433.3	96.8	mmBtu/hr	2.80E-01	AP-42 Table 1.4-2.	NA	27.1	87.2
New Stripper Steam - No. 6 Oil	90%	7,884.0	No. 6 Oil[D,F]	18.4%	1,450.7	NA	100%	1,450.7	92.2	mmBtu/hr	3.13E-01	AP-42 Table 1.3-1.	NA	28.9	20.9
Backup Stripper Steam - Natural Gas	8%	700.8	Natural Gas[D,F]	81.6%	571.9	NA	100%	571.9	25.3	mmBtu/hr	2.80E-01	AP-42 Table 1.4-2.	NA	7.1	2.0
Backup Stripper Steam - No. 6 Oil	8%	700.8	No. 6 Oil[D,F]	18.4%	128.9	NA	100%	128.9	24.1	mmBtu/hr	3.13E-01	AP-42 Table 1.3-1.	NA	7.5	0.5
NOX PROJECTED ACTUAL EMISSIONS															**147.9**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**24.2**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Ammonia input to recovery furnace increases >1% (methanol input limited to 1% of black liquor input by BLRBAC).

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - >90% of methanol condensed and burned in recovery furnace, < 10% of methanol vented into LVHC System.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

CO EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		CO Emissions Factor		CO Control	CO Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	SOG to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	0.0728	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	4.1	16.6
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7	NA	100.0%	7,835.7	26.0	mmBtu/hr	8.40E-02	AP-42 Table 1.4-2.	NA	2.2	8.6
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3	NA	100.0%	168.3	24.8	mmBtu/hr	3.33E-02	AP-42 Table 1.3-1.	NA	0.8	0.1
CO BASELINE ACTUAL EMISSIONS															**25.2**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3	100.0%	7,489.8	NA	NA	NA	NA	NA	NA	NA
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3	75%	5,617.4	2,700	ADTP/day	0.0728	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	8.2	23.0
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2	25%	1,872.5	2,700	ADTP/day	0.0728	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	8.2	7.7
New Stripper Online	90%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	0.0728	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	8.2	1.6
Backup Stripper Online	8%	700.8	NA	100.0%	700.8	SOG to CB1/CB2	100.0%	700.8	2,700	ADTP/day	0.0728	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	8.2	2.9
No Stripper Online	2%	175.2	Foul Condensate to Hard Pipe	100.0%	175.2	Hydrogen Peroxide Addition	100.0%	175.2	NA	NA	NA	NA	NA	NA	NA
Recovery Furnace #3 LVHC Ignitor	75%	6,570.0	Natural Gas[I]	15.0%	985.5	NA	100.0%	985.5	1.0	mmBtu/hr	8.40E-02	AP-42 Table 1.4-2.	NA	0.1	0.0
New Stripper Steam - Natural Gas	90%	7,884.0	Natural Gas[D]	81.6%	6,433.3	NA	100.0%	6,433.3	96.8	mmBtu/hr	8.40E-02	AP-42 Table 1.4-2.	NA	8.1	26.2
New Stripper Steam - No. 6 Oil	90%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7	NA	100.0%	1,450.7	92.2	mmBtu/hr	3.33E-02	AP-42 Table 1.3-1.	NA	3.1	2.2
Backup Stripper Steam - Natural Gas	8%	700.8	Natural Gas[D]	81.6%	571.9	NA	100.0%	571.9	25.3	mmBtu/hr	8.40E-02	AP-42 Table 1.4-2.	NA	2.1	0.6
Backup Stripper Steam - No. 6 Oil	8%	700.8	No. 6 Oil[D]	18.4%	128.9	NA	100.0%	128.9	24.1	mmBtu/hr	3.33E-02	AP-42 Table 1.3-1.	NA	0.8	0.1
CO PROJECTED ACTUAL EMISSIONS															**64.2**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**39.0**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - reserved.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

VOC EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		VOC Emissions Factor		Removal[C]	VOC Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	LVHC to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	4.35	Average daily methanol stripped based on daily Subpart S compliance through 2/28/2023.	98.0%	4.95	19.81
Aerated Stabilization Basin (ASB)	100.0%	8,760.0	Foul Condensate to Hard Pipe	100.0%	8,760.0	NA	100.0%	8,760.0	1,365	ADTP/day	8.73E-01	WATER9 Inputs and Outputs Provided.	NA	49.67	217.54
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	3.10E-03	July 2019 Project Columbia Application. Page C-3 for Total LVHC Emissions.	NA	0.18	0.77
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7	NA	100.0%	7,835.7	26.0	mmBtu/hr	5.50E-03	AP-42 Table 1.4-2.	NA	0.1	0.6
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3	NA	100.0%	168.3	24.8	mmBtu/hr	1.87E-03	AP-42 Table 1.3-3. NMTOC for no. 6 oil.	NA	0.0	0.0
VOC BASELINE ACTUAL EMISSIONS															**238.69**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3[G]	100%	7,489.8	2,700	ADTP/day	14.40	Vendor / Preliminary Design Information	99.9%	1.62	6.07
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3[G]	75%	5,617.4	2,700	ADTP/day	1.60	Vendor / Preliminary Design Information	98%	3.60	10.11
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2[G]	25%	1,872.5	2,700	ADTP/day	1.60	Vendor / Preliminary Design Information	98%	3.60	3.37
New Stripper Online	90%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100%	394.2	2,700	ADTP/day	16.00	Vendor / Preliminary Design Information	98%	36.00	7.10
Backup Stripper Online	8%	700.8	NA	100.0%	700.8	SOG to CB1/CB2	100%	700.8	2,700	ADTP/day	16.00	Vendor / Preliminary Design Information	98%	36.00	12.61
ASB - New Stripper Online	90%	7,884.0	No Foul Condensate to Hard Pipe	100.0%	7,884.0	NA	100%	7,884.0	2,700	ADTP/day	0.29	WATER9 Inputs and Outputs Provided.	NA	32.40	127.72
ASB - Backup Stripper Online	8%	700.8	TRS Stripped From Foul Condensate	100.0%	700.8	NA	100%	700.8	2,700	ADTP/day	1.42	WATER9 Inputs and Outputs Provided.	NA	159.98	56.06
ASB - No Stripper Online	2%	175.2	Foul Condensate to Hard Pipe	100.0%	175.2	NA	100%	175.2	2,700	ADTP/day	2.20	WATER9 Inputs and Outputs Provided.	NA	247.05	21.64
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to RF3	75%	6,570.0	2,700	ADTP/day	3.10E-03	July 2019 Project Columbia Application. Page C-3 for Total LVHC Emissions.	NA	0.35	1.15
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	25%	2,190.0	2,700	ADTP/day	3.10E-03	July 2019 Project Columbia Application. Page C-3 for Total LVHC Emissions.	NA	0.35	0.38
Recovery Furnace #3 LVHC Ignitor	75%	6,570.0	Natural Gas[I]	15.0%	985.5	NA	100%	985.5	1.0	mmBtu/hr	5.50E-03	AP-42 Table 1.4-2.	NA	0.0	0.0
New Stripper Steam - Natural Gas	90%	7,884.0	Natural Gas[D]	81.6%	6,433.3	NA	100%	6,433.3	96.8	mmBtu/hr	5.50E-03	AP-42 Table 1.4-2.	NA	0.5	1.7
New Stripper Steam - No. 6 Oil	90%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7	NA	100%	1,450.7	92.2	mmBtu/hr	1.87E-03	AP-42 Table 1.3-3. NMTOC for no. 6 oil.	NA	0.2	0.1
Backup Stripper Steam - Natural Gas	8%	700.8	Natural Gas[D]	81.6%	571.9	NA	100%	571.9	25.3	mmBtu/hr	5.50E-03	AP-42 Table 1.4-2.	NA	0.1	0.0
Backup Stripper Steam - No. 6 Oil	8%	700.8	No. 6 Oil[D]	18.4%	128.9	NA	100%	128.9	24.1	mmBtu/hr	1.87E-03	AP-42 Table 1.3-3. NMTOC for no. 6 oil.	NA	0.0	0.0
VOC PROJECTED ACTUAL EMISSIONS															**248.09**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**9.40**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - VOC destruction >98% in vapor phase, 99.9% in liquid phase.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - >90% of methanol condensed and burned in recovery furnace, < 10% of methanol vented into LVHC System.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

TRS EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time %	Stripper Scenario Operating Time hrs	Operating Configuration	Operating Configuration Time %	Operating Configuration Time hrs	Controls	Controls Operating Time %	Controls Operating Time hrs	Production Rate Value	Production Rate UOM	TRS Emissions Factor lb/UOM	TRS Emissions Factor Reference	Sulfur Capture[C] %	TRS Emissions lb/hr	TRS Emissions tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	LVHC to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	2.88E-03	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	0.16	0.65
Aerated Stabilization Basin (ASB)	100.0%	8,760.0	NA	100.0%	8,760.0	NA	100.0%	8,760.0	1,365	ADTP/day	4.08E-02	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	2.32	10.16
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	8.01E-03	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	0.46	2.00
TRS BASELINE ACTUAL EMISSIONS															**12.81**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3[G,H]	100.0%	7,489.8	2,700	ADTP/day	0.33	Vendor / Preliminary Design Information	99.9%	0.04	0.14
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3[G,H]	75.0%	5,617.4	2,700	ADTP/day	0.49	Vendor / Preliminary Design Information	99.9%	0.05	0.15
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2[G]	25.0%	1,872.5	2,700	ADTP/day	0.49	Vendor / Preliminary Design Information	99%	0.55	0.51
New Stripper Online	90.0%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	0.81	Vendor / Preliminary Design Information	99%	0.91	0.18
Backup Stripper Online	8.0%	700.8	NA	100.0%	700.8	SOG to CB1/CB2	100.0%	700.8	2,700	ADTP/day	0.81	Vendor / Preliminary Design Information	99%	0.91	0.32
ASB - New Stripper Online	90.0%	7,884.0	No Foul Condensate to Hard Pipe	100.0%	7,884.0	NA	100.0%	7,884.0	2,700	ADTP/day	2.42E-02	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	2.72	10.74
ASB - Backup Stripper Online	8.0%	700.8	TRS Stripped From Foul Condensate	100.0%	700.8	NA	100.0%	700.8	2,700	ADTP/day	2.72E-02	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	3.06	1.07
ASB - No Stripper Online	2.0%	175.2	Foul Condensate to Hard Pipe	100.0%	175.2	Hydrogen Peroxide Addition	100.0%	175.2	2,700	ADTP/day	7.28E-02	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	8.19	0.72
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	1.75E+00	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. Pre-control emissions based on LVHC scrubber efficiency (50%) and estimated 99% combustion efficiency in combination boilers.	99.9%	0.20	0.65
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	8.76E-03	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. DHEC Approved Test.	NA	0.99	1.08
TRS PROJECTED ACTUAL EMISSIONS															**15.56**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**2.75**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Sulfur capture in recovery furnace >99.9% (see note H), sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - Recovery Furnace captures 99% of sulfur and converts 99% of remaining uncaptured sulfur.

H2S EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		H2S Emissions Factor		Sulfur Capture[C]	H2S Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	LVHC to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	4.13E-04	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	0.02	0.09
Aerated Stabilization Basin (ASB)	100.0%	8,760.0	Foul Condensate to Hard Pipe	100.0%	8,760.0	Hydrogen Peroxide Addition	100.0%	8,760.0	1,365	ADTP/day	1.36E-02	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	0.77	3.39
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	5.03E-04	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	0.03	0.13
H2S BASELINE ACTUAL EMISSIONS															**3.61**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3[G,H]	100.0%	7,489.8	2,700	ADTP/day	0.24	Vendor / Preliminary Design Information	99.9%	0.03	0.10
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3[G,H]	75.0%	5,617.4	2,700	ADTP/day	0.37	Vendor / Preliminary Design Information	99.9%	0.04	0.12
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2[G]	25.0%	1,872.5	2,700	ADTP/day	0.37	Vendor / Preliminary Design Information	99%	0.41	0.39
New Stripper Online	90.0%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	0.61	Vendor / Preliminary Design Information	99%	0.69	0.14
Backup Stripper Online	8.0%	700.8	NA	100.0%	700.8	SOG to CB1/CB2	100.0%	700.8	2,700	ADTP/day	0.61	Vendor / Preliminary Design Information	99%	0.69	0.24
ASB - New Stripper Online	90.0%	7,884.0	No Foul Condensate to Hard Pipe	100.0%	7,884.0	NA	100.0%	7,884.0	2,700	ADTP/day	9.27E-03	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	1.04	4.11
ASB - Backup Stripper Online	8.0%	700.8	H2S Stripped From Foul Condensate	100.0%	700.8	NA	100.0%	700.8	2,700	ADTP/day	9.81E-03	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	1.10	0.39
ASB - No Stripper Online	2.0%	175.2	Foul Condensate to Hard Pipe	100.0%	175.2	Hydrogen Peroxide Addition	100.0%	175.2	2,700	ADTP/day	9.54E-03	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	1.07	0.09
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	1.17E-01	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. Pre-control emissions based on LVHC scrubber efficiency (50%) and estimated 99% combustion efficiency in combination boilers.	99.9%	0.01	0.04
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	5.87E-04	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. DHEC Approved Test.	NA	0.07	0.07
H2S PROJECTED ACTUAL EMISSIONS															**5.69**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**2.09**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Sulfur capture in recovery furnace >99.9% (see note H), sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - Recovery Furnace captures 99% of sulfur and converts 99% of remaining uncaptured sulfur.

PM EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		PM Emissions Factor		PM Control	PM Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	26.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.8
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	24.8	mmBtu/hr	1.61E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	4.0	0.3
PM BASELINE ACTUAL EMISSIONS															**1.1**
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	7.60E-03	3.74E-03
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.7	2.4
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	1.61E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	14.8	10.8
Backup Stripper Steam - Natural Gas	8.0%	700.8	Natural Gas[D]	81.6%	571.9		100.0%	571.9	25.3	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.1
Backup Stripper Steam - No. 6 Oil	8.0%	700.8	No. 6 Oil[D]	18.4%	128.9		100.0%	128.9	24.1	mmBtu/hr	1.61E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	3.9	0.3
PM PROJECTED ACTUAL EMISSIONS															**13.4**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**12.3**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - reserved.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

PM10 EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		PM10 Emissions Factor		PM10 Control	PM10 Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	26.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.8
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	24.8	mmBtu/hr	1.17E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	2.9	0.2
PM10 BASELINE ACTUAL EMISSIONS															**1.0**
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	7.60E-03	3.74E-03
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.7	2.4
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	1.17E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	10.8	7.8
Backup Stripper Steam - Natural Gas	8.0%	700.8	Natural Gas[D]	81.6%	571.9		100.0%	571.9	25.3	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.1
Backup Stripper Steam - No. 6 Oil	8.0%	700.8	No. 6 Oil[D]	18.4%	128.9		100.0%	128.9	24.1	mmBtu/hr	1.17E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	2.8	0.2
PM10 PROJECTED ACTUAL EMISSIONS															**10.4**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**9.4**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - reserved.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

PM2.5 EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		PM2.5 Emissions Factor		PM2.5 Control	PM2.5 Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	26.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.8
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	24.8	mmBtu/hr	8.80E-02	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	2.2	0.2
PM2.5 BASELINE ACTUAL EMISSIONS															**1.0**
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	7.60E-03	3.74E-03
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.7	2.4
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	8.80E-02	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	8.1	5.9
Backup Stripper Steam - Natural Gas	8.0%	700.8	Natural Gas[D]	81.6%	571.9		100.0%	571.9	25.3	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.1
Backup Stripper Steam - No. 6 Oil	8.0%	700.8	No. 6 Oil[D]	18.4%	128.9		100.0%	128.9	24.1	mmBtu/hr	8.80E-02	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	2.1	0.1
PM2.5 PROJECTED ACTUAL EMISSIONS															**8.4**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**7.5**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - reserved.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

LEAD EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		Lead Emissions Factor		Lead Control	Lead Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	26.0	mmBtu/hr	5.00E-07	AP-42 Table 1.4-2.	NA	1.30E-05	5.10E-05
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	24.8	mmBtu/hr	2.80E-05	U.S. EPA document "Estimating Air Toxic Emissions from Coal and Oil Combustion Sources" [EPA-450/2-89-001] for Uncontrolled Residual Oil-fired Utility Boilers (Table 4-1)	NA	6.95E-04	5.85E-05
LEAD BASELINE ACTUAL EMISSIONS															**1.10E-04**
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	5.00E-07	AP-42 Table 1.4-2.	NA	5.00E-07	2.46E-07
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	5.00E-07	AP-42 Table 1.4-2.	NA	4.84E-05	1.56E-04
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	2.80E-05	U.S. EPA document "Estimating Air Toxic Emissions from Coal and Oil Combustion Sources" [EPA-450/2-89-001] for Uncontrolled Residual Oil-fired Utility Boilers (Table 4-1)	NA	2.58E-03	1.87E-03
Backup Stripper Steam - Natural Gas	8.0%	700.8	Natural Gas[D]	81.6%	571.9		100.0%	571.9	25.3	mmBtu/hr	5.00E-07	AP-42 Table 1.4-2.	NA	1.27E-05	3.62E-06
Backup Stripper Steam - No. 6 Oil	8.0%	700.8	No. 6 Oil[D]	18.4%	128.9		100.0%	128.9	24.1	mmBtu/hr	2.80E-05	U.S. EPA document "Estimating Air Toxic Emissions from Coal and Oil Combustion Sources" [EPA-450/2-89-001] for Uncontrolled Residual Oil-fired Utility Boilers (Table 4-1)	NA	6.75E-04	4.35E-05
LEAD PROJECTED ACTUAL EMISSIONS															**2.08E-03**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**1.97E-03**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - reserved.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

CO2 EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time %	Stripper Scenario Operating Time hrs	Operating Configuration	Operating Configuration Time %	Operating Configuration Time hrs	Controls	Controls Operating Time %	Controls Operating Time hrs	Production Rate Value	Production Rate UOM	CO2 Emissions Factor lb/UOM	CO2 Emissions Factor Reference	CO2 Control %	CO2 Emissions lb/hr	CO2 Emissions tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	26.0	mmBtu/hr	1.17E+02	40 CFR Part 98, Table C-1	NA	3,044.8	11,929
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	24.8	mmBtu/hr	1.66E+02	40 CFR Part 98, Table C-1	NA	4,109.9	346
CO2 BASELINE ACTUAL EMISSIONS															**12,275**
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	1.17E+02	40 CFR Part 98, Table C-1	NA	116.9	58
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	1.17E+02	40 CFR Part 98, Table C-1	NA	11,313.5	36,392
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	1.66E+02	40 CFR Part 98, Table C-1	NA	15,270.9	11,076
Backup Stripper Steam - Natural Gas	8.0%	700.8	Natural Gas[D]	81.6%	571.9		100.0%	571.9	25.3	mmBtu/hr	1.17E+02	40 CFR Part 98, Table C-1	NA	2,958.3	846
Backup Stripper Steam - No. 6 Oil	8.0%	700.8	No. 6 Oil[D]	18.4%	128.9		100.0%	128.9	24.1	mmBtu/hr	1.66E+02	40 CFR Part 98, Table C-1	NA	3,993.0	257
CO2 PROJECTED ACTUAL EMISSIONS															**48,629**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**36,354**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - reserved.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

SUMMARY OF ASB EMISSIONS FACTORS

Scenario	ASB Emissions Factors (lb/ODTP)						
	H_2S	DMDS	DMS	MMC	Methanol	VOC[A]	TRS[B]
Baseline Actual Emissions	0.0151	0.0114	0.0185	3.28E-04	0.92	0.97	0.0453
New Stripper Scenario	0.0103	0.0028	0.0136	1.88E-04	0.30	0.32	0.0269
Backup Stripper Scenario	0.0109	0.0033	0.0147	1.30E-03	1.53	1.58	0.0302
No Stripper Scenario	0.0106	0.0504	0.0192	7.42E-04	2.31	2.44	0.0809

A - Includes VOC TRS compounds, methanol, acetaldehyde, methyl ethyl ketone, and propionaldehyde.

B - TRS as compounds

Stripper Inlet Foul Condensate - Table 2-17 (Weston report dated October 2, 2021, Work Order No. 15730.001.008)

		Concentration (ppm)				
Date	**Sample Time**	**Hydrogen Sulfide**	**Methyl Mercaptan**	**Dimethyl Sulfide**	**Dimethyl Disulfide**	**Total TRS**
6/24/2021	15:10	130	14	16	13	173
6/24/2021	15:10	140	14	16	17	187
6/24/2021	17:00	140	17	18	14	189
6/24/2021	18:45	150	19	18	16	203
6/25/2021	10:35	130	12	12	11	165
6/25/2021	12:05	120	10	12	9.6	151.6
6/25/2021	13:45	190	22	22	23	257
Average of all data		142.9	15.4	16.3	14.8	189.4
Max of 6/24 or 6/25		146.7	16.0	17.0	15.0	194.7

		MW	
H2S	Hydrogen Sulfide	34.08	g/mol
Ch4S	Methyl Mercaptan	48.11	g/mol
C2H6S	Dimethyl Sulfide	62.13	g/mol
C2H6S2	Dimethyl Disulfide	94.20	g/mol
S	Sulfur	32.07	g/mol

Convert compound to equivalent S (ppm)

Hydrogen Sulfide	Methyl Mercaptan	Dimethyl Sulfide	Dimethyl Disulfide
138.0	10.7	8.8	10.2
82.3%	6.4%	5.2%	6.1%

S (ppm)	168	Maximum feed to stripper (AHL)
Lb S/gallon FC	1.40E-03	
Lb S/hr @850 gpm	71.3	
Lb S/ADTP (@2200 ODTP)[a]	0.70	

[a] Conservative Lb S/ADTP emissions factor using 2200 ODTP (2200 ODTP * ADTP/0.9 ODTP = 2444.4 ADTP) Emissions factor is representative of the lower end of the range of pulp production at the maximum steam stripper design of 850 gpm. Calculations are scaled to 2700 ADTP to represent worst case emissions.

Assumption
1. Assume no losses in feed tank
2. Assume 98% efficiency of S across stripper therefore 0.69 # S/ADTP in SOG

CONFIDENTIAL TAB M - New-Indy Catawba Monthly Production

Month	Kraft Mill ADTP	Combination Boiler No. 1 Natural Gas mmBtu	Combination Boiler No. 2 Natural Gas mmBtu	Total Natural Gas mmBtu	Combination Boiler No. 1 No. 6 Fuel Oil gallons	Combination Boiler No. 2 No. 6 Fuel Oil gallons	Total No. 6 Fuel Oil gallons	Total No. 6 Fuel Oil mmBtu		
Mar-21	42,474	61,175	99,507	160,683	0	2,057	2,057	309	1,370	
Apr-21	43,075	41,363	75,012	116,376	0	0	0	0	1,436	
May-21	46,962	38,834	63,467	102,301	0	0	0	0	1,515	
Jun-21	42,867	1,909	59,909	61,818	0	1,199	1,199	180	1,429	
Jul-21	49,371	67,565	55,824	123,389	3	97	100	15	1,593	
Aug-21	44,614	33,863	32,461	66,325	0	0	0	0	1,439	
Sep-21	40,177	40,779	41,811	82,590	86	0	86	13	1,339	
Oct-21	47,234	69,732	75,498	145,230	0	0	0	0	1,524	
Nov-21	39,185	60,664	80,397	141,061	0	0	0	0	1,306	
Dec-21	38,734	62,931	60,176	123,107	0	0	0	0	1,249	
Jan-22	43,690	84,088	82,251	166,339	69,200	66,720	135,920	20,388	1,409	
Feb-22	37,736	57,764	75,924	133,688	27,042	370	27,412	4,112	1,348	
Mar-22	43,944	62,423	82,083	144,506	335	0	335	50	1,418	
Apr-22	40,046	44,634	62,835	107,469	0	0	0	0	1,335	
May-22	38,896	39,982	73,918	113,900	0	0	0	0	1,255	
Jun-22	23,184	43,071	89,239	132,310	2,238	0	2,238	336	773	
Jul-22	39,890	64,532	86,134	150,666	0	0	0	0	1,287	
Aug-22	53,396	48,067	73,591	121,658	0	0	0	0	1,722	
Sep-22	45,044	60,782	65,899	126,681	24	0	24	4	1,501	
Oct-22	47,517	70,539	89,760	160,299	0	0	0	0	1,533	
Nov-22	40,133	82,534	114,164	196,698	0	0	0	0	1,338	
Dec-22	33,859	101,466	95,023	196,490	170,076	0	170,076	25,511	1,092	
Jan-23	35,464	95,982	92,733	188,715	102,558	0	102,558	15,384	1,144	996,766
Feb-23	39,276	78,431	96,813	175,244	21,626	53	21,679	3,252	1,403	498,383
Total	996,766			3,237,544				69,553		
Annual Average	498,383									
				97.9%				2.1%		

October 2021 SO2 Testing - Weston

	Combination Boiler No. 1 Stack			Combination Boiler No. 2 Stack		
	NCG+SOG	NCG	SOG	NCG+SOG	NCG	SOG
ODTP/hr	77.3	79.0		91.1	92.9	
ADTP/hr	85.9	87.8		101.2	103.2	
lb SO2/hr	342.8	230.7		380.9	309.9	
lb SO2/ADTP	3.99	2.63	1.36	3.76	3.00	0.76

	Controlled Emissions		Sulfur Capture		Uncontrolled Emissions	
	Average lb SO2/ADTP	Maximum lb SO2/ADTP	Bark Ash[C] %	LVHC Scrubber %	Average lb SO2/ADTP	Maximum lb SO2/ADTP
SOG	1.06	1.36	20%	NA	1.33	1.70
NCG	2.82	3.00				
LVHC[A,B]	1.97	2.10	20%	50%	4.92	5.25
HVLC[A,B]	0.85	0.90	20%	NA	1.06	1.13

A - NCG gases include LVHC gases and HVLC gases.

B - NCG gases split using ratio of controlled SO2 emissions from LVHC (1.10 lb SO2/ADTP) and HVLC (0.473 lb SO2/ADTP) from Project Columbia Application (July 2019 and April 2020 Addendum - Attachment C).

C - Estimated sulfur capture based on 2012 stack test (NCASI data suggests ~32% capture).

TABLE 2-2
NO. 1 COMBINATION BOILER
CONDITION 1: NCG AND SOG GASES
SUMMARY OF SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	10/13/21	10/13/21	10/13/21	----
Time Began	0844	1029	1206	----
Time Ended	0944	1129	1306	----
Stack Gas Data				
Temperature, °F	430	435	438	434
Velocity, ft/sec	64	63	63	63
Moisture, %	17	17	17	17
CO_2 Concentration, %	8.8	9.0	8.6	8.8
O_2 Concentration, %	10.5	10.5	10.8	10.6
VFR, x 10^5 dscfm	1.46	1.45	1.44	1.45
Sulfur Dioxide				
Concentration, ppm	280	227	204	237
Emission Rate, lb/hr	407.4	328.3	292.6	342.8

TABLE 2-3
NO. 1 COMBINATION BOILER
CONDITION 2: NCG GASES ONLY
SUMMARY OF SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	10/13/21	10/13/21	10/13/21	----
Time Began	1407	1544	1714	----
Time Ended	1507	1644	1814	----
Stack Gas Data				
Temperature, °F	447	450	444	447
Velocity, ft/sec	61	62	63	62
Moisture, %	17	18	16	17
CO_2 Concentration, %	9.6	9.9	8.9	9.5
O_2 Concentration, %	10.1	9.8	10.7	10.2
VFR, x 10^5 dscfm	1.37	1.39	1.43	1.40
Sulfur Dioxide				
Concentration, ppm	140	176	180	165
Emission Rate, lb/hr	191.3	243.6	257.0	230.7

Combination Boiler #1

Condition 1: With NCGs, with SOGs
13-Oct-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	Pulp KAPPA
1	0844	262.3	29.9	126.9	1.23	40	10.9	511	230	1407	1103	10851	77.3	82.7
2	1029	266.3	33.0	109.1	1.23	40	10.9	505	213	1409	1200	10885	77.3	85.7
3	1206	257.2	32.6	100.4	1.23	40	10.9	504	2	1443	1206	10963	77.3	84.8
Average:		261.9	31.8	112.1	1.23	40	10.9	507	148	1420	1170	10900	77.3	84.4

Condition 2: With NCGs, without SOGs
13-Oct-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	Pulp KAPPA
1	1407	267.7	34.0	102.0	1.23	40	10.9	506	2	1416	[redacted]	11071	79.0	83.9
2	1544	272.9	34.8	101.3	1.23	40	10.9	504	252	1414	[redacted]	10976	79.0	81.6
3	1714	256.9	30.05	115.96	1.23	40	10.9	505	183	1430	[redacted]	11061	79.0	80.3
Average:		265.8	33.0	106.4	1.23	40	10.9	505	146	1420	[redacted]	11036	79.0	81.9

TABLE 2-4
NO. 2 COMBINATION BOILER
CONDITION 1: NCG AND SOG GASES
SUMMARY OF SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	10/14/21	10/14/21	10/14/21	----
Time Began	0830	1026	1222	----
Time Ended	0930	1126	1322	----
Stack Gas Data				
Temperature, °F	463	477	465	469
Velocity, ft/sec	63	68	61	64
Moisture, %	17	19	16	17
CO_2 Concentration, %	8.2	9.5	7.5	8.4
O_2 Concentration, %	10.8	10.1	11.5	10.8
VFR, x 10^5 dscfm	1.40	1.43	1.35	1.39
Sulfur Dioxide				
Concentration, ppm	275	262	286	274
Emission Rate, lb/hr	383.7	373.7	385.4	380.9

TABLE 2-5
NO. 2 COMBINATION BOILER
CONDITION 2: NCG GASES ONLY
SUMMARY OF SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	10/14/21	10/14/21	10/14/21	----
Time Began	1410	1547	1725	----
Time Ended	1510	1647	1825	----
Stack Gas Data				
Temperature, °F	457	461	460	459
Velocity, ft/sec	59	59	58	59
Moisture, %	15	15	15	15
CO_2 Concentration, %	7.2	7.6	7.0	7.3
O_2 Concentration, %	11.9	11.2	11.7	11.6
VFR, x 10^5 dscfm	1.33	1.33	1.33	1.33
Sulfur Dioxide				
Concentration, ppm	235	234	232	234
Emission Rate, lb/hr	311.3	311.0	307.4	309.9

Combination Boiler #2

Condition 1: With NCGs, with SOGs
14-Oct-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	Pulp KAPPA
1	0830	241	29.8	188.7	1.23	40	10.9	505	209	1409	1203	11071	91.1	94.5
2	1026	251	46.3	115.6	1.23	40	10.9	504	200	1420	1179	11160	91.1	88.2
3	1222	211	25.4	171.4	1.23	40	10.9	505	199	1429	1157	11090	91.1	80.7
Average:		234	33.8	158.6	1.23	40	10.9	505	203	1419	1180	11107	91.1	87.8

Condition 2: With NCGs, without SOGs
14-Oct-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	Pulp KAPPA
1	1410	198	21.7	174.8	1.23	40	10.9	505	209	1438	[redacted]	11109	92.9	78.8
2	1547	218	35.4	206.4	1.23	40	10.9	505	224	1435	[redacted]	11060	92.9	78.7
3	1725	214	49.6	220.6	0.65	40	10.9	505	262	1453	[redacted]	10977	92.9	79.3
Average:		210	35.6	200.6	1.04	40	10.9	505	232	1442	[redacted]	11049	92.9	

June 2021 TRS_H2S Testing - Weston

TRS as TRS	Combination Boiler No. 1 Stack NCG+SOG	Combination Boiler No. 1 Stack NCG	Combination Boiler No. 1 Stack SOG	Combination Boiler No. 2 Stack NCG+SOG	Combination Boiler No. 2 Stack NCG	Combination Boiler No. 2 Stack SOG
ODTP/hr	55.9	76.0		88.3	85.2	
ADTP/hr	62.1	84.4		98.1	94.7	
lb TRS (as H2S)/hr	0.75	0.68		0.85	0.92	
lb TRS (as TRS)/hr	1.07	0.97		1.22	1.32	
lb TRS (as TRS)/ADTP	1.73E-02	1.15E-02	5.75E-03	1.24E-02	1.39E-02	-1.51E-03

H2S	Combination Boiler No. 1 Stack NCG+SOG	Combination Boiler No. 1 Stack NCG	Combination Boiler No. 1 Stack SOG	Combination Boiler No. 2 Stack NCG+SOG	Combination Boiler No. 2 Stack NCG	Combination Boiler No. 2 Stack SOG
ODTP/hr	55.9	76.0		88.3	85.2	
ADTP/hr	62.1	84.4		98.1	94.7	
lb H2S/hr	0.07	0.05		0.07	0.04	
lb H2S/ADTP	1.13E-03	5.92E-04	5.35E-04	7.13E-04	4.23E-04	2.91E-04

	Controlled Emissions		Sulfur Conversion		Uncontrolled Emissions	
	Average	Maximum	Combustion	LVHC Scrubber	Average	Maximum
TRS as TRS	lb TRS/ADTP	lb TRS/ADTP	%	%	lb TRS/ADTP	lb TRS/ADTP
SOG[D]	2.88E-03	5.75E-03	99%	NA	0.29	0.58
NCG	1.27E-02	1.39E-02				
LVHC[A,B]	8.01E-03	8.76E-03	99%	50%	1.60	1.75
HVLC[A,B]	4.69E-03	5.13E-03	99%	NA	0.47	0.51

	Controlled Emissions		Sulfur Conversion		Uncontrolled Emissions	
	Average	Maximum	Combustion	LVHC Scrubber	Average	Maximum
H2S	lb H2S/ADTP	lb H2S/ADTP	%	%	lb H2S/ADTP	lb H2S/ADTP
SOG	4.13E-04	5.35E-04	99%	NA	4.13E-02	5.35E-02
NCG	5.07E-04	5.92E-04				
LVHC[A,C]	5.03E-04	5.87E-04	99%	50%	1.01E-01	1.17E-01
HVLC[A,C]	4.45E-06	5.19E-06	99%	NA	4.45E-04	5.19E-04

A - NCG gases include LVHC gases and HVLC gases.
B - NCG gases split using ratio of controlled TRS emissions from LVHC (8.97E-3 lb TRS/ADTP) and HVLC (5.25E-3 lb TRS/ADTP) from Project Columbia Application (July 2019 and April 2020 Addendum - Attachment C).
C - NCG gases split using ratio of controlled H2S emissions from LVHC (3.82E-3 lb H2S/ADTP) and HVLC (3.38E-5 lb H2S/ADTP) from Project Columbia Application (July 2019 and April 2020 Addendum - Attachment C).
D - Combination Boiler No. 2 SOG averaged as zero (0).

			CB1			CB1			CB2			CB2						
TRS as S		MW	NCG+SOG			NCG			NCG+SOG			NCG						
sulfur	S	32.065	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3	AVG		PLC Cross Check back to TRS as H2S	
hydrogen sulfide	H_2S	34.081	0.08	0.07	0.1	0.07	0.07	0.07	0.08	0.08	0.08	0.05	0.05	0.05	0.07	8.0%	0.085742	0.085742
methyl mercaptan	CH_4S	48.107	0.55	0.53	0.49	0.52	0.52	0.53	0.77	0.63	0.64	0.94	0.91	0.69	0.64	72.6%	0.778738	0.55169
dimethyl sulfide	C_2H_6S	62.134	0.16	0.16	0.16	0.16	0.16	0.17	0.08	0.08	0.08	0.08	0.07	0.07	0.12	13.5%	0.144248	0.079121
dimethyl disulfide	$C_2H_6S_2$	94.199	0.07	0.07	0.07	0.07	0.07	0.07	0.04	0.04	0.04	0.03	0.03	0.03	0.05	5.9%	0.06355	0.045984
															0.89	Total TRS	1.072278	0.762538
															84.8%			

10^6 ACFM Flowrate Basis to lb/min

H_2S	0.007081766	0.006196545	0.008852208	0.006196545	0.006196545	0.006196545	0.007081766	0.007081766	0.007081766	0.004426104	0.004426104	0.004426104
CH_4S	0.068724286	0.066225221	0.061227091	0.064975688	0.064975688	0.066225221	0.096214	0.078720545	0.079970078	0.117456052	0.113707455	0.08621774
C_2H_6S	0.025821922	0.025821922	0.025821922	0.025821922	0.025821922	0.027435792	0.012910961	0.012910961	0.012910961	0.012910961	0.011297091	0.011297091
$C_2H_6S_2$	0.017127091	0.017127091	0.017127091	0.017127091	0.017127091	0.017127091	0.009786909	0.009786909	0.009786909	0.007340182	0.007340182	0.007340182

TRS as H2S	0.082325532	0.07966987	0.078784649	0.078784649	0.078784649	0.080555091	0.089407299	0.077014208	0.077899429	0.100029948	0.096489065	0.077014208	
TRS as TRS	0.118755065	0.115370779	0.113028312	0.114121247	0.114121247	0.116984649	0.125993636	0.108500182	0.109749714	0.142133299	0.136770831	0.109281117	
Ratio TRS as H2S/TRS a	0.693238074	0.690555015	0.697034647	0.690359171	0.690359171	0.688595396	0.709617575	0.709807177	0.70979163	0.703775603	0.705479846	0.704734816	0.69944568

1.43

TABLE 2-11
NO. 1 COMBINATION BOILER
CONDITION 1: NCG AND SOG GASES
SUMMARY OF H_2S, TOTAL TRS, AND SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	6/23/21	6/23/21	6/23/21	—
Time Began	1158	1400	1541	—
Time Ended	1258	1500	1641	—
Stack Gas Data				
Temperature, °F	415	418	415	416
Velocity, ft/sec	59	57	57	57
Moisture, %	17	18	16	17
CO_2 Concentration, %	7.8	8.4	7.7	8.0
O_2 Concentration, %	12.1	11.4	12.0	11.8
VFR, x 10^5 dscfm	1.35	1.31	1.33	1.33
Hydrogen Sulfide				
Concentration, ppm	0.09	0.08	0.12	0.10
Emission Rate, lb/hr	0.07	0.06	0.08	0.07
Total Reduced Sulfur				
Concentration, ppm	1.09	1.07	1.03	1.06
Emission Rate, lb/hr	0.78	0.74	0.73	0.75
Sulfur Dioxide				
Concentration, ppm	195	278	344	272
Emission Rate, lb/hr	262.7	362.5	457.4	360.9

TABLE 2-12
NO. 1 COMBINATION BOILER
CONDITION 2: NCG GASES ONLY
SUMMARY OF H_2S, TOTAL TRS, AND SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	6/23/21	6/23/21	6/23/21	—
Time Began	1824	2019	2202	—
Time Ended	1924	2119	2302	—
Stack Gas Data				
Temperature, °F	416	411	415	414
Velocity, ft/sec	56	56	56	56
Moisture, %	16	16	17	17
CO_2 Concentration, %	8.3	7.8	8.1	8.1
O_2 Concentration, %	11.4	11.9	11.6	11.6
VFR, x 10^5 dscfm	1.30	1.31	1.30	1.30
Hydrogen Sulfide				
Concentration, ppm	0.08	0.08	0.08	0.08
Emission Rate, lb/hr	0.05	0.05	0.05	0.05
Total Reduced Sulfur				
Concentration, ppm	0.97	0.98	0.99	0.98
Emission Rate, lb/hr	0.67	0.68	0.68	0.68
Sulfur Dioxide				
Concentration, ppm	313	348	349	337
Emission Rate, lb/hr	404.4	452.9	450.8	436.1

Combination Boiler #1

Condition 1: With NCGs, with SOGs
23-Jun-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	SO_2 Emissions (lbs/hr)	SO_2 Emissions (lbs/ODT Pulp)	TRS Emissions (lbs/hr)
1	1158	208	25.1	80.8	1.37	40	10.9	458	146	1585	621	11575	49.7	262.7	5.29	0.56
2	1400	225	29.3	68.8	1.37	40	10.9	491	152	1595	1219	11048	54.0	362.5	6.71	0.49
3	1541	207	24.8	81.2	1.37	40	10.9	491	45	1578	1136	11009	64.0	457.4	7.15	0.50
Average:		213	26.4	76.9	1.37	40	10.9	480	114	1586	992	11211	55.9	360.9	6.46	0.52

Condition 2: With NCGs, without SOGs
23-Jun-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	SO_2 Emissions (lbs/hr)	SO_2 Emissions (lbs/ODT Pulp)	TRS Emissions (lbs/hr)
1	1824	230	26.3	94.9	1.37	40	10.9	489	123	1587	[redacted]	10515	74.1	404.4	5.46	0.43
2	2019	216	23.7	97.5	1.37	40	10.9	491	184	1593		10377	74.7	452.9	6.06	0.42
3	2202	220	25.2	92.4	1.37	40	10.9	490	152	1570		10573	79.2	450.8	5.69	0.46
Average:		222	25.1	94.9	1.37	40	10.9	490	153	1583		10488	76.0	436.1	5.74	0.44

TABLE 2-13
NO. 2 COMBINATION BOILER
CONDITION 1: NCG AND SOG GASES
SUMMARY OF H_2S, TOTAL TRS, AND SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	6/24/21	6/24/21	6/24/21	----
Time Began	1445	1630	1806	----
Time Ended	1545	1730	1906	----
Stack Gas Data				
Temperature, °F	475	474	479	476
Velocity, ft/sec	69	69	69	69
Moisture, %	14	14	15	14
CO_2 Concentration, %	6.6	6.9	7.3	6.9
O_2 Concentration, %	13.1	12.7	12.3	12.7
VFR, x 10^5 dscfm	1.57	1.56	1.54	1.56
Hydrogen Sulfide				
Concentration, ppm	0.09	0.09	0.09	0.09
Emission Rate, lb/hr	0.07	0.07	0.07	0.07
Total Reduced Sulfur				
Concentration, ppm	1.13	0.97	0.97	1.02
Emission Rate, lb/hr	0.94	0.80	0.80	0.85
Sulfur Dioxide				
Concentration, ppm	324	327	322	324
Emission Rate, lb/hr	508.7	507.2	496.1	504.0

TABLE 2-14
NO. 2 COMBINATION BOILER
CONDITION 2: NCG GASES ONLY
SUMMARY OF H_2S, TOTAL TRS, AND SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	6/25/21	6/25/21	6/25/21	----
Time Began	1000	1135	1315	----
Time Ended	1100	1235	1415	----
Stack Gas Data				
Temperature, °F	468	470	481	473
Velocity, ft/sec	68	69	69	69
Moisture, %	14	14	14	14
CO_2 Concentration, %	6.9	6.8	7.3	7.0
O_2 Concentration, %	12.8	12.7	12.3	12.6
VFR, x 10^5 dscfm	1.56	1.55	1.56	1.56
Hydrogen Sulfide				
Concentration, ppm	0.05	0.05	0.05	0.05
Emission Rate, lb/hr	0.04	0.04	0.04	0.04
Total Reduced Sulfur				
Concentration, ppm	1.22	1.18	0.94	1.11
Emission Rate, lb/hr	1.01	0.97	0.78	0.92
Sulfur Dioxide				
Concentration, ppm	247	245	235	242
Emission Rate, lb/hr	383.2	380.0	366.2	376.4

Combination Boiler #2

Condition 1: With NCGs, with SOGs
24-Jun-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	SO_2 Emissions (lbs/hr)	SO_2 Emissions (lbs/ODT Pulp)	TRS Emissions (lbs/hr)
1	1445	219	39.0	125.3	1.37	40	10.9	491	190	1572	1231	10253	87.8	508.7	5.79	0.77
2	1630	224	31.1	146.4	1.37	40	10.9	490	186	1576	1231	10277	88.6	507.2	5.72	0.63
3	1806	241	33.6	146.4	1.37	40	10.9	490	190	1580	1231	10300	88.6	496.1	5.60	0.63
Average:		228	34.6	139.4	1.37	40	10.9	490	189	1576	1231	10277	88.3	504.0	5.71	0.68

Condition 2: With NCGs, without SOGs
25-Jun-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	SO_2 Emissions (lbs/hr)	SO_2 Emissions (lbs/ODT Pulp)	TRS Emissions (lbs/hr)
1	1000	234	35.7	132.7	1.37	40	10.9	482	155	1579	[redacted]	10475	87.2	383.2	4.39	0.86
2	1135	225	30.8	147.8	1.37	40	10.9	479	252	1573		10425	84.3	380.0	4.51	0.82
3	1315	245	30.6	141.7	1.37	40	10.9	482	97	1571		10500	84.2	366.2	4.35	0.63
Average:		235	32.4	140.7	1.37	40	10.9	481	168	1574		10467	85.2	376.4	4.42	0.77

Buckner, Katharine

From:	Caleb Fetner <cfetner@all4inc.com>
Sent:	Friday, June 16, 2023 12:36 PM
To:	Buckner, Katharine
Cc:	Tourville, Bob; Steven Moore; Sheryl Watkins
Subject:	RE: existing Foul Condensate Collection Tank (equip ID 9800) and other questions
Attachments:	Attachment A - Existing Stripper Methanol in SOG.xlsx; REVISED Emissions Calculations (6-13-23)_corrected_backup_stripper_VOC.xlsx; 2440-0005.RE-comments on stripper app 5 (6-16-23).docx

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***

Hi Katherine,

On behalf of the mill, please see attached responses to your questions sent June 12, 2023. I have also attached the latest version of the PSD emissions calculations spreadsheet, along with Attachment A (spreadsheet supporting development of VOC emissions factor for SOG).

Please let us know if you have any questions, and have a good weekend.

Caleb

Caleb Fetner / Consulting Engineer
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From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Monday, June 12, 2023 2:33 PM
To: Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Subject: existing Foul Condensate Collection Tank (equip ID 9800) and other questions

External Email

Hey Bob,

When we last spoke on June 2, there was some discrepancy on the size of the existing foul condensate collection tank, equipment ID 9800. The current TV has the size listed as 180,000 gallons. I think this was the tank there was a discrepancy about. Did you look into this to verify the size of this tank? If this was not the tank in question, what tank was it and was the size verified?

Additional comments:

1. Please provide the data, calculations, and assumptions used to derive the VOC emission factors for the new stripper.

2. Why do the design parameters/emission factors for the backup stripper match those for when the new stripper is operating with the SRL offline? If the backup stripper is operating to remove TRS and the new stripper is

operating to remove MeOH, how can the design values/emission factors be the same? This is for SO2, TRS, H2S, and VOC.

Please provide this information by Friday, June 16, 2023.

Thank you,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

Office: (803) 898-3213
bucknekk@dhec.sc.gov

S.C. Dept. of Health & Environmental Control
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Mill Day	FC MeOH, ppm	FC to Stripper, Avg GPM	Pulp Production, ODT	15-day total ODT	MeOH to Steam Stripper, lbs/day	15-day total MeOH to Steam Stripper lb/day	15-day avg. MeOH to Steam Stripper lb/ODT	ESFR	Use Default Removal %?	Stripped Condensate MeOH, ppm	Steam Feed Rate lb/hr	Steam Stripper Removal Efficiency (%)	Methanol Leaving Stripper lbs/ODT	Methanol Treated in Stripper lb/ODT
6/23/2021	1700	487.4	1539.4		9,951			18.0	NO		69135.4			
6/24/2021	2400	487.6	2102.5		14,055			16.7	NO		64778.2			
6/25/2021	2600	480.7	2040.2		15,008			18.0	NO		66965.4			
6/26/2021	2400	476.9	1883.8		13,746			14.5	NO		54505.6			
6/27/2021	2500	426.6	1807.8		12,807			16.0	NO		46965.4			
6/28/2021	2500	475.7	1697.1		14,281			17.8	NO		63961.9			
6/29/2021	2400	411.5	1804.4		11,862			10.5	NO		36333.2			
6/30/2021	2050	359.0	1873.6		8,838			15.2	NO		38197.7			
7/1/2021	1900	475.2	1359.5		10,843			18.3	YES		66113.8		2,488.0	6.1
7/2/2021	1600	491.4	1165.8		9,442			16.9	NO		64901.2			
7/3/2021	2000	501.9	1749.2		12,055			18.3	YES		70422.8		2,766.0	5.3
7/4/2021	2200	450.8	1663.3		11,912			17.6	NO		59075.9			
7/6/2021	1600	451.5	1806.0		8,676			16.6	NO		54325.0			
7/7/2021	2200	499.9	1947.1		13,207			18.0	NO		67944.5			
7/8/2021	2300	499.9	1449.4	25889.3	13,809	180,491	6.97	18.3	YES		68947.4			
7/9/2021	2383	496.1	1694.2	26044.0	14,200	184,741	7.09	18.3	YES		68069.2			
7/10/2021	2267	491.5	1609.2	25550.7	13,381	184,067	7.20	18.2	YES		67717.2			
7/11/2021	2000	489.9	1355.9	24866.4	11,768	180,826	7.27	17.9	NO		67454.9			
7/12/2021	1700	475.5	1783.7	24766.3	9,707	176,788	7.14	17.4	NO	340	62953.1	75%	1.81	5.3
7/13/2021	1900	479.9	1476.9	24435.4	10,952	174,932	7.16	18.2	YES	--	65779.4		1.64	5.5
7/14/2021	1600	480.1	746.1	23484.4	9,224	169,875	7.23	18.2	YES	--	66859.8		1.66	5.6
7/15/2021	1400	312.9	1430.2	23110.2	5,261	163,274	7.07	18.2	YES	--	31714.6		1.62	5.4
7/16/2021	1600	275.3	1470.3	22706.9	5,289	159,726	7.03	17.4	NO	270	33140.2	79%	1.47	5.6
7/17/2021	2000	427.7	1604.5	22951.9	10,273	159,155	6.93	18.6	YES	--	55244.6		1.59	5.3
7/18/2021	2100	490.0	1926.0	23712.1	12,357	162,071	6.83	18.2	YES	--	67812.6		1.57	5.3
7/19/2021	2400	490.0	1826.6	23789.5	14,123	164,139	6.90	18.2	YES	--	68582.1		1.58	5.3
7/20/2021	2000	480.7	1949.4	24075.5	11,545	163,772	6.80	18.2	YES	--	67966.5		1.56	5.2
7/21/2021	2200	494.8	1771.3	24040.9	13,074	168,171	7.00	17.9	NO	480	69152.4	72%	1.95	5.0
7/22/2021	2000	487.4	1797.3	23891.1	11,706	166,669	6.98	18.9	YES	--	69986.4		1.60	5.4
7/23/2021	2100	480.0	1700.1	24141.8	12,106	164,966	6.83	19.0	YES	--	68185.9		1.57	5.3
7/24/2021	2000	480.0	1593.5	24041.2	11,529	162,295	6.75	19.0	YES	--	69160.5		1.55	5.2
7/25/2021	1800	480.0	1555.1	23987.1	10,376	159,290	6.64	19.0	YES	--	69398.3		1.52	5.1
7/26/2021	1700	474.9	1626.5	24257.7	9,697	157,219	6.48	19.0	YES	--	68701.2		1.49	5.0
7/27/2021	1800	424.8	1722.9	24196.9	9,182	156,694	6.48	19.0	YES	--	60261.5		1.49	5.0
7/28/2021	1700	425.0	1060.2	23780.2	8,676	154,419	6.49	19.0	YES	--	60715.4		1.49	5.0
7/29/2021	1700	430.9	1780.8	24814.9	8,797	153,992	6.21	19.0	YES	--	61849.2		1.42	4.8
7/30/2021	1900	439.3	1743.1	25127.7	10,025	158,756	6.32	19.0	YES	--	63105.7		1.45	4.9
7/31/2021	2000	440.0	1779.6	25437.0	10,569	164,035	6.45	19.0	YES	--	63554.3		1.48	5.0
8/1/2021	1900	302.4	1632.4	25464.8	6,901	160,663	6.31	25.2	YES	--	41136.3		1.45	4.9
8/2/2021	1900	449.0	1331.5	24870.4	10,246	158,552	6.38	19.0	YES	--	63631.7		1.46	4.9
8/3/2021	950	443.1	206.7	23250.5	5,055	149,484	6.43	18.8	YES	--	58828.2		1.48	5.0
8/4/2021	1100	289.1	295.0	21596.1	3,819	141,758	6.56	28.9	YES	--	45853.7		1.51	5.1
8/5/2021	1200	203.5	448.7	20273.5	2,932	131,616	6.49	25.6	YES	--	21488.8		1.49	5.0
8/6/2021	1300	381.7	1420.4	19896.6	5,959	125,869	6.33	20.5	YES	--	52829.5		1.45	4.9
8/7/2021	1400	451.9	1253.1	19449.6	7,598	121,361	6.24	17.7	NO	Enter Tested Value	60043.5	75%	1.54	4.7
8/8/2021	2000	455.0	1615.8	19471.9	10,929	120,761	6.20	19.5	YES	--	60490.1		1.42	4.8
8/9/2021	970	454.9	1593.5	19510.4	5,299	115,684	5.93	18.8	YES	--	58945.9		1.36	4.6
8/10/2021	1100	459.4	1873.8	19757.6	6,069	112,056	5.67	19.1	YES	--	61359.2		1.30	4.4
8/11/2021	2400	458.0	1899.8	19934.5	13,201	116,076	5.82	19.2	YES		58816.7		1.34	4.5
8/12/2021	2700	433.9	1885.6	20760.0	14,071	121,470	5.85	20.0	YES	--	56771.9		1.34	4.5

8/13/2021	2600	427.2	1645.9	20625.1	13,340	126,012	6.11	19.5	YES	--	53581.1		1.40	4.7
8/14/2021	2400	446.4	1592.0	20473.9	12,867	128,855	6.29	19.5	YES	--	55154.6		1.44	4.8
8/15/2021	2000	459.5	1697.7	20392.0	11,038	129,324	6.34	18.9	YES	--	64288.1		1.46	4.9
8/16/2021	1300	417.1	1866.8	20626.4	6,511	128,935	6.25	19.5	YES	--	54449.0		1.43	4.8
8/17/2021	1100	424.8	1871.1	21166.0	5,611	124,300	5.87	21.3	YES	--	55070.9		1.35	4.5
8/18/2021	1200	376.0	1830.2	22789.5	5,419	124,664	5.47	20.2	YES	--	44794.7		1.26	4.2
8/19/2021	1300	344.8	1899.9	24394.4	5,382	126,227	5.17	25.4	YES	--	45807.8		1.19	4.0
8/20/2021	1200	380.8	1559.3	25505.0	5,488	128,783	5.05	19.3	YES	--	47699.0		1.16	3.9
8/21/2021	1200	455.0	1743.8	25828.3	6,557	129,380	5.01	19.2	YES	--	60338.9		1.15	3.9
8/22/2021	1200	447.5	1538.5	26113.8	6,449	128,231	4.91	19.5	YES	--	58959.4		1.13	3.8
8/23/2021	860	454.9	956.3	25454.3	4,698	122,001	4.79	19.6	NO	480	60925.5	29%	3.39	1.4
8/24/2021	680	390.3	1124.7	24985.4	3,187	119,889	4.80	19.2	NO	370	47305.6	32%	3.24	1.6
8/25/2021	880	459.9	1400.0	24511.6	4,861	118,680	4.84	19.0	NO	510	60878.4	27%	3.55	1.3
8/26/2021	1300	460.0	1376.6	23988.4	7,181	112,660	4.70	19.0	YES	--	60887.7		1.08	3.6
8/27/2021	1200	464.2	1698.1	23800.9	6,690	105,279	4.42	19.0	YES	--	61256.4		1.01	3.4
8/28/2021	1400	470.1	1557.3	23712.3	7,903	99,842	4.21	19.0	YES	--	62294.2		0.97	3.2
8/29/2021	1100	470.0	1588.0	23708.3	6,209	93,184	3.93	19.0	YES	--	62635.7		0.90	3.0
8/30/2021	2100	470.0	1444.2	23454.9	11,853	94,000	4.01	19.0	YES		62513.7		0.92	3.1
8/31/2021	1900	450.0	1236.1	22824.2	10,268	97,756	4.28	19.6	YES		60398.7		0.98	3.3
9/1/2021	1800	426.6	1415.2	22368.3	9,223	101,368	4.53	20.3	NO	520	58300.3	63%	1.67	2.9
9/2/2021	1800	388.1	1650.6	22188.7	8,389	104,338	4.70	21.0	NO	1400	53125.9	1%	4.66	0.0
9/3/2021	2100	385.0	1793.4	22082.2	9,709	108,665	4.92	20.3	NO	1400	51591.1	15%	4.16	0.8
9/4/2021	1900	417.5	1711.7	22234.5	9,527	112,704	5.07	20.0	NO	1300	56253.6	13%	4.40	0.7
9/5/2021	2100	282.3	1674.5	22165.3	7,119	113,266	5.11	27.6	NO	620	38245.0	62%	1.92	3.2
9/6/2021	1800	384.4	1482.5	22109.2	8,310	115,127	5.21	26.2	NO	640	52209.5	55%	2.35	2.9
9/7/2021	1400	293.4	1198.7	22351.6	4,934	115,363	5.16	20.6	NO	250	31205.6	78%	1.12	4.0
9/8/2021	1400	335.9	1273.5	22500.5	5,647	117,823	5.24	20.2	NO	390	36886.3	66%	1.78	3.5
9/9/2021	2400	463.7	1397.4	22497.9	13,364	126,326	5.61	18.9	YES		61740.5		1.29	4.3
9/10/2021	2500	446.7	1290.2	22411.6	13,411	132,556	5.91	18.7	YES		58439.3		1.36	4.6
9/11/2021	2300	440.0	1200.0	21913.5	12,155	138,021	6.30	19.0	YES		57808.1		1.45	4.9
9/12/2021	2300	426.8	1200.0	21556.1	11,789	141,907	6.58	19.8	YES		55897.7		1.51	5.1
9/13/2021	2700	440.0	1178.3	21146.3	14,267	149,965	7.09	19.0	YES		57857.0		1.63	5.5
9/14/2021	2400	449.7	1142.3	20844.4	12,962	151,074	7.25	19.0	YES		59477.3		1.66	5.6
9/15/2021	2000	439.5	638.6	20246.9	10,557	151,363	7.48	19.9	YES		57460.6		1.72	5.8
9/16/2021	2550	450.0	1200.1	20031.8	13,782	155,922	7.78	19.0	YES		59486.4		1.79	6.0
9/17/2021	2850	450.0	1200.1	19581.2	15,401	162,934	8.32	19.0	YES		58466.3		1.91	6.4
9/18/2021	2900	439.1	1199.9	18987.7	15,292	168,516	8.87	18.6	YES		57381.4		2.04	6.8
9/19/2021	2700	445.8	1441.7	18717.8	14,455	173,444	9.27	18.8	YES		57191.9		2.13	7.1
9/20/2021	2100	456.3	1721.7	18765.0	11,508	177,833	9.48	19.1	YES		59819.7		2.17	7.3
9/21/2021	2300	372.0	1260.5	18543.1	10,275	179,798	9.70	27.1	YES		48998.2		2.22	7.5
9/22/2021	1400		1068.8	18413.1	0	174,864	9.50				35931.4		9.50	0.0
9/23/2021	65		607.3	17746.9	0	169,217	9.53				11148.9		9.53	0.0
9/24/2021	1800		1102.2	17451.7	0	155,853	8.93				11120.1		8.93	0.0
9/25/2021	1900		1437.3	17598.9	0	142,442	8.09				10411.7		8.09	0.0
9/26/2021	2000		1600.2	17999.1	0	130,287	7.24				23394.8		7.24	0.0
9/27/2021	2200	502.3	1636.7	18435.8	13,272	131,769	7.15	20.0	YES		67410.0		1.64	5.5
9/28/2021	2500	499.5	1726.8	18984.3	14,996	132,498	6.98	20.0	YES		67066.5		1.60	5.4
9/29/2021	2100	505.1	1741.5	19583.5	12,738	132,274	6.75	20.0	YES		67763.5		1.55	5.2
9/30/2021	2300	478.5	1390.8	20335.8	13,217	134,934	6.64	19.9	YES		63595.4		1.52	5.1
10/1/2021	2100	422.2	1144.0	20279.6	10,648	131,801	6.50	21.1	YES		55259.3		1.49	5.0
10/2/2021	2300	441.7	1501.9	20581.4	12,200	128,599	6.25	18.8	YES		56397.4		1.43	4.8
10/3/2021	2500	445.8	1784.5	21166.0	13,385	126,692	5.99	20.0	YES		60420.6		1.37	4.6
10/4/2021	2300	443.8	938.6	20662.9	12,258	124,496	6.03	19.8	NO	85	60334.0	95.3%	0.28	5.7
10/5/2021	1400	395.7	1461.4	20402.6	6,653	119,641	5.86	20.0	NO	51	52598.3	95.4%	0.27	5.6
10/6/2021	2000	510.4	1755.1	20897.1	12,260	121,627	5.82	20.0	NO	81	69978.4	94.8%	0.30	5.5
10/7/2021	2300	446.6	1283.3	21111.6	12,335	133,962	6.35	19.2	YES		52357.0		1.46	4.9

10/8/2021	1400	193.8	703.4	21207.7	3,259	137,220	6.47	19.1	YES		31330.3		1.48	5.0
10/9/2021	410	94.8	181.9	20287.4	467	137,687	6.79				16667.9		6.79	0.0
10/10/2021	2000	504.0	1638.2	20488.2	12,107	149,794	7.31	19.6	YES		69874.5		1.68	5.6
10/11/2021	2300	511.0	1799.8	20687.8	14,114	163,908	7.92	20.0	YES		71628.9		1.82	6.1
10/12/2021	2600	511.0	1799.6	20850.8	15,956	166,592	7.99	20.0	YES		72008.9		1.83	6.2
10/13/2021	2900	505.7	1752.9	20876.9	17,613	169,209	8.11	19.8	YES		70273.5		1.86	6.2
10/14/2021	2800	505.0	1800.1	20935.5	16,982	173,453	8.29	20.0	YES		71071.2		1.90	6.4
10/15/2021	3100	464.2	1340.1	20884.7	17,281	177,517	8.50	22.4	YES		64895.2		1.95	6.5
10/16/2021	1700	499.1	1323.1	21063.8	10,189	177,058	8.41	19.5	YES		70597.8		1.93	6.5
10/17/2021	3100	493.1	1798.1	21360.1	18,357	183,215	8.58	20.7	YES		70315.8		1.97	6.6
10/18/2021	2300	505.0	1730.6	21306.2	13,949	183,779	8.63	20.0	YES		72108.6		1.98	6.6
10/19/2021	2000	505.0	1649.9	22017.5	12,130	183,651	8.34	20.0	YES		72378.6		1.91	6.4
10/20/2021	2000	493.4	1848.3	22404.4	11,852	188,850	8.43	19.9	YES		70551.1		1.93	6.5
10/21/2021	2200	482.5	1850.3	22499.6	12,749	189,339	8.42	20.1	YES		68297.8		1.93	6.5
10/22/2021	2000	500.0	1787.4	23003.7	12,009	189,013	8.22	20.0	YES		71948.8		1.89	6.3
10/23/2021	2200	500.0	1743.7	24043.9	13,210	198,965	8.28	20.0	YES		71905.4		1.90	6.4
10/24/2021	2000	399.5	1586.3	25448.3	9,596	208,094	8.18	29.1	YES		57275.9		1.88	6.3
10/25/2021	2200	485.1	1498.2	25308.3	12,817	208,805	8.25	19.8	YES		70692.9		1.89	6.4
10/26/2021	2367	498.0	1523.2	25031.7	14,154	208,845	8.34	19.9	YES		67518.8		0.50	7.8
10/27/2021	1983	458.0	1463.4	24695.5	10,909	203,798	8.25	19.0	YES				0.58	7.7
10/28/2021	1533	466.1	1674.7	24617.3	8,583	194,769	7.91	19.8	YES				0.63	7.3
10/29/2021	2467	500.0	1749.2	24566.4	14,811	192,598	7.84	20.0	YES				0.63	7.2
10/30/2021	1000	500.0	1799.9	25026.2	6,005	181,322	7.25	20.0	YES				1.66	5.6
10/31/2021	2400	488.3	1799.9	25503.1	14,074	185,206	7.26	20.0	YES				1.67	5.6
11/1/2021	2800	483.1	1558.8	25263.7	16,244	183,094	7.25	19.5	YES				1.66	5.6
11/2/2021	1900	452.5	1491.5	25024.6	10,324	179,469	7.17	19.4	YES				1.65	5.5
11/4/2021	1600	205.8	797.4	22323.8	3,955	159,442	7.14	36.3	YES				1.64	5.5
11/5/2021	1500	266.8	946.3	21419.8	4,807	151,500	7.07	25.6	YES				1.62	5.4
11/6/2021	1400	335.1	1630.8	21263.2	5,635	145,125	6.83	21.0	YES				1.57	5.3
11/7/2021	1900	328.9	1550.7	21070.3	7,504	139,419	6.62	22.1	YES				1.52	5.1
11/8/2021	1900	152.0	1376.1	20860.1	3,467	133,290	6.39	26.5	YES				1.47	4.9
11/9/2021	1100	320.0	1202.7	20564.5	4,227	124,699	6.06	21.4	YES				1.39	4.7
11/10/2021	1900	100.4	1214.5	20255.9	2,291	112,836	5.57	48.2	YES				1.28	4.3
11/11/2021	2150	86.7	1283.2	20075.6	2,239	104,167	5.19	31.7	YES				1.19	4.0
11/12/2021	2400	104.2	1776.7	20177.7	3,004	98,587	4.89	56.7	YES				1.12	3.8
11/13/2021	2400	404.1	1370.0	19798.5	11,647	95,422	4.82	20.9	YES				1.11	3.7
11/14/2021	2500	410.0	1282.2	19280.8	12,311	101,728	5.28	21.0	YES				1.21	4.1
11/15/2021	2600	296.6	1082.0	18562.9	9,262	96,917	5.22	28.3	YES				1.20	4.0
11/16/2021	1900	321.0	1294.2	18298.3	7,324	87,997	4.81	18.5	YES				1.10	3.7
11/17/2021	2100	350.1	961.5	17768.3	8,828	86,501	4.87	18.8	YES				1.12	3.8
11/18/2021	2200	339.2	1292.4	19060.7	8,961	95,462	5.01	11.3	NO	71	29388.3	96.2%	0.19	4.8
11/19/2021	1400	334.4	1578.4	19841.7	5,622	97,129	4.90	19.0	YES				1.12	3.8
11/20/2021	1700	335.0	1657.5	20552.9	6,839	99,162	4.82	19.0	YES				1.11	3.7
11/21/2021	2400	335.0	1600.0	20522.1	9,656	103,183	5.03	19.4	YES				1.15	3.9
11/22/2021	2100	335.0	1626.8	20598.2	8,449	104,127	5.06	19.5	YES				1.16	3.9
11/23/2021	44	333.4	1654.5	20876.7	176	100,836	4.83	18.5	YES				1.11	3.7
11/24/2021	2100	335.0	1714.0	21388.0	8,449	105,058	4.91	19.5	YES				1.13	3.8
11/25/2021	2100	335.0	1531.0	21704.5	8,449	111,216	5.12	19.5	YES				1.18	3.9
11/26/2021	1800	335.0	1425.9	21847.3	7,242	116,219	5.32	19.5	YES				1.22	4.1
11/27/2021	2000	335.0	1458.6	21529.2	8,047	121,262	5.63	19.5	YES				1.29	4.3
11/28/2021	2100	330.9	1091.7	21250.9	8,346	117,961	5.55	19.8	YES				1.27	4.3
11/29/2021	1900	306.9	1051.6	21020.2	7,002	112,653	5.36	19.9	YES				1.23	4.1
11/30/2021	2200	326.0	1079.6	21017.8	8,613	112,003	5.33	19.9	YES				1.22	4.1
12/1/2021	2200	334.9	693.5	20417.1	8,848	113,527	5.56	19.2	YES				1.28	4.3
12/2/2021	690	309.5	583.5	20039.2	2,565	107,263	5.35	21.7	YES				1.23	4.1
12/3/2021	1700	329.8	774.0	19520.7	6,734	105,036	5.38	18.8	YES				1.23	4.1

12/4/2021	1900	355.0	1380.7	19323.0	8,100	107,514	5.56	19.3	YES				1.28	4.3
12/5/2021	2100	355.0	1599.9	19265.4	8,953	109,628	5.69	19.3	YES				1.31	4.4
12/6/2021	1800	355.1	1614.0	19279.3	7,675	107,648	5.58	19.1	YES				1.28	4.3
12/7/2021	1700	401.8	1699.8	19352.4	8,203	107,402	5.55	19.3	YES				1.27	4.3
12/8/2021	1600	393.2	1095.7	18793.5	7,556	114,782	6.11	19.2	YES				1.40	4.7
12/9/2021	1700	385.8	1380.2	18459.7	7,877	114,210	6.19	19.0	YES				1.42	4.8
12/10/2021	1800	375.0	1275.4	18204.1	8,106	113,867	6.26	16.8	NO	420	44239.7	71.2%	1.80	4.5
12/11/2021	1700	375.0	1105.7	17883.9	7,656	114,281	6.39	18.2	YES				1.47	4.9
12/12/2021	2100	373.3	1514.2	17939.5	9,414	115,649	6.45	18.9	YES				1.48	5.0
12/13/2021	1500	375.0	1380.5	18228.3	6,755	114,058	6.26	19.0	YES				1.44	4.8
12/14/2021	1300	375.0	914.4	18091.1	5,854	112,910	6.24	19.0	YES				1.43	4.8
12/15/2021	1800	375.0	397.4	17408.9	8,107	112,404	6.46	19.0	YES				1.48	5.0
12/16/2021	580	375.0	986.7	17702.2	2,612	106,168	6.00	19.0	YES				1.38	4.6
12/17/2021	2000	374.7	1386.4	18505.1	8,999	112,602	6.08	20.0	YES				1.40	4.7
12/18/2021	2100	366.3	1398.7	19129.8	9,238	115,107	6.02	19.8	YES				1.38	4.6
12/19/2021	2000	375.0	1535.6	19284.7	9,008	116,014	6.02	20.5	YES				1.38	4.6
12/20/2021	2000	374.8	535.9	18220.6	9,003	116,064	6.37	20.5	YES				1.46	4.9
12/21/2021	1100	355.1	649.4	17256.1	4,692	113,080	6.55	19.8	YES				1.50	5.0
12/22/2021	1800	365.1	1409.7	16965.9	7,892	112,769	6.65	20.0	YES				0.48	6.2
12/23/2021	1900	374.9	1461.0	17331.3	8,556	113,769	6.56	20.5	YES				0.47	6.1
12/24/2021	2400	352.0	1687.8	17638.9	10,145	116,037	6.58	21.2	YES				0.47	6.1
12/25/2021	2000	375.0	1745.6	18109.1	9,007	116,938	6.46	20.2	YES				0.47	6.0
12/26/2021	2400	366.5	1750.1	18753.5	10,564	119,846	6.39	20.2	YES				0.46	5.9
12/27/2021	2400	375.0	1740.7	18980.0	10,808	121,240	6.39	19.6	YES				1.47	4.9
12/28/2021	2300	344.9	1363.8	18963.3	9,526	124,011	6.54	21.4	YES				0.47	6.1
12/29/2021	2100	327.4	1360.5	19409.4	8,256	126,413	6.51	20.2	YES				0.47	6.0
12/30/2021	1900	345.1	1325.6	20337.5	7,873	126,179	6.20	21.0	YES				0.45	5.8
12/31/2021	2300	345.0	1378.3	20729.2	9,530	133,097	6.42	21.0	YES				0.46	6.0
1/1/2022	1900	345.0	1487.3	20830.0	7,872	131,970	6.34	21.0	YES				0.46	5.9
1/2/2022	2200	345.7	1657.6	21089.0	9,135	131,867	6.25	20.8	YES				0.45	5.8
1/3/2022	2500	347.4	1700.1	21253.5	10,429	133,289	6.27	21.0	YES				0.45	5.8
1/4/2022	2200	344.6	1700.1	22417.7	9,104	133,390	5.95	21.0	YES				0.43	5.5
1/5/2022	2200	345.0	1699.7	23468.0	9,114	137,812	5.87	20.3	YES				0.42	5.4
1/6/2022	1400	345.0	1670.6	23728.9	5,801	135,721	5.72	20.1	YES				0.41	5.3
1/7/2022	2300	345.0	1684.7	23952.6	9,529	136,694	5.71	19.7	YES				0.41	5.3
1/8/2022	2300	339.7	1699.8	23964.6	9,384	135,934	5.67	17.4	NO	200	47087.1	88.9%	0.63	5.0
1/9/2022	2500	366.2	1641.6	23860.7	10,995	137,922	5.78	19.7	YES		37523.8		0.42	5.4
1/10/2022	1900	341.8	1546.9	23657.5	7,800	135,157	5.71	19.8	YES		36789.5		0.41	5.3
1/11/2022	360	0.0	1684.3	23601.1	0	124,349	5.27	48.8	YES		21952.2		0.38	
1/12/2022	1900	0.0	1666.9	23904.2	0	114,823	4.80	28.7	YES		15827.2		0.35	
1/13/2022	1400	0.0	1737.4	24281.1	0	106,567	4.39	26.0	YES		16081.2		0.32	
1/14/2022	865	265.2	1663.6	24619.1	2,755	101,449	4.12	20.6	YES		34575.0		0.30	3.8
1/15/2022	1500	399.9	1649.9	24890.6	7,204	99,124	3.98	20.7	YES		63500.0		0.29	3.7
1/16/2022	1800	400.0	1215.6	24619.0	8,647	99,899	4.06	20.7	YES		64454.5		0.29	3.8
1/17/2022	1500	400.0	1580.1	24541.5	7,206	97,969	3.99	21.5	YES		66211.5		0.29	3.7
1/18/2022	1600	320.6	1324.9	24166.2	6,161	93,701	3.88	27.4	YES		52897.3		0.28	3.6
1/19/2022	1400	393.7	1387.0	23853.2	6,620	91,216	3.82	20.1	YES		57445.0		0.28	3.5
1/20/2022	1600	400.0	1341.6	23495.0	7,686	89,788	3.82	21.0	YES		57882.5		0.28	3.5
1/21/2022	1500	373.2	1526.1	23350.5	6,723	90,710	3.88	19.8	YES		45481.4		0.28	3.6
1/22/2022	1400	397.4	1674.4	23340.2	6,682	87,863	3.76	20.2	YES		52302.7		0.27	3.5
1/23/2022	1500	400.0	1656.8	23297.1	7,206	85,685	3.68	20.9	YES		59216.2		0.27	3.4
1/24/2022	1800	395.7	1268.9	22924.4	8,554	83,243	3.63	20.9	YES		57916.9		0.26	3.4
1/25/2022	745	526.3	504.4	21882.0	4,709	80,153	3.66	18.3	NO	74.5	72879.6	87.2%	0.47	3.2
1/28/2022	380	449.5	1005.2	21202.8	2,052	82,204	3.88	21.4	NO	4.8	69142.7	98.3%	0.06	3.8
1/29/2022	1000	449.9	1011.7	20547.7	5,403	87,607	4.26	21.7	YES		69190.4		0.31	4.0
1/30/2022	1800	450.0	1539.0	20349.2	9,727	97,334	4.78	21.4	YES		68556.1		0.35	4.4

1/31/2022	2100	450.0	1282.6	19968.2	11,349	105,928	5.30	21.9	YES		69289.6		0.38	4.9
2/1/2022	1200	450.0	1000.2	19318.5	6,485	105,208	5.45	22.7	YES		68621.7		0.39	5.1
2/2/2022	1300	450.0	1001.7	19104.6	7,026	103,587	5.42	20.1	YES		62667.6		0.39	5.0
2/3/2022	1200	450.0	1000.4	18524.9	6,486	102,867	5.55	15.7	NO	410	54084.3	57.6%	2.35	3.2
2/4/2022	1800	435.5	1320.4	18520.4	9,414	106,120	5.73	18.3	NO	19	59307.8	98.7%	0.08	5.7
2/5/2022	1700	450.0	1458.1	18591.5	9,187	108,687	5.85	20.0	YES		67379.3		0.42	5.4
2/6/2022	1700	438.9	1584.7	18834.6	8,960	109,961	5.84	19.9	YES		65712.0		0.42	5.4
2/7/2022	1500	415.2	1625.2	18933.7	7,479	110,717	5.85	20.4	YES		62155.5		0.42	5.4
2/8/2022	1500	424.9	1714.8	18974.2	7,655	111,690	5.89	20.3	YES		63595.4		0.42	5.5
2/9/2022	1700	425.0	1591.4	18908.7	8,677	113,162	5.98	20.6	YES		63560.3		0.43	5.6
2/10/2022	1600	425.0	1173.1	18812.8	8,166	112,774	5.99	20.5	YES		63525.5		0.43	5.6
2/11/2022	1700	442.4	922.4	19230.8	9,032	117,097	6.09	19.9	YES		66233.8		0.44	5.6
2/12/2022	1400	450.0	1522.1	19747.8	7,566	122,612	6.21	20.6	YES		68061.0		0.45	5.8
2/13/2022	1600	450.7	1272.9	20009.0	8,660	125,868	6.29	20.4	YES		68439.6		0.45	5.8
2/14/2022	2033	475.0	1612.2	20082.2	11,599	127,740	6.36	19.0	NO		69046.9		6.36	0.0
2/15/2022	1767	475.0	1441.2	20240.8	10,078	126,469	6.25	18.9	NO		69072.5		6.25	0.0
2/16/2022	2133	475.0	1423.8	20664.4	12,169	132,153	6.40	19.0	NO		68584.1		6.40	0.0
2/17/2022	2200	475.0	1002.6	20665.4	12,550	137,677	6.66	19.5	NO	140	70114.2	91.8%	0.55	6.1
2/18/2022	1600	475.0	1249.1	20914.0	9,127	140,319	6.71	19.5	NO	100	70280.4	91.9%	0.54	6.2
2/19/2022	2200	438.7	1576.8	21170.4	11,590	142,495	6.73	19.8	NO	150	65445.6	91.1%	0.60	6.1
2/20/2022	2200	420.0	1746.5	21458.7	11,096	144,404	6.73	20.3	NO	41	62966.1	97.6%	0.16	6.6
2/21/2022	2000	422.2	975.5	20849.6	10,140	145,584	6.98	20.0	NO	38	63230.1	97.5%	0.17	6.8
2/22/2022	2000	410.0	1230.4	20454.8	9,847	147,953	7.23	20.6	NO	31	61108.0	98.0%	0.15	7.1
2/23/2022	2000	410.5	1667.6	20407.6	9,860	150,157	7.36	20.5	NO	35	59241.7	97.7%	0.17	7.2
2/24/2022	2250	406.3	1584.0	20400.3	10,979	152,460	7.47	20.7	NO	24	60521.1	98.6%	0.10	7.4
2/25/2022	2300	382.9	1238.4	20465.6	10,575	154,869	7.57	20.3	NO	40	57324.8	97.7%	0.17	7.4
2/26/2022	2600	380.0	1503.2	21046.3	11,865	157,701	7.49	20.3	NO	180	56939.3	91.0%	0.67	6.8
2/27/2022	2900	374.6	1477.2	21001.5	13,045	163,180	7.77	20.3	NO	250	56059.9	88.8%	0.87	6.9
2/28/2022	2600	370.0	1201.1	20929.6	11,553	166,074	7.93	21.2	NO	230	57395.3	88.4%	0.92	7.0
3/1/2022	2600	370.0	1249.8	20567.3	11,552	166,027	8.07	21.7	NO	210	58653.5	89.4%	0.86	7.2
3/2/2022	2400	370.0	1082.9	20209.0	10,664	166,613	8.24	22.3	NO	130	59713.3	92.8%	0.59	7.7
3/3/2022	2300	370.0	1551.6	20336.9	10,220	164,664	8.10	21.2	NO	170	56886.8	90.3%	0.78	7.3
3/4/2022	2500	370.0	1800.1	21134.4	11,109	163,223	7.72	20.8	NO	200	56134.4	89.6%	0.81	6.9
3/5/2022	2600	297.4	912.5	20797.8	9,286	163,382	7.86	18.0	NO	220	35329.0	89.5%	0.82	7.0
3/6/2022	2100	362.7	1519.3	20740.3	9,147	160,938	7.76	20.5	NO	33	54703.2	98.0%	0.16	7.6
3/7/2022	3000	360.9	1434.6	20428.4	13,002	162,845	7.97	19.2	NO	240	51841.4	89.7%	0.82	7.2
3/8/2022	2400	370.0	1588.7	21041.5	10,665	163,370	7.76	20.5	NO	190	54953.0	89.7%	0.80	7.0
3/9/2022	2500	387.2	1057.2	20868.3	11,624	165,147	7.91	20.8	NO	66	57940.7	96.6%	0.27	7.6
3/10/2022	2000	399.6	1176.5	20377.2	9,598	164,885	8.09	20.8	NO	49	59792.5	96.8%	0.26	7.8
3/11/2022	1500	411.1	1448.0	20241.2	7,406	161,312	7.97	20.9	NO	34	60772.6	97.1%	0.23	7.7
3/12/2022	1600	395.9	1714.5	20717.3	7,607	158,344	7.64	21.9	NO	46	58235.5	96.3%	0.28	7.4
3/13/2022	2300	412.0	1835.8	21049.9	11,381	157,861	7.50	19.9	NO	47	54861.9	97.4%	0.19	7.3
3/14/2022	2000	400.0	1581.1	21153.8	9,608	154,423	7.30	21.0	NO	50	58612.7	96.8%	0.24	7.1
3/15/2022	1700	400.0	1800.3	21753.0	8,166	151,037	6.94	21.0	NO	34	58626.2	97.4%	0.18	6.8
3/16/2022	1700	400.0	1558.6	22061.8	8,167	147,652	6.69	21.0	NO	50	58802.0	96.2%	0.25	6.4
3/17/2022	1800	400.0	1417.4	22396.2	8,646	145,634	6.50	20.9	NO	50	58985.6	96.4%	0.23	6.3
3/18/2022	1400	400.0	1125.8	21970.3	6,725	142,139	6.47	20.9	NO	44	58880.0	95.9%	0.26	6.2
3/19/2022	1300	392.3	1036.8	21207.0	6,125	137,154	6.47	20.6	NO	40	58015.0	96.0%	0.26	6.2
3/21/2022	2200	354.6	1341.7	21636.3	9,370	137,239	6.34	20.6	NO	55	51089.7	96.8%	0.20	6.1
3/22/2022	1600	339.9	1623.2	21740.2	6,532	134,624	6.19	21.0	NO	79	48624.8	93.7%	0.39	5.8
3/23/2022	1700	386.0	1037.1	21342.7	7,881	129,502	6.07	20.8	NO	120	56280.7	90.9%	0.55	5.5
3/24/2022	1700	381.5	1839.3	21593.3	7,788	126,625	5.86	21.0	NO	57	55844.4	95.7%	0.25	5.6
3/25/2022	2000	365.6	1445.5	21981.6	8,781	123,783	5.63	21.0	NO	55	53200.9	96.5%	0.20	5.4
3/26/2022	1900	372.3	1690.0	22495.1	8,496	122,681	5.45	21.0	NO	77	54674.0	94.8%	0.29	5.2
3/27/2022	2100	353.8	1464.0	22511.1	8,922	124,197	5.52	20.8	NO	72	51326.1	95.6%	0.24	5.3
3/28/2022	2100	356.0	1540.0	22336.6	8,979	125,569	5.62	20.3	NO	71	49867.1	95.7%	0.24	5.4

3/29/2022	1500	340.7	1406.3	21907.1	6,137	120,325	5.49	20.1	NO	85	48820.7	92.7%	0.40	5.1
3/30/2022	2300	370.6	1371.0	21697.0	10,238	120,956	5.57	21.0	NO	64	54671.7	96.4%	0.20	5.4
3/31/2022	1600	363.8	1657.9	21554.6	6,990	119,779	5.56	21.1	NO	65	52118.9	94.8%	0.29	5.3
4/1/2022	1000	355.0	1800.5	21796.4	4,263	115,875	5.32	21.0	NO	58	50486.3	92.6%	0.40	4.9
4/2/2022	2000	382.3	1596.2	21975.2	9,182	116,412	5.30	19.7	NO	77	54868.9	95.0%	0.26	5.0
4/3/2022	1900	378.0	1600.1	22449.6	8,624	118,311	5.27	20.2	NO	51	54923.9	96.5%	0.18	5.1
4/4/2022	1600	359.4	1496.9	22909.8	6,905	119,092	5.20	20.8	NO	76	52193.2	93.9%	0.32	4.9
4/5/2022	1800	351.0	1755.6	23323.6	7,587	117,308	5.03	21.0	NO	59	51555.7	95.8%	0.21	4.8
4/6/2022	1500	365.0	1348.0	23048.4	6,575	117,351	5.09	19.2	NO	89.3	50949.4	92.4%	0.39	4.7
4/7/2022	1200	350.6	1406.0	23417.3	5,052	114,522	4.89	20.6	NO	77	51157.0	91.7%	0.41	4.5
4/8/2022	1600	350.0	1699.2	23277.2	6,726	113,460	4.87	21.0	NO	60	51935.8	95.1%	0.24	4.6
4/9/2022	1800	338.4	1850.1	23681.8	7,316	111,994	4.73	21.0	NO	64	50186.2	95.4%	0.22	4.5
4/10/2022	1800	335.0	1759.8	23751.5	7,241	110,739	4.66	21.0	NO	80	48021.7	94.3%	0.27	4.4
4/11/2022	1200	335.0	1833.0	24120.6	4,828	106,644	4.42	21.0	NO	53	47855.4	94.3%	0.25	4.2
4/12/2022	1100	335.0	1640.4	24221.0	4,426	102,090	4.21	21.0	NO	47	47925.6	94.5%	0.23	4.0
4/13/2022	1100	335.0	1543.2	24357.9	4,426	100,379	4.12	21.0	NO	57	48073.9	93.3%	0.27	3.8
4/14/2022	1100	329.0	1516.4	24503.2	4,347	94,487	3.86	21.0	NO	56	47202.4	93.4%	0.25	3.6
4/15/2022	1500	320.0	1603.9	24449.2	5,765	93,262	3.81	21.0	NO	66	47370.4	94.3%	0.22	3.6
4/16/2022	1500	320.0	1800.0	24448.7	5,764	94,763	3.88	21.0	NO	87	46076.2	92.5%	0.29	3.6
4/17/2022	1100	320.0	1698.1	24550.6	4,227	89,808	3.66	20.9	NO	60	45986.4	93.0%	0.26	3.4
4/18/2022	1400	320.0	1609.7	24560.2	5,380	86,563	3.52	21.0	NO	81	46462.9	92.5%	0.26	3.3
4/19/2022	1900	306.3	1651.7	24714.9	6,989	86,647	3.51	13.5	NO	98	31645.7	93.8%	0.22	3.3
4/20/2022	1700	302.3	1273.1	24232.5	6,171	85,232	3.52	17.5	NO	120	36197.9	91.3%	0.31	3.2
4/21/2022	1500	339.3	1401.4	24285.9	6,112	84,770	3.49	20.5	NO	100	50382.4	91.4%	0.30	3.2
4/22/2022	1300	345.1	239.5	23119.4	5,389	85,106	3.68	18.3	NO	31	48518.8	96.9%	0.11	3.6
4/23/2022	380	315.3	609.9	22030.0	1,439	79,819	3.62	21.3	NO	4.7	45120.4	98.4%	0.06	3.6
4/24/2022	1500	327.8	1205.5	21385.5	5,904	78,408	3.67	20.2	NO	37	48987.7	96.8%	0.12	3.5
4/25/2022	1700	325.0	1199.7	20825.4	6,636	77,803	3.74	20.0	NO	44	48603.9	96.6%	0.13	3.6
4/26/2022	1900	325.0	1101.3	20093.7	7,416	80,391	4.00	20.8	NO	53	49282.4	96.4%	0.15	3.9
4/27/2022	630	325.0	1061.3	19514.6	2,459	78,425	4.02	20.9	NO	27	49075.2	94.4%	0.22	3.8
4/28/2022	2300	325.0	1149.8	19121.1	8,976	82,974	4.34	20.9	NO	67	48964.2	96.2%	0.16	4.2
4/29/2022	2800	324.9	1102.2	18707.0	10,927	89,554	4.79	20.5	NO	60	49429.5	97.2%	0.13	4.7
4/30/2022	1900	325.0	1248.7	18351.8	7,416	91,206	4.97	20.7	NO	59	49457.7	96.0%	0.20	4.8
5/1/2022	1700	325.0	1602.5	18154.3	6,636	92,078	5.07	20.9	NO	55	49273.1	95.8%	0.21	4.9
5/2/2022	2000	330.1	1886.0	18342.2	7,929	95,780	5.22	20.2	NO	62	48853.9	96.0%	0.21	5.0
5/3/2022	2200	321.3	2106.6	18839.1	8,490	98,889	5.25	20.1	NO	94	47240.3	94.5%	0.29	5.0
5/4/2022	2267	332.1	2089.9	19277.3	9,041	100,941	5.24	19.6	NO	*50*	47798.7	97.2%	0.15	5.1
5/5/2022	1983	330.0	1954.4	19958.6	7,860	102,630	5.14	19.7	NO	*50*	47550.6	96.8%	0.17	5.0
5/6/2022	2133	322.6	2121.1	20678.3	8,266	104,783	5.07	19.8	NO	*50*	45588.1	97.0%	0.15	4.9
5/7/2022	2000	336.2	2065.2	22504.0	8,076	107,470	4.78	18.7	NO	61	47553.0	96.1%	0.19	4.6
5/8/2022	2400	314.0	2093.3	23987.4	9,051	115,083	4.80	20.1	NO	130	47646.5	92.9%	0.34	4.5
5/9/2022	2200	303.3	2099.4	24881.3	8,013	117,191	4.71	20.1	NO	180	43395.1	89.5%	0.50	4.2
5/10/2022	1900	324.3	2100.2	25781.9	7,401	117,956	4.58	19.5	NO	180	48482.7	87.7%	0.56	4.0
5/11/2022	1900	322.3	1873.7	26554.3	7,355	117,896	4.44	20.1	NO	260	46577.2	82.4%	0.78	3.7
5/12/2022	2000	307.3	2099.0	27592.0	7,380	122,817	4.45	17.3	NO	190	40124.8	88.0%	0.53	3.9
5/13/2022	2000	292.4	1897.8	28340.0	7,024	120,865	4.26	20.3	NO	240	41437.7	84.6%	0.66	3.6
5/14/2022	2000	315.0	1674.2	28912.1	7,567	117,505	4.06	20.7	NO	570	46727.3	63.1%	1.50	2.6
5/15/2022	1800	300.3	1656.9	29320.3	6,493	116,581	3.98	20.3	NO	51	43157.8	96.4%	0.15	3.8
5/16/2022	2100	303.7	1743.8	29461.6	7,659	117,604	3.99	21.0	NO	65	45337.8	96.0%	0.16	3.8
5/17/2022	2100	301.9	1722.8	29298.5	7,614	117,289	4.00	20.9	NO	62	44622.6	96.2%	0.15	3.9
5/18/2022	1900	300.0	354.4	27546.3	6,845	115,645	4.20	21.0	NO	56	44005.5	96.2%	0.16	4.0
5/24/2022	280	300.0	151.3	25607.7	1,009	107,612	4.20	18.0	NO	1.3	45593.9	99.4%	0.03	4.2
5/25/2022	530	300.0	1438.5	25091.9	1,909	101,661	4.05	21.7	NO	2.8	48596.6	99.3%	0.03	4.0
5/26/2022	1400	300.2	1964.6	24935.3	5,047	98,443	3.95	21.9	NO	78	48450.3	92.6%	0.29	3.7
5/27/2022	1600	300.0	1871.0	24741.1	5,764	96,131	3.89	21.0	NO	47	48033.8	96.1%	0.15	3.7
5/28/2022	1600	292.1	362.3	23010.1	5,613	92,693	4.03	18.3	NO	110	45125.9	91.0%	0.36	3.7

6/15/2022	1300	235.0	1010.7	21921.4	3,668	88,348	4.03	29.0	NO	110	27679.4	89.5%	0.42	3.6
6/16/2022	1200		1332.0	21153.1	0	80,947	3.83	34.6	NO		20805.4	94.1%	0.23	3.6
6/17/2022	1200		754.7	20034.1	0	73,592	3.67	68.8	NO		6249.0	94.1%	0.22	3.5
6/18/2022	1300		540.1	18475.2	0	66,212	3.58	80.4	NO		7499.0	94.1%	0.21	3.4
6/19/2022	1400		1469.0	18046.4	0	59,188	3.28	100.0	NO		8123.2	94.1%	0.19	3.1
6/20/2022	1400		1310.8	17683.0	0	51,621	2.92	57.9	NO		11710.0	94.1%	0.17	2.7
6/21/2022	1400		1424.8	17450.9	0	45,129	2.59	84.3	NO		9494.5	94.1%	0.15	2.4
6/22/2022	1400		1253.8	16961.0	0	37,470	2.21	77.6	NO		6337.6	94.1%	0.13	2.1
6/23/2022	1800		1786.8	17024.9	0	29,856	1.75	37.6	NO		11561.6	94.1%	0.10	1.7
6/24/2022	1800		1999.9	18670.4	0	23,011	1.23	53.5	NO		10876.4	94.1%	0.07	1.2
6/25/2022	1800		1999.8	20518.9	0	22,002	1.07	54.1	NO		8573.3	94.1%	0.06	1.0
6/26/2022	1800		2014.3	21094.7	0	20,093	0.95	15.5	NO		30065.2	94.1%	0.06	0.9
6/27/2022	1900	395.0	1771.1	20901.2	9,014	24,060	1.15	20.4	NO	40	59087.3	97.3%	0.03	1.1
6/28/2022	1800	391.6	1723.5	20753.8	8,465	26,761	1.29	19.1	NO	96	56362.4	93.1%	0.09	1.2
6/29/2022	1900	370.0	1438.0	21829.6	8,442	29,589	1.36	21.1	NO	42	56218.7	97.1%	0.04	1.3
6/30/2022	850	353.1	73.5	20892.4	3,605	29,526	1.41	21.9	NO	28	53678.9	95.7%	0.06	1.4
7/1/2022	510	337.7	1067.0	20627.3	2,068	31,594	1.53	22.2	NO	21	51368.7	94.6%	0.08	1.4
7/2/2022	1800	345.0	999.9	20872.6	7,458	39,052	1.87	22.0	NO	50	53857.3	96.4%	0.07	1.8
7/3/2022	1600	328.0	966.5	21299.0	6,303	45,355	2.13	21.3	NO	46	50475.2	96.2%	0.08	2.0
7/4/2022	1900	330.0	886.0	20716.0	7,530	52,885	2.55	22.0	NO	4.6	51503.4	99.7%	0.01	2.5
7/5/2022	1700	345.7	857.3	20262.4	7,058	59,943	2.96	20.4	NO	49	51290.1	96.3%	0.11	2.8
7/6/2022	1600	340.7	144.2	18981.8	6,546	66,489	3.50	19.4	NO	48	48405.7	96.1%	0.13	3.4
7/7/2022	950	339.6	1069.2	18797.2	3,875	70,364	3.74	19.9	NO	66	49164.1	91.0%	0.34	3.4
7/8/2022	1900	342.5	1038.4	18048.8	7,815	78,180	4.33	20.1	NO	24	49955.6	98.4%	0.07	4.3
7/9/2022	1800	350.0	1203.6	17252.5	7,566	85,746	4.97	20.1	NO	59	50755.5	95.8%	0.21	4.8
7/10/2022	1600	350.0	1212.5	16465.2	6,725	92,471	5.62	20.1	NO	140	49126.4	88.8%	0.63	5.0
7/11/2022	1000	267.2	1112.7	15563.7	3,209	95,680	6.15	22.9	NO	62	32394.8	92.3%	0.47	5.7
7/12/2022	2000	236.1	1010.7	14803.3	5,670	92,336	6.24	28.3	YES		30157.3	94.0%	0.37	5.9
7/13/2022	640	293.9	1296.7	14376.4	2,259	86,129	5.99	22.5	NO	39	38964.5	92.3%	0.46	5.5
7/14/2022	1900	270.3	1681.6	14620.0	6,167	83,855	5.74	20.8	YES		34559.3	94.0%	0.34	5.4
7/15/2022	2000	300.0	1700.2	16246.6	7,206	87,456	5.38	20.0	NO	120	41759.0	92.3%	0.41	5.0
7/16/2022	2000	300.0	1851.2	17030.9	7,206	92,593	5.44	20.0	NO	110	41880.6	93.0%	0.38	5.1
7/17/2022	2100	297.8	1514.9	17545.8	7,511	92,646	5.28	20.4	NO	130	41681.7	92.1%	0.42	4.9
7/18/2022	2000	302.3	1906.3	18485.7	7,261	93,604	5.06	19.0	NO	90	41392.7	94.3%	0.29	4.8
7/19/2022	2100	270.8	1900.1	19499.8	6,830	92,905	4.76	24.4	NO	69	39493.2	95.8%	0.20	4.6
7/20/2022	2000	310.0	1900.2	20542.6	7,446	93,293	4.54	20.0	NO	100	44169.3	93.6%	0.29	4.2
7/21/2022	2000	310.0	939.8	21338.3	7,446	94,192	4.41	20.0	NO	93	43889.4	94.0%	0.26	4.2
7/22/2022	1100	309.9	529.2	20798.2	4,094	94,411	4.54	19.6	NO	53	44240.7	93.8%	0.28	4.3
7/23/2022	1300	305.3	1955.8	21715.6	4,767	91,363	4.21	19.3	NO	83	42740.0	91.8%	0.34	3.9
7/24/2022	2300	300.0	2035.2	22547.1	8,287	92,084	4.08	18.5	NO	170	40990.2	90.6%	0.38	3.7
7/25/2022	2300	300.0	802.9	22137.5	8,287	93,645	4.23	19.0	NO	300	42033.0	83.3%	0.71	3.5
7/26/2022	750	300.0	995.2	22020.0	2,702	93,138	4.23	20.5	NO	65	44111.5	88.8%	0.47	3.8
7/27/2022	2100	300.0	1546.3	22555.5	7,566	95,034	4.21	20.5	NO	66	43392.4	95.9%	0.17	4.0
7/28/2022	1250	300.0	1709.5	22968.3	4,504	97,279	4.24	19.9	NO	71	42722.7	92.7%	0.31	3.9
7/29/2022	2200	300.0	1046.6	22333.3	7,926	99,038	4.43	20.5	NO	67	44069.5	96.1%	0.17	4.3
7/30/2022	2000	300.0	1684.9	22318.0	7,206	99,038	4.44	20.5	NO	70	43766.9	95.5%	0.20	4.2
7/31/2022	1800	300.0	1728.0	22194.8	6,486	98,318	4.43	20.5	NO	72	43661.7	94.8%	0.23	4.2
8/1/2022	2100	300.0	1736.4	22416.3	7,566	98,373	4.39	20.5	NO	110	43555.0	93.2%	0.30	4.1
8/2/2022	1900	300.0	1133.7	21643.7	6,845	97,957	4.53	20.5	NO	85	42500.7	94.3%	0.26	4.3
8/3/2022	1600	300.0	1139.0	20882.6	5,765	96,892	4.64	20.4	NO	62	42633.8	95.0%	0.23	4.4
8/4/2022	1800	287.5	1592.2	20574.7	6,215	95,661	4.65	21.1	NO	100	40510.8	92.9%	0.33	4.3
8/5/2022	1900	300.0	1672.6	21307.5	6,845	95,060	4.46	20.5	NO	130	43970.9	91.2%	0.39	4.1
8/6/2022	2200	300.0	2039.0	22817.3	7,926	98,892	4.33	20.5	NO	240	44099.8	85.9%	0.61	3.7
8/7/2022	2300	300.0	2112.5	22974.1	8,287	102,412	4.46	20.5	NO	260	43960.7	85.4%	0.65	3.8
8/8/2022	2400	300.0	2095.0	23033.8	8,647	102,772	4.46	20.5	NO	220	44045.8	88.1%	0.53	3.9
8/9/2022	2133	300.0	2103.9	24334.8	7,686	102,172	4.20	20.5	NO	200	44473.2	87.8%	0.51	3.7

8/10/2022	2033	300.0	1987.0	25326.7	7,326	106,796	4.22	20.5	NO	195	45071.1	87.5%	0.53	3.7
8/11/2022	2000	300.0	1631.0	25411.4	7,206	106,435	4.19	20.5	NO	190	44864.0	87.7%	0.52	3.7
8/12/2022	1900	300.0	1734.3	25436.2	6,846	108,777	4.28	20.5	NO	180	45074.0	87.7%	0.53	3.7
8/13/2022	2000	300.0	1835.5	26225.2	7,206	108,057	4.12	20.5	NO	200	45312.1	87.0%	0.54	3.6
8/14/2022	2000	300.0	1880.9	26421.2	7,206	108,057	4.09	20.5	NO	230	45504.5	85.0%	0.61	3.5
8/15/2022	2100	300.0	1748.6	26441.7	7,566	109,138	4.13	20.4	NO	220	45364.0	86.4%	0.56	3.6
8/16/2022	2000	300.0	1551.4	26256.7	7,206	108,778	4.14	20.5	NO	190	45527.5	87.6%	0.51	3.6
8/17/2022	2000	300.0	1568.6	26691.6	7,206	109,138	4.09	20.5	NO	180	45785.0	88.3%	0.48	3.6
8/18/2022	2100	300.0	1413.3	26965.9	7,566	110,939	4.11	20.5	NO	190	45599.1	88.2%	0.49	3.6
8/19/2022	1900	207.1	1958.8	27332.4	4,725	109,450	4.00	20.6	NO	190	28007.9	87.3%	0.51	3.5
8/20/2022	2100	150.0	2139.8	27799.6	3,783	106,388	3.83	21.4	NO	960	21565.2	41.2%	2.25	1.6
8/21/2022	2000	150.0	1991.7	27752.3	3,603	102,064	3.68	21.5	NO	1150	21871.2	25.7%	2.73	0.9
8/22/2022	2200	150.0	1632.9	27272.7	3,963	97,741	3.58	21.5	NO	1150	22059.6	32.4%	2.42	1.2
8/23/2022	2100	150.0	1341.6	26519.3	3,783	92,877	3.50	21.5	NO	230	23021.7	85.7%	0.50	3.0
8/24/2022	1600	150.0	1195.9	25611.3	2,882	88,073	3.44	21.5	NO	200	23085.9	83.7%	0.56	2.9
8/25/2022	1600	210.6	1219.1	24843.4	4,046	84,793	3.41	19.8	NO	230	30791.5	81.4%	0.63	2.8
8/26/2022	1600	284.2	1919.6	25131.9	5,461	83,048	3.30	20.2	NO	37	42218.5	97.0%	0.10	3.2
8/27/2022	2100	293.8	2088.3	25485.9	7,409	83,612	3.28	20.0	NO	86	43799.8	94.7%	0.17	3.1
8/28/2022	2100	333.9	1310.0	24960.3	8,420	84,826	3.40	20.2	NO	310	52230.2	80.6%	0.66	2.7
8/29/2022	2200	335.0	2099.5	25178.9	8,851	86,471	3.43	20.3	NO	59	50120.7	96.5%	0.12	3.3
8/30/2022	2300	327.6	2042.4	25472.7	9,048	87,953	3.45	20.8	NO	59	49002.4	96.7%	0.12	3.3
8/31/2022	2100	335.0	2079.8	26001.0	8,448	89,196	3.43	20.1	NO	42	49651.8	97.4%	0.09	3.3
9/1/2022	2300	335.0	2100.3	26532.7	9,253	91,243	3.44	20.3	NO	47	50234.3	97.3%	0.09	3.3
9/2/2022	2200	335.0	1799.3	26918.7	8,851	92,528	3.44	20.3	NO	64	50330.7	96.2%	0.13	3.3
9/3/2022	1800	335.0	2100.2	27060.1	7,242	95,045	3.51	20.3	NO	44	50477.8	96.8%	0.11	3.4
9/4/2022	2100	335.0	2099.7	27020.0	8,449	99,711	3.69	20.2	NO	66	50383.6	95.9%	0.15	3.5
9/5/2022	2100	335.0	1427.3	26455.5	8,449	104,556	3.95	20.2	NO	62	50626.1	96.2%	0.15	3.8
9/6/2022	1200	309.8	1527.7	26350.3	4,465	105,057	3.99	22.8	NO	47	45328.3	94.9%	0.20	3.8
9/7/2022	1800	335.0	1207.7	26216.4	7,242	108,516	4.14	20.3	NO	37	51986.0	97.3%	0.11	4.0
9/8/2022	2100	335.0	1078.6	26099.2	8,449	114,083	4.37	20.3	NO	44	51200.9	97.3%	0.12	4.3
9/9/2022	2100	335.0	1013.7	25893.8	8,449	118,485	4.58	20.3	NO	46	50619.8	97.1%	0.13	4.4
9/10/2022	1600	335.0	1348.7	25322.8	6,437	119,461	4.72	20.3	NO	38	50110.7	96.9%	0.15	4.6
9/11/2022	1800	335.0	1478.5	24713.1	7,242	119,294	4.83	20.3	NO	40	49762.3	97.1%	0.14	4.7
9/12/2022	1800	335.0	1972.2	25375.3	7,242	118,116	4.65	20.3	NO	37	49540.3	97.3%	0.12	4.5
9/13/2022	2200	335.0	1707.0	24982.8	8,851	118,115	4.73	20.3	NO	49	49893.0	97.1%	0.14	4.6
9/14/2022	1800	335.0	1226.4	24166.9	7,242	116,309	4.81	20.3	NO	37	50403.3	97.3%	0.13	4.7
9/15/2022	1600	305.2	1608.5	23695.7	5,865	113,726	4.80	24.3	NO	37	46407.0	97.0%	0.14	4.7
9/16/2022	2000	308.1	1871.4	23466.8	7,400	111,872	4.77	19.0	NO	450	42745.0	71.3%	1.37	3.4
9/17/2022	2000	287.8	1595.7	23263.2	6,913	109,934	4.73	20.6	NO	58	39842.6	96.3%	0.17	4.6
9/18/2022	1700	312.4	1251.8	22414.8	6,378	109,071	4.87	20.3	NO	52	46360.1	96.0%	0.19	4.7
9/19/2022	1800	315.0	1000.1	21315.2	6,810	107,432	5.04	20.3	NO	35	47783.7	97.5%	0.13	4.9
9/20/2022	1800	315.0	854.1	20742.0	6,809	105,792	5.10	20.3	NO	43	47944.9	96.9%	0.16	4.9
9/21/2022	1300	315.0	64.4	19278.7	4,918	106,246	5.51	20.4	NO	13	45235.4	98.7%	0.07	5.4
9/22/2022	1500	318.3	1250.3	19321.3	5,734	104,738	5.42	20.0	NO	40	47284.2	96.5%	0.19	5.2
9/23/2022	1600	320.0	1403.5	19646.2	6,149	102,438	5.21	20.4	NO	63	47558.9	94.9%	0.27	4.9
9/24/2022	1500	320.0	1410.9	20043.5	5,765	99,754	4.98	20.4	NO	45	47464.0	96.1%	0.19	4.8
9/25/2022	1600	320.0	1837.7	20532.6	6,149	99,466	4.84	20.4	NO	46	47370.3	96.3%	0.18	4.7
9/26/2022	1800	313.5	1900.0	20954.1	6,777	99,002	4.72	21.4	NO	59	46100.9	95.8%	0.20	4.5
9/27/2022	1867	335.0	1601.7	20583.6	7,510	99,269	4.82	19.5	NO	41	48567.7	97.2%	0.14	4.7
9/28/2022	1800	335.0	1816.3	20692.9	7,242	97,660	4.72	20.3	NO	39.5	50358.1	97.1%	0.13	4.6
9/29/2022	1950	335.0	1944.2	21410.7	7,845	98,264	4.59	20.4	NO	69	50243.8	95.4%	0.21	4.4
9/30/2022	2100	335.0	2000.8	21802.9	8,449	100,848	4.63	20.4	NO	97	50239.1	94.0%	0.28	4.3
10/1/2022	2000	335.0	2000.8	21932.4	8,046	101,494	4.63	20.4	NO	76	50278.9	95.1%	0.23	4.4
10/2/2022	2000	335.0	1648.7	21985.4	8,047	102,627	4.67	20.4	NO	47	50583.4	96.9%	0.14	4.5
10/3/2022	1800	335.0	1532.6	22266.2	7,242	103,491	4.65	20.4	NO	63	50877.9	95.4%	0.21	4.4
10/4/2022	1800	331.9	1943.8	23209.9	7,175	103,856	4.47	20.1	NO	37	50029.0	97.3%	0.12	4.4

10/5/2022	2000	330.0	1998.8	24354.6	7,926	104,973	4.31	20.0	NO	38	49444.4	97.5%	0.11	4.2
10/6/2022	2000	330.0	1767.2	26057.4	7,927	107,982	4.14	20.0	NO	40	49422.9	97.4%	0.11	4.0
10/7/2022	1900	330.0	2092.3	26899.5	7,530	109,778	4.08	20.0	NO	47	49397.9	96.8%	0.13	3.9
10/8/2022	1900	330.0	1813.6	27309.6	7,529	111,159	4.07	20.0	NO	52	49853.3	96.4%	0.15	3.9
10/9/2022	1900	330.0	1716.7	27615.3	7,530	112,924	4.09	20.0	NO	21	52398.9	98.5%	0.06	4.0
10/10/2022	1900	330.0	1783.2	27560.8	7,530	114,305	4.15	19.3	NO	23	51104.3	98.4%	0.07	4.1
10/11/2022	1400	305.1	1809.3	27470.1	5,129	112,657	4.10	21.8	NO	29	46338.6	97.3%	0.11	4.0
10/12/2022	1800	236.3	931.9	26800.3	5,109	110,256	4.11	15.6	NO	17	24724.5	98.9%	0.05	4.1
10/13/2022	1800	75.2	1848.0	26832.0	1,626	104,641	3.90	18.5	NO		14065.5	77.0%	0.90	3.0
10/14/2022	1800	315.5	1721.4	26609.1	6,819	103,615	3.89	15.9	NO	180	39037.4	87.5%	0.49	3.4
10/15/2022	1800	315.6	759.0	25367.4	6,823	101,989	4.02	20.5	NO	67	47974.4	95.1%	0.20	3.8
10/16/2022	1500	320.5	1672.2	25038.8	5,773	99,716	3.98	20.5	NO	67	48492.5	94.2%	0.23	3.8
10/17/2022	1900	322.0	1898.8	25288.9	7,347	99,017	3.92	20.5	NO	150	48812.1	89.7%	0.40	3.5
10/18/2022	1767	322.0	1608.7	25365.0	6,833	98,609	3.89	20.5	NO	94.7	48921.9	93.0%	0.27	3.6
10/19/2022	1633	322.0	1609.7	25030.9	6,315	97,749	3.91	20.5	NO	121.5	49069.4	90.3%	0.38	3.5
10/20/2022	1667	303.5	1738.3	24770.4	6,075	95,898	3.87	23.4	NO	116.7	46678.7	90.8%	0.35	3.5
10/21/2022	940	0.0	1196.2	24199.4	0	87,971	3.64	100.0	NO	76	11151.3		3.64	0.0
10/22/2022	720	327.9	1165.2	23272.3	2,835	83,277	3.58	20.2	NO	43	47121.6	92.3%	0.28	3.3
10/23/2022	600	305.0	1416.8	22875.5	2,198	77,945	3.41	22.9	NO		29553.6	100.0%	0.00	3.4
10/24/2022	1600	48.3	1730.3	22889.1	928	71,343	3.12	98.8			83582.9		3.12	
10/25/2022	1700	29.2	1152.2	22258.0	597	64,409	2.89	100.0			102669.9		2.89	
10/26/2022	1500	6.7	1308.7	21757.4	120	59,401	2.73	100.0			102671.9		2.73	
10/27/2022	1200	35.0	493.2	21318.7	505	54,796	2.57	68.8			24009.5		2.57	
10/28/2022	1700	303.8	1578.2	21048.9	6,203	59,373	2.82	16.3	NO	46	38936.2	96.6%	0.10	2.7
10/29/2022	1600	350.0	1601.3	20928.9	6,725	59,278	2.83	20.5	NO	44	55741.3	96.4%	0.10	2.7
10/30/2022	1700	321.1	1176.8	21346.6	6,556	59,011	2.76	20.3	NO	37	47560.6	97.2%	0.08	2.7
10/31/2022	1700	350.3	1413.4	21087.8	7,152	60,389	2.86	20.3	NO	28	58364.9	97.8%	0.06	2.8
11/1/2022	1600	350.1	1384.2	20573.2	6,727	59,768	2.91	20.4	NO	390	57229.2	67.7%	0.94	2.0
11/2/2022	1800	350.0	624.8	19589.4	7,566	60,501	3.09	20.5	NO	140	54157.2	89.8%	0.31	2.8
11/3/2022	1400	340.1	855.1	18834.8	5,718	59,904	3.18	20.5	NO	32	53930.5	97.0%	0.10	3.1
11/4/2022	1800	328.7	1358.6	18455.2	7,105	60,934	3.30	18.7	NO	31	48486.6	97.8%	0.07	3.2
11/5/2022	1700	350.0	1707.6	18966.6	7,145	68,079	3.59	20.5	NO	43	56197.9	96.7%	0.12	3.5
11/6/2022	1900	350.0	1981.5	19782.8	7,986	73,231	3.70	20.5	NO	37	56282.6	97.4%	0.10	3.6
11/7/2022	2100	342.2	1095.0	19461.1	8,630	79,663	4.09	19.5	NO	38	54950.2	97.6%	0.10	4.0
11/8/2022	1600	342.1	1466.9	19197.7	6,574	85,309	4.44	19.1	NO	35	54104.1	97.1%	0.13	4.3
11/9/2022	1700	350.0	1247.9	19293.3	7,146	91,859	4.76	20.8	NO	40	56096.4	96.9%	0.15	4.6
11/10/2022	1700	350.0	421.6	18406.3	7,146	98,884	5.37	20.5	NO	80	55946.2	93.8%	0.33	5.0
11/11/2022	1700	350.0	1261.8	19174.8	7,145	105,525	5.50	20.5	NO	72	56103.7	94.4%	0.31	5.2
11/12/2022	1800	350.0	1214.5	18811.1	7,567	106,888	5.68	20.5	NO	99	55245.5	92.8%	0.41	5.3
11/13/2022	1900	350.0	1895.9	19105.7	7,986	108,149	5.66	20.5	NO	120	54005.0	91.7%	0.47	5.2
11/14/2022	2100	350.0	1720.3	19649	8,827	110,421	5.6	20.4	NO	140	53922.1	91.3%	0.5	5.1
11/15/2022	1700	350.0	1753.5	19989	7,145	110,414	5.5	20.0	NO	130	53431.4	90.0%	0.6	5.0
11/16/2022	2000	286.1	1985.9	20591	6,872	110,559	5.4	28.2	NO	120	41530.3	92.3%	0.4	5.0
11/17/2022	2100	290.6	1847.4	21814	7,328	110,321	5.1	26.0	NO	120	43182.4	92.6%	0.4	4.7
11/18/2022	2000	350.1	1332.7	22291	8,409	113,011	5.1	20.5	NO	110	54442.8	92.8%	0.4	4.7
11/19/2022	1400	350.0	1365.8	22298	5,885	111,791	5.0	20.5	NO	88	54269.3	91.8%	0.4	4.6
11/20/2022	1200	350.0	341.3	20932	5,044	109,689	5.2	20.5	NO	89	53906.7	90.3%	0.5	4.7
11/21/2022	940	350.0	590.1	19541	3,951	105,654	5.4	20.5	NO	66	51866.8	90.9%	0.5	4.9
11/22/2022	1700	347.5	1343.8	19789	7,094	104,118	5.3	19.3	NO	66	50344.1	95.0%	0.3	5.0
11/23/2022	1700	350.0	1815.4	20138	7,146	104,690	5.2	20.5	NO	140	54299.9	89.2%	0.6	4.6
11/24/2022	2200	350.0	1910.6	20801	9,248	106,791	5.1	20.5	NO	190	54610.2	88.7%	0.6	4.6
11/25/2022	2100	350.0	1900.0	22279	8,827	108,472	4.9	19.8	NO	150	53860.0	90.7%	0.5	4.4
11/26/2022	2100	350.0	1815.3	22832	8,827	110,153	4.8	19.3	NO	170	53322.9	89.4%	0.5	4.3
11/27/2022	1900	350.0	1083.4	22701	7,986	110,573	4.9	20.5	NO	160	54036.7	89.0%	0.5	4.3
11/28/2022	1000	350.0	1000.0	21805	4,203	106,790	4.9	20.2	NO	92	51972.1	88.1%	0.6	4.3
11/29/2022	1600	348.6	1190.5	21276	6,698	104,661	4.9	18.2	NO	110	48152.7	91.2%	0.4	4.5

11/30/2022	1800	350.0	1575.2	21097	7,565	105,081	5.0	20.5	NO	140	54604.5	89.8%	0.5	4.5
12/1/2022	1500	350.0	1250.3	20362	6,306	104,515	5.1	20.2	NO	140	54446.7	87.8%	0.6	4.5
12/2/2022	1700	350.0	964.7	19479	7,145	104,333	5.4	20.5	NO	140	54746.5	89.2%	0.6	4.8
12/3/2022	1500	350.0	1572.5	19719	6,305	102,229	5.2	20.0	NO	120	53957.3	89.5%	0.5	4.6
12/4/2022	1900	350.0	1996.1	20349	7,987	104,331	5.1	19.9	NO	180	53258.3	87.6%	0.6	4.5
12/5/2022	2000	350.0	1999.8	22008	8,407	107,694	4.9	19.8	NO	180	52924.8	88.3%	0.6	4.3
12/6/2022	1900	345.7	1389.4	22807	7,889	111,631	4.9	20.0	NO	170	52773.6	88.3%	0.6	4.3
12/7/2022	1800	325.0	1033.5	22497	7,026	111,564	5.0	20.5	NO	99	49777.6	92.8%	0.4	4.6
12/8/2022	1500	325.0	1000.3	21681	5,855	110,272	5.1	20.5	NO	87	49844.2	92.4%	0.4	4.7
12/9/2022	1500	324.8	1000.4	20771	5,852	106,877	5.1	20.5	NO	96	49836.4	91.6%	0.4	4.7
12/10/2022	1500	331.0	1511.0	20382	5,963	104,013	5.1	20.5	NO	89	50787.9	92.2%	0.4	4.7
12/11/2022	1600	325.0	1808.0	20375	6,245	101,431	5.0	20.5	NO	99	49992.5	91.9%	0.4	4.6
12/12/2022	1800	325.0	1662.6	20954	7,026	100,471	4.8	20.5	NO	220	49993.6	84.0%	0.8	4.0
12/13/2022	1700	325.0	1122.3	21077	6,635	102,902	4.9	20.5	NO	120	49535.0	90.8%	0.4	4.4
12/14/2022	1700	325.0	1052.1	20938	6,636	102,840	4.9	20.5	NO	120	49242.8	90.8%	0.5	4.5
12/15/2022	1800	325.0	1036.5	20399	7,025	102,300	5.0	20.5	NO	130	49548.8	90.6%	0.5	4.5
12/16/2022	1400	325.0	1395.5	20545	5,465	101,460	4.9	20.5	NO	120	49567.6	88.8%	0.6	4.4
12/17/2022	1700	325.0	1372.7	20953	6,635	100,949	4.8	20.5	NO	110	50376.5	91.5%	0.4	4.4
12/18/2022	1600	325.0	1553.4	20934	6,245	100,889	4.8	20.5	NO	120	50311.7	90.2%	0.5	4.3
12/19/2022	2100	320.3	1508.6	20446	8,079	100,981	4.9	13.9	NO	110	37830.0	93.5%	0.3	4.6
12/20/2022	1700	325.0	1438.6	19885	6,635	99,210	5.0	20.5	NO	270	50243.0	79.2%	1.0	4.0
12/21/2022	1700	325.0	1414.5	19910	6,636	97,957	4.9	20.4	NO	130	50407.6	90.0%	0.5	4.4
12/22/2022	1900	325.0	1605.7	20482	7,416	98,347	4.8	20.5	NO	130	50439.6	91.0%	0.4	4.4
12/23/2022	1800	231.0	1278.5	20760	4,994	97,486	4.7	29.06	NO	140	44225.1	89.2%	0.5	4.2
12/29/2022	1200	349.4	619.5	20379	5,036	96,670	4.7	15.98	NO	170	42434.2	82.4%	0.8	3.9
12/30/2022	1200	313.4	872.9	19741	4,516	95,223	4.8	20.90	NO	470	41279.9	50.5%	2.4	2.4
12/31/2022	1200	341.0	567.2	18501	4,914	93,892	5.1	18.71	NO	470	45453.2	50.4%	2.5	2.6
1/1/2023	1300	350.0	688.2	17526	5,464	92,330	5.3	20.49	NO	340	49980.0	66.4%	1.8	3.5
1/2/2023	1200	350.0	1022.1	17426	5,045	90,740	5.2	20.50	NO	330	50060.9	64.6%	1.8	3.4
1/3/2023	1700	350.0	877.0	17251	7,146	91,250	5.3	20.49	NO	440	50685.8	66.6%	1.8	3.5
1/4/2023	1400	350.0	1185.2	17400	5,885	90,110	5.2	20.50	NO	380	51200.7	64.9%	1.8	3.4
1/5/2023	1800	350.0	1199.5	17204	7,565	92,211	5.4	20.5	NO	490	51055.0	64.8%	1.9	3.5
1/6/2023	1400	350.0	1121.4	16952	5,885	91,460	5.4	20.5	NO	380	50805.0	65.0%	1.9	3.5
1/7/2023	1400	350.0	1315.2	16714	5,885	91,100	5.5	20.5	NO	380	50241.3	65.1%	1.9	3.5
1/8/2023	1500	350.0	1287.9	16493	6,305	89,327	5.4	20.5	NO	400	51877.6	65.4%	1.9	3.5
1/9/2023	1600	328.1	1652.1	16707	6,304	88,996	5.3	20.2	NO	450	51886.3	63.0%	2.0	3.4
1/10/2023	2000	315.1	1776.5	17068.7	7,569	89,929	5.3	20.0	NO	600	50418.5	60.4%	2.1	3.2
1/11/2023	1900	319.7	1253.2	16716	7,295	89,809	5.4	20.5	NO	590	52439.7	58.8%	2.2	3.2
1/12/2023	1900	320.0	1676.5	17114	7,302	92,117	5.4	20.5	NO	560	52783.1	60.8%	2.1	3.3
1/13/2023	1800	319.5	1831.1	18326	6,907	93,988	5.1	20.6	NO	550	52750.2	59.4%	2.1	3.0
1/14/2023	1800	349.6	1290.3	18743	7,558	97,030	5.2	20.1	NO	610	58320.1	54.8%	2.3	2.8
1/15/2023	1700	350.0	1774.7	19951	7,145	99,261	5.0	20.5	NO	510	58439.9	60.0%	2.0	3.0
1/16/2023	2000	350.0	1927.3	21190	8,406	102,204	4.8	20.5	NO	600	58113.6	60.0%	1.9	2.9
1/17/2023	2000	350.0	1788.3	21956	8,408	105,567	4.8	20.5	NO	570	58165.5	62.0%	1.8	3.0
1/18/2023	1400	350.0	1636.2	22715	5,884	104,305	4.6	20.5	NO	520	58258.7	50.5%	2.3	2.3
1/19/2023	1700	350.0	1456.7	22987	7,146	105,566	4.6	20.5	NO	570	59062.4	55.2%	2.1	2.5
1/20/2023	1700	350.1	1010.2	22797	7,147	105,147	4.6	19.7	NO	560	58449.5	56.1%	2.0	2.6
1/21/2023	1200	350.0	799.7	22476	5,044	104,306	4.6	19.9	NO	390	59417.0	56.5%	2.0	2.6
1/22/2023	1600	350.0	846.5	22007	6,725	105,146	4.8	20.5	NO	490	61489.6	58.6%	2.0	2.8
1/23/2023	96	350.0	131.9	20851	403	99,244	4.8	20.5	NO	29	56704.8	60.0%	1.9	2.9
1/26/2023	130	349.9	871.5	20071	546	93,486	4.7	20.5	NO	36	57741.8	63.2%	1.7	2.9
1/27/2023	965	354.9	1303.1	19597	4,113	90,030	4.6	20.3	NO	305	59639.1	57.8%	1.9	2.7
1/28/2023	1500	328.3	976.8	19321	5,914	88,648	4.6	19.7	NO	470	53108.1	58.5%	1.9	2.7
1/29/2023	1400		747.2	18391	0	81,346	4.4	13.7	NO		26537.0			
1/30/2023	1100		921.5	17482	0	74,439	4.3	98.8	NO		67557.6			
1/31/2023	1300		1521.2	17713	0	66,881	3.8	100.0	NO		102656.8			

2/1/2023	1600		1539.4	17478	0	59,736	3.4	83.1	NO		46258.6			
2/2/2023	1500		1408.9	16959	0	51,329	3.0	27.1	NO		18442.5			
2/3/2023	1400	350.1	1577.0	16748	5,887	48,809	2.9	19.5	NO	23	55715.7	97.8%	0.1	2.9
2/4/2023	1600	350.0	1612.2	16724	6,725	49,650	3.0	19.5	NO	27	55802.6	97.8%	0.1	2.9
2/5/2023	1600	350.0	1652.8	16920	6,725	49,229	2.9	19.5	NO	28	55324.8	97.7%	0.1	2.8
2/6/2023	1800	309.3	1415.8	17326	6,686	48,769	2.8	19.5	NO	36	48587.1	97.4%	0.1	2.7
2/7/2023	1800	332.3	900.4	17426	7,184	50,909	2.9	19.8	NO	52	53585.5	96.2%	0.1	2.8
2/8/2023	880	350.0	999.2	17579	3,699	47,883	2.7	20.0	NO	15	56476.7	97.7%	0.1	2.7
2/9/2023	900	338.4	613.4	18061	3,657	51,137	2.8	19.5	NO	15	53873.5	97.8%	0.1	2.8
2/10/2023	930	350.0	1214.0	18403	3,910	54,500	3.0	20.0	NO	15	56799.2	97.9%	0.1	2.9
2/11/2023	1500	350.0	1776.2	18876	6,305	56,692	3.0	20.0	NO	26	56641.8	97.7%	0.1	2.9
2/12/2023	1700	350.0	1599.1	19498	7,146	57,923	3.0	20.0	NO	35	57081.5	97.3%	0.1	2.9
2/13/2023	1667	350.0	1618.3	20370	7,005	64,928	3.2	20.0	NO	32.67	57071.3	97.4%	0.1	3.1
2/14/2023	1650	350.0	1735.9	21184	6,936	71,864	3.4	19.8	NO	33.5	56289.4	97.3%	0.1	3.3
2/15/2023	1800	350.0	1499.9	21163	7,566	79,430	3.8	20.0	NO	36	56703.2	97.4%	0.1	3.7
2/16/2023	1800	350.0	1644.9	21268	7,567	86,997	4.1	19.0	NO	28	54266.4	98.0%	0.1	4.0
2/17/2023	2000	343.9	865.8	20725	8,260	95,257	4.6	16.5	NO	43	49527.4	97.2%	0.1	4.5
2/18/2023	1200	350.0	1778.4	20926	5,044	94,414	4.5	20.0	NO	39	57074.3	95.7%	0.2	4.3
2/19/2023	2000	350.0	1651.4	20966	8,407	96,095	4.6	20.0	NO	44	57410.6	97.1%	0.1	4.4
2/20/2023	1900	346.3	835.9	20149	7,903	97,273	4.8	20.1	NO	35	58357.2	97.5%	0.1	4.7
2/21/2023	1800	350.0	1234.1	19967	7,566	98,153	4.9	20.0	NO	21	57221.1	98.5%	0.1	4.8
2/22/2023	1800	350.0	1807.9	20874	7,566	98,535	4.7	20.0	NO	28	56703.4	97.9%	0.1	4.6
2/23/2023	1700	350.0	862.8	20738	7,146	101,982	4.9	19.9	NO	31	57150.3	97.6%	0.1	4.8
2/24/2023	1400	350.0	1845.4	21970	5,885	104,209	4.7	20.0	NO	28	56947.1	97.3%	0.1	4.6
2/25/2023	1900	350.0	1545.5	22302	7,986	108,286	4.9	20.0	NO	43	56720.7	97.0%	0.1	4.7
2/26/2023	1800	350.0	1900.2	22426	7,566	109,547	4.9	20.0	NO	40	56600.5	97.1%	0.1	4.7
2/27/2023	1800	350.0	1260.6	22087	7,567	109,968	5.0	20.0	NO	38	57078.5	97.2%	0.1	4.8
2/28/2023	1300	350.0	1277.0	21746	5,464	108,427	5.0	20.0	NO	22	56291.5	97.8%	0.1	4.9

NEW-INDY CATAWBA MILL STRIPPER PROJECT

Stripper Operating Scenario	Operating Time	
	%	hrs
New Stripper Online	90%	7,884.0
Backup Stripper Online	8%	700.8
No Stripper Online	2%	175.2

LVHC Control Operating Scenario	Operating Time	
	%	hrs
RF3 Available for LVHC	75%	6,570.0
LVHC to CB1/CB2	25%	2,190.0

	Baseline				
Existing Stripper Steam Demand	21.1	MMBtu/hr	was previously	23.9	MMBtu/hr

(Attachment A to May 22 Response to DHEC Comments on App 1)

Summary of PSD Applicability
(tons/year)

Pollutant[A]	PM	PM_{10}	$PM_{2.5}$	NO_X	SO_2	CO	H2SO4	TRS	VOC	Pb	H_2S	CO_2
Baseline Actual Emissions	1.11	1.02	0.959	124	737	25.2	1.23	12.8	233	1.10E-04	3.61	12,275
Projected Actual Emissions	13.4	10.4	8.45	148	629	64.2	2.43	15.6	243	2.08E-03	5.69	48,629
Net Emissions Changes (PAE - BAE)	12.3	9.41	7.49	24.2	-108.18	39.0	1.20	2.75	10.2	1.97E-03	2.09	36,354
PSD Significant Emissions Rates	**25**	**15**	**10**	**40**	**40**	**100**	**7**	**10**	**40**	**0.6**	**10**	**75,000**
PSD Significant?	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**

A - HF is not emitted from new, modified, or affected emissions units.

SO2 EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		SO2 Emissions Factor		Sulfur Capture[C]	SO2 Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100%	8,004.0	SOG to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	1.06	October 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	60.4	241.8
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	1.97	October 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	112.0	490.6
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B,E]	97.9%	7,835.7	NA	100.0%	7,835.7	26.0	mmBtu/hr	6.00E-04	AP-42 Table 1.4-2.	NA	0.02	0.1
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B,E]	2.1%	168.3	NA	100.0%	168.3	24.8	mmBtu/hr	2.20E+00	AP-42 Table 1.3-1. 2.1% Sulfur Content.	NA	54.6	4.6
SO2 BASELINE ACTUAL EMISSIONS (BAE)															**737.0**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90.0%	7,884.0	SRL Online	95%	7,489.8	SRL Methanol to RF2/3[G]	100.0%	7,489.8	2,700	ADTP/day	0.56	Vendor / Preliminary Design Information	99%	0.6	2.4
New Stripper Online	90.0%	7,884.0	SRL Online	95%	7,489.8	SRL LVHC to RF3[G]	75.0%	5,617.4	2,700	ADTP/day	0.84	Vendor / Preliminary Design Information	99%	0.9	2.7
New Stripper Online	90.0%	7,884.0	SRL Online	95%	7,489.8	SRL LVHC to CB1/CB2[G]	25.0%	1,872.5	2,700	ADTP/day	0.84	Vendor / Preliminary Design Information	50%	47.2	44.2
New Stripper Online	90.0%	7,884.0	SRL Offline	5%	394.2	SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	1.40	Vendor / Preliminary Design Information	0%	157.4	31.0
Backup Stripper Online	8.0%	700.8	NA	100%	700.8	SOG to CB1/CB2	100.0%	700.8	2,700	ADTP/day	1.40	Vendor / Preliminary Design Information	0%	157.4	55.1
No Stripper Online	2.0%	175.2	Foul Condensate to Hard Pipe	100%	175.2	Hydrogen Peroxide Addition	100.0%	175.2	NA	NA	NA	NA	NA	NA	NA
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	5.25	October 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. Pre-control emissions based on LVHC scrubber efficiency (50%) and estimated bark ash sulfur capture (20%) from 2012 stack test.	99%	5.9	19.4
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	5.25	October 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. Pre-control emissions based on LVHC scrubber efficiency (50%) and estimated bark ash sulfur capture (20%) from 2012 stack test.	50%	295.2	323.3
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5	NA	100.0%	985.5	1.0	mmBtu/hr	6.00E-04	AP-42 Table 1.4-2.	NA	0.00	0.0
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D,F]	81.6%	6,433.3	NA	100.0%	6,433.3	96.8	mmBtu/hr	6.00E-04	AP-42 Table 1.4-2.	NA	0.06	0.2
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D,F]	18.4%	1,450.7	NA	100.0%	1,450.7	92.2	mmBtu/hr	2.20E+00	AP-42 Table 1.3-1. 2.1% Sulfur Content.	NA	202.9	147.2
Backup Stripper Steam - Natural Gas	8.0%	700.8	Natural Gas[D,F]	81.6%	571.9	NA	100.0%	571.9	25.3	mmBtu/hr	6.00E-04	AP-42 Table 1.4-2.	NA	0.02	0.004
Backup Stripper Steam - No. 6 Oil	8.0%	700.8	No. 6 Oil[D,F]	18.4%	128.9	NA	100.0%	128.9	24.1	mmBtu/hr	2.20E+00	AP-42 Table 1.3-1. 2.1% Sulfur Content.	NA	53.1	3.4
SO2 PROJECTED ACTUAL EMISSIONS (PAE)															**628.84**
NET EMISSIONS CHANGE (PAE - BAE)															
NET EMISSIONS CHANGE (PAE - BAE)															**-108.18**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boiliers No. 1 and No. 2 during baseline.

C - Sulfur capture in recovery furnace >99, sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

H2SO4 EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		H2SO4 Emissions Factor		Sulfur Capture	H2SO4 Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/ADTP	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	4.93E-03	NCASI Technical Bulletin 858, Table 10	NA	0.3	1.2
H2SO4 BASELINE ACTUAL EMISSIONS (BAE)															**1.2**
PROJECTED ACTUAL EMISSIONS															
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	4.93E-03	NCASI Technical Bulletin 858, Table 10	NA	0.55	1.82
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	4.93E-03	NCASI Technical Bulletin 858, Table 10	NA	0.55	0.61
H2SO4 PROJECTED ACTUAL EMISSIONS (PAE)															**2.43**
NET EMISSIONS CHANGE (PAE - BAE)															
NET EMISSIONS CHANGE (PAE - BAE)															**1.20**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boiliers No. 1 and No. 2 during baseline.

C - Sulfur capture in recovery furnace >99, sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

NOX EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		NOX Emissions Factor		Ammonia Increase[C]	NOX Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	SOG to CB1/CB2	100%	8,004.0	1,365	ADTP/day	0.415	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	23.6	94.5
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B,E]	97.9%	7,835.7	NA	100%	7,835.7	26.0	mmBtu/hr	2.80E-01	AP-42 Table 1.4-2.	NA	7.3	28.6
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B,E]	2.1%	168.3	NA	100%	168.3	24.8	mmBtu/hr	3.13E-01	AP-42 Table 1.3-1.	NA	7.8	0.7
NOX BASELINE ACTUAL EMISSIONS															**123.7**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3[G]	100%	7,489.8	2,852	TBLS/day	1.500	NCASI Technical Bulletin 884, Table 4.12.	1.0%	1.8	6.7
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3[G]	75%	5,617.4	316.9	TBLS/day	1.500	NCASI Technical Bulletin 884, Table 4.12.	1.0%	0.2	0.6
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2[G]	25%	1,872.5	270.0	ADTP/day	0.415	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	4.7	4.4
New Stripper Online	90%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100%	394.2	2,700	ADTP/day	0.415	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	46.7	9.2
Backup Stripper Online	8%	700.8	NA	100.0%	700.8	SOG to CB1/CB2	100%	700.8	2,700	ADTP/day	0.415	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	46.7	16.4
No Stripper Online	2%	175.2	Foul Condensate to Hard Pipe	100.0%	175.2	Hydrogen Peroxide Addition	100%	175.2	NA	NA	NA	NA	NA	NA	NA
Recovery Furnace #3 LVHC Ignitor	75%	6,570.0	Natural Gas[I]	15.0%	985.5	NA	100%	985.5	1.0	mmBtu/hr	2.80E-01	AP-42 Table 1.4-2.	NA	0.3	0.1
New Stripper Steam - Natural Gas	90%	7,884.0	Natural Gas[D,F]	81.6%	6,433.3	NA	100%	6,433.3	96.8	mmBtu/hr	2.80E-01	AP-42 Table 1.4-2.	NA	27.1	87.2
New Stripper Steam - No. 6 Oil	90%	7,884.0	No. 6 Oil[D,F]	18.4%	1,450.7	NA	100%	1,450.7	92.2	mmBtu/hr	3.13E-01	AP-42 Table 1.3-1.	NA	28.9	20.9
Backup Stripper Steam - Natural Gas	8%	700.8	Natural Gas[D,F]	81.6%	571.9	NA	100%	571.9	25.3	mmBtu/hr	2.80E-01	AP-42 Table 1.4-2.	NA	7.1	2.0
Backup Stripper Steam - No. 6 Oil	8%	700.8	No. 6 Oil[D,F]	18.4%	128.9	NA	100%	128.9	24.1	mmBtu/hr	3.13E-01	AP-42 Table 1.3-1.	NA	7.5	0.5
NOX PROJECTED ACTUAL EMISSIONS															**147.9**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**24.2**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Ammonia input to recovery furnace increases >1% (methanol input limited to 1% of black liquor input by BLRBAC).

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - >90% of methanol condensed and burned in recovery furnace, < 10% of methanol vented into LVHC System.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

CO EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		CO Emissions Factor		CO Control	CO Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	SOG to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	0.0728	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	4.1	16.6
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7	NA	100.0%	7,835.7	26.0	mmBtu/hr	8.40E-02	AP-42 Table 1.4-2.	NA	2.2	8.6
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3	NA	100.0%	168.3	24.8	mmBtu/hr	3.33E-02	AP-42 Table 1.3-1.	NA	0.8	0.1
CO BASELINE ACTUAL EMISSIONS															**25.2**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3	100.0%	7,489.8	NA	NA	NA	NA	NA	NA	NA
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3	75%	5,617.4	2,700	ADTP/day	0.0728	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	8.2	23.0
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2	25%	1,872.5	2,700	ADTP/day	0.0728	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	8.2	7.7
New Stripper Online	90%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	0.0728	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	8.2	1.6
Backup Stripper Online	8%	700.8	NA	100.0%	700.8	SOG to CB1/CB2	100.0%	700.8	2,700	ADTP/day	0.0728	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	8.2	2.9
No Stripper Online	2%	175.2	Foul Condensate to Hard Pipe	100.0%	175.2	Hydrogen Peroxide Addition	100.0%	175.2	NA	NA	NA	NA	NA	NA	NA
Recovery Furnace #3 LVHC Ignitor	75%	6,570.0	Natural Gas[I]	15.0%	985.5	NA	100.0%	985.5	1.0	mmBtu/hr	8.40E-02	AP-42 Table 1.4-2.	NA	0.1	0.0
New Stripper Steam - Natural Gas	90%	7,884.0	Natural Gas[D]	81.6%	6,433.3	NA	100.0%	6,433.3	96.8	mmBtu/hr	8.40E-02	AP-42 Table 1.4-2.	NA	8.1	26.2
New Stripper Steam - No. 6 Oil	90%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7	NA	100.0%	1,450.7	92.2	mmBtu/hr	3.33E-02	AP-42 Table 1.3-1.	NA	3.1	2.2
Backup Stripper Steam - Natural Gas	8%	700.8	Natural Gas[D]	81.6%	571.9	NA	100.0%	571.9	25.3	mmBtu/hr	8.40E-02	AP-42 Table 1.4-2.	NA	2.1	0.6
Backup Stripper Steam - No. 6 Oil	8%	700.8	No. 6 Oil[D]	18.4%	128.9	NA	100.0%	128.9	24.1	mmBtu/hr	3.33E-02	AP-42 Table 1.3-1.	NA	0.8	0.1
CO PROJECTED ACTUAL EMISSIONS															**64.2**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**39.0**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - reserved.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

VOC EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		VOC Emissions Factor		Removal[C]	VOC Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	LVHC to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	4.35	Average daily methanol stripped based on daily Subpart S compliance through 2/28/2023.	98.0%	4.95	19.81
Aerated Stabilization Basin (ASB)	100.0%	8,760.0	Foul Condensate to Hard Pipe	100.0%	8,760.0	NA	100.0%	8,760.0	1,365	ADTP/day	8.51E-01	WATER9 Inputs and Outputs Provided.	NA	48.39	211.96
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	3.10E-03	July 2019 Project Columbia Application. Page C-3 for Total LVHC Emissions.	NA	0.18	0.77
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7	NA	100.0%	7,835.7	26.0	mmBtu/hr	5.50E-03	AP-42 Table 1.4-2.	NA	0.1	0.6
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3	NA	100.0%	168.3	24.8	mmBtu/hr	1.87E-03	AP-42 Table 1.3-3. NMTOC for no. 6 oil.	NA	0.0	0.0
VOC BASELINE ACTUAL EMISSIONS															**233.11**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3[G]	100%	7,489.8	2,700	ADTP/day	14.40	Vendor / Preliminary Design Information	99.9%	1.62	6.07
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3[G]	75%	5,617.4	2,700	ADTP/day	1.60	Vendor / Preliminary Design Information	98%	3.60	10.11
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2[G]	25%	1,872.5	2,700	ADTP/day	1.60	Vendor / Preliminary Design Information	98%	3.60	3.37
New Stripper Online	90%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100%	394.2	2,700	ADTP/day	16.00	Vendor / Preliminary Design Information	98%	36.00	7.10
Backup Stripper Online[H]	8%	700.8	NA	100.0%	700.8	SOG to CB1/CB2	100%	700.8	2,700	ADTP/day	7.20	Vendor / Preliminary Design Information	98%	16.20	5.68
ASB - New Stripper Online	90%	7,884.0	No Foul Condensate to Hard Pipe	100.0%	7,884.0	NA	100%	7,884.0	2,700	ADTP/day	0.29	WATER9 Inputs and Outputs Provided.	NA	32.85	129.50
ASB - Backup Stripper Online	8%	700.8	TRS Stripped From Foul Condensate	100.0%	700.8	NA	100%	700.8	2,700	ADTP/day	1.43	WATER9 Inputs and Outputs Provided.	NA	160.92	56.39
ASB - No Stripper Online	2%	175.2	Foul Condensate to Hard Pipe	100.0%	175.2	NA	100%	175.2	2,700	ADTP/day	2.20	WATER9 Inputs and Outputs Provided.	NA	247.14	21.65
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to RF3	75%	6,570.0	2,700	ADTP/day	3.10E-03	July 2019 Project Columbia Application. Page C-3 for Total LVHC Emissions.	NA	0.35	1.15
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	25%	2,190.0	2,700	ADTP/day	3.10E-03	July 2019 Project Columbia Application. Page C-3 for Total LVHC Emissions.	NA	0.35	0.38
Recovery Furnace #3 LVHC Ignitor	75%	6,570.0	Natural Gas[I]	15.0%	985.5	NA	100%	985.5	1.0	mmBtu/hr	5.50E-03	AP-42 Table 1.4-2.	NA	0.0	0.0
New Stripper Steam - Natural Gas	90%	7,884.0	Natural Gas[D]	81.6%	6,433.3	NA	100%	6,433.3	96.8	mmBtu/hr	5.50E-03	AP-42 Table 1.4-2.	NA	0.5	1.7
New Stripper Steam - No. 6 Oil	90%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7	NA	100%	1,450.7	92.2	mmBtu/hr	1.87E-03	AP-42 Table 1.3-3. NMTOC for no. 6 oil.	NA	0.2	0.1
Backup Stripper Steam - Natural Gas	8%	700.8	Natural Gas[D]	81.6%	571.9	NA	100%	571.9	25.3	mmBtu/hr	5.50E-03	AP-42 Table 1.4-2.	NA	0.1	0.0
Backup Stripper Steam - No. 6 Oil	8%	700.8	No. 6 Oil[D]	18.4%	128.9	NA	100%	128.9	24.1	mmBtu/hr	1.87E-03	AP-42 Table 1.3-3. NMTOC for no. 6 oil.	NA	0.0	0.0
VOC PROJECTED ACTUAL EMISSIONS															**243.27**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**10.16**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - VOC destruction >98% in vapor phase, 99.9% in liquid phase.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - >90% of methanol condensed and burned in recovery furnace, < 10% of methanol vented into LVHC System.

H - Backup Stripper in TRS Mode removes 45% of the methanol from the foul condensate. The stripped condensate is discharged to the hardpipe for additional methanol treatment in the ASB.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

TRS EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		TRS Emissions Factor		Sulfur Capture[C]	TRS Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	LVHC to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	2.88E-03	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	0.16	0.65
Aerated Stabilization Basin (ASB)	100.0%	8,760.0	NA	100.0%	8,760.0	NA	100.0%	8,760.0	1,365	ADTP/day	4.08E-02	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	2.32	10.16
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	8.01E-03	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	0.46	2.00
TRS BASELINE ACTUAL EMISSIONS															**12.81**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3[G,H]	100.0%	7,489.8	2,700	ADTP/day	0.33	Vendor / Preliminary Design Information	99.9%	0.04	0.14
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3[G,H]	75.0%	5,617.4	2,700	ADTP/day	0.49	Vendor / Preliminary Design Information	99.9%	0.05	0.15
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2[G]	25.0%	1,872.5	2,700	ADTP/day	0.49	Vendor / Preliminary Design Information	99%	0.55	0.51
New Stripper Online	90.0%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	0.81	Vendor / Preliminary Design Information	99%	0.91	0.18
Backup Stripper Online	8.0%	700.8	NA	100.0%	700.8	SOG to CB1/CB2	100.0%	700.8	2,700	ADTP/day	0.81	Vendor / Preliminary Design Information	99%	0.91	0.32
ASB - New Stripper Online	90.0%	7,884.0	No Foul Condensate to Hard Pipe	100.0%	7,884.0	NA	100.0%	7,884.0	2,700	ADTP/day	2.42E-02	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	2.72	10.74
ASB - Backup Stripper Online	8.0%	700.8	TRS Stripped From Foul Condensate	100.0%	700.8	NA	100.0%	700.8	2,700	ADTP/day	2.72E-02	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	3.06	1.07
ASB - No Stripper Online	2.0%	175.2	Foul Condensate to Hard Pipe	100.0%	175.2	Hydrogen Peroxide Addition	100.0%	175.2	2,700	ADTP/day	7.28E-02	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	8.19	0.72
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	1.75E+00	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. Pre-control emissions based on LVHC scrubber efficiency (50%) and estimated 99% combustion efficiency in combination boilers.	99.9%	0.20	0.65
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	8.76E-03	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. DHEC Approved Test.	NA	0.99	1.08
TRS PROJECTED ACTUAL EMISSIONS															**15.56**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**2.75**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Sulfur capture in recovery furnace >99.9% (see note H), sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - Recovery Furnace captures 99% of sulfur and converts 99% of remaining uncaptured sulfur.

H2S EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		H2S Emissions Factor		Sulfur Capture[C]	H2S Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	LVHC to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	4.13E-04	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	0.02	0.09
Aerated Stabilization Basin (ASB)	100.0%	8,760.0	Foul Condensate to Hard Pipe	100.0%	8,760.0	Hydrogen Peroxide Addition	100.0%	8,760.0	1,365	ADTP/day	1.36E-02	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	0.77	3.39
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	5.03E-04	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	0.03	0.13
H2S BASELINE ACTUAL EMISSIONS															**3.61**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3[G,H]	100.0%	7,489.8	2,700	ADTP/day	0.24	Vendor / Preliminary Design Information	99.9%	0.03	0.10
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3[G,H]	75.0%	5,617.4	2,700	ADTP/day	0.37	Vendor / Preliminary Design Information	99.9%	0.04	0.12
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2[G]	25.0%	1,872.5	2,700	ADTP/day	0.37	Vendor / Preliminary Design Information	99%	0.41	0.39
New Stripper Online	90.0%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	0.61	Vendor / Preliminary Design Information	99%	0.69	0.14
Backup Stripper Online	8.0%	700.8	NA	100.0%	700.8	SOG to CB1/CB2	100.0%	700.8	2,700	ADTP/day	0.61	Vendor / Preliminary Design Information	99%	0.69	0.24
ASB - New Stripper Online	90.0%	7,884.0	No Foul Condensate to Hard Pipe	100.0%	7,884.0	NA	100.0%	7,884.0	2,700	ADTP/day	9.27E-03	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	1.04	4.11
ASB - Backup Stripper Online	8.0%	700.8	H2S Stripped From Foul Condensate	100.0%	700.8	NA	100.0%	700.8	2,700	ADTP/day	9.81E-03	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	1.10	0.39
ASB - No Stripper Online	2.0%	175.2	Foul Condensate to Hard Pipe	100.0%	175.2	Hydrogen Peroxide Addition	100.0%	175.2	2,700	ADTP/day	9.54E-03	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	1.07	0.09
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	1.17E-01	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. Pre-control emissions based on LVHC scrubber efficiency (50%) and estimated 99% combustion efficiency in combination boilers.	99.9%	0.01	0.04
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	5.87E-04	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. DHEC Approved Test.	NA	0.07	0.07
H2S PROJECTED ACTUAL EMISSIONS															**5.69**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**2.09**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Sulfur capture in recovery furnace >99.9% (see note H), sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - Recovery Furnace captures 99% of sulfur and converts 99% of remaining uncaptured sulfur.

PM EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time %	Stripper Scenario Operating Time hrs	Operating Configuration	Operating Configuration Time %	Operating Configuration Time hrs	Controls	Controls Operating Time %	Controls Operating Time hrs	Production Rate Value	Production Rate UOM	PM Emissions Factor lb/UOM	PM Emissions Factor Reference	PM Control %	PM Emissions lb/hr	PM Emissions tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	26.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.8
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	24.8	mmBtu/hr	1.61E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	4.0	0.3
PM BASELINE ACTUAL EMISSIONS															**1.1**
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	7.60E-03	3.74E-03
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.7	2.4
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	1.61E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	14.8	10.8
Backup Stripper Steam - Natural Gas	8.0%	700.8	Natural Gas[D]	81.6%	571.9		100.0%	571.9	25.3	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.1
Backup Stripper Steam - No. 6 Oil	8.0%	700.8	No. 6 Oil[D]	18.4%	128.9		100.0%	128.9	24.1	mmBtu/hr	1.61E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	3.9	0.3
PM PROJECTED ACTUAL EMISSIONS															**13.4**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**12.3**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - reserved.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

PM10 EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		PM10 Emissions Factor		PM10 Control	PM10 Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	26.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.8
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	24.8	mmBtu/hr	1.17E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	2.9	0.2
PM10 BASELINE ACTUAL EMISSIONS															**1.0**
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	7.60E-03	3.74E-03
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.7	2.4
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	1.17E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	10.8	7.8
Backup Stripper Steam - Natural Gas	8.0%	700.8	Natural Gas[D]	81.6%	571.9		100.0%	571.9	25.3	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.1
Backup Stripper Steam - No. 6 Oil	8.0%	700.8	No. 6 Oil[D]	18.4%	128.9		100.0%	128.9	24.1	mmBtu/hr	1.17E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	2.8	0.2
PM10 PROJECTED ACTUAL EMISSIONS															**10.4**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**9.4**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - reserved.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

PM2.5 EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time %	Stripper Scenario Operating Time hrs	Operating Configuration	Operating Configuration Time %	Operating Configuration Time hrs	Controls	Controls Operating Time %	Controls Operating Time hrs	Production Rate Value	Production Rate UOM	PM2.5 Emissions Factor lb/UOM	PM2.5 Emissions Factor Reference	PM2.5 Control %	PM2.5 Emissions lb/hr	PM2.5 Emissions tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	26.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.8
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	24.8	mmBtu/hr	8.80E-02	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	2.2	0.2
PM2.5 BASELINE ACTUAL EMISSIONS															**1.0**
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	7.60E-03	3.74E-03
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.7	2.4
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	8.80E-02	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	8.1	5.9
Backup Stripper Steam - Natural Gas	8.0%	700.8	Natural Gas[D]	81.6%	571.9		100.0%	571.9	25.3	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.1
Backup Stripper Steam - No. 6 Oil	8.0%	700.8	No. 6 Oil[D]	18.4%	128.9		100.0%	128.9	24.1	mmBtu/hr	8.80E-02	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	2.1	0.1
PM2.5 PROJECTED ACTUAL EMISSIONS															**8.4**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**7.5**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - reserved.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

LEAD EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		Lead Emissions Factor		Lead Control	Lead Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	26.0	mmBtu/hr	5.00E-07	AP-42 Table 1.4-2.	NA	1.30E-05	5.10E-05
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	24.8	mmBtu/hr	2.80E-05	U.S. EPA document "Estimating Air Toxic Emissions from Coal and Oil Combustion Sources" [EPA-450/2-89-001] for Uncontrolled Residual Oil-fired Utility Boilers (Table 4-1)	NA	6.95E-04	5.85E-05
LEAD BASELINE ACTUAL EMISSIONS															**1.10E-04**
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	5.00E-07	AP-42 Table 1.4-2.	NA	5.00E-07	2.46E-07
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	5.00E-07	AP-42 Table 1.4-2.	NA	4.84E-05	1.56E-04
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	2.80E-05	U.S. EPA document "Estimating Air Toxic Emissions from Coal and Oil Combustion Sources" [EPA-450/2-89-001] for Uncontrolled Residual Oil-fired Utility Boilers (Table 4-1)	NA	2.58E-03	1.87E-03
Backup Stripper Steam - Natural Gas	8.0%	700.8	Natural Gas[D]	81.6%	571.9		100.0%	571.9	25.3	mmBtu/hr	5.00E-07	AP-42 Table 1.4-2.	NA	1.27E-05	3.62E-06
Backup Stripper Steam - No. 6 Oil	8.0%	700.8	No. 6 Oil[D]	18.4%	128.9		100.0%	128.9	24.1	mmBtu/hr	2.80E-05	U.S. EPA document "Estimating Air Toxic Emissions from Coal and Oil Combustion Sources" [EPA-450/2-89-001] for Uncontrolled Residual Oil-fired Utility Boilers (Table 4-1)	NA	6.75E-04	4.35E-05
LEAD PROJECTED ACTUAL EMISSIONS															**2.08E-03**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**1.97E-03**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - reserved.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

CO2 EMISSIONS REFERENCES

	Stripper Scenario Operating Time			Operating Configuration Time			Controls Operating Time		Production Rate		CO2 Emissions Factor		CO2 Control	CO2 Emissions	
Stripper Operating Scenario	%	hrs	**Operating Configuration**	%	hrs	**Controls**	%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	26.0	mmBtu/hr	1.17E+02	40 CFR Part 98, Table C-1	NA	3,044.8	11,929
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	24.8	mmBtu/hr	1.66E+02	40 CFR Part 98, Table C-1	NA	4,109.9	346
CO2 BASELINE ACTUAL EMISSIONS															**12,275**
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	1.17E+02	40 CFR Part 98, Table C-1	NA	116.9	58
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	1.17E+02	40 CFR Part 98, Table C-1	NA	11,313.5	36,392
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	1.66E+02	40 CFR Part 98, Table C-1	NA	15,270.9	11,076
Backup Stripper Steam - Natural Gas	8.0%	700.8	Natural Gas[D]	81.6%	571.9		100.0%	571.9	25.3	mmBtu/hr	1.17E+02	40 CFR Part 98, Table C-1	NA	2,958.3	846
Backup Stripper Steam - No. 6 Oil	8.0%	700.8	No. 6 Oil[D]	18.4%	128.9		100.0%	128.9	24.1	mmBtu/hr	1.66E+02	40 CFR Part 98, Table C-1	NA	3,993.0	257
CO2 PROJECTED ACTUAL EMISSIONS															**48,629**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**36,354**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - reserved.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

SUMMARY OF ASB EMISSIONS FACTORS

Scenario	ASB Emissions Factors (lb/ODTP)						
	H_2S	DMDS	DMS	MMC	Methanol	VOC[A]	TRS[B]
Baseline Actual Emissions	0.0151	0.0114	0.0185	3.28E-04	0.89	0.95	0.0453
New Stripper Scenario	0.0103	0.0028	0.0136	1.88E-04	0.30	0.32	0.0269
Backup Stripper Scenario	0.0109	0.0033	0.0147	1.30E-03	1.53	1.59	0.0302
No Stripper Scenario	0.0106	0.0504	0.0192	7.42E-04	2.31	2.44	0.0809

A - Includes VOC TRS compounds, methanol, acetaldehyde, methyl ethyl ketone, and propionaldehyde.

B - TRS as compounds

Stripper Inlet Foul Condensate - Table 2-17 (Weston report dated October 2, 2021, Work Order No. 15730.001.008)

		Concentration (ppm)				
Date	**Sample Time**	**Hydrogen Sulfide**	**Methyl Mercaptan**	**Dimethyl Sulfide**	**Dimethyl Disulfide**	**Total TRS**
6/24/2021	15:10	130	14	16	13	173
6/24/2021	15:10	140	14	16	17	187
6/24/2021	17:00	140	17	18	14	189
6/24/2021	18:45	150	19	18	16	203
6/25/2021	10:35	130	12	12	11	165
6/25/2021	12:05	120	10	12	9.6	151.6
6/25/2021	13:45	190	22	22	23	257
Average of all data		142.9	15.4	16.3	14.8	189.4
Max of 6/24 or 6/25		146.7	16.0	17.0	15.0	194.7

		MW	
H2S	Hydrogen Sulfide	34.08	g/mol
Ch4S	Methyl Mercaptan	48.11	g/mol
C2H6S	Dimethyl Sulfide	62.13	g/mol
C2H6S2	Dimethyl Disulfide	94.20	g/mol
S	Sulfur	32.07	g/mol

Convert compound to equivalent S (ppm)

Hydrogen Sulfide	Methyl Mercaptan	Dimethyl Sulfide	Dimethyl Disulfide
138.0	10.7	8.8	10.2
82.3%	6.4%	5.2%	6.1%

S (ppm)	168	Maximum feed to stripper (AHL)
Lb S/gallon FC	1.40E-03	
Lb S/hr @850 gpm	71.3	
Lb S/ADTP (@2200 ODTP)[a]	0.7001	

[a] Conservative Lb S/ADTP emissions factor using 2200 ODTP (2200 ODTP * ADTP/0.9 ODTP = 2444.4 ADTP) Emissions factor is representative of the lower end of the range of pulp production at the maximum steam stripper design of 850 gpm. Calculations are scaled to 2700 ADTP to represent worst case emissions.

Assumption
1. Assume no losses in feed tank
2. Assume 98% efficiency of S across stripper therefore 0.69 # S/ADTP in SOG

CONFIDENTIAL TAB M - New-Indy Catawba Monthly Production

Month	Kraft Mill ADTP	Combination Boiler No. 1 Natural Gas mmBtu	Combination Boiler No. 2 Natural Gas mmBtu	Total Natural Gas mmBtu	Combination Boiler No. 1 No. 6 Fuel Oil gallons	Combination Boiler No. 2 No. 6 Fuel Oil gallons	Total No. 6 Fuel Oil gallons	Total No. 6 Fuel Oil mmBtu		
Mar-21	42,474	61,175	99,507	160,683	0	2,057	2,057	309	1,370	
Apr-21	43,075	41,363	75,012	116,376	0	0	0	0	1,436	
May-21	46,962	38,834	63,467	102,301	0	0	0	0	1,515	
Jun-21	42,867	1,909	59,909	61,818	0	1,199	1,199	180	1,429	
Jul-21	49,371	67,565	55,824	123,389	3	97	100	15	1,593	
Aug-21	44,614	33,863	32,461	66,325	0	0	0	0	1,439	
Sep-21	40,177	40,779	41,811	82,590	86	0	86	13	1,339	
Oct-21	47,234	69,732	75,498	145,230	0	0	0	0	1,524	
Nov-21	39,185	60,664	80,397	141,061	0	0	0	0	1,306	
Dec-21	38,734	62,931	60,176	123,107	0	0	0	0	1,249	
Jan-22	43,690	84,088	82,251	166,339	69,200	66,720	135,920	20,388	1,409	
Feb-22	37,736	57,764	75,924	133,688	27,042	370	27,412	4,112	1,348	
Mar-22	43,944	62,423	82,083	144,506	335	0	335	50	1,418	
Apr-22	40,046	44,634	62,835	107,469	0	0	0	0	1,335	
May-22	38,896	39,982	73,918	113,900	0	0	0	0	1,255	
Jun-22	23,184	43,071	89,239	132,310	2,238	0	2,238	336	773	
Jul-22	39,890	64,532	86,134	150,666	0	0	0	0	1,287	
Aug-22	53,396	48,067	73,591	121,658	0	0	0	0	1,722	
Sep-22	45,044	60,782	65,899	126,681	24	0	24	4	1,501	
Oct-22	47,517	70,539	89,760	160,299	0	0	0	0	1,533	
Nov-22	40,133	82,534	114,164	196,698	0	0	0	0	1,338	
Dec-22	33,859	101,466	95,023	196,490	170,076	0	170,076	25,511	1,092	
Jan-23	35,464	95,982	92,733	188,715	102,558	0	102,558	15,384	1,144	996,766
Feb-23	39,276	78,431	96,813	175,244	21,626	53	21,679	3,252	1,403	498,383
Total	996,766			3,237,544				69,553		
Annual Average	498,383									
				97.9%				2.1%		

New Indy Catawba ASB BAE Methanol Emissions Factor REVISED June 7 Response

Month	Pulp Production ADTP	Pulp Production ODTP	Methanol Emissions Factor lb/ODTP	Emissions Factor Reference
Mar-21	42,474	38,226	1.50	Average of 2021 Subpart S Performance Tests. Representative of ASB operation from March 2021 to February 2022.
Apr-21	43,075	38,767	1.50	
May-21	46,962	42,266	1.50	
Jun-21	42,867	38,581	1.50	
Jul-21	49,371	44,434	1.50	
Aug-21	44,614	40,152	1.50	
Sep-21	40,177	36,159	1.50	
Oct-21	47,234	42,510	1.50	
Nov-21	39,185	35,266	1.50	
Dec-21	38,734	34,860	1.50	
Jan-22	43,690	39,321	1.50	
Feb-22	37,736	33,962	0.33	Average of 2022 Subpart S Performance Tests. Representative of ASB operation from February 2022 to February 2023.
Mar-22	43,944	39,549	0.33	
Apr-22	40,046	36,041	0.33	
May-22	38,896	35,006	0.33	
Jun-22	23,184	20,866	0.33	
Jul-22	39,890	35,901	0.33	
Aug-22	53,396	48,057	0.33	
Sep-22	45,044	40,539	0.33	
Oct-22	47,517	42,765	0.33	
Nov-22	40,133	36,120	0.33	
Dec-22	33,859	30,474	0.33	
Jan-23	35,464	31,918	0.33	
Feb-23	39,276	35,348	0.33	
Baseline Methanol Emissions Factor (Pulp Weighted Average)			**0.89**	**lb/ODTP**

Additional information added to spreadsheet on 6/16/2023.

BAE Other VOC Emissions Factors

Date of Subpart S Performance Testing	Acetadehyde, ppm	MEK, ppm	Prop., ppm
7/9/2021	24.3	7.7	1.1
7/10/2021	25.3	5.7	4.0
7/11/2021	25.0	6.5	7.0
10/26/2021	25.0	12.3	0.8
10/27/2021	27.5	13.3	1.0
10/28/2021	10.6	6.6	1.2
10/29/2021	15.0	8.6	0.9
2/14/2022	16.7	7.5	0.7
2/15/2022	17.0	9.5	0.6
2/16/2022	15.7	8.6	1.0
5/4/2022	20.7	7.1	1.0
5/5/2022	16.3	7.3	1.0
5/6/2022	15.0	6.8	1.0
8/9/2022	15.3	5.9	0.7
8/10/2022	25.0	7.2	1.1
8/11/2022	20.3	6.0	1.0
9/27/2022	14.3	5.3	0.7
9/28/2022	15.0	5.2	0.7
9/29/2022	18.0	5.6	0.9
10/18/2022	25.0	5.6	1.0
10/19/2022	23.7	5.5	1.1
10/20/2022	23.0	6.6	0.9
AVG ppm:	**19.72**	**7.28**	**1.34**
Lbs into ASB	55.48	20.49	3.78
Fair estimated from WATER9 properties	0.55	0.38	0.43
Lbs emitted	30.73	7.73	1.61
Average Pulp Production during Subpart S testing	1716		
lb/ODTP	**0.018**	**0.005**	**0.001**

PAE Other VOC Emissions Factors

	BAE lb/ODTP	New Stripper	PAE lb/ODTP Backup Stripper	No Stripper
Methanol	0.89	0.30	1.53	2.31
Acetadehyde	0.018	0.006	0.031	0.046
MEK	0.005	0.002	0.008	0.012
Propionaldehyde	0.001	0.000	0.002	0.002
DMDS	0.0114	0.0028	0.0033	0.0504
DMS	0.0185	0.0136	0.0147	0.0192
MMC	3.28E-04	1.88E-04	1.30E-03	7.42E-04
VOC:	**0.95**	**0.32**	**1.59**	**2.44**

October 2021 SO2 Testing - Weston

	Combination Boiler No. 1 Stack			Combination Boiler No. 2 Stack		
	NCG+SOG	NCG	SOG	NCG+SOG	NCG	SOG
ODTP/hr	77.3	79.0		91.1	92.9	
ADTP/hr	85.9	87.8		101.2	103.2	
lb SO2/hr	342.8	230.7		380.9	309.9	
lb SO2/ADTP	3.99	2.63	1.36	3.76	3.00	0.76

	Controlled Emissions		Sulfur Capture		Uncontrolled Emissions	
	Average	Maximum	Bark Ash[C]	LVHC Scrubber	Average	Maximum
	lb SO2/ADTP	lb SO2/ADTP	%	%	lb SO2/ADTP	lb SO2/ADTP
SOG	1.06	1.36	20%	NA	1.33	1.70
NCG	2.82	3.00				
LVHC[A,B]	1.97	2.10	20%	50%	4.92	5.25
HVLC[A,B]	0.85	0.90	20%	NA	1.06	1.13

A - NCG gases include LVHC gases and HVLC gases.

B - NCG gases split using ratio of controlled SO2 emissions from LVHC (1.10 lb SO2/ADTP) and HVLC (0.473 lb SO2/ADTP) from Project Columbia Application (July 2019 and April 2020 Addendum - Attachment C).
C - Estimated sulfur capture based on 2012 stack test (NCASI data suggests ~32% capture).

TABLE 2-2
NO. 1 COMBINATION BOILER
CONDITION 1: NCG AND SOG GASES
SUMMARY OF SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	10/13/21	10/13/21	10/13/21	----
Time Began	0844	1029	1206	----
Time Ended	0944	1129	1306	----
Stack Gas Data				
Temperature, °F	430	435	438	434
Velocity, ft/sec	64	63	63	63
Moisture, %	17	17	17	17
CO_2 Concentration, %	8.8	9.0	8.6	8.8
O_2 Concentration, %	10.5	10.5	10.8	10.6
VFR, x 10^5 dscfm	1.46	1.45	1.44	1.45
Sulfur Dioxide				
Concentration, ppm	280	227	204	237
Emission Rate, lb/hr	407.4	328.3	292.6	342.8

TABLE 2-3
NO. 1 COMBINATION BOILER
CONDITION 2: NCG GASES ONLY
SUMMARY OF SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	10/13/21	10/13/21	10/13/21	----
Time Began	1407	1544	1714	----
Time Ended	1507	1644	1814	----
Stack Gas Data				
Temperature, °F	447	450	444	447
Velocity, ft/sec	61	62	63	62
Moisture, %	17	18	16	17
CO_2 Concentration, %	9.6	9.9	8.9	9.5
O_2 Concentration, %	10.1	9.8	10.7	10.2
VFR, x 10^5 dscfm	1.37	1.39	1.43	1.40
Sulfur Dioxide				
Concentration, ppm	140	176	180	165
Emission Rate, lb/hr	191.3	243.6	257.0	230.7

Combination Boiler #1

Condition 1: With NCGs, with SOGs
13-Oct-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	Pulp KAPPA
1	0844	262.3	29.9	126.9	1.23	40	10.9	511	230	1407	1103	10851	77.3	82.7
2	1029	266.3	33.0	109.1	1.23	40	10.9	505	213	1409	1200	10885	77.3	85.7
3	1206	257.2	32.6	100.4	1.23	40	10.9	504	2	1443	1206	10963	77.3	84.8
Average:		261.9	31.8	112.1	1.23	40	10.9	507	148	1420	1170	10900	77.3	84.4

Condition 2: With NCGs, without SOGs
13-Oct-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	Pulp KAPPA
1	1407	267.7	34.0	102.0	1.23	40	10.9	506	2	1416	[redacted]	11071	79.0	83.9
2	1544	272.9	34.8	101.3	1.23	40	10.9	504	252	1414	[redacted]	10976	79.0	81.6
3	1714	256.9	30.05	115.96	1.23	40	10.9	505	183	1430	[redacted]	11061	79.0	80.3
Average:		265.8	33.0	106.4	1.23	40	10.9	505	146	1420	[redacted]	11036	79.0	81.9

TABLE 2-4
NO. 2 COMBINATION BOILER
CONDITION 1: NCG AND SOG GASES
SUMMARY OF SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	10/14/21	10/14/21	10/14/21	----
Time Began	0830	1026	1222	----
Time Ended	0930	1126	1322	----
Stack Gas Data				
Temperature, °F	463	477	465	469
Velocity, ft/sec	63	68	61	64
Moisture, %	17	19	16	17
CO_2 Concentration, %	8.2	9.5	7.5	8.4
O_2 Concentration, %	10.8	10.1	11.5	10.8
VFR, x 10^5 dscfm	1.40	1.43	1.35	1.39
Sulfur Dioxide				
Concentration, ppm	275	262	286	274
Emission Rate, lb/hr	383.7	373.7	385.4	380.9

TABLE 2-5
NO. 2 COMBINATION BOILER
CONDITION 2: NCG GASES ONLY
SUMMARY OF SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	10/14/21	10/14/21	10/14/21	----
Time Began	1410	1547	1725	----
Time Ended	1510	1647	1825	----
Stack Gas Data				
Temperature, °F	457	461	460	459
Velocity, ft/sec	59	59	58	59
Moisture, %	15	15	15	15
CO_2 Concentration, %	7.2	7.6	7.0	7.3
O_2 Concentration, %	11.9	11.2	11.7	11.6
VFR, x 10^5 dscfm	1.33	1.33	1.33	1.33
Sulfur Dioxide				
Concentration, ppm	235	234	232	234
Emission Rate, lb/hr	311.3	311.0	307.4	309.9

Combination Boiler #2

Condition 1: With NCGs, with SOGs
14-Oct-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	Pulp KAPPA
1	0830	241	29.8	188.7	1.23	40	10.9	505	209	1409	1203	11071	91.1	94.5
2	1026	251	46.3	115.6	1.23	40	10.9	504	200	1420	1179	11160	91.1	88.2
3	1222	211	25.4	171.4	1.23	40	10.9	505	199	1429	1157	11090	91.1	80.7
Average:		234	33.8	158.6	1.23	40	10.9	505	203	1419	1180	11107	91.1	87.8

Condition 2: With NCGs, without SOGs
14-Oct-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	Pulp KAPPA
1	1410	198	21.7	174.8	1.23	40	10.9	505	209	1438	[redacted]	11109	92.9	78.8
2	1547	218	35.4	206.4	1.23	40	10.9	505	224	1435	[redacted]	11060	92.9	78.7
3	1725	214	49.6	220.6	0.65	40	10.9	505	262	1453	[redacted]	10977	92.9	79.3
Average:		210	35.6	200.6	1.04	40	10.9	505	232	1442	[redacted]	11049	92.9	

June 2021 TRS_H2S Testing - Weston

TRS as TRS	Combination Boiler No. 1 Stack NCG+SOG	NCG	SOG	Combination Boiler No. 2 Stack NCG+SOG	NCG	SOG
ODTP/hr	55.9	76.0		88.3	85.2	
ADTP/hr	62.1	84.4		98.1	94.7	
lb TRS (as H2S)/hr	0.75	0.68		0.85	0.92	
lb TRS (as TRS)/hr	1.07	0.97		1.22	1.32	
lb TRS (as TRS)/ADTP	1.73E-02	1.15E-02	5.75E-03	1.24E-02	1.39E-02	-1.51E-03

H2S	Combination Boiler No. 1 Stack NCG+SOG	NCG	SOG	Combination Boiler No. 2 Stack NCG+SOG	NCG	SOG
ODTP/hr	55.9	76.0		88.3	85.2	
ADTP/hr	62.1	84.4		98.1	94.7	
lb H2S/hr	0.07	0.05		0.07	0.04	
lb H2S/ADTP	1.13E-03	5.92E-04	5.35E-04	7.13E-04	4.23E-04	2.91E-04

	Controlled Emissions		Sulfur Conversion		Uncontrolled Emissions	
	Average	Maximum	Combustion	LVHC Scrubber	Average	Maximum
TRS as TRS	lb TRS/ADTP	lb TRS/ADTP	%	%	lb TRS/ADTP	lb TRS/ADTP
SOG[D]	2.88E-03	5.75E-03	99%	NA	0.29	0.58
NCG	1.27E-02	1.39E-02				
LVHC[A,B]	8.01E-03	8.76E-03	99%	50%	1.60	1.75
HVLC[A,B]	4.69E-03	5.13E-03	99%	NA	0.47	0.51

	Controlled Emissions		Sulfur Conversion		Uncontrolled Emissions	
	Average	Maximum	Combustion	LVHC Scrubber	Average	Maximum
H2S	lb H2S/ADTP	lb H2S/ADTP	%	%	lb H2S/ADTP	lb H2S/ADTP
SOG	4.13E-04	5.35E-04	99%	NA	4.13E-02	5.35E-02
NCG	5.07E-04	5.92E-04				
LVHC[A,C]	5.03E-04	5.87E-04	99%	50%	1.01E-01	1.17E-01
HVLC[A,C]	4.45E-06	5.19E-06	99%	NA	4.45E-04	5.19E-04

A - NCG gases include LVHC gases and HVLC gases.
B - NCG gases split using ratio of controlled TRS emissions from LVHC (8.97E-3 lb TRS/ADTP) and HVLC (5.25E-3 lb TRS/ADTP) from Project Columbia Application (July 2019 and April 2020 Addendum - Attachment C).
C - NCG gases split using ratio of controlled H2S emissions from LVHC (3.82E-3 lb H2S/ADTP) and HVLC (3.38E-5 lb H2S/ADTP) from Project Columbia Application (July 2019 and April 2020 Addendum - Attachment C).
D - Combination Boiler No. 2 SOG averaged as zero (0).

			CB1			CB1			CB2			CB2						
TRS as S		MW	NCG+SOG			NCG			NCG+SOG			NCG						
sulfur	S	32.065	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3	AVG		PLC Cross Check back to TRS as H2S	
hydrogen sulfide	H_2S	34.081	0.08	0.07	0.1	0.07	0.07	0.07	0.08	0.08	0.08	0.05	0.05	0.05	0.07	8.0%	0.085742	0.085742
methyl mercaptan	CH_4S	48.107	0.55	0.53	0.49	0.52	0.52	0.53	0.77	0.63	0.64	0.94	0.91	0.69	0.64	72.6%	0.778738	0.55169
dimethyl sulfide	C_2H_6S	62.134	0.16	0.16	0.16	0.16	0.16	0.17	0.08	0.08	0.08	0.08	0.07	0.07	0.12	13.5%	0.144248	0.079121
dimethyl disulfide	$C_2H_6S_2$	94.199	0.07	0.07	0.07	0.07	0.07	0.07	0.04	0.04	0.04	0.03	0.03	0.03	0.05	5.9%	0.06355	0.045984
															0.89	Total TRS	1.072278	0.762538
															84.8%			

10^6 ACFM Flowrate Basis to lb/min

H_2S	0.007081766	0.006196545	0.008852208	0.006196545	0.006196545	0.006196545	0.007081766	0.007081766	0.007081766	0.004426104	0.004426104	0.004426104		
CH_4S	0.068724286	0.066225221	0.061227091	0.064975688	0.064975688	0.066225221	0.096214	0.078720545	0.079970078	0.117456052	0.113707455	0.08621774		
C_2H_6S	0.025821922	0.025821922	0.025821922	0.025821922	0.025821922	0.027435792	0.012910961	0.012910961	0.012910961	0.012910961	0.011297091	0.011297091		
$C_2H_6S_2$	0.017127091	0.017127091	0.017127091	0.017127091	0.017127091	0.017127091	0.009786909	0.009786909	0.009786909	0.007340182	0.007340182	0.007340182		
TRS as H2S	0.082325532	0.07966987	0.078784649	0.078784649	0.078784649	0.080555091	0.089407299	0.077014208	0.077899429	0.100029948	0.096489065	0.077014208		
TRS as TRS	0.118755065	0.115370779	0.113028312	0.114121247	0.114121247	0.116984649	0.125993636	0.108500182	0.109749714	0.142133299	0.136770831	0.109281117		
Ratio TRS as H2S/TRS a	0.693238074	0.690555015	0.697034647	0.690359171	0.690359171	0.688595396	0.709617575	0.709807177	0.70979163	0.703775603	0.705479846	0.704734816	0.69944568	
														1.43

TABLE 2-11
NO. 1 COMBINATION BOILER
CONDITION 1: NCG AND SOG GASES
SUMMARY OF H_2S, TOTAL TRS, AND SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	6/23/21	6/23/21	6/23/21	---
Time Began	1158	1400	1541	---
Time Ended	1258	1500	1641	---
Stack Gas Data				
Temperature, °F	415	418	415	416
Velocity, ft/sec	59	57	57	57
Moisture, %	17	18	16	17
CO_2 Concentration, %	7.8	8.4	7.7	8.0
O_2 Concentration, %	12.1	11.4	12.0	11.8
VFR, x 10^5 dscfm	1.35	1.31	1.33	1.33
Hydrogen Sulfide				
Concentration, ppm	0.09	0.08	0.12	0.10
Emission Rate, lb/hr	0.07	0.06	0.08	0.07
Total Reduced Sulfur				
Concentration, ppm	1.09	1.07	1.03	1.06
Emission Rate, lb/hr	0.78	0.74	0.73	0.75
Sulfur Dioxide				
Concentration, ppm	195	278	344	272
Emission Rate, lb/hr	262.7	362.5	457.4	360.9

TABLE 2-12
NO. 1 COMBINATION BOILER
CONDITION 2: NCG GASES ONLY
SUMMARY OF H_2S, TOTAL TRS, AND SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	6/23/21	6/23/21	6/23/21	---
Time Began	1824	2019	2202	---
Time Ended	1924	2119	2302	---
Stack Gas Data				
Temperature, °F	416	411	415	414
Velocity, ft/sec	56	56	56	56
Moisture, %	16	16	17	17
CO_2 Concentration, %	8.3	7.8	8.1	8.1
O_2 Concentration, %	11.4	11.9	11.6	11.6
VFR, x 10^5 dscfm	1.30	1.31	1.30	1.30
Hydrogen Sulfide				
Concentration, ppm	0.08	0.08	0.08	0.08
Emission Rate, lb/hr	0.05	0.05	0.05	0.05
Total Reduced Sulfur				
Concentration, ppm	0.97	0.98	0.99	0.98
Emission Rate, lb/hr	0.67	0.68	0.68	0.68
Sulfur Dioxide				
Concentration, ppm	313	348	349	337
Emission Rate, lb/hr	404.4	452.9	450.8	436.1

Combination Boiler #1

Condition 1: With NCGs, with SOGs
23-Jun-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	SO_2 Emissions (lbs/hr)	SO_2 Emissions (lbs/ODT Pulp)	TRS Emissions (lbs/hr)
1	1158	208	25.1	80.8	1.37	40	10.9	458	146	1585	621	11575	49.7	262.7	5.29	0.56
2	1400	225	29.3	68.8	1.37	40	10.9	491	152	1595	1219	11048	54.0	362.5	6.71	0.49
3	1541	207	24.8	81.2	1.37	40	10.9	491	45	1578	1136	11009	64.0	457.4	7.15	0.50
Average:		213	26.4	76.9	1.37	40	10.9	480	114	1586	992	11211	55.9	360.9	6.46	0.52

Condition 2: With NCGs, without SOGs
23-Jun-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	SO_2 Emissions (lbs/hr)	SO_2 Emissions (lbs/ODT Pulp)	TRS Emissions (lbs/hr)
1	1824	230	26.3	94.9	1.37	40	10.9	489	123	1587		10515	74.1	404.4	5.46	0.43
2	2019	216	23.7	97.5	1.37	40	10.9	491	184	1593		10377	74.7	452.9	6.06	0.42
3	2202	220	25.2	92.4	1.37	40	10.9	490	152	1570		10573	79.2	450.8	5.69	0.46
Average:		222	25.1	94.9	1.37	40	10.9	490	153	1583		10488	76.0	436.1	5.74	0.44

TABLE 2-13
NO. 2 COMBINATION BOILER
CONDITION 1: NCG AND SOG GASES
SUMMARY OF H_2S, TOTAL TRS, AND SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	6/24/21	6/24/21	6/24/21	----
Time Began	1445	1630	1806	----
Time Ended	1545	1730	1906	----
Stack Gas Data				
Temperature, °F	475	474	479	476
Velocity, ft/sec	69	69	69	69
Moisture, %	14	14	15	14
CO_2 Concentration, %	6.6	6.9	7.3	6.9
O_2 Concentration, %	13.1	12.7	12.3	12.7
VFR, x 10^5 dscfm	1.57	1.56	1.54	1.56
Hydrogen Sulfide				
Concentration, ppm	0.09	0.09	0.09	0.09
Emission Rate, lb/hr	0.07	0.07	0.07	0.07
Total Reduced Sulfur				
Concentration, ppm	1.13	0.97	0.97	1.02
Emission Rate, lb/hr	0.94	0.80	0.80	0.85
Sulfur Dioxide				
Concentration, ppm	324	327	322	324
Emission Rate, lb/hr	508.7	507.2	496.1	504.0

TABLE 2-14
NO. 2 COMBINATION BOILER
CONDITION 2: NCG GASES ONLY
SUMMARY OF H_2S, TOTAL TRS, AND SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	6/25/21	6/25/21	6/25/21	----
Time Began	1000	1135	1315	----
Time Ended	1100	1235	1415	----
Stack Gas Data				
Temperature, °F	468	470	481	473
Velocity, ft/sec	68	69	69	69
Moisture, %	14	14	14	14
CO_2 Concentration, %	6.9	6.8	7.3	7.0
O_2 Concentration, %	12.8	12.7	12.3	12.6
VFR, x 10^5 dscfm	1.56	1.55	1.56	1.56
Hydrogen Sulfide				
Concentration, ppm	0.05	0.05	0.05	0.05
Emission Rate, lb/hr	0.04	0.04	0.04	0.04
Total Reduced Sulfur				
Concentration, ppm	1.22	1.18	0.94	1.11
Emission Rate, lb/hr	1.01	0.97	0.78	0.92
Sulfur Dioxide				
Concentration, ppm	247	245	235	242
Emission Rate, lb/hr	383.2	380.0	366.2	376.4

Combination Boiler #2

Condition 1: With NCGs, with SOGs
24-Jun-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	SO_2 Emissions (lbs/hr)	SO_2 Emissions (lbs/ODT Pulp)	TRS Emissions (lbs/hr)
1	1445	219	39.0	125.3	1.37	40	10.9	491	190	1572	1231	10253	87.8	508.7	5.79	0.77
2	1630	224	31.1	146.4	1.37	40	10.9	490	186	1576	1231	10277	88.6	507.2	5.72	0.63
3	1806	241	33.6	146.4	1.37	40	10.9	490	190	1580	1231	10300	88.6	496.1	5.60	0.63
Average:		228	34.6	139.4	1.37	40	10.9	490	189	1576	1231	10277	88.3	504.0	5.71	0.68

Condition 2: With NCGs, without SOGs
25-Jun-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	SO_2 Emissions (lbs/hr)	SO_2 Emissions (lbs/ODT Pulp)	TRS Emissions (lbs/hr)
1	1000	234	35.7	132.7	1.37	40	10.9	482	155	1579	[redacted]	10475	87.2	383.2	4.39	0.86
2	1135	225	30.8	147.8	1.37	40	10.9	479	252	1573	[redacted]	10425	84.3	380.0	4.51	0.82
3	1315	245	30.6	141.7	1.37	40	10.9	482	97	1571	[redacted]	10500	84.2	366.2	4.35	0.63
Average:		235	32.4	140.7	1.37	40	10.9	481	168	1574	[redacted]	10467	85.2	376.4	4.42	0.77

SCDHEC BAQ comments/questions for New-Indy (2440-0005)
on the new Stripper construction application, sent Jun 12, 2023, responses due June 16, 2023

1. Please provide the data, calculations, and any assumptions used to develop the emission factor for the baseline VOC for "Backup Stripper SOG".
The VOC emissions factor of 4.35 lb/ADTP for the "Backup Stripper SOG" is based on the average daily methanol (MeOH) stripped from daily Subpart S compliance through 2/28/2023, 4.35 lb/ODTP, and this value was conservatively assumed to be 4.35 lb VOC/ADTP to account for small amounts of the other VOC's in the foul condensate [4.35 lb MeOH/ODTP x (0.9 ODTP/ADTP) x (1.0 lb VOC/ 0.9 lb MeOH)]. Attachment A provides the data, calculations, and assumptions for development of the 4.35 lb methanol/ODTP factor and we have also included the accompanying emissions spreadsheet.

2. On the third set of comments, sent May 8, 2023, information on MEK, acetaldehyde, and propionaldehyde was submitted as part of item 15. Can you provide the spreadsheet for the calculations? Can you explain the calculations at the end and any assumptions? It appears that the "lbs into ASB" should be multiplied by the "Fair estimate..." factor to get the "lbs emitted". Maybe there is some rounding but I don't arrive at the same "lbs emitted" values. I get: MEK 7.786, Acetaldehyde 30.514, and Propionaldehyde 1.625.
A revised PSD spreadsheet is included with this submittal that provides the data, calculations, and assumptions for development of the baseline emissions factors for MEK, acetaldehyde, and propionaldehyde. See the new ACE,MEK,PROP tab.

3. What is the basis for MEK, acetaldehyde, and propionaldehyde used in the projected actual emissions for each scenario – New stripper, backup stripper, no stripper? Please provide the calculations, assumptions, etc. so these rates can be verified.
A revised PSD spreadsheet is included with this submittal that provides the data, calculations, and assumptions for development of the projected emissions factors for MEK, acetaldehyde, and propionaldehyde. See the new ACE,MEK,PROP tab.

4. In the Foul Cond Sulfur tab, there is a calculation that is missing a value, cell G29. It says "<Ref>", so a link to a factor is missing. What is this number? What does it represent?
The calculation in cell G29 was extraneous information that was not meant to be carried through to the final submittal. This cell is not linked to any emissions calculations or underlying data used in the emissions calculations and we will remove it from the spreadsheet.

5. Please provide the data, calculations, and assumptions used to derive the VOC emission factors for the new stripper.
The VOC emissions factor used to estimate the new stripper emissions is based on industry values supplied by the vendor designing the new stripper. The vendor supplied emissions of MeOH are 16 lb MeOH/ODTP [16 lb MeOH/ODTP × (0.9 ODTP/ADTP) = 14.4 lb MeOH/ADTP]. This was conservatively assumed to be 16 lb VOC/ADTP to account for small amounts of the other VOC's in the foul condensate.

The methanol condenser was conservatively estimated to condense 90% of the methanol from the stripper-off-gases for burning the liquid methanol (aka stripper rectified liquid or SRL) in the

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recovery furnaces [16.0 lb VOC/ADTP × (90 ÷ 100) = 14.4 lb VOC/ADTP]. The remaining methanol (10% or 16.0 lb VOC/ADTP × (10 ÷ 100) = 1.60 lb VOC/ADTP]) is incinerated in the No. 3 recovery furnace when the condenser is operating, or in the combination boilers when the condenser is down.

6. Why do the design parameters/emission factors for the backup stripper match those for when the new stripper is operating with the SRL offline? If the backup stripper is operating to remove TRS and the new stripper is operating to remove MeOH, how can the design values/emission factors be the same? This is for SO2, TRS, H2S, and VOC.

The new stripper and the backup stripper will both remove the same amounts of TRS and H2S from the foul condensate, generating the same amounts of SO2 when controlled. The backup stripper will remove 45% of the methanol from the foul condensate when operated as a TRS stripper. The VOC emissions factor for the backup stripper has been adjusted with this response to reflect 45% of the methanol being stripped from the condensate [16.0 lb VOC/ADTP × (45 ÷ 100) = 7.20 lb VOC/ADTP]. A revised PSD spreadsheet is included with this submittal.

Please note that the stripped condensate from the backup stripper will be sent to the ASB through the hardpipe to biologically treat the remaining 55% of the methanol. Although New-Indy Catawba plans to utilize the hardpipe to route the stripped condensates to the ASB; the Mill currently has no plans to utilize the Hardpipe and ASB for compliance with treatment of the pulping condensates under 40 CFR Part 63, Subpart S.

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Buckner, Katharine

From:	Caleb Fetner <cfetner@all4inc.com>
Sent:	Thursday, July 6, 2023 6:23 PM
To:	Buckner, Katharine; Tourville, Bob
Cc:	McAvoy, Bryan P.; Steven Moore; Ryan Cleary
Subject:	RE: SC DHEC Modeling Section comments on New Indy's stripper project application
Attachments:	Response to Comments - Modeling Tables - July 6 2023.xlsx; July 6 Response to BAQ Modeling Section's Comments.docx

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***

Hi Katharine,

Please see attached documents with responses to your questions below. Please reach out if anything is unclear.

Thanks,
Caleb

Caleb Fetner / Consulting Engineer
678.293.9431 / Profile / LinkedIn

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From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Friday, June 30, 2023 3:56 PM
To: Caleb Fetner <cfetner@all4inc.com>; Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Cc: McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>; Steven Moore <smoore@all4inc.com>; Ryan Cleary <rcleary@all4inc.com>
Subject: RE: SC DHEC Modeling Section comments on New Indy's stripper project application

Hey Caleb,
Thank you for the information on the splits. I will review and let you know if I have any questions.

I have been reviewing and verifying rates used in the modeling and have a couple questions/comments for you.

1. For all 3 Ditches, please provide the information used and the calculations for the rates used in the model.
2. On the Clarifier, an incorrect diameter may have been used. In Response to Comments – Modeling Tables sheet, the Vol Area tab, the diameter is listed as 42 m. Previously a diameter of 84 m has been used. Please review and either provide a revised table or explain why 42 m is correct.

Please submit this information by Thursday, July 6, 2023.

Thanks,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

Office: (803) 898-3213
bucknekk@dhec.sc.gov

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Columbia, SC 29201

Connect: www.scdhec.gov Facebook Twitter

From: Caleb Fetner <cfetner@all4inc.com>
Sent: Friday, June 30, 2023 12:48 PM
To: Buckner, Katharine <bucknekk@dhec.sc.gov>; Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Cc: McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>; Steven Moore <smoore@all4inc.com>; Ryan Cleary <rcleary@all4inc.com>
Subject: RE: SC DHEC Modeling Section comments on New Indy's stripper project application

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Hi Katharine,

Apportioning the total ASB emissions between the three zones for the purposes of modeling was estimated based on the WATER9 results for the TRS compounds in the worst-case scenario (No Stripper Scenario) for TRS compounds. Based on the WATER9 results for each zone, ~98% of the total ASB emissions were apportioned to zone 1.

H2SSIM/WATER9 Results	DMDS, g/s	DMS, g/s	MMC, g/s
ASB Zone 1	0.57	0.22	8.40E-03
ASB Zone 2	9.43E-03	4.70E-03	1.56E-04
ASB Zone 3	1.85E-04	1.70E-04	5.26E-06
Total ASB	**0.58**	**0.22**	**8.56E-03**

This is a similar calculation to what you outlined in your question for H2S, but with the sum of the TRS compounds from the No Stripper Scenario (worst-case for TRS). The % splits were first developed for TRS as H2S, but was conservatively also applied to the H2S emissions rates as well due to the expected maximum receptor being closer to zone 1.

Please let me know if you have any further questions.

Caleb

Caleb Fetner / Consulting Engineer
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www.all4inc.com / Locations / Articles / Podcast / Training
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From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Friday, June 30, 2023 8:23 AM
To: Caleb Fetner <cfetner@all4inc.com>; Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>

Cc: McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>
Subject: RE: SC DHEC Modeling Section comments on New Indy's stripper project application

Thank you. I was just making sure you saw the request.

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

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bucknekk@dhec.sc.gov

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Columbia, SC 29201

Connect: www.scdhec.gov Facebook Twitter

From: Caleb Fetner <cfetner@all4inc.com>
Sent: Friday, June 30, 2023 8:22 AM
To: Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>; Buckner, Katharine <bucknekk@dhec.sc.gov>
Cc: McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>
Subject: RE: SC DHEC Modeling Section comments on New Indy's stripper project application

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Hi all – pulled together the information to answer Katherine's question and will be sending later today.

Caleb Fetner / Consulting Engineer
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www.all4inc.com / Locations / Articles / Podcast / Training
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From: Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Sent: Friday, June 30, 2023 8:17 AM
To: Buckner, Katharine <bucknekk@dhec.sc.gov>
Cc: McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>; Caleb Fetner <cfetner@all4inc.com>
Subject: Re: SC DHEC Modeling Section comments on New Indy's stripper project application

I did.

Caleb
Please let me know where we stand with information to Katharine?

From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Friday, June 30, 2023 8:12 AM
To: Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>

Cc: McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>
Subject: RE: SC DHEC Modeling Section comments on New Indy's stripper project application

Hey Bob,
Resending this to make sure you saw this earlier this week.

Thanks,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

Office: (803) 898-3213
bucknekk@dhec.sc.gov

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Connect: www.scdhec.gov Facebook Twitter

From: Buckner, Katharine
Sent: Wednesday, June 28, 2023 3:50 PM
To: Robert Tourville <BOB.TOURVILLE@NEW-INDYCB.COM>
Cc: McAvoy, Bryan P. <MCAVOYBP@dhec.sc.gov>
Subject: FW: SC DHEC Modeling Section comments on New Indy's stripper project application

Hey Bob,
Thak you for all this information and responses. I have been working on verifying rates and stuff. I have one question. In the "Revised Emission Calculations (6-26-23)…", in the "WWTP Factors" tab, how were the Zone splits calculated? What data was used to determine this? Please explain the rationale on these. I tried to come up with these but did not follow how they were done, etc.

For instance, Backup Stripper is the worst for H_2S. Using page B-76 from the app, if you total the H_2S for all 3 zones, then divide zone 1 by the total, I get 62%.

Thanks,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

Office: (803) 898-3213
bucknekk@dhec.sc.gov

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Connect: www.scdhec.gov Facebook Twitter

From: Steven Moore <smoore@all4inc.com>
Sent: Tuesday, June 27, 2023 1:23 PM
To: McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>; Buckner, Katharine <bucknekk@dhec.sc.gov>; Bob Tourville <BOB.TOURVILLE@NEW-INDYCB.COM>
Cc: Sheryl Watkins <swatkins@all4inc.com>; Ryan Cleary <rcleary@all4inc.com>; Caleb Fetner <cfetner@all4inc.com>
Subject: FW: SC DHEC Modeling Section comments on New Indy's stripper project application

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On behalf of and at the request of New-Indy Catawba, please find the attached responses to the comments received on June 20, 2023.
If you have any additional questions please contact Bob Tourville at New-Indy Catawba.

Steven Moore / Senior Managing Consultant
D: 919.234.5981 / C: 864.616.4711 / Profile
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From: Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Sent: Tuesday, June 20, 2023 11:09 AM
To: Steven Moore <smoore@all4inc.com>; Sheryl Watkins <swatkins@all4inc.com>
Subject: FW: SC DHEC Modeling Section comments on New Indy's stripper project application

Just in. Can you follow up and respond by next Tuesday, June 27.

From: McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>
Sent: Tuesday, June 20, 2023 11:04 AM
To: Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Cc: Buckner, Katharine <bucknekk@dhec.sc.gov>
Subject: SC DHEC Modeling Section comments on New Indy's stripper project application

External Email

Hello,

I'm in the modeling section of the SCDHEC's Bureau of Air Quality. We've reviewed the facility's application for the installation of a new condensate stripper. Attached are some comments related to that review.

The first two questions are simply a request for a more complete of the Standard 2 and Standard 8 emission rates data related to the project.

The third question points out an emission factor error. Correcting the error would result in lower methyl mercaptan emission rates from one source.

The final two questions relate to the Std. 8 air toxics emissions calculations from the ASB's and ditches. Katharine will be able to help with questions related to emission factors, and I can help with questions about the air compliance averaging period referenced in question 5.

I work from home a few days a week, so please try my cell if you cannot reach me in the office.

We request a reply to these questions by Tuesday, June 27th.

Bryan McAvoy

Meteorologist

S.C. Dept. of Health & Environmental Control

Office: (803) 898-1275

Cell: (864) 350-0930

Email: mcavoybp@dhec.sc.gov

Connect:
https://url.avanan.click/v2/___www.scdhec.gov___.YXAzOm5ld2luZHk6YTpvOjNiZjJjN2M2MmU4MmFhZWVmNWFjNDM2NzM2NTE2OTlmOjY6YjUyYjo1YjE3ZGZiODk2ODZlNmNhMWEwZmVhNTcxMjYxNDc3MjllMzllYzdhMjllN2E3ODZkODA1N2RkNDA2ZTY0YmI3OnQ6VA

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New-Indy Catawba
2023 New Stripper Permitting
Response to Comment 2 - Point Sources

Modeled Source ID	UTM Easting (m)	UTM Northing (m)	Stack Height (m)	Temperature (K)	Exit Velocity (m/s)	Stack Diameter (m)	Stack Orientation	Stack Capped?	H_2S Emissions (g/s)	MMC Emissions (g/s)	TRS Emissions (g/s)
FUTRF2	510,095.85	3,855,743.58	59.44	457.98	30.21	2.13	VERTICAL	No	2.02E-02	8.89E-03	2.96E-02
FUTRF3	510,032.37	3,855,802.28	68.58	445.43	18.81	3.20	VERTICAL	No	3.64E-02	1.61E-02	5.35E-02
FUTST2	510,030.37	3,855,771.28	66.45	350.04	10.49	1.83	VERTICAL	No	4.72E-02	1.16E-02	5.73E-02
FUTST3	510,030.37	3,855,771.28	66.45	350.04	10.49	1.83	VERTICAL	No	8.53E-02	2.09E-02	1.04E-01
FUTLK2	510,206.31	3,855,812.91	56.08	470.37	9.78	1.83	VERTICAL	No	1.22E-01	5.86E-05	1.22E-01
FUTNCG1	510,039.32	3,855,689.18	69.49	457.48	14.39	3.05	VERTICAL	No	1.60E-02	1.58E-01	1.71E-01
FUTPD	509,894.71	3,855,778.28	23.74	343.15	13.11	1.52	VERTICAL	No	4.34E-03	5.49E-02	4.99E-02
FUTPM2_1	509,915.49	3,855,960.57	26.37	350.93	19.20	1.42	VERTICAL	No	5.38E-03	6.97E-03	1.67E-02
FUTPM2_2	509,894.11	3,855,948.21	26.37	358.15	17.07	1.42	VERTICAL	No	8.89E-03	9.42E-03	2.66E-02
FUTPM2_3	509,874.69	3,855,936.64	26.37	357.59	21.95	1.42	VERTICAL	No	3.84E-03	6.76E-03	1.87E-02
FUTPM3_1	509,799.90	3,855,820.64	25.73	350.93	19.20	1.27	VERTICAL	No	7.40E-03	8.66E-03	2.22E-02
FUTPM3_2	509,791.38	3,855,814.96	25.45	354.82	23.77	1.42	VERTICAL	No	1.51E-02	2.05E-02	4.75E-02
FUTPM3_3	509,782.85	3,855,810.05	25.45	358.15	24.99	1.42	VERTICAL	No	2.02E-02	2.14E-02	5.85E-02
FUTPM3_4	509,778.46	3,855,806.69	25.45	363.15	17.07	1.42	VERTICAL	No	7.44E-03	8.23E-03	2.23E-02
FUTPM3_6	509,768.38	3,855,802.04	25.73	361.48	23.77	1.32	VERTICAL	No	9.55E-03	9.75E-03	3.06E-02
FUTPM3_7	509,762.18	3,855,798.17	26.87	360.37	22.86	1.68	VERTICAL	No	8.18E-03	1.33E-02	3.68E-02
FUTPM3_8	509,752.11	3,855,792.74	26.87	357.59	21.95	1.68	VERTICAL	No	7.88E-03	1.50E-02	4.14E-02
POSTAERB	510,295.58	3,854,460.36	3.05	0.00	8.52	0.46	HORIZONTAL	No	1.40E-04	5.12E-04	2.45E-03

New-Indy Catawba
2023 New Stripper Permitting
Response to Comment 2 - Volume and Area Sources

Volume Sources

Modeled Source ID	UTM Easting (m)	UTM Northing (m)	Release Height (m)	Length of Side (m)	Initial Horizontal Dimension (m)	Initial Vertical Dimension (m)	H_2S Emissions (g/s)	MMC Emissions (g/s)	TRS Emissions (g/s)
CAUST	510,240.52	3,855,749.76	13.70	18.00	4.19	6.40	0.00E+00	1.23E-02	3.45E-02
NEWSPLTK[a]	510,015.82	3,855,803.47	18.29	18.29	4.25	8.51	1.20E-03	5.67E-04	1.11E-02

(a) The NEWSPLTK source was added as part of the new stripper project modeling demonstration.

Area Sources

Modeled Source ID	UTM Easting (m)	UTM Northing (m)	Release Height (m)	Length of Side (x) (m)	Length of Side (y) (m)	Rotation Angle (°)	H_2S Emissions ($g/s/m^2$)	MMC Emissions ($g/s/m^2$)	TRS Emissions ($g/s/m^2$)
PULPSTOR	509,928.73	3,855,822.71	15.24	93.28	98.17	-27.40	0.00E+00	6.34E-06	1.01E-04
BLAKSTOR	510,021.22	3,855,756.55	12.19	85.00	85.00	-27.40	4.22E-06	4.19E-06	2.02E-05
MIXTANK	510,044.49	3,855,765.65	6.10	23.35	19.88	0.00	0.00E+00	2.58E-06	3.81E-06
WLIQSTOR	510,153.86	3,855,704.12	16.80	20.00	20.00	-30.00	5.67E-06	3.65E-04	3.75E-04

AREAPOLY Sources

Modeled Source ID	UTM Easting (m)	UTM Northing (m)	Release Height (m)	Modeled Area (m^2)	Initial Vertical Dimension (m)	H_2S Emissions ($g/s/m^2$)	MMC Emissions ($g/s/m^2$)	TRS Emissions ($g/s/m^2$)
EQLBASIN	510,439.13	3,855,563.34	0.00	7,610.8	0.00	9.37E-07	0.00E+00	9.37E-07
DITCH1	510,812.79	3,856,255.42	0.00	2,219.3	0.00	1.50E-07	3.21E-07	2.58E-05
ASB1[b]	510,803.40	3,856,319.69	6.10	50,889.4	0.00	2.69E-06	3.20E-07	1.43E-05
ASB2[b]	510,964.42	3,856,054.20	6.10	68,158.5	0.00	4.81E-08	5.74E-09	2.55E-07
ASB3[b]	511,052.13	3,855,887.21	6.10	72,789.5	0.00	1.21E-09	1.45E-10	6.47E-09
DITCH2[c]	510,992.97	3,855,727.21	0.00	1,844.2	0.00	1.34E-06	3.17E-07	2.63E-06
SLDGLAGN	510,924.33	3,855,544.61	0.00	45,225.3	0.00	9.37E-07	0.00E+00	9.37E-07
HOLDPOND	510,391.65	3,855,142.65	0.00	390,739.1	0.00	1.61E-07	6.20E-11	1.61E-07
DITCH0	510,377.59	3,855,634.91	0.00	240.9	0.00	1.11E-07	5.05E-07	3.75E-05

(b)Worst-case emissions rates for ASB1, ASB2, and ASB3 calculated for the new stripper project.
(c) DHEC modified the DITCH2 UTM coordinates order to correct an elevation issue - only for the 1-hr H2S demonstration. For 1-hour H_2S - DITCH2 starting coordinates were (510,904.77, 3,855,661.77).

AREACIRC Sources

Modeled Source ID	UTM Easting (m)	UTM Northing (m)	Release Height (m)	Radius (m)	Initial Vertical Dimension (m)	H_2S Emissions ($g/s/m^2$)	MMC Emissions ($g/s/m^2$)	TRS Emissions ($g/s/m^2$)
CLARIFY	510,342.42	3,855,604.87	0.00	42.00	0.00	3.70352E-06	3.96E-08	6.94E-06

SCDHEC's Modeling Section Email Questions, dated June 30, 2023, to New Indy Concerning the March 23, 2023 Construction Permit Application for the Installation of a New Condensate Stripper.

1) For all 3 Ditches, please provide the information used and the calculations for the rates used in the model.

New-Indy Catawba Response: Please refer to the information and calculations submitted by New-Indy Catawba on October 27, 2021, and December 2, 2021, regarding the maximum emissions rates used in the air dispersion modeling analyses for Ditch 0, Ditch 1 and Ditch 2.

2) On the Clarifier, an incorrect diameter may have been used. In Response to Comments – Modeling Tables sheet, the Vol Area tab, the diameter is listed as 42 m. Previously a diameter of 84 m has been used. Please review and either provide a revised table or explain why 42 m is correct.

New-Indy Catawba Response: The units for the modeled emissions rates for the Clarifier provided in the workbook, "Response to Comments – Modeling Tables – June 27 2023.xlsx" were incorrectly labeled as diameter. Both the historical modeling and the submitted modeling for the New Condensate Stripper uses a modeled radius of 42.0 m (diameter of 84.0 m). The corrected units have been incorporated in the "Response to Comments – Modeling Tables – July 6 2023.xlsx" workbook.

Buckner, Katharine

From:	Caleb Fetner <cfetner@all4inc.com>
Sent:	Wednesday, June 21, 2023 8:59 AM
To:	Buckner, Katharine
Cc:	Bob Tourville; Sheryl Watkins; Steven Moore
Subject:	RE: follow up on responses from 6-16-2023

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***

Hey Katherine – I'm following up on your question to Bob on Monday that he forwarded to me.

August 9-11, 2022 was quarterly Subpart S performance test where the methanol treated in the steam stripper is calculated on a daily basis for each day of the performance test rather than the 15-day average of methanol sent to the steam stripper. The amount treated in the stripper for those days in Attachment A were the results if the ongoing compliance method was used which is why there is a difference with the performance test results.

That said, the results of the performance test (seen below) are the correct values to use for those three days, but as you pointed out, it does not have a tangible impact on the baseline SOG VOC emissions factor if those three days are corrected.

Day	HAP Treated in Stripper (lb/ODTP)
9-Aug	3.2
10-Aug	3.2
11-Aug	3.9

Hope that helps.

Caleb Fetner / Consulting Engineer
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From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Monday, June 19, 2023 4:18 PM
To: Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Subject: follow up on responses from 6-16-2023

External Email

Hey Bob,
I have been reviewing the responses sent on 6-16-2023 to my questions/comments earlier that week. I have a follow up question for you.

1. In the Attachment A – Existing Stripper Methanol in SOG, when comparing the methanol treated in the stripper column data to that submitted in reports to the BAQ, I have found a discrepancy in a values. The values reported for Aug 9-11, 2022 are different between those reported to BAQ and those in the attachment. There were two submittals to the BAQ that included the Aug 9-11, 2022, dated September 21, 2022 and October 17, 2022. Why are the values reported to BAQ in the two reports referenced different than that in the Attachment A document? I plugged in the numbers from the BAQ reports and it did not affect the overall emission factor for VOC for the baseline actual emissions from the existing stripper. Please provide an explanation for the differences.

Thank you for this last round of responses. These have been very helpful.

Thank you,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

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bucknekk@dhec.sc.gov

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Buckner, Katharine

From: Caleb Fetner <cfetner@all4inc.com>
Sent: Tuesday, July 11, 2023 4:44 PM
To: Buckner, Katharine
Cc: Tourville, Bob; Steven Moore; Sheryl Watkins
Subject: RE: 40 CFR 64, CAM for stripper project
Attachments: July 11 CAM response.docx

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Hi Katharine – see attached in response to your questions on CAM. Appreciate your patience with the holiday week last week.

Thanks,
Caleb

Caleb Fetner / Consulting Engineer
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From: Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Sent: Friday, June 30, 2023 8:22 AM
To: Sheryl Watkins <swatkins@all4inc.com>; Steven Moore <smoore@all4inc.com>; Caleb Fetner <cfetner@all4inc.com>
Subject: Fw: 40 CFR 64, CAM for stripper project

From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Thursday, June 29, 2023 4:52 PM
To: Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Subject: RE: 40 CFR 64, CAM for stripper project

External Email

Hey I sent that too quickly.

Please also address CAM for the Boilers, the Recovery Furnaces, and the caustic scrubber.

I don't think anything else part of this project would need to be looked at for CAM.

Thank you,

Katharine K. Buckner
Wood and Surface Coating Permit Section

Bureau of Air Quality – Air Permitting Division

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bucknekk@dhec.sc.gov

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From: Buckner, Katharine
Sent: Thursday, June 29, 2023 4:33 PM
To: Robert Tourville <BOB.TOURVILLE@NEW-INDYCB.COM>
Subject: 40 CFR 64, CAM for stripper project

Hey Bob,

According to the Title V renewal SOB, the existing stripper is subject to CAM. CAM was not addressed in the construction application for the new stripper. Can you please address CAM for the new stripper. Please try to provide this as soon as you can.

Thank you,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

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Columbia, SC 29201

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As requested by electronic mail on June 29, 2023, New-Indy Catawba LLC (New-Indy Catawba) has addressed the Compliance Assurance Monitoring (CAM) Rule at 40 CFR Part 64 for the new and modified emissions units included in the construction air permit application for the new condensate steam stripper submitted on March 23, 2023. Although CAM is an operating permit requirement and New-Indy Catawba has not yet been issued a construction permit or applied for a revised operating permit, New-Indy Catawba is responding to your request with a table that outlines the CAM requirements that apply to the combination boilers, recovery furnaces, and the caustic scrubber on the LVHC system and that will apply for the backup and new steam strippers. New-Indy Catawba is not proposing any changes to the previously approved CAM approaches for these units.

Table 1. CAM Approaches for Stripper Project New and Modified Emissions Units

Unit ID	Equip. No.	Control Device No.	Pollutant	Applicable Requirement	Ranges		Range Basis
07	2505	2505C	PM	SC Reg. 61-62.5, Std. 4	**CAM Indicator Range**: No. 2 Recovery Furnace ESP {MACT MM Presumptive for CAM} **Excursion range** corrective action required if outside following range(s) under conditions defined by CAM condition:		• Based on MACT MM requirements
					• Opacity [average of ten (10) consecutive six-minute (6-min.) averages]	**≤ 20**	
07	5105	5105C	PM	SC Reg. 61-62.5, Std. 4 40 CFR 60, Subpart BB SC Reg. 61-62.5, Std. 7	**CAM Indicator Range**: No. 3 Recovery Furnace ESP {MACT MM Presumptive for CAM} **Excursion range** corrective action required if outside following range(s) under conditions defined by CAM condition:		• Based on MACT MM requirements
					• Opacity [average of ten (10) consecutive six-minute (6-min.) averages]	**≤ 20**	
08	2605	2610C1	PM	SC Reg. 61-62.5, Std. 4	**CAM Indicator Ranges**: No. 1 Combination Boiler ESP {MACT DDDDD Presumptive for CAM} **Excursion range** corrective action required if outside following range(s) under conditions defined by CAM condition:		• Based on MACT DDDDD compliance demonstration
					• Opacity, daily block average • Steam load, 30-day average • Boiler O_2 concentration, 30-day average	**Test value**	
08	2605	2605	TRS	SC Reg. 61-62.5, Std. 4 40 CFR 60, Subpart BB	**CAM Indicator Range**: No. 1 Combination Boiler **Excursion range** corrective action required if outside following range(s) under conditions defined by CAM condition:		• Flame Failure System and Bypass Vents
					• Venting:	**≥ 5 minutes**	

Table 1. CAM Approaches for Stripper Project New and Modified Emissions Units							
Unit ID	**Equip. No.**	**Control Device No.**	**Pollutant**	**Applicable Requirement**	**Ranges**		**Range Basis**
08	3705	3705C	PM	SC Reg. 61-62.5, Std. 4	**CAM Indicator Ranges**: No. 2 Combination Boiler ESP {MACT DDDDD Presumptive for CAM} **Excursion range** corrective action required if outside following range(s) under conditions defined by CAM condition:		• Based on MACT DDDDD compliance demonstration
					• Opacity, daily block average • Steam load, 30-day average • Boiler O_2 concentration, 30-day average	**Tested value**	
08	3705	3705	TRS	SC Reg. 61-62.5, Std. 4 40 CFR 60, Subpart BB	**CAM Indicator Range**: No. 2 Combination Boiler) **Excursion range** corrective action required if outside following range(s) under conditions defined by CAM condition:		• Flame Failure System and Bypass Vents
					• Venting:	**≥ 5 minutes**	
08	9801	9820	TRS	40 CFR 60, Subpart BB	**CAM Indicator Range:** Backup Steam Stripper **Excursion range** (corrective action required if outside following range(s) under conditions defined by CAM condition):		• Test Data for TRS removal
					Steam feed rate (kpph), condensate flow (gpm), and condensate feed temperature (°F) are continuously monitored in order to calculate an effective steam to feed ratio (ESFR). The CAM indicator is minimum 15-day average ESFR.	**≥Tested value**	
08	9803	9820, 2605, 3705	TRS	40 CFR 60, Subpart BB	**CAM Indicator Range:** New Steam Stripper **Excursion range** (corrective action required if outside following range(s) under conditions defined by CAM condition):		• Test Data for TRS removal
					Steam feed rate (kpph), condensate flow (gpm), and condensate feed temperature (°F) will be continuously monitored in order to calculate an effective steam to feed ratio (ESFR). The CAM indicator is minimum 15-day average ESFR.	**≥Tested value**	
02	5260	5260C	TRS	40 CFR 60, Subpart BB	**CAM Indicator Ranges:** LVHC Scrubber **Excursion range** (corrective action required if outside following range(s) under conditions defined by CAM condition):		• Test data
					• Scrubber liquid flow (at least once daily) • Scrubbing liquid pH (at least once daily)	**≥30 gpm** **≥10**	

Buckner, Katharine

From: Caleb Fetner <cfetner@all4inc.com>
Sent: Friday, July 14, 2023 8:02 AM
To: McAvoy, Bryan P.; Buckner, Katharine
Cc: Tourville, Bob; Steven Moore; Sheryl Watkins; Ryan Cleary
Subject: RE: TRS rates in model

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Good morning Bryan, happy Friday.

We are trying to look into Katharine's question below on the emissions rates from the ditches, but I believe Katharine is out yesterday/today. Can you please send the "outputs from H2SSIM model and Water 9 that were dated June 27, 2022" that she is referencing below, so we can verify the rates she is requesting?

Thanks in advance,
Caleb

Caleb Fetner / Consulting Engineer
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From: Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Sent: Wednesday, July 12, 2023 3:43 PM
To: Caleb Fetner <cfetner@all4inc.com>; Sheryl Watkins <swatkins@all4inc.com>
Subject: Fw: TRS rates in model

Sheryl can you address?

From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Wednesday, July 12, 2023 3:39 PM
To: Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Cc: McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>
Subject: TRS rates in model

External Email

Hey Bob,
I left a voice mail earlier. I am following up with this email.

We are trying to verify the rates for H_2S, TRS as H_2S, and methyl mercaptan (MM) used in the modeling. Specifically, we are interested in the rates for the three ditches – Ditch 0 + splitter, Ditch 1, and Ditch 2. The last time modeling was done, rates from July 2022 were used. These rates are different from those used in Oct and Dec 2021 and they are different than those submitted as part of the new stripper project.

As I mentioned in the voice mail, I had outputs from H2SSIM model and Water 9 that were dated June 27, 2022. These rates were used in the last modeling.

Can you verify if the rates from June 27, 2022 are accurate and should be used in the model? Or are these not accurate and why?

Thanks,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

Office: (803) 898-3213
bucknekk@dhec.sc.gov

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Buckner, Katharine

From: Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Sent: Wednesday, August 16, 2023 11:12 AM
To: Buckner, Katharine; Sheryl Watkins; Caleb Fetner
Cc: McAvoy, Bryan P.
Subject: RE: Modeling for new stripper project

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I think a call is best. I am available most of day on Thursday and all day Friday. Please send me your availabilities and I will schedule a call.

From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Tuesday, August 15, 2023 10:22 AM
To: Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>; Sheryl Watkins <swatkins@all4inc.com>; Caleb Fetner <cfetner@all4inc.com>
Cc: McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>
Subject: Modeling for new stripper project

External Email

Hey All,

Bryan and I have been trying to understand the differences mainly in the rates used for the ditches this time in the modeling for the new stripper and the July 2022 modeling that was done for compliance demonstration. It appears the rates for the ditches in the new stripper app are those from using the RSK analysis method for the July 2021 IPT testing. The 2022 modeling demonstration used the average rates from the ALS analysis method. An email from Dan Mallett on June 17, 2022, relays the request by DHEC (Michael Shroup) to do the modeling demonstration using the avg ALS results.

So should this modeling for the new stripper also use rates from the ALS method too? Who makes the call on what rates should be used in the modeling now and going forward?

Sheryl explained about initially the RSK-175 method was used because EPA required it. The July 2021 IPT results were reported in a summary letter in May 2022. Then in June 2022, the summary was updated and reported results in from the ALS method.

We can have a call to discuss if necessary. Let us discuss with our management too.

Thanks,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

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Buckner, Katharine

From:	Caleb Fetner <cfetner@all4inc.com>
Sent:	Monday, October 2, 2023 4:49 PM
To:	Buckner, Katharine
Cc:	McAvoy, Bryan P.; Ryan Cleary; Rachel Davis; Robert Tourville; Sheryl Watkins; Steven Moore
Subject:	RE: ALS vs RSK method of analysis for liquid samples
Attachments:	Revised Modeling WWTP Rates for ALS (9-28-23).xlsx; New Stripper Modeling Results - 05 - 20230915.xlsx; New Stripper - ALS Modeling Transmittal Document (10-2-23).docx; Referenced Files.zip

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***

Hi Katharine,

At the request of the mill, I am providing the updated air dispersion modeling emissions rates for the WWTP sources using the ALS GC method. The following files are attached.

1. Revised Modeling WWTP Rates for ALS (9-28-23)
    a. Provides the updated ALS-based emissions rates in both g/s and g/s/m2, as well as a comparison to both the previous DHEC modeling demonstration and the original new stripper application modeling rates.
    b. References are given for each emissions rate – pointing to a specific document in the attached Referenced Files zipped folder.
2. New Stripper Modeling Results - 05 – 20230915
3. New Stripper - ALS Modeling Transmittal Document (10-2-23)
    a. Provides background information and explanation of this update.

We will send the updated modeling files to you and Bryan in a separate email, but wanted to get you the emissions rates and results for your review.

Please let me know if you have any questions or have any difficulties opening any files.

Caleb

Caleb Fetner / Consulting Engineer
678.293.9431 / Profile / LinkedIn

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From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Friday, August 25, 2023 7:30 AM
To: Robert Tourville <BOB.TOURVILLE@NEW-INDYCB.COM>; Sheryl Watkins <swatkins@all4inc.com>; Caleb Fetner <cfetner@all4inc.com>
Cc: Hardee, Christopher <hardeecd@dhec.sc.gov>; Shroup, Michael <shroupmd@dhec.sc.gov>; McCaslin, Steven <mccaslsd@dhec.sc.gov>; McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>; Verzwyvelt, Michael <verzwymg@dhec.sc.gov>
Subject: ALS vs RSK method of analysis for liquid samples

Hello All,

We have discussed it internally and the method to use to analyze liquid samples is the ALS GC method. Michael Shroup also discussed it with EPA and they too said the method to use is the ALS GC.

Let me know if you would like to discuss further.

Thank you,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

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bucknekk@dhec.sc.gov

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October 2, 2023
New-Indy Catawba – Update to Air Dispersion Modeling Analysis for New Stripper Permitting

Background:

New-Indy Catawba submitted an updated ambient air dispersion modeling analysis in support of the New Condensate Stripper Construction Permit Application (application). Facility-wide modeling of hydrogen sulfide (H_2S), methyl mercaptan (MMC), and total reduced sulfur (TRS) compounds was conducted using the source parameters, meteorology, and receptor network provided by SCDHEC, with the exception of the additional secondary containment tank (Source ID NEWSPLTK) and associated structure (Structure ID NEWSPLTK) that were included in the March 8, 2023 modeling submitted to SCDHEC.

For WWTP sources, New-Indy Catawba used the maximum actual emissions rates as submitted in the October 2021 analysis (for H2S, and TRS) and corresponding MMC emissions rates, with the exception of the ASB. Based on EPA's direction, the October 2021 modeling analysis was performed using WWTP emissions rates derived from the RSK-175 method results, rather than the ALS GC method results.

Refined emissions rates reflecting the new steam stripper operation and foul condensate flow for the ASB were developed in support of the application based on ALS GC method results. Due to the ASB being the only WWTP source impacted by the new condensate steam stripper, New-Indy Catawba submitted the ambient air dispersion modeling analysis in Appendix C of the application with the updated ASB emissions rates (ALS GC method), but did not change the emissions rates of the other WWTP sources from the October 2021 modeling analysis (RSK-175 method).

The emissions rates used in the application modeling analysis were most recently provided to SCDHEC in New-Indy Catawba's July 6, 2023 response.

In discussions and communications after submittal of the application, SCDHEC has directed New-Indy Catawba to update the air dispersion modeling analysis with emissions rates for all of the WWTP sources based on the ALS GC method results, specifically in the August 25, 2023 email from Katharine Buckner (SCDHEC).

Discussion of Updated WWTP Emissions Rates:

The ALS-based emissions rates are being provided to SCDHEC in the "Revised Modeling WWTP Rates for ALS (9-28-23) spreadsheet. The references of the emissions rates are included in the spreadsheet. Other referenced spreadsheets and PDFs with any supporting calculations are also provided with this transmittal.

In general, the average ALS GC results from the July 2021 sampling were used to estimate actual emissions rates, which was then scaled up to a maximum emissions rate using the ratio of the July 2021 actual pulp production to a max of 2700 ADTP/day. The modeling analysis is based on these maximum emissions rates. There are no changes to the Post Aeration Basin, Holding Pond (H_2S only), and Sludge Pond emissions rates, as they were not dependent upon July 2021 liquid sulfur sampling results.

Air Dispersion Modeling Results:

The air dispersion modeling analysis was conducted using the updated ALS emissions rates for WWTP sources as discussed above, with the same source parameters and emissions rates for non-WWTP sources and the Post-Aeration Basin as the original modeling analysis for the application. Results of the air dispersion modeling analysis demonstrate that ambient concentrations are below the relevant standards for H_2S, MM, and TRS for each averaging period.

Modeled Source ID	UTM Easting (m)	UTM Northing (m)	Release Height (m)	Modeled Area (m^2)	Initial Vertical Dimension (m)	H_2S Emissions (g/s)	MMC Emissions (g/s)	TRS Emissions (g/s)	H_2S Emissions ($g/s/m^2$)	MMC Emissions ($g/s/m^2$)	TRS Emissions ($g/s/m^2$)
EQLBASIN	510,439.13	3,855,563.34	0.00	7,610.8	0.00	7.14E-03	--	7.14E-03	9.38E-07		9.38E-07
DITCH1	510,812.79	3,856,255.42	0.00	2,219.3	0.00	4.10E-03	2.33E-03	1.28E-01	1.85E-06	1.05E-06	5.78E-05
ASB1[b]	510,803.40	3,856,319.69	6.10	50,889.4	0.00	1.37E-01	1.63E-02	7.28E-01	2.68E-06	3.20E-07	1.43E-05
ASB2[b]	510,964.42	3,856,054.20	6.10	68,158.5	0.00	2.45E-03	2.92E-04	1.30E-02	3.59E-08	4.28E-09	1.91E-07
ASB3[b]	511,052.13	3,855,887.21	6.10	72,789.5	0.00	6.17E-05	7.35E-06	3.29E-04	8.47E-10	1.01E-10	4.52E-09
DITCH2[c]	510,992.97	3,855,727.21	0.00	1,844.2	0.00	9.28E-02	4.20E-03	1.01E-01	5.03E-05	2.28E-06	5.49E-05
SLDGLAGN	510,924.33	3,855,544.61	0.00	45,225.3	0.00	4.14E-02	--	4.14E-02	9.16E-07		9.16E-07
HOLDPOND	510,391.65	3,855,142.65	0.00	390,739.1	0.00	6.26E-02	1.75E-04	6.28E-02	1.60E-07	4.48E-10	1.61E-07
DITCH0	510,377.59	3,855,634.91	0.00	240.9	0.00	3.03E-04	3.72E-04	1.86E-02	1.26E-06	1.54E-06	7.72E-05

Modeled Source ID	UTM Easting (m)	UTM Northing (m)	Release Height (m)	Radius (m)	Modeled Area (m^2)	H_2S Emissions (g/s)	MMC Emissions (g/s)	TRS Emissions (g/s)	H_2S Emissions ($g/s/m^2$)	MMC Emissions ($g/s/m^2$)	TRS Emissions ($g/s/m^2$)
CLARIFY	510,342.42	3,855,604.87	0.00	42.00	5541.77	2.59E-04	7.26E-04	3.98E-02	4.67E-08	1.31E-07	7.18E-06

Comparison to July 6 2023 Response to DHEC Provided R

Original application emissions rates

H_2S Emissions ($g/s/m^2$)	MMC Emissions ($g/s/m^2$)	TRS Emissions ($g/s/m^2$)
9.37E-07		9.37E-07
1.50E-07	3.21E-07	2.58E-05
2.69E-06	3.20E-07	1.43E-05
4.81E-08	5.74E-09	2.55E-07
1.21E-09	1.45E-10	6.47E-09
1.34E-06	3.17E-07	2.63E-06
9.37E-07		9.37E-07
1.61E-07	6.20E-11	1.61E-07
1.11E-07	5.05E-07	3.75E-05

H_2S Emissions ($g/s/m^2$)	MMC Emissions ($g/s/m^2$)	TRS Emissions ($g/s/m^2$)
3.70352E-06	3.96E-08	6.94E-06

Emissions Rate Basis

Source	Pollutant	Actual g/s	Reference File Provided	Maximum g/s
Equalization Basin	H2S	4.56E-03	EQ Basin and Sludge Lagoon Calcs.xlsx	7.14E-03
	TRS	4.56E-03	TRS = H2S	7.14E-03
Ditch 0	H2S	1.94E-04	ALS AVG Ditch #0 Calcs.xlsx	3.03E-04
	MMC	2.38E-04	PC and Ditch 0-1_ALS AVG_WATER9.pdf Sum of Unit 3 Open Trench, Open Sum, and Closed Trench WATER9	3.72E-04
	TRS	1.19E-02	Sum of reduced sulfur compounds, as H2S	1.86E-02
Ditch 1	H2S	2.62E-03	ALS AVG Ditch #1 Calcs.xlsx	4.10E-03
	MMC	1.49E-03	PC and Ditch 0-1_ALS AVG_WATER9.pdf	2.33E-03
	TRS	8.19E-02	Sum of reduced sulfur compounds, as H2S	1.28E-01
Ditch 2	H2S	5.93E-02	ALS AVG Ditch #2 Calcs.xlsx	9.28E-02
	MMC	2.68E-03	Holding Pond_Ditch 2_ ALS AVG_WATER9	4.20E-03
	TRS	6.47E-02	Sum of reduced sulfur compounds, as H2S	1.01E-01
Sludge Lagoon	H2S	2.65E-02	EQ Basin and Sludge Lagoon Calcs.xlsx	4.14E-02
	MMC			
	TRS	2.65E-02	TRS = H2S	4.14E-02
Holding Pond	H2S	4.00E-02	No change.	6.26E-02
	MMC	1.12E-04	Holding Pond_Ditch 2_ ALS AVG_WATER9	1.75E-04
	TRS	4.01E-02	Sum of reduced sulfur compounds, as H2S	6.28E-02
Primary Clarifier	H2S	1.65E-04	PC ALS AVG H2SSIM.pdf	2.59E-04
	MMC	4.64E-04	PC and Ditch 0-1_ALS AVG_WATER9	7.26E-04
	TRS	2.54E-02	Sum of reduced sulfur compounds, as H2S	3.98E-02

2700 ADTP, max

1726 ADTP, actual July 2021 pulp production.

156%

ASB

Worst-case Emissions for Modeling	H_2S	MMC	TRS as H_2S
Total ASB lb/ODTP	0.0109	1.30E-03	5.81E-02
Total ASB lb/hr	1.10	0.13	5.88
Total ASB g/s	0.139	0.017	0.741
Zone 1 g/s	1.37E-01	1.63E-02	7.28E-01
Zone 2 g/s	2.45E-03	2.92E-04	1.30E-02
Zone 3 g/s	6.17E-05	7.35E-06	3.29E-04

REVISED Emissions Calculations (6-26-23)_Modeling Emissions Rates

June 27, 2023 Response to DHEC on New Stripper Application

Rates:

H_2S	MMC	TRS	
Percent Change vs. July 6 Response			
0.1%		0.1%	EQLBASIN
1134%	226%	124%	DITCH1
-0.3%	-0.1%	0.0%	ASB1[(b)]
-25%	-25%	-25%	ASB2[(b)]
-30%	-30%	-30%	ASB3[(b)]
3653%	619%	1989%	DITCH2[(c)]
-2%		-2%	SLDGLAGN
-1%	622%	0%	HOLDPOND
1037%	206%	106%	DITCH0

H_2S	MMC	TRS	
Percent Change due to ALS			
-98.7%	231%	3.5%	CLARIFY

Comparison to DHEC Rates:

Emissions rates used by DHEC in modeling demonstration

H2S	MMC	TRS
($g/s/m^2$)	($g/s/m^2$)	($g/s/m^2$)
5.99E-07	--	5.99E-07
1.18E-06	6.70E-07	3.69E-05
1.05E-06	1.53E-06	4.69E-06
5.92E-07	3.26E-08	6.73E-07
3.29E-07	8.40E-10	3.32E-07
3.22E-05	1.46E-06	3.51E-05
5.85E-07	--	5.85E-07
1.02E-07	2.86E-10	1.03E-07
8.05E-07	9.87E-07	4.93E-05

H2S	MMC	TRS
($g/s/m^2$)	($g/s/m^2$)	($g/s/m^2$)
3.00E-08	8.38E-08	4.59E-06

H_2S	MMC	TRS	
Percent Change vs. DHEC			
56.5%		56.5%	EQLBASIN
56.5%	56.5%	56.5%	DITCH1
			ASB1[(b)]
			ASB2[(b)]
			ASB3[(b)]
56.4%	56.5%	56.4%	DITCH2[(c)]
56.5%		56.5%	SLDGLAGN
56.7%	56.5%	56.5%	HOLDPOND
56.1%	56.5%	56.4%	DITCH0

H_2S	MMC	TRS	
Percent Change due to ALS			
55.6%	56.5%	56.5%	CLARIFY

New-Indy Catawba, LLC
2023 New Steam Stripper Application

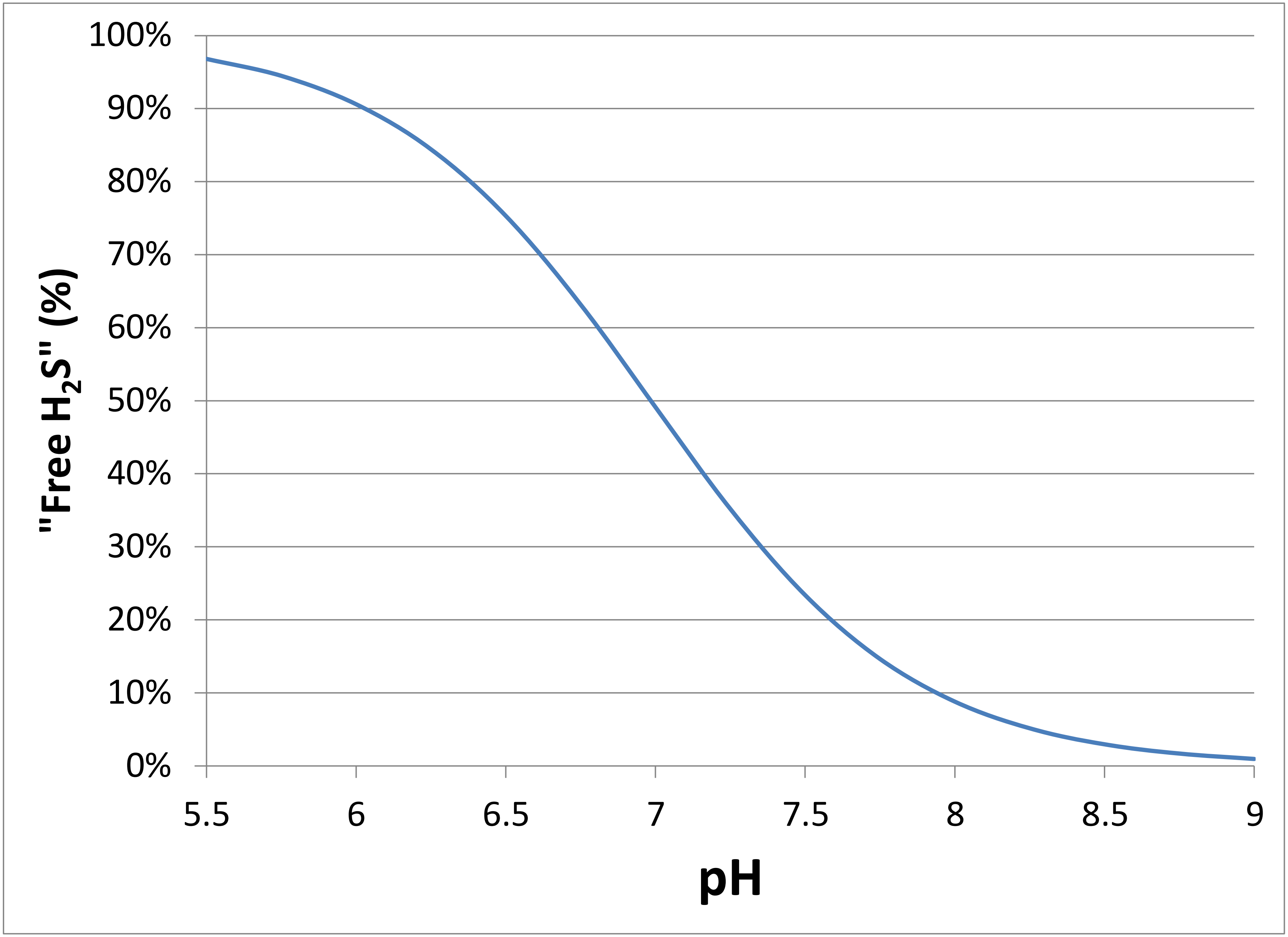
Pollutant	Standard[a]	Averaging Period[b]	Modeled Concentration (µg/m³)	UTM Easting (m)	UTM Northing (m)	Rank[a]	Standard[a][c][d] (µg/m³)
H_2S	MAAC	24-hour	20.20	511,397.27	3,856,649.76	1st High	140
	EPA Action Level	30-minute	100.80	511,249.70	3,856,644.83	1-hour 1st High	837
MMC	MAAC	24-hour	9.46	510,115.55	3,856,041.31	1st High	10
	EPA Action Level	30-minute	48.00	510,209.41	3,856,039.95	1-hour 1st High	57,000
TRS	MAAC	24-hour	77.25	511,249.70	3,856,644.83	1st High	140
	EPA Action Level	30-minute	385.32	510,143.86	3,855,999.18	1-hour 1st High	837

(a) https://scdhec.gov/sites/default/files/media/document/BAQ_SC%20Modeling%20Guidelines_10.15.18_revised%204.15.19.pdf.

(b) 30-minute averaging period to be compared against maximum 1-hour modeled concentration, per DHEC October 6, 2021 request.

(c) TRS does not have a SC Standard - compare to H_2S.

(d) Methyl Mercaptan does not have an established AEGL-1 value due to insufficient data. Comparison of modeled concentrations are to the 30-minute AEGL-2 value for MMC only.



100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
"Free H_2S" (%)
5.5
6
6.5
7
7.5
8
8.5
9
pH

Free Sulfide Fraction Calculation Tool

pH	9.08	Convert Total Sulfide to H2S(dissolved)	
		Hydrogen Concentration	8.31764E-10
K1	1.036E-07	Hydrogen Concenration	8.31764E-13
K2	6.43E-16		
Free Fraction	0.796%	**Convert Total Sulfide Measurement to H2S(dissolved)**	

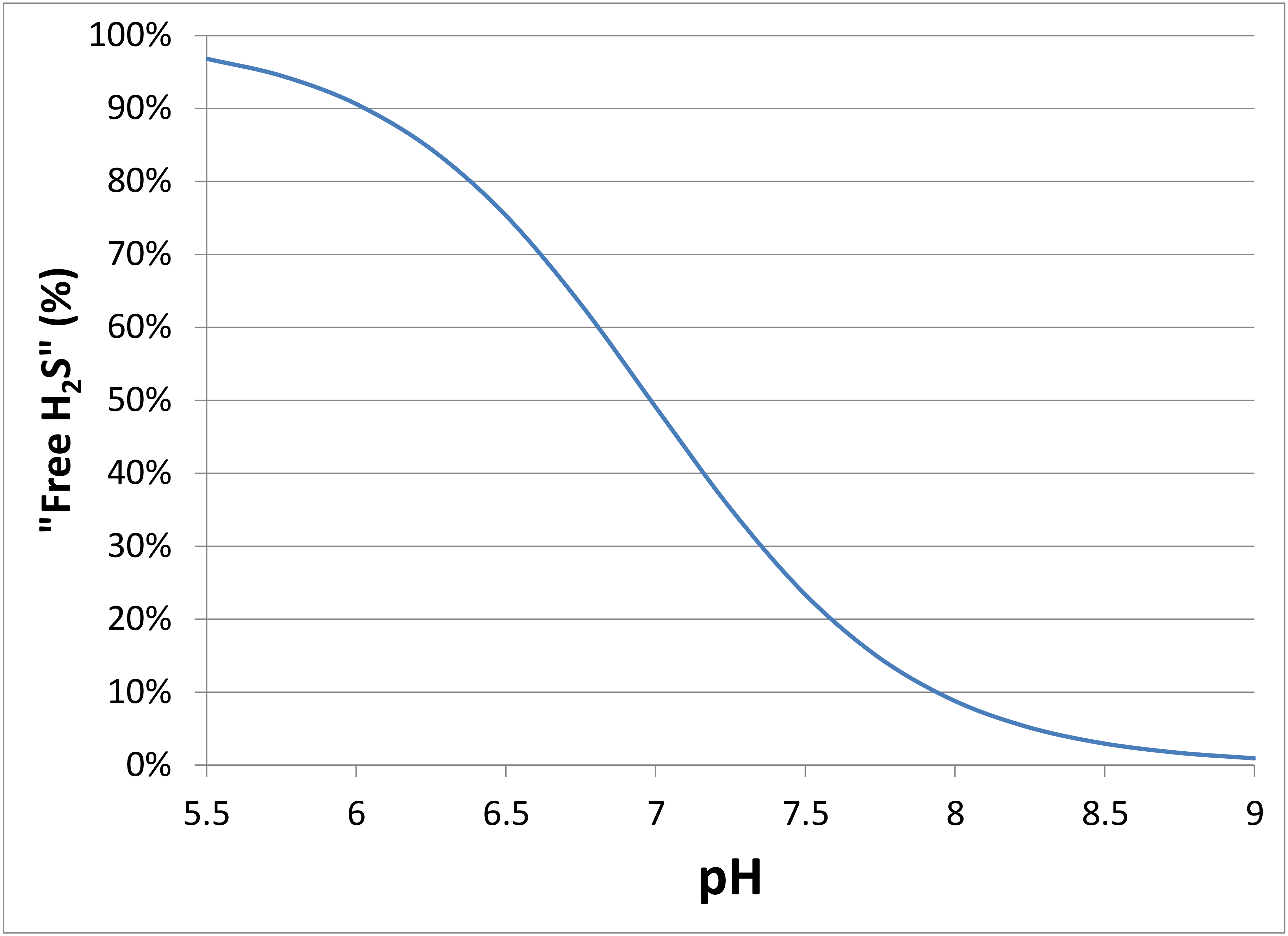
5.5	96.8%
5.75	94.5%
6	90.6%
6.25	84.4%
6.5	75.3%
6.75	63.2%
7	49.1%
7.25	35.2%
7.5	23.4%
7.75	14.7%
8	8.8%
8.25	5.1%
8.5	3.0%
8.75	1.7%
9	1.0%

Ditch #0 H2S Emissions Calculation

0.0004428	m/s	KL
3.65	m	Width of Ditch #0
61	m	Length of Ditch #0
0.25	mg/L	Concentration of Hydrogen Sulfide Entering Ditch #0
0.0080		Free Sulfide pH Adjustment
1,000	L/m^3	Conversion Factor
1,000	mg/g	Conversion Factor

$$0.0004428\ \text{m/s} \times 3.65\ \text{m} \times 61\ \text{m} \times 0.25\ \text{mg/L} \times 0.0080 \times 1000\ \text{L/m}^3 \times \frac{1\ \text{g}}{1000\ \text{mg}}$$

H2S emissions rate
0.0001936 g/s


100%
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60%
50%
40%
30%
20%
10%
0%
"Free H_2S" (%)
5.5
6
6.5
7
7.5
8
8.5
9
pH

Free Sulfide Fraction Calculation Tool

pH	8.94	Hydrogen Concentration	1.14815E-09
K1	1.036E-07	Hydrogen Concenration	1.14815E-12
K2	6.43E-16		

Convert Total Sulfide to H2S(dissolved)

Free Fraction	1.096%	**Convert Total Sulfide Measurement to H2S(dissolved)**

5.5	96.8%
5.75	94.5%
6	90.6%
6.25	84.4%
6.5	75.3%
6.75	63.2%
7	49.1%
7.25	35.2%
7.5	23.4%
7.75	14.7%
8	8.8%
8.25	5.1%
8.5	3.0%
8.75	1.7%
9	1.0%

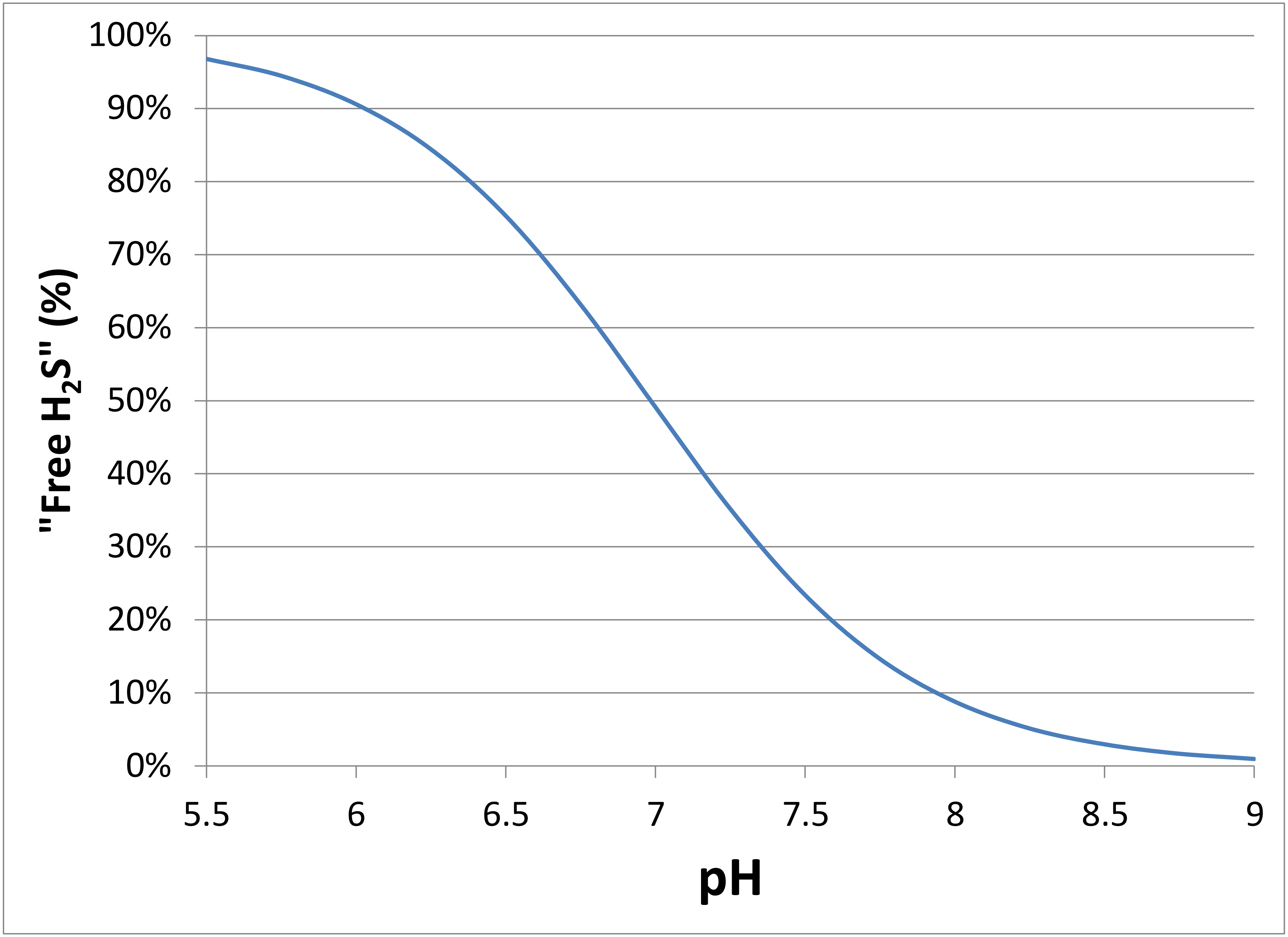
Ditch #1 H2S Emissions Calculation

0.0004428	m/s	KL
3.65	m	Width of Ditch #1
600	m	Length of Ditch #1
0.25	mg/L	Concentration of Hydrogen Sulfide Entering Ditch #1
0.011		Free Sulfide pH Adjustment
1,000	L/m^3	Conversion Factor
1,000	mg/g	Conversion Factor

$$\underset{m/s}{0.0004428} \times \underset{m}{3.65} \times \underset{m}{600} \times \underset{mg/L}{0.25} \times 0.011 \times \underset{L/m^3}{1000} \times \frac{1\ g}{1000\ mg}$$

H2S emissions rate

0.00262 g/s



100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
"Free H_2S" (%)
5.5
6
6.5
7
7.5
8
8.5
9
pH

Free Sulfide Fraction Calculation Tool

pH	7.47	Convert Total Sulfide to H2S(dissolved)	
		Hydrogen Concentration	3.38844E-08
K1	1.036E-07	Hydrogen Concenration	3.38844E-11
K2	6.43E-16		

Free Fraction	24.646%	**Convert Total Sulfide Measurement to H2S(dissolved)**	

5.5	96.8%
5.75	94.5%
6	90.6%
6.25	84.4%
6.5	75.3%
6.75	63.2%
7	49.1%
7.25	35.2%
7.5	23.4%
7.75	14.7%
8	8.8%
8.25	5.1%
8.5	3.0%
8.75	1.7%
9	1.0%

Ditch #2 H2S Emissions Calculation

0.0004276	m/s	KL
3.65	m	Width of Ditch #2
500	m	Length of Ditch #2
0.308	mg/L	Concentration of Hydrogen Sulfide Entering Ditch #2
0.246		Free Sulfide pH Adjustment
1,000	L/m^3	Conversion Factor
1,000	mg/g	Conversion Factor

$$0.0004276 \ \tfrac{m}{s} \times 3.65 \ m \times 500 \ m \times 0.31 \ \tfrac{mg}{L} \times 0.246 \times 1000 \ \tfrac{L}{m^3} \times \frac{1 \ g}{1000 \ mg}$$

H2S emissions rate
0.05930 g/s

Equalization Basin H2S Emissions Calculation

4.2	lb/day-acre	NCASI SARA HB Emissions Factor for Sludge Pond
49.12%		Percent H2S emitted at average pH of ponds tested for NCASI emissions factor (average pH 7).
1.881955	acre	Free water surface Area of EQ Basin
5.4%		Percent H2S emitted at site-specific pH of 8.22

$$\frac{4.2}{\text{lb/day-acre}} \times \frac{5.40\%}{49.12\%} \times \frac{1 \text{ day}}{24 \text{ hrs}} \times \frac{1.881955}{\text{acre}} \times \frac{0.125998 \text{ g/s}}{1 \text{ lb/hr}}$$

H2S emissions rate
0.00456 g/s

#4 Sludge Lagoon H2S Emissions Calculation

4.2	lb/day-acre	NCASI SARA HB Emissions Factor for Sludge Pond
49.12%		Percent H2S emitted at average pH of ponds tested for NCASI emissions factor (average pH 7).
10.92	acre	Free water surface Area of #4 Sludge Lagoon
5.4%		Percent H2S emitted at site-specific pH of 8.22

$$\frac{4.2}{\text{lb/day-acre}} \times \frac{5.40\%}{49.12\%} \times \frac{1\ \text{day}}{24\ \text{hrs}} \times \frac{10.92}{\text{acre}} \times \frac{0.125998\ \text{g/s}}{1\ \text{lb/hr}}$$

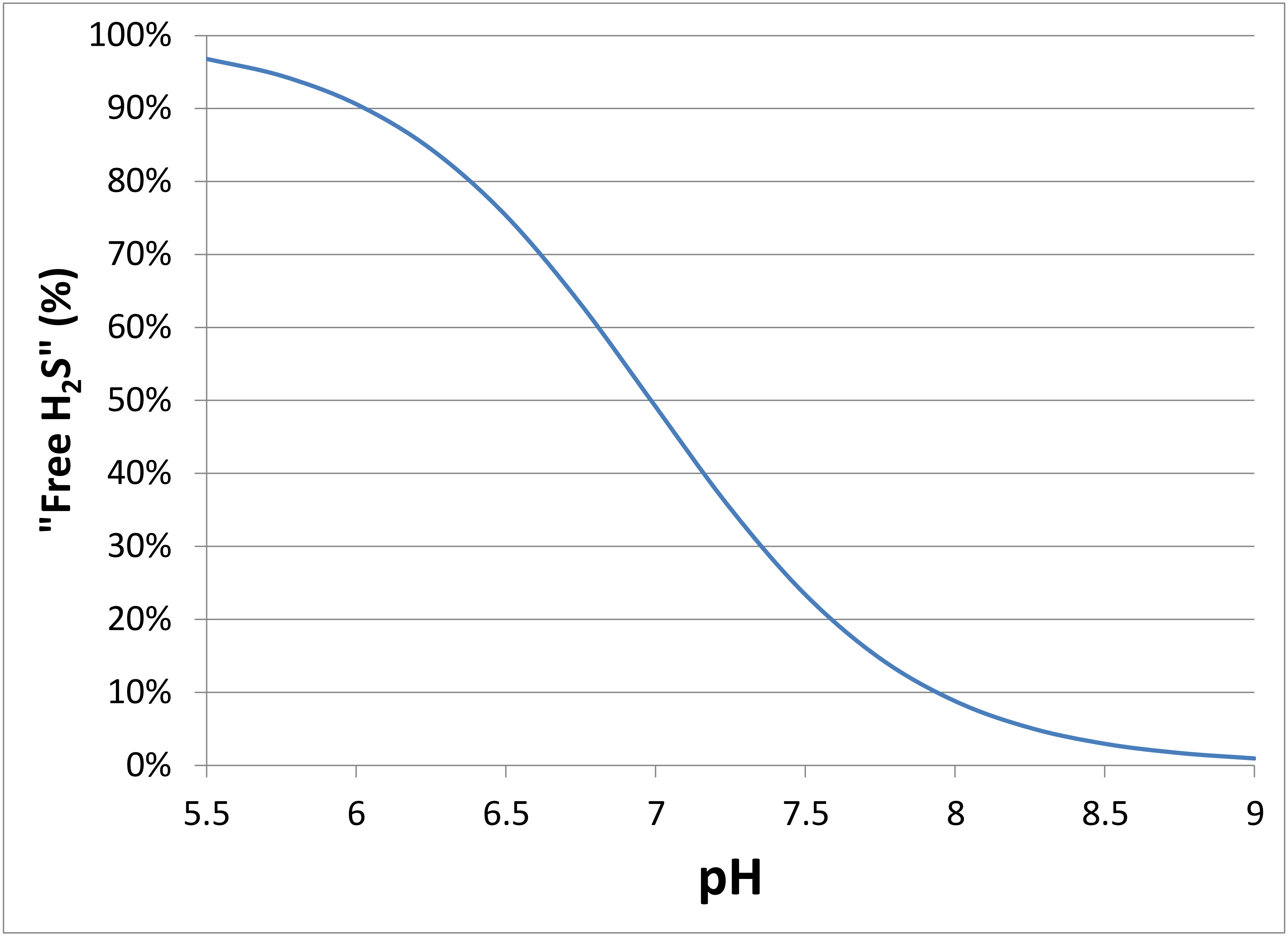
H2S emissions rate
0.02647 g/s

Free Sulfide Fraction Calculation Tool

pH	8.23	Convert Total Sulfide to H2S(dissolved)	
K1	1.036E-07	Hydrogen Concentration	5.91562E-09
K2	6.43E-16	Hydrogen Concenration	5.91562E-12

Free Fraction	5.402%	**Convert Total Sulfide Measurement to H2S(dissolved)**

5.5	96.8%
5.75	94.5%
6	90.6%
6.25	84.4%
6.5	75.3%
6.75	63.2%
7	49.1%
7.25	35.2%
7.5	23.4%
7.75	14.7%
8	8.8%
8.25	5.1%
8.5	3.0%
8.75	1.7%
9	1.0%



100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
"Free H_2S" (%)
5.5
6
6.5
7
7.5
8
8.5
9
pH

HOLDING POND WATER9
ALS AVERAGE CONCENTRATIONS

```
Type of unit is
1 Total water added at the unit (l/s)      50     0
2 Area of openings at unit (cm2)                  50
3 Radius of drop pipe (cm)                        5
4 Drop length to conduit (cm)                     61
5 Humidity of inlet air (%)                       40
6 Temperature of air (C)                          25
7 Drain air velocity (ft/min)                     84
8 manhole air velocity (ft/min)                   128
9 Conduit air velocity (ft/min)                   66
10 Wind speed (cm/s at 10 m)                      447
11 distance to next unit (cm)                     500
12 slope of underflow conduit                     .015
13 friction factor liquid                         .016
14 friction factor gas                            .006
15 radius of underflow conduit (cm)               12
16 Underflow T (C)                                25
17 oscillation cycle time (min)                   5
18 design collection velocities  (ft/s)           2
19 design branch line fraction full               .4

Type of unit is
8 HL partition flag=1, adjust for sorption        0
9 unit recycle convergence number                 200
10 oil molecular weight                           0
11 oil density  (g/cc)                            0
12 NaUT 1=municipal 2=industrial  3=turb.         0
13 NaUT 1=mass tr. 2=equil                        0
14 parts biomass per 1000 parts COD
15 oil water partition method 0=owpc
16 use UNIFAC aqueous data base =1
17 specify mass transfer for unit, =1
18 Use biomass for unit option, =1
19 biogrowth Monod half concentration ppm

DETAILED CALCULATIONS at Unit 10 def.open trench
Type: open trench
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\June 2022 TRS WATER9 H2SSIM Runs\ALS AVG
  RUNS\IPT Holding Pond ALS AVG 6/28/2022 5:25:58 PM  10:25:55
COMPOUND: DIMETHYL DISULFIDE

Type of unit is open trench
1 Description of unit                      10    def.open trench
2 Underflow T (C)                                31.6
3 Total water added at the unit (l/s)            0
8 Subsurface entrance=1                          0
9 subsurface exit =1                             0
10 width of trench (m)                           3.65
11 distance to next unit (cm)                    50000
12 slope of underflow conduit                    0.015
13 depth  of trench (m)                          3
19 pH  (enter 0 for no pH adjustment)            7.47

Trench model for mass transfer from a surface.
 The effective depth of water flow (h) is 0.44324 ft.
 The water flow rate is 9.505e+05 cm3/s.
 The velocity of the flow (v)is 6.32388 ft/s.
 The width of the unit is 365. cm.
 The oxygen diffusion coefficient (ratio) adjustment factor is 0.55467.
 reareation constant(ft/day) = 21.6 * v ^ 0.67 / h ^ 0.85 * Ratio
 The liquid phase mass transfer coefficient from surface is 2.904e-04 m/s.
The Schmidt number is 1.72847.
The friction velocity is 13.347 m/s
```

```
kg is estimated as 0.005209 m/s.  Model: 3
The slope of the U drain is 0.015
The water velocity is 192.752 cm/s.  (6.32388 ft/s.)
The depth of the water is 13.51 cm (5.51429 in.)
Kl= 2.904e-04 m/s;  Kg=  5.208595E-03 m/s
the ratio of the mass transfer to depth is  1.14422640253297E-03
The residence time in the trench is  259.4007 sec.
fraction emitted 0.25682
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.
   fraction loss in unit                    0.
   fraction loss in line run                0.25682
   component upstream of unit, g/s          0.009317
   mol fract. headspace upstream (y)        1.585e-07
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             0.
   mol fract. headspace vent base           0.
   headspace flow out vent (cc/s)           0.
   headspace flow down line (cc/s)          0.
   KG surface (m/s)                         0.005209
   KL surface (m/s)                         2.904e-04
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.
   total component into unit, g/s           0.009317
   TOTAL AIR EMISSIONS  (g/s)               0.002393
                    (Mg/year)               0.075461
   EMISSION FACTOR  (g/cm2-s)               1.311e-10
   UNIT EXIT CONCENTRATION (ppmw)           0.007285
DETAILED CALCULATIONS at Unit 11 def.aerated biotre
Type: aerated biotreatment
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\June 2022 TRS WATER9 H2SSIM Runs\ALS AVG
  RUNS\IPT Holding Pond ALS AVG 6/28/2022 5:25:58 PM  10:25:55
COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment
1 Description of unit                      11    def.aerated biotre
2 Wastewater temperature   (C)                   30.4
3 length of aeration unit (m)                    818
4 width of aeration unit (m)                     475
5 depth of aeration unit (m)                     8.5
6 Area of agitation (each aerator,m2)            47
7 Total number of agitators in the unit          2
8 Power of agitation (each aerator,HP)           75
9 Impeller diameter (cm)                         49.53
10 Impeller rotation (RPM)                       1200
11 Agitator mechanical efficiency                0.83
12 aerator effectiveness, alpha                  0.83
13 if there is plug flow, enter 1                0
14 Overall biorate (mg/g bio-hr)                 19
15 Aeration air flow (m3/s)                      0
16 active biomass, aeration (g/l)                0.3
17 If covered, then enter 1                      0
18 special input                                 0
19 pH  (enter 0 for no pH adjustment)            7.56

Properties of DIMETHYL DISULFIDE at 30.4 deg.C (86.7 deg.F)
   hl= 0.001437 atm-m3/mol      vp= 38.537 mmHg (0.74539 psia)
       79.85 y/x
       0.057737 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.028e-05 cm2/s  dv= 0.086185 cm2/s
Compound flow rate from inlet water is 0.006924 g/s.
Compound flow rate from inlet vent is 0. g/s.
```

```
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 965.198 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 82.748.
kl is estimated as 5.923e-06 m/s.
kg is estimated as 0.005084 m/s.  Model: 2
kg is estimated as 0.005084 m/s.  Model: 2
The Schmidt number is 1.74044.
The friction velocity is 31.28 m/s
kg is estimated as 0.010834 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.11443 m/s.
kl (agitated)is estimated as 0.045752 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 7.251e-06 m/s.
 The effective stripping time (surface + diffused air) is 1.954e+04 minutes.
 (325.645 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 5.791e+04 min. (965.198 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                        0.11657
   KL aerated (m/s)                        0.045752
   KL OVERALL AERATED (m/s)                0.00596
   KG quiescent (m/s)                      0.005179
   KL quiescent (m/s)                      5.923e-06
   KL OVERALL QUIESCENT (m/s)              5.81e-06
   KL OVERALL (m/s)                        7.251e-06
   air stripping time constant (min)       1.954e+04
   FRACTION SURFACE VOLATILIZED            0.002996
   FRACTION SUBMERGED VOLATILIZED          0.
   TOTAL FRACTION VOLATILIZED              0.002996
   FRACTION BIOLOGICALLY REMOVED           0.99599
   FRACTION ABSORBED                       0.
   TOTAL AIR EMISSIONS  (g/s)              2.075e-05
                    (Mg/year)              6.542e-04
   EMISSION FACTOR  (g/cm2-s)              5.339e-15
   UNIT EXIT CONCENTRATION (ppmw)          7.364e-06
DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\June 2022 TRS WATER9 H2SSIM Runs\ALS AVG
  RUNS\IPT Holding Pond ALS AVG 6/28/2022 5:25:58 PM  10:25:55
COMPOUND: DIMETHYL DISULFIDE

Type of unit is system exit stream
1 Description of unit                     12    def.system exit st

   TOTAL AIR EMISSIONS  (g/s)              0.
                    (Mg/year)              0.
   EMISSION FACTOR  (g/cm2-s)              5.339e-15
   UNIT EXIT CONCENTRATION (ppmw)          7.364e-06
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\June 2022 TRS WATER9 H2SSIM Runs\ALS AVG
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  RUNS\IPT Holding Pond ALS AVG 6/28/2022 5:25:58 PM  10:25:55
COMPOUND: DIMETHYL DISULFIDE

Type of unit is open hub drain
1 Description of unit                       13    default open hub d
2 Underflow T (C)                                 31.6
3 Total water added at the unit (l/s)             0
4 Area of openings at unit (cm2)                  50
5 Radius of drop pipe (cm)                        5
6 Drop length to conduit (cm)                     61
7 Open surface=1                                  0
8 Subsurface entrance=1                           0
9 subsurface exit =1                              0
10 radius of underflow conduit (cm)               12
11 distance to next unit (cm)                     500
12 slope of underflow conduit                     0.015
16 velocity air at drain opening (ft/min)         84
17 municipal waste in conduit =1                  0
18 Assume equilibrium in unit, =1                 0
19 pH  (enter 0 for no pH adjustment)             7.47

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  950.489 l/s.
   Weight fraction down is  1.04E-08
   Gas concentration in  0 mol fraction.
   Gas flow  950.489 L/s
   Weight fraction out at base of drop is  9.80262324051644E-09
   fraction transferred in the drain drop from hub is .05744
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.05744
   fraction loss in unit                    0.
   fraction loss in line run                -9.996e-08
   component upstream of unit, g/s          0.
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        1.585e-07
   headspace end of conduit (y)             1.585e-07
   mol fract. headspace vent base           1.585e-07
   headspace flow out vent (cc/s)           -9.505e+05
   headspace flow down line (cc/s)          9.505e+05
   KG surface (m/s)                         1621.827
   KL surface (m/s)                         5.743e-09
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.009885
   total component into unit, g/s           0.009317
   TOTAL AIR EMISSIONS  (g/s)               0.
                    (Mg/year)               0.
   EMISSION FACTOR  (g/cm2-s)               5.339e-15
   UNIT EXIT CONCENTRATION (ppmw)           0.009803
DETAILED CALCULATIONS at Unit 14 default open hub d
Type: open hub drain
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\June 2022 TRS WATER9 H2SSIM Runs\ALS AVG
  RUNS\IPT Holding Pond ALS AVG 6/28/2022 5:25:58 PM  10:25:55
COMPOUND: DIMETHYL DISULFIDE

Type of unit is open hub drain
1 Description of unit                       14    default open hub d
2 Underflow T (C)                                 25
3 Total water added at the unit (l/s)             0
4 Area of openings at unit (cm2)                  50
5 Radius of drop pipe (cm)                        5
6 Drop length to conduit (cm)                     61
7 Open surface=1                                  0
8 Subsurface entrance=1                           0
```

```
9 subsurface exit =1                                 0
10 radius of underflow conduit (cm)                  12
11 distance to next unit (cm)                        500
12 slope of underflow conduit                        0.015
16 velocity air at drain opening (ft/min)            84
17 municipal waste in conduit =1                     0
18 Assume equilibrium in unit, =1                    0
19 pH  (enter 0 for no pH adjustment)                0

   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.
   fraction loss in unit                    0.
   fraction loss in line run                0.
   component upstream of unit, g/s          0.
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             0.
   mol fract. headspace vent base           0.
   headspace flow out vent (cc/s)           0.43059
   headspace flow down line (cc/s)          -0.01876
   KG surface (m/s)                         0.00101
   KL surface (m/s)                         1.8e-21
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.
   total component into unit, g/s           0.
   TOTAL AIR EMISSIONS  (g/s)               0.
                     (Mg/year)              0.
   EMISSION FACTOR  (g/cm2-s)               5.339e-15
   UNIT EXIT CONCENTRATION (ppmw)           0.
```

```
Type of unit is
1 Total water added at the unit (l/s)      50     0
2 Area of openings at unit (cm2)                  50
3 Radius of drop pipe (cm)                        5
4 Drop length to conduit (cm)                     61
5 Humidity of inlet air (%)                       40
6 Temperature of air (C)                          25
7 Drain air velocity (ft/min)                     84
8 manhole air velocity (ft/min)                   128
9 Conduit air velocity (ft/min)                   66
10 Wind speed (cm/s at 10 m)                      447
11 distance to next unit (cm)                     500
12 slope of underflow conduit                     .015
13 friction factor liquid                         .016
14 friction factor gas                            .006
15 radius of underflow conduit (cm)               12
16 Underflow T (C)                                25
17 oscillation cycle time (min)                   5
18 design collection velocities  (ft/s)           2
19 design branch line fraction full               .4

Type of unit is
8 HL partition flag=1, adjust for sorption        0
9 unit recycle convergence number                 200
10 oil molecular weight                           0
11 oil density  (g/cc)                            0
12 NaUT 1=municipal 2=industrial  3=turb.         0
13 NaUT 1=mass tr. 2=equil                        0
14 parts biomass per 1000 parts COD
15 oil water partition method 0=owpc
16 use UNIFAC aqueous data base =1
17 specify mass transfer for unit, =1
18 Use biomass for unit option, =1
19 biogrowth Monod half concentration ppm

DETAILED CALCULATIONS at Unit 10 def.open trench
Type: open trench
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\June 2022 TRS WATER9 H2SSIM Runs\ALS AVG
  RUNS\IPT Holding Pond ALS AVG 6/28/2022 5:25:58 PM  10:25:28
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is open trench
1 Description of unit                      10    def.open trench
2 Underflow T (C)                                31.6
3 Total water added at the unit (l/s)            0
8 Subsurface entrance=1                          0
9 subsurface exit =1                             0
10 width of trench (m)                           3.65
11 distance to next unit (cm)                    50000
12 slope of underflow conduit                    0.015
13 depth  of trench (m)                          3
19 pH  (enter 0 for no pH adjustment)            7.47

Trench model for mass transfer from a surface.
 The effective depth of water flow (h) is 0.44324 ft.
 The water flow rate is 9.505e+05 cm3/s.
 The velocity of the flow (v)is 6.32388 ft/s.
 The width of the unit is 365. cm.
 The oxygen diffusion coefficient (ratio) adjustment factor is 0.75312.
 reareation constant(ft/day) = 21.6 * v ^ 0.67 / h ^ 0.85 * Ratio
 The liquid phase mass transfer coefficient from surface is 3.943e-04 m/s.
The Schmidt number is 1.03042.
The friction velocity is 13.347 m/s
```

```
kg is estimated as 0.006957 m/s.  Model: 3
The slope of the U drain is 0.015
The water velocity is 192.752 cm/s.  (6.32388 ft/s.)
The depth of the water is 13.51 cm (5.51429 in.)
Kl= 3.943e-04 m/s;  Kg=  6.956951E-03 m/s
the ratio of the mass transfer to depth is  1.9339408383684E-03
The residence time in the trench is  259.4007 sec.
fraction emitted 0.39448
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.
   fraction loss in unit                    0.
   fraction loss in line run                0.39448
   component upstream of unit, g/s          0.007986
   mol fract. headspace upstream (y)        3.614e-07
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             0.
   mol fract. headspace vent base           0.
   headspace flow out vent (cc/s)           0.
   headspace flow down line (cc/s)          0.
   KG surface (m/s)                         0.006957
   KL surface (m/s)                         3.943e-04
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.
   total component into unit, g/s           0.007986
   TOTAL AIR EMISSIONS  (g/s)               0.00315
                    (Mg/year)               0.099346
   EMISSION FACTOR  (g/cm2-s)               1.726e-10
   UNIT EXIT CONCENTRATION (ppmw)           0.005087
DETAILED CALCULATIONS at Unit 11 def.aerated biotre
Type: aerated biotreatment
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\June 2022 TRS WATER9 H2SSIM Runs\ALS AVG
  RUNS\IPT Holding Pond ALS AVG 6/28/2022 5:25:58 PM  10:25:28
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is aerated biotreatment
1 Description of unit                      11    def.aerated biotre
2 Wastewater temperature   (C)                   30.4
3 length of aeration unit (m)                    818
4 width of aeration unit (m)                     475
5 depth of aeration unit (m)                     8.5
6 Area of agitation (each aerator,m2)            47
7 Total number of agitators in the unit          2
8 Power of agitation (each aerator,HP)           75
9 Impeller diameter (cm)                         49.53
10 Impeller rotation (RPM)                       1200
11 Agitator mechanical efficiency                0.83
12 aerator effectiveness, alpha                  0.83
13 if there is plug flow, enter 1                0
14 Overall biorate (mg/g bio-hr)                 19
15 Aeration air flow (m3/s)                      0
16 active biomass, aeration (g/l)                0.3
17 If covered, then enter 1                      0
18 special input                                 0
19 pH  (enter 0 for no pH adjustment)            7.56

Properties of DIMETHYL SULFIDE  (DMS) at 30.4 deg.C (86.7 deg.F)
   hl= 0.002556 atm-m3/mol      vp= 615.845 mmHg (11.912 psia)
       141.988 y/x
       0.10267 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr         dl= 1.486e-05 cm2/s  dv= 0.14457 cm2/s
Compound flow rate from inlet water is 0.004836 g/s.
Compound flow rate from inlet vent is 0. g/s.
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```
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 965.198 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 82.748.
kl is estimated as 7.572e-06 m/s.
kg is estimated as 0.007189 m/s.  Model: 2
kg is estimated as 0.007189 m/s.  Model: 2
The Schmidt number is 1.03756.
The friction velocity is 31.28 m/s
kg is estimated as 0.014912 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.1482 m/s.
kl (agitated)is estimated as 0.055007 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 1.046e-05 m/s.
 The effective stripping time (surface + diffused air) is 1.354e+04 minutes. (225.655 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 5.791e+04 min. (965.198 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                        0.15098
   KL aerated (m/s)                        0.055007
   KL OVERALL AERATED (m/s)                0.012264
   KG quiescent (m/s)                      0.007324
   KL quiescent (m/s)                      7.572e-06
   KL OVERALL QUIESCENT (m/s)              7.498e-06
   KL OVERALL (m/s)                        1.046e-05
   air stripping time constant (min)       1.354e+04
   FRACTION SURFACE VOLATILIZED            0.018853
   FRACTION SUBMERGED VOLATILIZED          0.
   TOTAL FRACTION VOLATILIZED              0.018853
   FRACTION BIOLOGICALLY REMOVED           0.97674
   FRACTION ABSORBED                       0.
   TOTAL AIR EMISSIONS  (g/s)              9.116e-05
                    (Mg/year)              0.002875
   EMISSION FACTOR  (g/cm2-s)              2.346e-14
   UNIT EXIT CONCENTRATION (ppmw)          2.242e-05
DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker Poe Privileged and Confidential\June 2022 TRS WATER9 H2SSIM Runs\ALS AVG RUNS\IPT Holding Pond ALS AVG 6/28/2022 5:25:58 PM  10:25:28
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is system exit stream
1 Description of unit                     12    def.system exit st

   TOTAL AIR EMISSIONS  (g/s)              0.
                    (Mg/year)              0.
   EMISSION FACTOR  (g/cm2-s)              2.346e-14
   UNIT EXIT CONCENTRATION (ppmw)          2.242e-05
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker Poe Privileged and Confidential\June 2022 TRS WATER9 H2SSIM Runs\ALS AVG
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  RUNS\IPT Holding Pond ALS AVG 6/28/2022 5:25:58 PM  10:25:28
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is open hub drain
1 Description of unit                      13    default open hub d
2 Underflow T (C)                                31.6
3 Total water added at the unit (l/s)            0
4 Area of openings at unit (cm2)                 50
5 Radius of drop pipe (cm)                       5
6 Drop length to conduit (cm)                    61
7 Open surface=1                                 0
8 Subsurface entrance=1                          0
9 subsurface exit =1                             0
10 radius of underflow conduit (cm)              12
11 distance to next unit (cm)                    500
12 slope of underflow conduit                    0.015
16 velocity air at drain opening (ft/min)        84
17 municipal waste in conduit =1                 0
18 Assume equilibrium in unit, =1                0
19 pH  (enter 0 for no pH adjustment)            7.47

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  950.489 l/s.
   Weight fraction down is  9.300001E-09
   Gas concentration in  0 mol fraction.
   Gas flow  950.489 L/s
   Weight fraction out at base of drop is  8.40183103595816E-09
   fraction transferred in the drain drop from hub is .096577
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.096577
   fraction loss in unit                    0.
   fraction loss in line run                0.
   component upstream of unit, g/s          0.
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        3.614e-07
   headspace end of conduit (y)             3.614e-07
   mol fract. headspace vent base           3.613e-07
   headspace flow out vent (cc/s)           -9.505e+05
   headspace flow down line (cc/s)          9.505e+05
   KG surface (m/s)                         2290.047
   KL surface (m/s)                         7.434e-09
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.00884
   total component into unit, g/s           0.007986
   TOTAL AIR EMISSIONS  (g/s)               0.
                    (Mg/year)               0.
   EMISSION FACTOR  (g/cm2-s)               2.346e-14
   UNIT EXIT CONCENTRATION (ppmw)           0.008402
DETAILED CALCULATIONS at Unit 14 default open hub d
Type: open hub drain
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\June 2022 TRS WATER9 H2SSIM Runs\ALS AVG
  RUNS\IPT Holding Pond ALS AVG 6/28/2022 5:25:58 PM  10:25:28
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is open hub drain
1 Description of unit                      14    default open hub d
2 Underflow T (C)                                25
3 Total water added at the unit (l/s)            0
4 Area of openings at unit (cm2)                 50
5 Radius of drop pipe (cm)                       5
6 Drop length to conduit (cm)                    61
7 Open surface=1                                 0
8 Subsurface entrance=1                          0
```

```
      9 subsurface exit =1                              0
      10 radius of underflow conduit (cm)               12
      11 distance to next unit (cm)                     500
      12 slope of underflow conduit                     0.015
      16 velocity air at drain opening (ft/min)         84
      17 municipal waste in conduit =1                  0
      18 Assume equilibrium in unit, =1                 0
      19 pH  (enter 0 for no pH adjustment)             0

         fraction loss in waste1 drop to hub      0.
         fraction loss in waste2 drop to hub      0.
         fraction loss in waste3 drop to hub      0.
         fraction loss in collection hub drop     0.
         fraction loss in unit                    0.
         fraction loss in line run                0.
         component upstream of unit, g/s          0.
         mol fract. headspace upstream (y)        0.
         headspace at conduit discharge, y        0.
         headspace end of conduit (y)             0.
         mol fract. headspace vent base           0.
         headspace flow out vent (cc/s)           -0.2153
         headspace flow down line (cc/s)          -0.01876
         KG surface (m/s)                         0.001426
         KL surface (m/s)                         1.8e-21
         flow of waste down hub (l/s)             0.
         component flow in waste into unit (g/s)  0.
         total component into unit, g/s           0.
         TOTAL AIR EMISSIONS  (g/s)               0.
                           (Mg/year)              0.
         EMISSION FACTOR  (g/cm2-s)               2.346e-14
         UNIT EXIT CONCENTRATION (ppmw)           0.
```

```
Type of unit is
1 Total water added at the unit (l/s)      50     0
2 Area of openings at unit (cm2)                  50
3 Radius of drop pipe (cm)                        5
4 Drop length to conduit (cm)                     61
5 Humidity of inlet air (%)                       40
6 Temperature of air (C)                          25
7 Drain air velocity (ft/min)                     84
8 manhole air velocity (ft/min)                   128
9 Conduit air velocity (ft/min)                   66
10 Wind speed (cm/s at 10 m)                      447
11 distance to next unit (cm)                     500
12 slope of underflow conduit                     .015
13 friction factor liquid                         .016
14 friction factor gas                            .006
15 radius of underflow conduit (cm)               12
16 Underflow T (C)                                25
17 oscillation cycle time (min)                   5
18 design collection velocities  (ft/s)           2
19 design branch line fraction full               .4

Type of unit is
8 HL partition flag=1, adjust for sorption        0
9 unit recycle convergence number                 200
10 oil molecular weight                           0
11 oil density  (g/cc)                            0
12 NaUT 1=municipal 2=industrial  3=turb.         0
13 NaUT 1=mass tr. 2=equil                        0
14 parts biomass per 1000 parts COD
15 oil water partition method 0=owpc
16 use UNIFAC aqueous data base =1
17 specify mass transfer for unit, =1
18 Use biomass for unit option, =1
19 biogrowth Monod half concentration ppm

DETAILED CALCULATIONS at Unit 10 def.open trench
Type: open trench
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\June 2022 TRS WATER9 H2SSIM Runs\ALS AVG
  RUNS\IPT Holding Pond ALS AVG 6/28/2022 5:25:58 PM  10:23:40
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is open trench
1 Description of unit                      10    def.open trench
2 Underflow T (C)                                31.6
3 Total water added at the unit (l/s)            0
8 Subsurface entrance=1                          0
9 subsurface exit =1                             0
10 width of trench (m)                           3.65
11 distance to next unit (cm)                    50000
12 slope of underflow conduit                    0.015
13 depth  of trench (m)                          3
19 pH  (enter 0 for no pH adjustment)            7.47

Trench model for mass transfer from a surface.
 The effective depth of water flow (h) is 0.44324 ft.
 The water flow rate is 9.505e+05 cm3/s.
 The velocity of the flow (v)is 6.32388 ft/s.
 The width of the unit is 365. cm.
 The oxygen diffusion coefficient (ratio) adjustment factor is 0.76167.
 reareation constant(ft/day) = 21.6 * v ^ 0.67 / h ^ 0.85 * Ratio
 The liquid phase mass transfer coefficient from surface is 3.988e-04 m/s.
The Schmidt number is 0.64189.
The friction velocity is 13.347 m/s
```

```
kg is estimated as 0.009184 m/s.  Model: 3
The slope of the U drain is 0.015
The water velocity is 192.752 cm/s.  (6.32388 ft/s.)
The depth of the water is 13.51 cm (5.51429 in.)
Kl= 3.988e-04 m/s;  Kg=  9.18442E-03 m/s
the ratio of the mass transfer to depth is  2.32502892978858E-03
The residence time in the trench is  259.4007 sec.
fraction emitted 0.45289
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.
   fraction loss in unit                    0.
   fraction loss in line run                0.45289
   component upstream of unit, g/s          0.005927
   mol fract. headspace upstream (y)        5.012e-07
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             0.
   mol fract. headspace vent base           0.
   headspace flow out vent (cc/s)           0.
   headspace flow down line (cc/s)          0.
   KG surface (m/s)                         0.009184
   KL surface (m/s)                         3.988e-04
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.
   total component into unit, g/s           0.005927
   TOTAL AIR EMISSIONS  (g/s)               0.002684
                    (Mg/year)               0.084649
   EMISSION FACTOR  (g/cm2-s)               1.471e-10
   UNIT EXIT CONCENTRATION (ppmw)           0.003411
DETAILED CALCULATIONS at Unit 11 def.aerated biotre
Type: aerated biotreatment
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\June 2022 TRS WATER9 H2SSIM Runs\ALS AVG
  RUNS\IPT Holding Pond ALS AVG 6/28/2022 5:25:58 PM  10:23:40
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment
1 Description of unit                        11    def.aerated biotre
2 Wastewater temperature   (C)                     30.4
3 length of aeration unit (m)                      818
4 width of aeration unit (m)                       475
5 depth of aeration unit (m)                       8.5
6 Area of agitation (each aerator,m2)              47
7 Total number of agitators in the unit            2
8 Power of agitation (each aerator,HP)             75
9 Impeller diameter (cm)                           49.53
10 Impeller rotation (RPM)                         1200
11 Agitator mechanical efficiency                  0.83
12 aerator effectiveness, alpha                    0.83
13 if there is plug flow, enter 1                  0
14 Overall biorate (mg/g bio-hr)                   19
15 Aeration air flow (m3/s)                        0
16 active biomass, aeration (g/l)                  0.3
17 If covered, then enter 1                        0
18 special input                                   0
19 pH  (enter 0 for no pH adjustment)              7.56

Properties of METHANETHIOL(methyl mercaptan) at 30.4 deg.C (86.7 deg.F)
   hl= 0.00373 atm-m3/mol      vp= 2038.439 mmHg (39.428 psia)
       207.231 y/x
       0.14984 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.507e-05 cm2/s  dv= 0.23208 cm2/s
Compound flow rate from inlet water is 0.003243 g/s.
Compound flow rate from inlet vent is 0. g/s.
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Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 965.198 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 82.748.
kl is estimated as 7.641e-06 m/s.
kg is estimated as 0.009872 m/s.  Model: 2
kg is estimated as 0.009872 m/s.  Model: 2
The Schmidt number is 0.64634.
The friction velocity is 31.28 m/s
kg is estimated as 0.020108 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.18777 m/s.
kl (agitated)is estimated as 0.055383 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 1.223e-05 m/s.
 The effective stripping time (surface + diffused air) is 1.159e+04 minutes.
 (193.128 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 5.791e+04 min. (965.198 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                          0.19129
   KL aerated (m/s)                          0.055383
   KL OVERALL AERATED (m/s)                  0.019113
   KG quiescent (m/s)                        0.010057
   KL quiescent (m/s)                        7.641e-06
   KL OVERALL QUIESCENT (m/s)                7.604e-06
   KL OVERALL (m/s)                          1.223e-05
   air stripping time constant (min)         1.159e+04
   FRACTION SURFACE VOLATILIZED              0.034475
   FRACTION SUBMERGED VOLATILIZED            0.
   TOTAL FRACTION VOLATILIZED                0.034475
   FRACTION BIOLOGICALLY REMOVED             0.95863
   FRACTION ABSORBED                         0.
   TOTAL AIR EMISSIONS  (g/s)                1.118e-04
                    (Mg/year)                0.003525
   EMISSION FACTOR  (g/cm2-s)                2.877e-14
   UNIT EXIT CONCENTRATION (ppmw)            2.353e-05
DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\June 2022 TRS WATER9 H2SSIM Runs\ALS AVG
  RUNS\IPT Holding Pond ALS AVG 6/28/2022 5:25:58 PM  10:23:40
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is system exit stream
1 Description of unit                      12    def.system exit st

   TOTAL AIR EMISSIONS  (g/s)                0.
                    (Mg/year)                0.
   EMISSION FACTOR  (g/cm2-s)                2.877e-14
   UNIT EXIT CONCENTRATION (ppmw)            2.353e-05
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\June 2022 TRS WATER9 H2SSIM Runs\ALS AVG
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  RUNS\IPT Holding Pond ALS AVG 6/28/2022 5:25:58 PM  10:23:40
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is open hub drain
1 Description of unit                      13    default open hub d
2 Underflow T (C)                                31.6
3 Total water added at the unit (l/s)            0
4 Area of openings at unit (cm2)                 50
5 Radius of drop pipe (cm)                       5
6 Drop length to conduit (cm)                    61
7 Open surface=1                                 0
8 Subsurface entrance=1                          0
9 subsurface exit =1                             0
10 radius of underflow conduit (cm)              12
11 distance to next unit (cm)                    500
12 slope of underflow conduit                    0.015
16 velocity air at drain opening (ft/min)        84
17 municipal waste in conduit =1                 0
18 Assume equilibrium in unit, =1                0
19 pH  (enter 0 for no pH adjustment)            7.47

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  950.489 l/s.
   Weight fraction down is  7.2E-09
   Gas concentration in  0 mol fraction.
   Gas flow  950.489 L/s
   Weight fraction out at base of drop is  6.23546093564362E-09
   fraction transferred in the drain drop from hub is .133964
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.13396
   fraction loss in unit                    0.
   fraction loss in line run                0.
   component upstream of unit, g/s          0.
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        5.012e-07
   headspace end of conduit (y)             5.012e-07
   mol fract. headspace vent base           5.011e-07
   headspace flow out vent (cc/s)           -9.505e+05
   headspace flow down line (cc/s)          9.505e+05
   KG surface (m/s)                         3140.126
   KL surface (m/s)                         7.505e-09
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.006844
   total component into unit, g/s           0.005927
   TOTAL AIR EMISSIONS  (g/s)               0.
                    (Mg/year)               0.
   EMISSION FACTOR  (g/cm2-s)               2.877e-14
   UNIT EXIT CONCENTRATION (ppmw)           0.006235
DETAILED CALCULATIONS at Unit 14 default open hub d
Type: open hub drain
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\June 2022 TRS WATER9 H2SSIM Runs\ALS AVG
  RUNS\IPT Holding Pond ALS AVG 6/28/2022 5:25:58 PM  10:23:40
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is open hub drain
1 Description of unit                      14    default open hub d
2 Underflow T (C)                                25
3 Total water added at the unit (l/s)            0
4 Area of openings at unit (cm2)                 50
5 Radius of drop pipe (cm)                       5
6 Drop length to conduit (cm)                    61
7 Open surface=1                                 0
8 Subsurface entrance=1                          0
```

```
     9 subsurface exit =1                                0
     10 radius of underflow conduit (cm)                 12
     11 distance to next unit (cm)                       500
     12 slope of underflow conduit                       0.015
     16 velocity air at drain opening (ft/min)           84
     17 municipal waste in conduit =1                    0
     18 Assume equilibrium in unit, =1                   0
     19 pH  (enter 0 for no pH adjustment)               0

        fraction loss in waste1 drop to hub      0.
        fraction loss in waste2 drop to hub      0.
        fraction loss in waste3 drop to hub      0.
        fraction loss in collection hub drop     0.
        fraction loss in unit                    0.
        fraction loss in line run                0.
        component upstream of unit, g/s          0.
        mol fract. headspace upstream (y)        0.
        headspace at conduit discharge, y        0.
        headspace end of conduit (y)             0.
        mol fract. headspace vent base           0.
        headspace flow out vent (cc/s)           0.2153
        headspace flow down line (cc/s)          -0.01876
        KG surface (m/s)                         0.001955
        KL surface (m/s)                         1.8e-21
        flow of waste down hub (l/s)             0.
        component flow in waste into unit (g/s)  0.
        total component into unit, g/s           0.
        TOTAL AIR EMISSIONS  (g/s)               0.
                             (Mg/year)           0.
        EMISSION FACTOR  (g/cm2-s)               2.877e-14
        UNIT EXIT CONCENTRATION (ppmw)           0.
```

NCASI WASTEWATER HYDROGEN SULFIDE EMISSIONS SIMULATOR (H2SSIM)

Version 1.3

7/9/2021 - 7/11/2021 Average

Data Type 1. Site Identification

Company Name	New-Indy
Facility Name	Catawba SC
Basin Name	Primary Clarifier

Data Type 2. Model Zone Information

Number of Zones	1
Zone Location of Hardpipe	None
Type of Basin	PC

Data Type 3. Load Characteristics

Loading Characteristics	Main Influent	Hardpipe	Units
Flow	21.35	0	MGD
Total Sulfide	0.24657041	0	mg/L
Sulfate	390	0	mg/L

Data Type 4. Atmospheric Conditions

Windspeed	3.79	mph
Ambient Temperature	79	F

Data Type 5. Zone Physical and Chemical Conditions

Zone Condition	Zone 1	Zone 2	Zone 3	Zone 4	Units
Dissolved Oxygen	0				mg/L
Temperature	111.9				F
pH	9.08				s.u.
Redox Condition	Anoxic	Aerobic	Aerobic	Aerobic	
Length	243.7				feet
Width	243.7				feet
Depth	5.41				meters
Mixing	Moderat	Moderat	Moderat		
Number of Aerators	0				
Total Horsepower	0				HP
Impellor Size	1.625				feet
Impellor RPM	1200				RPM
Diffused Air Flow	0				cms
Weir Height	0.38				meters

Model Controls

Run H2SSIM

View Parameters

Clear Input Sheet

H2SSIM Results

7/9/2021 - 7/11/2021 Average

Basin Emissions		Units
Total Emissions (H_2S)	0.000	gms/s
Total Emissions (H_2S)	11.6	lbs/yr
Total Emissions (H_2S)	0.0	tons/yr
Total Emissions (H_2S)	0.0	tonnes/yr
Emission Flux (H_2S)	1.0	gms/m^2 yr

Zone Emissions	Zone 1	Zone 2	Zone 3	Zone 4	Units
Zone Emissions (H_2S)	0.00				gms/s
Zone Emissions (H_2S)	11.6				lbs/yr
Emission Flux (H_2S)	1.0				gms/m^2 yr
Liquid Conc. (Total Sulfide)	0.472				mg/L
Liquid Sulfide Load (lbs/yr)	4839.400				lbs/yr

Percent Inlet Sulfide Removed	69.7%

Current Parameters	
kgen	0.25
ThetaGen	1.06
KDO	0.05
KSO4	10
kanox	0.006
ThetaOx	1.05
m	1
n	0.2
MLVSS	2500
O_2 Transfer Coeff.	2
alpha 1	0.83
alpha 2	0.6

PRIMARY CLARIFIER WATER9
ALS AVERAGE CONCENTRATIONS

Type of unit is

1 Total water added at the unit (l/s)	50	0
2 Area of openings at unit (cm2)		50
3 Radius of drop pipe (cm)		5
4 Drop length to conduit (cm)		61
5 Humidity of inlet air (%)		40
6 Temperature of air (C)		25
7 Drain air velocity (ft/min)		84
8 manhole air velocity (ft/min)		128
9 Conduit air velocity (ft/min)		66
10 Wind speed (cm/s at 10 m)		447
11 distance to next unit (cm)		500
12 slope of underflow conduit		.015
13 friction factor liquid		.016
14 friction factor gas		.006
15 radius of underflow conduit (cm)		12
16 Underflow T (C)		25
17 oscillation cycle time (min)		5
18 design collection velocities (ft/s)		2
19 design branch line fraction full		.4

Type of unit is

8 HL partition flag=1, adjust for sorption	0
9 unit recycle convergence number	200
10 oil molecular weight	0
11 oil density (g/cc)	0
12 NaUT 1=municipal 2=industrial 3=turb.	0
13 NaUT 1=mass tr. 2=equil	0
14 parts biomass per 1000 parts COD	
15 oil water partition method 0=owpc	
16 use UNIFAC aqueous data base =1	
17 specify mass transfer for unit, =1	
18 Use biomass for unit option, =1	
19 biogrowth Monod half concentration ppm	

DETAILED CALCULATIONS at Unit 1 def.Closed trench
Type: Closed trench
Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker Poe Privileged and Confidential\June 2022 TRS WATER9 H2SSIM Runs\ALS AVG RUNS\ALS AVG IPT Clarifier 6/29/2022 8:05:17 AM 10:21:01
COMPOUND: DIMETHYL DISULFIDE

Type of unit is Closed trench

1 Description of unit	1	def.Closed trench
2 Underflow T (C)		44.4
3 Total water added at the unit (l/s)		0
4 Area of openings at unit (cm2)		50
5 Radius of drop pipe (cm)		5
6 Drop length to conduit (cm)		61
7 Open surface=1		0
8 Subsurface entrance=1		1
9 subsurface exit =1		1
10 width of trench (m)		1.2
11 distance to next unit (cm)		500
12 slope of underflow conduit		0.015
13 depth of trench (m)		1.2
16 velocity air at opening (ft/min)		84
17 municipal waste in conduit =1		0
18 Assume equilibrium in unit, =1		0
19 pH (enter 0 for no pH adjustment)		9.08

Trench model for mass transfer from a surface.
The effective depth of water flow (h) is 1.00454 ft.
The water flow rate is 9.356e+05 cm3/s.

```
 The velocity of the flow (v)is 8.35415 ft/s.
 The width of the unit is 120. cm.
 The oxygen diffusion coefficient (ratio) adjustment factor is 0.57394.
 reareation constant(ft/day) = 21.6 * v ^ 0.67 / h ^ 0.85 * Ratio
 The liquid phase mass transfer coefficient from surface is 1.806e-04 m/s.

Covered Ground Level Trench (U drain);   UNIT: 1
width 120. cm;  Rho 0.001091 g/cc;  Visc 1.8e-04 cp
Liquid Depth 30.618cm;  Slope 0.015;     Roughness  0.21336 cm
Length 0.5382 ft;  Friction Factor0.      Manning coef 0.
Headspace temp.  44.4 C;  Humidity 100. %;       Water temp. 44.4 C
Velocity  254.6344 cm/s;   Flow 0. gal/min
________drag_____________
average water velocity 254.634 cm/s.   Fraction full: 0.25515
average water surface velocity 288.957cm/sec
velocity of air from internal recirculation  144.479 cm/sec
Reynolds number for internal air flow 9.705e+04

Properties of DIMETHYL DISULFIDE at 44.4 deg.C (111.9 deg.F)
   hl= 0.002733 atm-m3/mol      vp= 73.279 mmHg (1.41737 psia)
       151.837 y/x
       0.10494 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.076e-05 cm2/s  dv= 0.093261 cm2/s
_____loss due to mass transfer in conduit run__________________
  The length of the run of conduit line is 5. m (16.404 ft.)
  Flow of headspace gas in the conduit run_____0. L/s
     the pressure gradient for the headspace flow is 0. gf/cm2
     the headspace area of the sewer 1.073e+04 cm2
     the headspace average velocity is 0. cm/s.
     the headspace recirculation velocity is 144.479 cm/s.
  Flow of water in the conduit run_______935.575 L/s
     the width of the surface is 120. cm.
     the depth of the liquid is 30.618 cm. (12.054 in.)
     the average depth of the liquid is 30.618 cm. (12.054 in.)
     fraction full of liquid is 0.25515
     the residence time of the liquid is 1.9636 s.
 The oil corrected aqueous HL is 1.518e+02 (y/x)
  Wind Velocity 447. cm/sec ( 10.M.P.H.) (879.921 ft/min)
  Velocity of headspace in sewer 0. cm/sec  (0. M.P.H.) (0.ft/min)
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.
   fraction loss in unit                    0.
   fraction loss in line run                0.
   component upstream of unit, g/s          0.
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             0.
   mol fract. headspace vent base           0.
   headspace flow out vent (cc/s)           0.
   headspace flow down line (cc/s)          0.
   KG surface (m/s)                         0.
   KL surface (m/s)                         1.806e-04
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.092435
   total component into unit, g/s           0.092435
   TOTAL AIR EMISSIONS  (g/s)               0.
                     (Mg/year)              0.
   EMISSION FACTOR  (g/cm2-s)               4.716e-09
   UNIT EXIT CONCENTRATION (ppmw)           0.0988
DETAILED CALCULATIONS at Unit 2 def.primary munici
Type: primary municipal clarifier
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\June 2022 TRS WATER9 H2SSIM Runs\ALS AVG
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COMPOUND: DIMETHYL DISULFIDE

Type of unit is primary municipal clarifier
1 Description of unit                      2     def.primary munici
2 Wastewater temperature   (C)                   44.4
3 primary clarifier diameter (m)                 84
4 primary clarifier depth  (m)                   5.41
5 clarifier solids removal efficiency            0.7
6 waterfall drop height (cm)                     38
7 clarifier weir/circumference                   1
8 Center well present, =1                        1
10 number of identical units in parallel         1
15 vent air emission control factor              0
16 cover vent rate (m3/s per m2 surface)         0.0005
17 If covered, then enter 1                      0
19 pH  (enter 0 for no pH adjustment)            9.08

Properties of DIMETHYL DISULFIDE at 44.4 deg.C (111.9 deg.F)
   hl= 0.002733 atm-m3/mol      vp= 73.279 mmHg (1.41737 psia)
       151.837 y/x
       0.10494 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.076e-05 cm2/s  dv= 0.093261 cm2/s
Clarifier surface_____________
The residence time in the clarifier is 8.902 hrs.
The Henry's law constant of 0.002733 atm-m3/mol is multiplied by
 a adsorption factor of 1..
The adsorption corrected aqueous HL is 1.518e+02 (y/x)
The gas phase mass transfer is estimated using correlation 3, MacKay (1983).
The Schmidt number is 1.60839.
The friction velocity is 13.347 m/s
kg is estimated as 0.005417 m/s.  Model: 3
Gas phase mass transfer 2.257e-05 g mol/ cm2-s.
  The flow of water is 935.575 cm3/s.
  The effective flow depth in the clarifier is 54.1 cm.
Clarifier model liquid phase mass transfer 8.494e-05 g mol/ cm2-s.
Overall mass transfer 8.288e-05 g mol/cm2-s.
Clarifier weir emissions_____________
The Schmidt number is 1.60839.
The friction velocity is 13.347 m/s
kg is estimated as 0.005417 m/s.  Model: 3
Weir mass transfer is estimated from the Pincince 11/7/89 primary model
 The water drop was 0.38 m.
 The water flow rate was 0.93558 m3/s. (12.763 m3/hr-m)
 R = Exp(0.* drop ^ 0.* (q * 3600 / cir) ^ 0.* 0. ^ 0.31
 R = 1.03824
The diffusion constant correction is (1.076e-05/.000024)^.677
The unadjusted fraction O2 lost from the model is 0.036834.
The overall O2 mass transfer coefficient from the model is 3.436e-04 m/s.
The overall compound mass transfer coefficient from the model is 2.007e-04 m/s.
   residence time (hours)                   8.90152
   KG surface (m/s)                         0.005519
   KL surface (m/s)                         1.529e-05
   KL OVERALL SURFACE (m/s)                 1.492e-05
   Fraction lost from clarifier surface     0.08458
   KG waterfall (m/s)                       0.005519
   KL waterfall (m/s)                       2.007e-04
   KL OVERALL WATERFALL (m/s)               1.514e-04
   Fraction lost from weir waterfall        0.01474
   fraction of equilibrium in the unit      0.
   Fraction absorbed in underflow           0.
   TOTAL FRACTION LOST TO THE AIR           0.09932
   TOTAL AIR EMISSIONS  (g/s)               0.009181
                     (Mg/year)              0.28952
   EMISSION FACTOR  (g/cm2-s)               1.657e-10
```

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   UNIT EXIT CONCENTRATION (ppmw)           0.088987
DETAILED CALCULATIONS at Unit 3 def.open trench
Type: open trench
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\June 2022 TRS WATER9 H2SSIM Runs\ALS AVG
  RUNS\ALS AVG IPT Clarifier 6/29/2022 8:05:17 AM  10:21:01
COMPOUND: DIMETHYL DISULFIDE

Type of unit is open trench
1 Description of unit                      3     def.open trench
2 Underflow T (C)                                44.4
3 Total water added at the unit (l/s)            0
8 Subsurface entrance=1                          0
9 subsurface exit =1                             0
10 width of trench (m)                           3.65
11 distance to next unit (cm)                    6100
12 slope of underflow conduit                    0.015
13 depth  of trench (m)                          3
19 pH  (enter 0 for no pH adjustment)            9.08

Trench model for mass transfer from a surface.
 The effective depth of water flow (h) is 0.43996 ft.
 The water flow rate is 9.356e+05 cm3/s.
 The velocity of the flow (v)is 6.27108 ft/s.
 The width of the unit is 365. cm.
 The oxygen diffusion coefficient (ratio) adjustment factor is 0.57394.
 reareation constant(ft/day) = 21.6 * v ^ 0.67 / h ^ 0.85 * Ratio
 The liquid phase mass transfer coefficient from surface is 3.007e-04 m/s.
The Schmidt number is 1.60839.
The friction velocity is 13.347 m/s
kg is estimated as 0.005417 m/s.  Model: 3
The slope of the U drain is 0.015
The water velocity is 191.142 cm/s.  (6.27108 ft/s.)
The depth of the water is 13.41 cm (5.47347 in.)
Kl= 3.007e-04 m/s;  Kg=  5.417201E-03 m/s
the ratio of the mass transfer to depth is  1.50754208738415E-03
The residence time in the trench is  31.91338 sec.
fraction emitted 0.046972
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.
   fraction loss in unit                    0.
   fraction loss in line run                0.046972
   component upstream of unit, g/s          0.083254
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             0.
   mol fract. headspace vent base           0.
   headspace flow out vent (cc/s)           0.
   headspace flow down line (cc/s)          0.
   KG surface (m/s)                         0.005417
   KL surface (m/s)                         3.007e-04
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.
   total component into unit, g/s           0.083254
   TOTAL AIR EMISSIONS  (g/s)               0.003911
                    (Mg/year)               0.12332
   EMISSION FACTOR  (g/cm2-s)               1.756e-09
   UNIT EXIT CONCENTRATION (ppmw)           0.084807
DETAILED CALCULATIONS at Unit 4 def.open sump
Type: open sump
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\June 2022 TRS WATER9 H2SSIM Runs\ALS AVG
  RUNS\ALS AVG IPT Clarifier 6/29/2022 8:05:17 AM  10:21:01
COMPOUND: DIMETHYL DISULFIDE
```

```
Type of unit is open sump
1 Description of unit                      4     def.open sump
2 Underflow T (C)                                44.4
3 Total water added at the unit (l/s)            0
4 Area of openings at unit (cm2)                 50
5 Radius of drop pipe (cm)                       5
6 Drop length to conduit (cm)                    61
7 Open surface=1                                 1
8 Subsurface entrance=1                          0
9 subsurface exit =1                             0
10 radius of underflow conduit (cm)              12
11 distance to next unit (cm)                    500
12 slope of underflow conduit                    0.015
13 Open surface of liquid at the unit (cm2)      1000
14 flow entrance depth under surface (cm)        10
15 depth of liquid in sump (cm)                  50
16 velocity air at opening (ft/min)              88
17 municipal waste in conduit =1                 0
18 Assume equilibrium in unit, =1                0
19 pH  (enter 0 for no pH adjustment)            9.08

Trench model for mass transfer from a surface.
 The effective depth of water flow (h) is 0.32808 ft.
 The water flow rate is 9.356e+05 cm3/s.
 The velocity of the flow (v)is 97.065 ft/s.
 The width of the unit is 31.623 cm.
 The oxygen diffusion coefficient (ratio) adjustment factor is 0.57394.
 reareation constant(ft/day) = 21.6 * v ^ 0.67 / h ^ 0.85 * Ratio
 The liquid phase mass transfer coefficient from surface is 0.002419 m/s.
The Schmidt number is 1.60839.
The friction velocity is 13.347 m/s
kg is estimated as 0.005417 m/s.  Model: 3
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.
   fraction loss in unit                    5.253e-05
   fraction loss in line run                0.
   component upstream of unit, g/s          0.079344
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             2.458e-06
   mol fract. headspace vent base           0.
   headspace flow out vent (cc/s)           0.
   headspace flow down line (cc/s)          -0.0306
   KG surface (m/s)                         0.005417
   KL surface (m/s)                         0.002419
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.
   total component into unit, g/s           0.079344
   TOTAL AIR EMISSIONS  (g/s)               4.168e-06
                     (Mg/year)              1.315e-04
   EMISSION FACTOR  (g/cm2-s)               1.756e-09
   UNIT EXIT CONCENTRATION (ppmw)           0.084803
DETAILED CALCULATIONS at Unit 5 def.Closed trench
Type: Closed trench
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\June 2022 TRS WATER9 H2SSIM Runs\ALS AVG
  RUNS\ALS AVG IPT Clarifier 6/29/2022 8:05:17 AM  10:21:01
COMPOUND: DIMETHYL DISULFIDE

Type of unit is Closed trench
1 Description of unit                      5     def.Closed trench
2 Underflow T (C)                                44.4
3 Total water added at the unit (l/s)            0
```

```
4 Area of openings at unit (cm2)                 50
5 Radius of drop pipe (cm)                       5
6 Drop length to conduit (cm)                    61
7 Open surface=1                                 0
8 Subsurface entrance=1                          0
9 subsurface exit =1                             0
10 width of trench (m)                           1.2
11 distance to next unit (cm)                    42614
12 slope of underflow conduit                    0.015
13 depth  of trench (m)                          3
16 velocity air at opening (ft/min)              84
17 municipal waste in conduit =1                 0
18 Assume equilibrium in unit, =1                0
19 pH  (enter 0 for no pH adjustment)            0

Trench model for mass transfer from a surface.
 The effective depth of water flow (h) is 1.00454 ft.
 The water flow rate is 9.356e+05 cm3/s.
 The velocity of the flow (v)is 8.35415 ft/s.
 The width of the unit is 120. cm.
 The oxygen diffusion coefficient (ratio) adjustment factor is 0.57394.
 reareation constant(ft/day) = 21.6 * v ^ 0.67 / h ^ 0.85 * Ratio
 The liquid phase mass transfer coefficient from surface is 1.806e-04 m/s.

Covered Ground Level Trench (U drain);   UNIT: 5
width 120. cm;  Rho 0.001091 g/cc;  Visc 1.8e-04 cp
Liquid Depth 30.618cm;  Slope 0.015;     Roughness  0.21336 cm
Length 45.869 ft;  Friction Factor0.      Manning coef 0.
Headspace temp.  44.4 C;  Humidity 100. %;       Water temp. 44.4 C
Velocity  254.6344 cm/s;   Flow 0. gal/min
________drag_____________
average water velocity 254.634 cm/s.   Fraction full: 0.10206
average water surface velocity 288.957cm/sec
velocity of air from internal recirculation  144.479 cm/sec
Reynolds number for internal air flow 1.535e+05

Properties of DIMETHYL DISULFIDE at 44.4 deg.C (111.9 deg.F)
   hl= 0.002733 atm-m3/mol      vp= 73.279 mmHg (1.41737 psia)
       151.837 y/x
       0.10494 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.076e-05 cm2/s  dv= 0.093261 cm2/s
_____loss due to mass transfer in conduit run__________________
  The length of the run of conduit line is 426.14 m (1398.097 ft.)
  Flow of headspace gas in the conduit run_____10.523 L/s
     the pressure gradient for the headspace flow is -0.1206 gf/cm2
     the headspace area of the sewer 3.233e+04 cm2
     the headspace average velocity is 0.32553 cm/s.
     the headspace recirculation velocity is 144.479 cm/s.
  Flow of water in the conduit run_______935.575 L/s
     the width of the surface is 120. cm.
     the depth of the liquid is 30.618 cm. (12.054 in.)
     the average depth of the liquid is 30.618 cm. (12.054 in.)
     fraction full of liquid is 0.10206
     the residence time of the liquid is 167.354 s.
 The oil corrected aqueous HL is 1.518e+02 (y/x)
  Wind Velocity 447. cm/sec ( 10.M.P.H.) (879.921 ft/min)
  Velocity of headspace in sewer 0.32553 cm/sec  (0.007282 M.P.H.) (0.6408ft/min)
kg is estimated as 7.653e-04 m/s.  Model: 5
Modified J factor model is used for mass transfer.
     the effective gas speed for the correlation is 144.479 cm/s.
     the effective width for the correlation is 4.261e+04cm.
     the gas phase mass transfer coefficient is 3.1887e-06 gmol/cm2-s.
(kg)                                            7.6528e-04 m/s.
  Trench model (Owens) for mass transfer in liquid phase.
     the average liquid velocity is 254.634 cm/s.
```

```
     the liquid depth in the underflow 30.618 cm.
     the liquid phase mass transfer coefficient is 9.6889e-04 gmol/cm2-s.
(kl)                                              1.744e-04 m/s.
  Overall mass transfer coefficient.
        KL = 1 / (1 / kg / koc + 1 / kl) * 0.18
     the corrected partition coefficient is 151.837 y/x at one atm.
(KL) the overall liquid based mass transfer coefficient is 5.811e-05 m/s.
Countercurrent flow model model is used for mass transfer.
     the overall mass transfer coefficient is 5.811e-05 m/s.
     the average depth of the liquid is 30.618 cm.
     the ratio of the transfer coefficient to average depth is 1.898e-04
     the residence time of the liquid is 167.354 s.
     the maximum fraction from open air mass transfer is 0.031263
     the molar liquid flow is 5.198e+04 gmol/s.
     the molar gas flow is 0.40406 gmol/s.
(fe) the fraction lost from the liquid is 1.1803e-03
     the g/s from the gas to the liquid is 0.e+00 g/s.
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.
   fraction loss in unit                    0.
   fraction loss in line run                0.001179
   component upstream of unit, g/s          0.079339
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        2.458e-06
   headspace end of conduit (y)             0.
   mol fract. headspace vent base           2.458e-06
   headspace flow out vent (cc/s)           1.052e+04
   headspace flow down line (cc/s)          -1.052e+04
   KG surface (m/s)                         7.653e-04
   KL surface (m/s)                         1.744e-04
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  -9.354e-05
   total component into unit, g/s           0.079339
   TOTAL AIR EMISSIONS  (g/s)               9.354e-05
                    (Mg/year)               0.00295
   EMISSION FACTOR  (g/cm2-s)               1.756e-09
   UNIT EXIT CONCENTRATION (ppmw)           0.084703
DETAILED CALCULATIONS at Unit 6 def.open trench
Type: open trench
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\June 2022 TRS WATER9 H2SSIM Runs\ALS AVG
  RUNS\ALS AVG IPT Clarifier 6/29/2022 8:05:17 AM  10:21:01
COMPOUND: DIMETHYL DISULFIDE

Type of unit is open trench
1 Description of unit                      6     def.open trench
2 Underflow T (C)                                44.4
3 Total water added at the unit (l/s)            0
8 Subsurface entrance=1                          0
9 subsurface exit =1                             0
10 width of trench (m)                           3.65
11 distance to next unit (cm)                    60000
12 slope of underflow conduit                    0.015
13 depth  of trench (m)                          3
19 pH  (enter 0 for no pH adjustment)            8.94

Trench model for mass transfer from a surface.
 The effective depth of water flow (h) is 0.43996 ft.
 The water flow rate is 9.356e+05 cm3/s.
 The velocity of the flow (v)is 6.27108 ft/s.
 The width of the unit is 365. cm.
 The oxygen diffusion coefficient (ratio) adjustment factor is 0.57394.
 reareation constant(ft/day) = 21.6 * v ^ 0.67 / h ^ 0.85 * Ratio
 The liquid phase mass transfer coefficient from surface is 3.007e-04 m/s.
```

```
The Schmidt number is 1.60839.
The friction velocity is 13.347 m/s
kg is estimated as 0.005417 m/s.  Model: 3
The slope of the U drain is 0.015
The water velocity is 191.142 cm/s.  (6.27108 ft/s.)
The depth of the water is 13.41 cm (5.47347 in.)
Kl= 3.007e-04 m/s;  Kg=  5.417201E-03 m/s
the ratio of the mass transfer to depth is  1.50754208738415E-03
The residence time in the trench is  313.9021 sec.
fraction emitted 0.37701
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.
   fraction loss in unit                    0.
   fraction loss in line run                0.37701
   component upstream of unit, g/s          0.079246
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             0.
   mol fract. headspace vent base           0.
   headspace flow out vent (cc/s)           0.
   headspace flow down line (cc/s)          0.
   KG surface (m/s)                         0.005417
   KL surface (m/s)                         3.007e-04
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.
   total component into unit, g/s           0.079246
   TOTAL AIR EMISSIONS  (g/s)               0.029876
                    (Mg/year)               0.94218
   EMISSION FACTOR  (g/cm2-s)               1.364e-09
   UNIT EXIT CONCENTRATION (ppmw)           0.052769
DETAILED CALCULATIONS at Unit 7 def.system exit st
Type: system exit stream
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\June 2022 TRS WATER9 H2SSIM Runs\ALS AVG
  RUNS\ALS AVG IPT Clarifier 6/29/2022 8:05:17 AM  10:21:01
COMPOUND: DIMETHYL DISULFIDE

Type of unit is system exit stream
1 Description of unit                      7     def.system exit st

   TOTAL AIR EMISSIONS  (g/s)               0.
                    (Mg/year)               0.
   EMISSION FACTOR  (g/cm2-s)               1.364e-09
   UNIT EXIT CONCENTRATION (ppmw)           0.052769

```

```
Type of unit is
1 Total water added at the unit (l/s)      50     0
2 Area of openings at unit (cm2)                  50
3 Radius of drop pipe (cm)                        5
4 Drop length to conduit (cm)                     61
5 Humidity of inlet air (%)                       40
6 Temperature of air (C)                          25
7 Drain air velocity (ft/min)                     84
8 manhole air velocity (ft/min)                   128
9 Conduit air velocity (ft/min)                   66
10 Wind speed (cm/s at 10 m)                      447
11 distance to next unit (cm)                     500
12 slope of underflow conduit                     .015
13 friction factor liquid                         .016
14 friction factor gas                            .006
15 radius of underflow conduit (cm)               12
16 Underflow T (C)                                25
17 oscillation cycle time (min)                   5
18 design collection velocities  (ft/s)           2
19 design branch line fraction full               .4

Type of unit is
8 HL partition flag=1, adjust for sorption        0
9 unit recycle convergence number                 200
10 oil molecular weight                           0
11 oil density  (g/cc)                            0
12 NaUT 1=municipal 2=industrial  3=turb.         0
13 NaUT 1=mass tr. 2=equil                        0
14 parts biomass per 1000 parts COD
15 oil water partition method 0=owpc
16 use UNIFAC aqueous data base =1
17 specify mass transfer for unit, =1
18 Use biomass for unit option, =1
19 biogrowth Monod half concentration ppm

DETAILED CALCULATIONS at Unit 1 def.Closed trench
Type: Closed trench
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\June 2022 TRS WATER9 H2SSIM Runs\ALS AVG
  RUNS\ALS AVG IPT Clarifier 6/29/2022 8:05:17 AM  10:20:35
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is Closed trench
1 Description of unit                      1     def.Closed trench
2 Underflow T (C)                                44.4
3 Total water added at the unit (l/s)            0
4 Area of openings at unit (cm2)                 50
5 Radius of drop pipe (cm)                       5
6 Drop length to conduit (cm)                    61
7 Open surface=1                                 0
8 Subsurface entrance=1                          1
9 subsurface exit =1                             1
10 width of trench (m)                           1.2
11 distance to next unit (cm)                    500
12 slope of underflow conduit                    0.015
13 depth  of trench (m)                          1.2
16 velocity air at opening (ft/min)              84
17 municipal waste in conduit =1                 0
18 Assume equilibrium in unit, =1                0
19 pH  (enter 0 for no pH adjustment)            9.08

Trench model for mass transfer from a surface.
 The effective depth of water flow (h) is 1.00454 ft.
 The water flow rate is 9.356e+05 cm3/s.
```

```
 The velocity of the flow (v)is 8.35415 ft/s.
 The width of the unit is 120. cm.
 The oxygen diffusion coefficient (ratio) adjustment factor is 0.77928.
 reareation constant(ft/day) = 21.6 * v ^ 0.67 / h ^ 0.85 * Ratio
 The liquid phase mass transfer coefficient from surface is 2.453e-04 m/s.

Covered Ground Level Trench (U drain);   UNIT: 1
width 120. cm;  Rho 0.001091 g/cc;  Visc 1.8e-04 cp
Liquid Depth 30.618cm;  Slope 0.015;     Roughness  0.21336 cm
Length 0.5382 ft;  Friction Factor0.      Manning coef 0.
Headspace temp.  44.4 C;  Humidity 100. %;       Water temp. 44.4 C
Velocity  254.6344 cm/s;   Flow 0. gal/min
________drag_____________
average water velocity 254.634 cm/s.   Fraction full: 0.25515
average water surface velocity 288.957cm/sec
velocity of air from internal recirculation  144.479 cm/sec
Reynolds number for internal air flow 9.705e+04

Properties of DIMETHYL SULFIDE  (DMS) at 44.4 deg.C (111.9 deg.F)
   hl= 0.004189 atm-m3/mol      vp= 1009.298 mmHg (19.522 psia)
       232.701 y/x
       0.16084 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.555e-05 cm2/s  dv= 0.15644 cm2/s
_____loss due to mass transfer in conduit run__________________
  The length of the run of conduit line is 5. m (16.404 ft.)
  Flow of headspace gas in the conduit run_____0. L/s
     the pressure gradient for the headspace flow is 0. gf/cm2
     the headspace area of the sewer 1.073e+04 cm2
     the headspace average velocity is 0. cm/s.
     the headspace recirculation velocity is 144.479 cm/s.
  Flow of water in the conduit run_______935.575 L/s
     the width of the surface is 120. cm.
     the depth of the liquid is 30.618 cm. (12.054 in.)
     the average depth of the liquid is 30.618 cm. (12.054 in.)
     fraction full of liquid is 0.25515
     the residence time of the liquid is 1.9636 s.
 The oil corrected aqueous HL is 2.327e+02 (y/x)
  Wind Velocity 447. cm/sec ( 10.M.P.H.) (879.921 ft/min)
  Velocity of headspace in sewer 0. cm/sec  (0. M.P.H.) (0.ft/min)
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.
   fraction loss in unit                    0.
   fraction loss in line run                0.
   component upstream of unit, g/s          0.
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             0.
   mol fract. headspace vent base           0.
   headspace flow out vent (cc/s)           0.
   headspace flow down line (cc/s)          0.
   KG surface (m/s)                         0.
   KL surface (m/s)                         2.453e-04
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.2498
   total component into unit, g/s           0.2498
   TOTAL AIR EMISSIONS  (g/s)               0.
                     (Mg/year)              0.
   EMISSION FACTOR  (g/cm2-s)               6.785e-11
   UNIT EXIT CONCENTRATION (ppmw)           0.267
DETAILED CALCULATIONS at Unit 2 def.primary munici
Type: primary municipal clarifier
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\June 2022 TRS WATER9 H2SSIM Runs\ALS AVG
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COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is primary municipal clarifier
1 Description of unit                        2     def.primary munici
2 Wastewater temperature   (C)                     44.4
3 primary clarifier diameter (m)                   84
4 primary clarifier depth  (m)                     5.41
5 clarifier solids removal efficiency              0.7
6 waterfall drop height (cm)                       38
7 clarifier weir/circumference                     1
8 Center well present, =1                          1
10 number of identical units in parallel           1
15 vent air emission control factor                0
16 cover vent rate (m3/s per m2 surface)           0.0005
17 If covered, then enter 1                        0
19 pH  (enter 0 for no pH adjustment)              9.08

Properties of DIMETHYL SULFIDE  (DMS) at 44.4 deg.C (111.9 deg.F)
   hl= 0.004189 atm-m3/mol      vp= 1009.298 mmHg (19.522 psia)
       232.701 y/x
       0.16084 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.555e-05 cm2/s  dv= 0.15644 cm2/s
Clarifier surface_____________
The residence time in the clarifier is 8.902 hrs.
The Henry's law constant of 0.004189 atm-m3/mol is multiplied by
 a adsorption factor of 1..
The adsorption corrected aqueous HL is 2.327e+02 (y/x)
The gas phase mass transfer is estimated using correlation 3, MacKay (1983).
The Schmidt number is 0.95884.
The friction velocity is 13.347 m/s
kg is estimated as 0.007252 m/s.  Model: 3
Gas phase mass transfer 3.022e-05 g mol/ cm2-s.
  The flow of water is 935.575 cm3/s.
  The effective flow depth in the clarifier is 54.1 cm.
Clarifier model liquid phase mass transfer 1.099e-04 g mol/ cm2-s.
Overall mass transfer 1.082e-04 g mol/cm2-s.
Clarifier weir emissions_____________
The Schmidt number is 0.95884.
The friction velocity is 13.347 m/s
kg is estimated as 0.007252 m/s.  Model: 3
Weir mass transfer is estimated from the Pincince 11/7/89 primary model
 The water drop was 0.38 m.
 The water flow rate was 0.93558 m3/s. (12.763 m3/hr-m)
 R = Exp(0.* drop ^ 0.* (q * 3600 / cir) ^ 0.* 0. ^ 0.31
 R = 1.04921
The diffusion constant correction is (1.555e-05/.000024)^.677
The unadjusted fraction O2 lost from the model is 0.046903.
The overall O2 mass transfer coefficient from the model is 4.376e-04 m/s.
The overall compound mass transfer coefficient from the model is 3.272e-04 m/s.
   residence time (hours)                   8.90152
   KG surface (m/s)                         0.007388
   KL surface (m/s)                         1.979e-05
   KL OVERALL SURFACE (m/s)                 1.948e-05
   Fraction lost from clarifier surface     0.109
   KG waterfall (m/s)                       0.007388
   KL waterfall (m/s)                       3.272e-04
   KL OVERALL WATERFALL (m/s)               2.6e-04
   Fraction lost from weir waterfall        0.024485
   fraction of equilibrium in the unit      0.
   Fraction absorbed in underflow           0.
   TOTAL FRACTION LOST TO THE AIR           0.13348
   TOTAL AIR EMISSIONS  (g/s)               0.033344
                    (Mg/year)               1.05152
   EMISSION FACTOR  (g/cm2-s)               6.017e-10
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   UNIT EXIT CONCENTRATION (ppmw)           0.23136
DETAILED CALCULATIONS at Unit 3 def.open trench
Type: open trench
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker Poe Privileged and Confidential\June 2022 TRS WATER9 H2SSIM Runs\ALS AVG RUNS\ALS AVG IPT Clarifier 6/29/2022 8:05:17 AM  10:20:35
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is open trench
1 Description of unit                      3     def.open trench
2 Underflow T (C)                                44.4
3 Total water added at the unit (l/s)            0
8 Subsurface entrance=1                          0
9 subsurface exit =1                             0
10 width of trench (m)                           3.65
11 distance to next unit (cm)                    6100
12 slope of underflow conduit                    0.015
13 depth  of trench (m)                          3
19 pH  (enter 0 for no pH adjustment)            9.08

Trench model for mass transfer from a surface.
 The effective depth of water flow (h) is 0.43996 ft.
 The water flow rate is 9.356e+05 cm3/s.
 The velocity of the flow (v)is 6.27108 ft/s.
 The width of the unit is 365. cm.
 The oxygen diffusion coefficient (ratio) adjustment factor is 0.77928.
 reareation constant(ft/day) = 21.6 * v ^ 0.67 / h ^ 0.85 * Ratio
 The liquid phase mass transfer coefficient from surface is 4.083e-04 m/s.
The Schmidt number is 0.95884.
The friction velocity is 13.347 m/s
kg is estimated as 0.007252 m/s.  Model: 3
The slope of the U drain is 0.015
The water velocity is 191.142 cm/s.  (6.27108 ft/s.)
The depth of the water is 13.41 cm (5.47347 in.)
Kl= 4.083e-04 m/s;  Kg=  7.251963E-03 m/s
the ratio of the mass transfer to depth is  2.30203530673789E-03
The residence time in the trench is  31.91338 sec.
fraction emitted 0.070832
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.
   fraction loss in unit                    0.
   fraction loss in line run                0.070832
   component upstream of unit, g/s          0.21646
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             0.
   mol fract. headspace vent base           0.
   headspace flow out vent (cc/s)           0.
   headspace flow down line (cc/s)          0.
   KG surface (m/s)                         0.007252
   KL surface (m/s)                         4.083e-04
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.
   total component into unit, g/s           0.21646
   TOTAL AIR EMISSIONS  (g/s)               0.015332
                     (Mg/year)              0.48351
   EMISSION FACTOR  (g/cm2-s)               6.886e-09
   UNIT EXIT CONCENTRATION (ppmw)           0.21497
DETAILED CALCULATIONS at Unit 4 def.open sump
Type: open sump
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker Poe Privileged and Confidential\June 2022 TRS WATER9 H2SSIM Runs\ALS AVG RUNS\ALS AVG IPT Clarifier 6/29/2022 8:05:17 AM  10:20:35
COMPOUND: DIMETHYL SULFIDE  (DMS)
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```
Type of unit is open sump
1 Description of unit                      4     def.open sump
2 Underflow T (C)                                44.4
3 Total water added at the unit (l/s)            0
4 Area of openings at unit (cm2)                 50
5 Radius of drop pipe (cm)                       5
6 Drop length to conduit (cm)                    61
7 Open surface=1                                 1
8 Subsurface entrance=1                          0
9 subsurface exit =1                             0
10 radius of underflow conduit (cm)              12
11 distance to next unit (cm)                    500
12 slope of underflow conduit                    0.015
13 Open surface of liquid at the unit (cm2)      1000
14 flow entrance depth under surface (cm)        10
15 depth of liquid in sump (cm)                  50
16 velocity air at opening (ft/min)              88
17 municipal waste in conduit =1                 0
18 Assume equilibrium in unit, =1                0
19 pH  (enter 0 for no pH adjustment)            9.08

Trench model for mass transfer from a surface.
 The effective depth of water flow (h) is 0.32808 ft.
 The water flow rate is 9.356e+05 cm3/s.
 The velocity of the flow (v)is 97.065 ft/s.
 The width of the unit is 31.623 cm.
 The oxygen diffusion coefficient (ratio) adjustment factor is 0.77928.
 reareation constant(ft/day) = 21.6 * v ^ 0.67 / h ^ 0.85 * Ratio
 The liquid phase mass transfer coefficient from surface is 0.003284 m/s.
The Schmidt number is 0.95884.
The friction velocity is 13.347 m/s
kg is estimated as 0.007252 m/s.  Model: 3
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.
   fraction loss in unit                    9.764e-05
   fraction loss in line run                0.
   component upstream of unit, g/s          0.20112
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             1.447e-05
   mol fract. headspace vent base           0.
   headspace flow out vent (cc/s)           0.
   headspace flow down line (cc/s)          -0.0306
   KG surface (m/s)                         0.007252
   KL surface (m/s)                         0.003284
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.
   total component into unit, g/s           0.20112
   TOTAL AIR EMISSIONS  (g/s)               1.964e-05
                    (Mg/year)               6.193e-04
   EMISSION FACTOR  (g/cm2-s)               6.886e-09
   UNIT EXIT CONCENTRATION (ppmw)           0.21495
DETAILED CALCULATIONS at Unit 5 def.Closed trench
Type: Closed trench
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\June 2022 TRS WATER9 H2SSIM Runs\ALS AVG
  RUNS\ALS AVG IPT Clarifier 6/29/2022 8:05:17 AM  10:20:35
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is Closed trench
1 Description of unit                      5     def.Closed trench
2 Underflow T (C)                                44.4
3 Total water added at the unit (l/s)            0
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```
4 Area of openings at unit (cm2)                        50
5 Radius of drop pipe (cm)                              5
6 Drop length to conduit (cm)                           61
7 Open surface=1                                        0
8 Subsurface entrance=1                                 0
9 subsurface exit =1                                    0
10 width of trench (m)                                  1.2
11 distance to next unit (cm)                           42614
12 slope of underflow conduit                           0.015
13 depth  of trench (m)                                 3
16 velocity air at opening (ft/min)                     84
17 municipal waste in conduit =1                        0
18 Assume equilibrium in unit, =1                       0
19 pH  (enter 0 for no pH adjustment)                   0

Trench model for mass transfer from a surface.
 The effective depth of water flow (h) is 1.00454 ft.
 The water flow rate is 9.356e+05 cm3/s.
 The velocity of the flow (v)is 8.35415 ft/s.
 The width of the unit is 120. cm.
 The oxygen diffusion coefficient (ratio) adjustment factor is 0.77928.
 reareation constant(ft/day) = 21.6 * v ^ 0.67 / h ^ 0.85 * Ratio
 The liquid phase mass transfer coefficient from surface is 2.453e-04 m/s.

Covered Ground Level Trench (U drain);   UNIT: 5
width 120. cm;  Rho 0.001091 g/cc;  Visc 1.8e-04 cp
Liquid Depth 30.618cm;  Slope 0.015;     Roughness  0.21336 cm
Length 45.869 ft;  Friction Factor0.      Manning coef 0.
Headspace temp.  44.4 C;  Humidity 100. %;       Water temp. 44.4 C
Velocity  254.6344 cm/s;   Flow 0. gal/min
________drag_____________
average water velocity 254.634 cm/s.   Fraction full: 0.10206
average water surface velocity 288.957cm/sec
velocity of air from internal recirculation  144.479 cm/sec
Reynolds number for internal air flow 1.535e+05

Properties of DIMETHYL SULFIDE  (DMS) at 44.4 deg.C (111.9 deg.F)
   hl= 0.004189 atm-m3/mol      vp= 1009.298 mmHg (19.522 psia)
       232.701 y/x
       0.16084 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.555e-05 cm2/s  dv= 0.15644 cm2/s
_____loss due to mass transfer in conduit run__________________
  The length of the run of conduit line is 426.14 m (1398.097 ft.)
  Flow of headspace gas in the conduit run_____10.523 L/s
     the pressure gradient for the headspace flow is -0.1206 gf/cm2
     the headspace area of the sewer 3.233e+04 cm2
     the headspace average velocity is 0.32553 cm/s.
     the headspace recirculation velocity is 144.479 cm/s.
  Flow of water in the conduit run_______935.575 L/s
     the width of the surface is 120. cm.
     the depth of the liquid is 30.618 cm. (12.054 in.)
     the average depth of the liquid is 30.618 cm. (12.054 in.)
     fraction full of liquid is 0.10206
     the residence time of the liquid is 167.354 s.
 The oil corrected aqueous HL is 2.327e+02 (y/x)
  Wind Velocity 447. cm/sec ( 10.M.P.H.) (879.921 ft/min)
  Velocity of headspace in sewer 0.32553 cm/sec  (0.007282 M.P.H.) (0.6408ft/min)
kg is estimated as 0.001081 m/s.  Model: 5
Modified J factor model is used for mass transfer.
     the effective gas speed for the correlation is 144.479 cm/s.
     the effective width for the correlation is 4.261e+04cm.
     the gas phase mass transfer coefficient is 4.5024e-06 gmol/cm2-s.
(kg)                                                   1.0806e-03 m/s.
  Trench model (Owens) for mass transfer in liquid phase.
     the average liquid velocity is 254.634 cm/s.
```

```
    the liquid depth in the underflow 30.618 cm.
    the liquid phase mass transfer coefficient is 1.254e-03 gmol/cm2-s.
(kl)                                              2.2572e-04 m/s.
  Overall mass transfer coefficient.
        KL = 1 / (1 / kg / koc + 1 / kl) * 0.18
    the corrected partition coefficient is 232.701 y/x at one atm.
(KL) the overall liquid based mass transfer coefficient is 1.0275e-04 m/s.
Countercurrent flow model model is used for mass transfer.
    the overall mass transfer coefficient is 1.027e-04 m/s.
    the average depth of the liquid is 30.618 cm.
    the ratio of the transfer coefficient to average depth is 3.356e-04
    the residence time of the liquid is 167.354 s.
    the maximum fraction from open air mass transfer is 0.054611
    the molar liquid flow is 5.198e+04 gmol/s.
    the molar gas flow is 0.40406 gmol/s.
(fe) the fraction lost from the liquid is 1.809e-03
    the g/s from the gas to the liquid is 0.e+00 g/s.
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.
   fraction loss in unit                    0.
   fraction loss in line run                0.001806
   component upstream of unit, g/s          0.2011
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        1.447e-05
   headspace end of conduit (y)             0.
   mol fract. headspace vent base           1.447e-05
   headspace flow out vent (cc/s)           1.052e+04
   headspace flow down line (cc/s)          -1.052e+04
   KG surface (m/s)                         0.001081
   KL surface (m/s)                         2.257e-04
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  -0.00036
   total component into unit, g/s           0.2011
   TOTAL AIR EMISSIONS  (g/s)               3.631e-04
                    (Mg/year)               0.011452
   EMISSION FACTOR  (g/cm2-s)               6.886e-09
   UNIT EXIT CONCENTRATION (ppmw)           0.21456
DETAILED CALCULATIONS at Unit 6 def.open trench
Type: open trench
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\June 2022 TRS WATER9 H2SSIM Runs\ALS AVG
  RUNS\ALS AVG IPT Clarifier 6/29/2022 8:05:17 AM  10:20:35
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is open trench
1 Description of unit                      6     def.open trench
2 Underflow T (C)                                44.4
3 Total water added at the unit (l/s)            0
8 Subsurface entrance=1                          0
9 subsurface exit =1                             0
10 width of trench (m)                           3.65
11 distance to next unit (cm)                    60000
12 slope of underflow conduit                    0.015
13 depth  of trench (m)                          3
19 pH  (enter 0 for no pH adjustment)            8.94

Trench model for mass transfer from a surface.
 The effective depth of water flow (h) is 0.43996 ft.
 The water flow rate is 9.356e+05 cm3/s.
 The velocity of the flow (v)is 6.27108 ft/s.
 The width of the unit is 365. cm.
 The oxygen diffusion coefficient (ratio) adjustment factor is 0.77928.
 reareation constant(ft/day) = 21.6 * v ^ 0.67 / h ^ 0.85 * Ratio
 The liquid phase mass transfer coefficient from surface is 4.083e-04 m/s.
```

```
The Schmidt number is 0.95884.
The friction velocity is 13.347 m/s
kg is estimated as 0.007252 m/s.  Model: 3
The slope of the U drain is 0.015
The water velocity is 191.142 cm/s.  (6.27108 ft/s.)
The depth of the water is 13.41 cm (5.47347 in.)
Kl= 4.083e-04 m/s;  Kg=  7.251963E-03 m/s
the ratio of the mass transfer to depth is  2.30203530673789E-03
The residence time in the trench is  313.9021 sec.
fraction emitted 0.51452
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.
   fraction loss in unit                    0.
   fraction loss in line run                0.51452
   component upstream of unit, g/s          0.20074
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             0.
   mol fract. headspace vent base           0.
   headspace flow out vent (cc/s)           0.
   headspace flow down line (cc/s)          0.
   KG surface (m/s)                         0.007252
   KL surface (m/s)                         4.083e-04
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.
   total component into unit, g/s           0.20074
   TOTAL AIR EMISSIONS  (g/s)               0.10328
                    (Mg/year)               3.25718
   EMISSION FACTOR  (g/cm2-s)               4.716e-09
   UNIT EXIT CONCENTRATION (ppmw)           0.10417
DETAILED CALCULATIONS at Unit 7 def.system exit st
Type: system exit stream
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
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  RUNS\ALS AVG IPT Clarifier 6/29/2022 8:05:17 AM  10:20:35
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is system exit stream
1 Description of unit                      7     def.system exit st

   TOTAL AIR EMISSIONS  (g/s)               0.
                    (Mg/year)               0.
   EMISSION FACTOR  (g/cm2-s)               4.716e-09
   UNIT EXIT CONCENTRATION (ppmw)           0.10417
```

```
Type of unit is
1 Total water added at the unit (l/s)      50     0
2 Area of openings at unit (cm2)                  50
3 Radius of drop pipe (cm)                        5
4 Drop length to conduit (cm)                     61
5 Humidity of inlet air (%)                       40
6 Temperature of air (C)                          25
7 Drain air velocity (ft/min)                     84
8 manhole air velocity (ft/min)                   128
9 Conduit air velocity (ft/min)                   66
10 Wind speed (cm/s at 10 m)                      447
11 distance to next unit (cm)                     500
12 slope of underflow conduit                     .015
13 friction factor liquid                         .016
14 friction factor gas                            .006
15 radius of underflow conduit (cm)               12
16 Underflow T (C)                                25
17 oscillation cycle time (min)                   5
18 design collection velocities  (ft/s)           2
19 design branch line fraction full               .4

Type of unit is
8 HL partition flag=1, adjust for sorption        0
9 unit recycle convergence number                 200
10 oil molecular weight                           0
11 oil density  (g/cc)                           0
12 NaUT 1=municipal 2=industrial  3=turb.         0
13 NaUT 1=mass tr. 2=equil                        0
14 parts biomass per 1000 parts COD
15 oil water partition method 0=owpc
16 use UNIFAC aqueous data base =1
17 specify mass transfer for unit, =1
18 Use biomass for unit option, =1
19 biogrowth Monod half concentration ppm

DETAILED CALCULATIONS at Unit 1 def.Closed trench
Type: Closed trench
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\June 2022 TRS WATER9 H2SSIM Runs\ALS AVG
  RUNS\ALS AVG IPT Clarifier 6/29/2022 8:05:17 AM  10:18:17
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is Closed trench
1 Description of unit                      1     def.Closed trench
2 Underflow T (C)                                44.4
3 Total water added at the unit (l/s)            0
4 Area of openings at unit (cm2)                 50
5 Radius of drop pipe (cm)                       5
6 Drop length to conduit (cm)                    61
7 Open surface=1                                 0
8 Subsurface entrance=1                          1
9 subsurface exit =1                             1
10 width of trench (m)                           1.2
11 distance to next unit (cm)                    500
12 slope of underflow conduit                    0.015
13 depth  of trench (m)                          1.2
16 velocity air at opening (ft/min)              84
17 municipal waste in conduit =1                 0
18 Assume equilibrium in unit, =1                0
19 pH  (enter 0 for no pH adjustment)            9.08

Trench model for mass transfer from a surface.
 The effective depth of water flow (h) is 1.00454 ft.
 The water flow rate is 9.356e+05 cm3/s.
```

```
 The velocity of the flow (v)is 8.35415 ft/s.
 The width of the unit is 120. cm.
 The oxygen diffusion coefficient (ratio) adjustment factor is 0.78813.
 reareation constant(ft/day) = 21.6 * v ^ 0.67 / h ^ 0.85 * Ratio
 The liquid phase mass transfer coefficient from surface is 2.481e-04 m/s.

Covered Ground Level Trench (U drain);   UNIT: 1
width 120. cm;  Rho 0.001091 g/cc;  Visc 1.8e-04 cp
Liquid Depth 30.618cm;  Slope 0.015;     Roughness  0.21336 cm
Length 0.5382 ft;  Friction Factor0.      Manning coef 0.
Headspace temp.  44.4 C;  Humidity 100. %;       Water temp. 44.4 C
Velocity  254.6344 cm/s;   Flow 0. gal/min
________drag_____________
average water velocity 254.634 cm/s.   Fraction full: 0.25515
average water surface velocity 288.957cm/sec
velocity of air from internal recirculation  144.479 cm/sec
Reynolds number for internal air flow 9.705e+04

Properties of METHANETHIOL(methyl mercaptan) at 44.4 deg.C (111.9 deg.F)
   hl= 0.005553 atm-m3/mol      vp= 3034.572 mmHg (58.695 psia)
       308.5 y/x
       0.21323 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.576e-05 cm2/s  dv= 0.25113 cm2/s
_____loss due to mass transfer in conduit run__________________
  The length of the run of conduit line is 5. m (16.404 ft.)
  Flow of headspace gas in the conduit run_____0. L/s
     the pressure gradient for the headspace flow is 0. gf/cm2
     the headspace area of the sewer 1.073e+04 cm2
     the headspace average velocity is 0. cm/s.
     the headspace recirculation velocity is 144.479 cm/s.
  Flow of water in the conduit run_______935.575 L/s
     the width of the surface is 120. cm.
     the depth of the liquid is 30.618 cm. (12.054 in.)
     the average depth of the liquid is 30.618 cm. (12.054 in.)
     fraction full of liquid is 0.25515
     the residence time of the liquid is 1.9636 s.
 The oil corrected aqueous HL is 3.085e+02 (y/x)
  Wind Velocity 447. cm/sec ( 10.M.P.H.) (879.921 ft/min)
  Velocity of headspace in sewer 0. cm/sec  (0. M.P.H.) (0.ft/min)
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.
   fraction loss in unit                    0.
   fraction loss in line run                0.
   component upstream of unit, g/s          0.
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             0.
   mol fract. headspace vent base           0.
   headspace flow out vent (cc/s)           0.
   headspace flow down line (cc/s)          0.
   KG surface (m/s)                         0.
   KL surface (m/s)                         2.481e-04
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.003368
   total component into unit, g/s           0.003368
   TOTAL AIR EMISSIONS  (g/s)               0.
                     (Mg/year)              0.
   EMISSION FACTOR  (g/cm2-s)               6.785e-11
   UNIT EXIT CONCENTRATION (ppmw)           0.0036
DETAILED CALCULATIONS at Unit 2 def.primary munici
Type: primary municipal clarifier
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
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```

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COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is primary municipal clarifier
1 Description of unit                      2     def.primary munici
2 Wastewater temperature   (C)                   44.4
3 primary clarifier diameter (m)                 84
4 primary clarifier depth  (m)                   5.41
5 clarifier solids removal efficiency            0.7
6 waterfall drop height (cm)                     38
7 clarifier weir/circumference                   1
8 Center well present, =1                        1
10 number of identical units in parallel         1
15 vent air emission control factor              0
16 cover vent rate (m3/s per m2 surface)         0.0005
17 If covered, then enter 1                      0
19 pH  (enter 0 for no pH adjustment)            9.08

Properties of METHANETHIOL(methyl mercaptan) at 44.4 deg.C (111.9 deg.F)
   hl= 0.005553 atm-m3/mol      vp= 3034.572 mmHg (58.695 psia)
       308.5 y/x
       0.21323 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.576e-05 cm2/s  dv= 0.25113 cm2/s
Clarifier surface_____________
The residence time in the clarifier is 8.902 hrs.
The Henry's law constant of 0.005553 atm-m3/mol is multiplied by
 a adsorption factor of 1..
The adsorption corrected aqueous HL is 3.085e+02 (y/x)
The gas phase mass transfer is estimated using correlation 3, MacKay (1983).
The Schmidt number is 0.5973.
The friction velocity is 13.347 m/s
kg is estimated as 0.00959 m/s.  Model: 3
Gas phase mass transfer 3.996e-05 g mol/ cm2-s.
  The flow of water is 935.575 cm3/s.
  The effective flow depth in the clarifier is 54.1 cm.
Clarifier model liquid phase mass transfer 1.11e-04 g mol/ cm2-s.
Overall mass transfer 1.1e-04 g mol/cm2-s.
Clarifier weir emissions_____________
The Schmidt number is 0.5973.
The friction velocity is 13.347 m/s
kg is estimated as 0.00959 m/s.  Model: 3
Weir mass transfer is estimated from the Pincince 11/7/89 primary model
 The water drop was 0.38 m.
 The water flow rate was 0.93558 m3/s. (12.763 m3/hr-m)
 R = Exp(0.* drop ^ 0.* (q * 3600 / cir) ^ 0.* 0. ^ 0.31
 R = 1.04967
The diffusion constant correction is (1.576e-05/.000024)^.677
The unadjusted fraction O2 lost from the model is 0.047322.
The overall O2 mass transfer coefficient from the model is 4.415e-04 m/s.
The overall compound mass transfer coefficient from the model is 3.331e-04 m/s.
   residence time (hours)                  8.90152
   KG surface (m/s)                        0.009769
   KL surface (m/s)                        1.998e-05
   KL OVERALL SURFACE (m/s)                1.98e-05
   Fraction lost from clarifier surface    0.11066
   KG waterfall (m/s)                      0.009769
   KL waterfall (m/s)                      3.331e-04
   KL OVERALL WATERFALL (m/s)              2.896e-04
   Fraction lost from weir waterfall       0.027185
   fraction of equilibrium in the unit     0.
   Fraction absorbed in underflow          0.
   TOTAL FRACTION LOST TO THE AIR          0.13785
   TOTAL AIR EMISSIONS  (g/s)              4.643e-04
                    (Mg/year)              0.014641
   EMISSION FACTOR  (g/cm2-s)              8.378e-12
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   UNIT EXIT CONCENTRATION (ppmw)           0.003104
DETAILED CALCULATIONS at Unit 3 def.open trench
Type: open trench
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COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is open trench
1 Description of unit                      3     def.open trench
2 Underflow T (C)                                44.4
3 Total water added at the unit (l/s)            0
8 Subsurface entrance=1                          0
9 subsurface exit =1                             0
10 width of trench (m)                           3.65
11 distance to next unit (cm)                    6100
12 slope of underflow conduit                    0.015
13 depth  of trench (m)                          3
19 pH  (enter 0 for no pH adjustment)            9.08

Trench model for mass transfer from a surface.
 The effective depth of water flow (h) is 0.43996 ft.
 The water flow rate is 9.356e+05 cm3/s.
 The velocity of the flow (v)is 6.27108 ft/s.
 The width of the unit is 365. cm.
 The oxygen diffusion coefficient (ratio) adjustment factor is 0.78813.
 reareation constant(ft/day) = 21.6 * v ^ 0.67 / h ^ 0.85 * Ratio
 The liquid phase mass transfer coefficient from surface is 4.129e-04 m/s.
The Schmidt number is 0.5973.
The friction velocity is 13.347 m/s
kg is estimated as 0.00959 m/s.  Model: 3
The slope of the U drain is 0.015
The water velocity is 191.142 cm/s.  (6.27108 ft/s.)
The depth of the water is 13.41 cm (5.47347 in.)
Kl= 4.129e-04 m/s;  Kg=  9.589518E-03 m/s
the ratio of the mass transfer to depth is  2.59608167167113E-03
The residence time in the trench is  31.91338 sec.
fraction emitted 0.079511
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.
   fraction loss in unit                    0.
   fraction loss in line run                0.079511
   component upstream of unit, g/s          0.002904
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             0.
   mol fract. headspace vent base           0.
   headspace flow out vent (cc/s)           0.
   headspace flow down line (cc/s)          0.
   KG surface (m/s)                         0.00959
   KL surface (m/s)                         4.129e-04
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.
   total component into unit, g/s           0.002904
   TOTAL AIR EMISSIONS  (g/s)               2.309e-04
                    (Mg/year)               0.007281
   EMISSION FACTOR  (g/cm2-s)               1.037e-10
   UNIT EXIT CONCENTRATION (ppmw)           0.002857
DETAILED CALCULATIONS at Unit 4 def.open sump
Type: open sump
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  Poe Privileged and Confidential\June 2022 TRS WATER9 H2SSIM Runs\ALS AVG
  RUNS\ALS AVG IPT Clarifier 6/29/2022 8:05:17 AM  10:18:17
COMPOUND: METHANETHIOL(methyl mercaptan)
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```
Type of unit is open sump
1 Description of unit                      4     def.open sump
2 Underflow T (C)                                44.4
3 Total water added at the unit (l/s)            0
4 Area of openings at unit (cm2)                 50
5 Radius of drop pipe (cm)                       5
6 Drop length to conduit (cm)                    61
7 Open surface=1                                 1
8 Subsurface entrance=1                          0
9 subsurface exit =1                             0
10 radius of underflow conduit (cm)              12
11 distance to next unit (cm)                    500
12 slope of underflow conduit                    0.015
13 Open surface of liquid at the unit (cm2)      1000
14 flow entrance depth under surface (cm)        10
15 depth of liquid in sump (cm)                  50
16 velocity air at opening (ft/min)              88
17 municipal waste in conduit =1                 0
18 Assume equilibrium in unit, =1                0
19 pH  (enter 0 for no pH adjustment)            9.08

Trench model for mass transfer from a surface.
 The effective depth of water flow (h) is 0.32808 ft.
 The water flow rate is 9.356e+05 cm3/s.
 The velocity of the flow (v)is 97.065 ft/s.
 The width of the unit is 31.623 cm.
 The oxygen diffusion coefficient (ratio) adjustment factor is 0.78813.
 reareation constant(ft/day) = 21.6 * v ^ 0.67 / h ^ 0.85 * Ratio
 The liquid phase mass transfer coefficient from surface is 0.003321 m/s.
The Schmidt number is 0.5973.
The friction velocity is 13.347 m/s
kg is estimated as 0.00959 m/s.  Model: 3
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.
   fraction loss in unit                    1.422e-04
   fraction loss in line run                0.
   component upstream of unit, g/s          0.002673
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             3.29e-07
   mol fract. headspace vent base           0.
   headspace flow out vent (cc/s)           0.
   headspace flow down line (cc/s)          -0.0306
   KG surface (m/s)                         0.00959
   KL surface (m/s)                         0.003321
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.
   total component into unit, g/s           0.002673
   TOTAL AIR EMISSIONS  (g/s)               3.8e-07
                    (Mg/year)               1.198e-05
   EMISSION FACTOR  (g/cm2-s)               1.037e-10
   UNIT EXIT CONCENTRATION (ppmw)           0.002857
DETAILED CALCULATIONS at Unit 5 def.Closed trench
Type: Closed trench
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  Poe Privileged and Confidential\June 2022 TRS WATER9 H2SSIM Runs\ALS AVG
  RUNS\ALS AVG IPT Clarifier 6/29/2022 8:05:17 AM  10:18:17
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is Closed trench
1 Description of unit                      5     def.Closed trench
2 Underflow T (C)                                44.4
3 Total water added at the unit (l/s)            0
```

```
4 Area of openings at unit (cm2)                     50
5 Radius of drop pipe (cm)                           5
6 Drop length to conduit (cm)                        61
7 Open surface=1                                     0
8 Subsurface entrance=1                              0
9 subsurface exit =1                                 0
10 width of trench (m)                               1.2
11 distance to next unit (cm)                        42614
12 slope of underflow conduit                        0.015
13 depth  of trench (m)                              3
16 velocity air at opening (ft/min)                  84
17 municipal waste in conduit =1                     0
18 Assume equilibrium in unit, =1                    0
19 pH  (enter 0 for no pH adjustment)                0

Trench model for mass transfer from a surface.
 The effective depth of water flow (h) is 1.00454 ft.
 The water flow rate is 9.356e+05 cm3/s.
 The velocity of the flow (v)is 8.35415 ft/s.
 The width of the unit is 120. cm.
 The oxygen diffusion coefficient (ratio) adjustment factor is 0.78813.
 reareation constant(ft/day) = 21.6 * v ^ 0.67 / h ^ 0.85 * Ratio
 The liquid phase mass transfer coefficient from surface is 2.481e-04 m/s.

Covered Ground Level Trench (U drain);   UNIT: 5
width 120. cm;  Rho 0.001091 g/cc;  Visc 1.8e-04 cp
Liquid Depth 30.618cm;  Slope 0.015;     Roughness  0.21336 cm
Length 45.869 ft;  Friction Factor0.      Manning coef 0.
Headspace temp.  44.4 C;  Humidity 100. %;       Water temp. 44.4 C
Velocity  254.6344 cm/s;   Flow 0. gal/min
________drag_____________
average water velocity 254.634 cm/s.   Fraction full: 0.10206
average water surface velocity 288.957cm/sec
velocity of air from internal recirculation  144.479 cm/sec
Reynolds number for internal air flow 1.535e+05

Properties of METHANETHIOL(methyl mercaptan) at 44.4 deg.C (111.9 deg.F)
   hl= 0.005553 atm-m3/mol      vp= 3034.572 mmHg (58.695 psia)
       308.5 y/x
       0.21323 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.576e-05 cm2/s  dv= 0.25113 cm2/s
_____loss due to mass transfer in conduit run__________________
  The length of the run of conduit line is 426.14 m (1398.097 ft.)
  Flow of headspace gas in the conduit run_____10.523 L/s
     the pressure gradient for the headspace flow is -0.1206 gf/cm2
     the headspace area of the sewer 3.233e+04 cm2
     the headspace average velocity is 0.32552 cm/s.
     the headspace recirculation velocity is 144.479 cm/s.
  Flow of water in the conduit run_______935.575 L/s
     the width of the surface is 120. cm.
     the depth of the liquid is 30.618 cm. (12.054 in.)
     the average depth of the liquid is 30.618 cm. (12.054 in.)
     fraction full of liquid is 0.10206
     the residence time of the liquid is 167.354 s.
 The oil corrected aqueous HL is 3.085e+02 (y/x)
  Wind Velocity 447. cm/sec ( 10.M.P.H.) (879.921 ft/min)
  Velocity of headspace in sewer 0.32552 cm/sec  (0.007282 M.P.H.) (0.64078ft/min)
kg is estimated as 0.001482 m/s.  Model: 5
Modified J factor model is used for mass transfer.
     the effective gas speed for the correlation is 144.479 cm/s.
     the effective width for the correlation is 4.261e+04cm.
     the gas phase mass transfer coefficient is 6.1738e-06 gmol/cm2-s.
(kg)                                                1.4817e-03 m/s.
  Trench model (Owens) for mass transfer in liquid phase.
     the average liquid velocity is 254.634 cm/s.
```

```
        the liquid depth in the underflow 30.618 cm.
        the liquid phase mass transfer coefficient is 1.266e-03 gmol/cm2-s.
   (kl)                                          2.2788e-04 m/s.
     Overall mass transfer coefficient.
           KL = 1 / (1 / kg / koc + 1 / kl) * 0.18
        the corrected partition coefficient is 308.5 y/x at one atm.
   (KL) the overall liquid based mass transfer coefficient is 1.3689e-04 m/s.
   Countercurrent flow model model is used for mass transfer.
        the overall mass transfer coefficient is 1.369e-04 m/s.
        the average depth of the liquid is 30.618 cm.
        the ratio of the transfer coefficient to average depth is 4.471e-04
        the residence time of the liquid is 167.354 s.
        the maximum fraction from open air mass transfer is 0.07209
        the molar liquid flow is 5.198e+04 gmol/s.
        the molar gas flow is 0.40405 gmol/s.
   (fe) the fraction lost from the liquid is 2.3981e-03
        the g/s from the gas to the liquid is 0.e+00 g/s.
      fraction loss in waste1 drop to hub      0.
      fraction loss in waste2 drop to hub      0.
      fraction loss in waste3 drop to hub      0.
      fraction loss in collection hub drop     0.
      fraction loss in unit                    0.
      fraction loss in line run                0.002393
      component upstream of unit, g/s          0.002673
      mol fract. headspace upstream (y)        0.
      headspace at conduit discharge, y        3.29e-07
      headspace end of conduit (y)             0.
      mol fract. headspace vent base           3.29e-07
      headspace flow out vent (cc/s)           1.052e+04
      headspace flow down line (cc/s)          -1.052e+04
      KG surface (m/s)                         0.001482
      KL surface (m/s)                         2.279e-04
      flow of waste down hub (l/s)             0.
      component flow in waste into unit (g/s)  -6.394e-06
      total component into unit, g/s           0.002673
      TOTAL AIR EMISSIONS  (g/s)               6.394e-06
                         (Mg/year)             2.016e-04
      EMISSION FACTOR  (g/cm2-s)               1.037e-10
      UNIT EXIT CONCENTRATION (ppmw)           0.00285
   DETAILED CALCULATIONS at Unit 6 def.open trench
   Type: open trench
     Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
     Poe Privileged and Confidential\June 2022 TRS WATER9 H2SSIM Runs\ALS AVG
     RUNS\ALS AVG IPT Clarifier 6/29/2022 8:05:17 AM  10:18:17
   COMPOUND: METHANETHIOL(methyl mercaptan)

   Type of unit is open trench
   1 Description of unit                      6     def.open trench
   2 Underflow T (C)                                44.4
   3 Total water added at the unit (l/s)            0
   8 Subsurface entrance=1                          0
   9 subsurface exit =1                             0
   10 width of trench (m)                           3.65
   11 distance to next unit (cm)                    60000
   12 slope of underflow conduit                    0.015
   13 depth  of trench (m)                          3
   19 pH  (enter 0 for no pH adjustment)            8.94

   Trench model for mass transfer from a surface.
    The effective depth of water flow (h) is 0.43996 ft.
    The water flow rate is 9.356e+05 cm3/s.
    The velocity of the flow (v)is 6.27108 ft/s.
    The width of the unit is 365. cm.
    The oxygen diffusion coefficient (ratio) adjustment factor is 0.78813.
    reareation constant(ft/day) = 21.6 * v ^ 0.67 / h ^ 0.85 * Ratio
    The liquid phase mass transfer coefficient from surface is 4.129e-04 m/s.
```

```
The Schmidt number is 0.5973.
The friction velocity is 13.347 m/s
kg is estimated as 0.00959 m/s.  Model: 3
The slope of the U drain is 0.015
The water velocity is 191.142 cm/s.  (6.27108 ft/s.)
The depth of the water is 13.41 cm (5.47347 in.)
Kl= 4.129e-04 m/s;  Kg=  9.589518E-03 m/s
the ratio of the mass transfer to depth is  2.59608167167113E-03
The residence time in the trench is  313.9021 sec.
fraction emitted 0.55732
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.
   fraction loss in unit                    0.
   fraction loss in line run                0.55732
   component upstream of unit, g/s          0.002666
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             0.
   mol fract. headspace vent base           0.
   headspace flow out vent (cc/s)           0.
   headspace flow down line (cc/s)          0.
   KG surface (m/s)                         0.00959
   KL surface (m/s)                         4.129e-04
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.
   total component into unit, g/s           0.002666
   TOTAL AIR EMISSIONS  (g/s)               0.001486
                    (Mg/year)               0.046859
   EMISSION FACTOR  (g/cm2-s)               6.785e-11
   UNIT EXIT CONCENTRATION (ppmw)           0.001262
DETAILED CALCULATIONS at Unit 7 def.system exit st
Type: system exit stream
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\June 2022 TRS WATER9 H2SSIM Runs\ALS AVG
  RUNS\ALS AVG IPT Clarifier 6/29/2022 8:05:17 AM  10:18:17
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is system exit stream
1 Description of unit                      7     def.system exit st

   TOTAL AIR EMISSIONS  (g/s)               0.
                    (Mg/year)               0.
   EMISSION FACTOR  (g/cm2-s)               6.785e-11
   UNIT EXIT CONCENTRATION (ppmw)           0.001262
```

Buckner, Katharine

From:	Caleb Fetner <cfetner@all4inc.com>
Sent:	Wednesday, October 25, 2023 10:01 AM
To:	Buckner, Katharine
Cc:	Robert Tourville; Rachel Davis; Sheryl Watkins; McAvoy, Bryan P.; Steven Moore; Ryan Cleary
Subject:	RE: status of air modeling review
Attachments:	New Stripper Modeling Results - 05b Updated ASB areas.xlsx; Revised Modeling WWTP Rates for ALS (9-28-23)_Updated model area.xlsx

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***

Hi Katharine,

Updating the AERMOD modeled areas to reflect less solids in the ASB ended up lowering the maximum concentrations. This is what we expected, but we needed to confirm through modeling. Attached are two spreadsheets:

1. Revised Modeling WWTP Rates for ALS (9-28-23)_Updated model area
   a. Shows the updated modeled ASB areas (AERMOD areas), which changed the unit area emission rates (g/s/m2). No change to any of the g/s rates from my 10/2 email. Emissions were based on the larger area to begin with.
2. New Stripper Modeling Results - 05b Updated ASB areas
   a. Results of modeling the larger areas, as well as a comparison to the results from my 10/2/2023 email.

Please let me know if you have any questions.

Thanks,
Caleb

Caleb Fetner / Consulting Engineer
678.293.9431 / Profile / LinkedIn
www.all4inc.com / Locations / Articles / Podcast / Training
ALL4 // STRATEGY WITH SOLUTION. PARTNERSHIP WITH A PURPOSE.

From: Caleb Fetner
Sent: Monday, October 16, 2023 3:32 PM
To: Buckner, Katharine <bucknekk@dhec.sc.gov>; Steven Moore <smoore@all4inc.com>
Cc: Robert Tourville <BOB.TOURVILLE@NEW-INDYCB.COM>; Rachel Davis <Rachel.Davis@new-indycb.com>; Sheryl Watkins <swatkins@all4inc.com>; McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>
Subject: RE: status of air modeling review

Hi Katharine,

We were unable to determine the effect changing the modeled area would have on the air dispersion modeling results with confidence; therefore, we are proceeding with updating the modeled areas in AERMOD to see. Note that the emissions rates (in g/s) were based on more water surface area that more closely match recent aerials, so this change is just to the area in the AERMOD model and no updates to H2SSIM or WATER9 runs were necessary.

Caleb

Caleb Fetner / Consulting Engineer
678.293.9431 / Profile / LinkedIn

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From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Monday, October 16, 2023 1:48 PM
To: Caleb Fetner <cfetner@all4inc.com>; Steven Moore <smoore@all4inc.com>
Cc: Robert Tourville <BOB.TOURVILLE@NEW-INDYCB.COM>; Rachel Davis <Rachel.Davis@new-indycb.com>; Sheryl Watkins <swatkins@all4inc.com>; McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>
Subject: status of air modeling review

Hey Caleb and Steve,

I was checking in on the review of the air dispersion modeling for the new stripper application. We had left it a couple of weeks ago that you would, with respect to the size of the ASB used in the modeling, evaluate if the current air modeling represents the worst case scenario or if using the larger basin size for the ASB would present the worst case scenario for emissions from the ASB. Do you have any determinations yet? Do you know if the air dispersion modeling will need to be redone?

Thanks,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

Office: (803) 898-3213
bucknekk@dhec.sc.gov

S.C. Dept. of Health & Environmental Control
2600 Bull Street
Columbia, SC 29201

Connect: www.scdhec.gov Facebook Twitter

New-Indy Catawba, LLC

2023 New Steam Stripper Application - Updated ASB AERMOD Areas

Pollutant	Standard[a]	Averaging Period[b]	Previous Modeled Concentration (µg/m³)	Modeled Concentration (µg/m³)	% Change	UTM Easting (m)	UTM Northing (m)	Rank[a]	Standard[a](c)(d) (µg/m³)
H_2S	MAAC	24-hour	20.20	18.15	-10%	511,200.42	3,856,646.62	1st High	140
	EPA Action Level	30-minute	100.80	94.59	-6%	511,249.70	3,856,644.83	1-hour 1st High	837
MMC	MAAC	24-hour	9.46	9.46	0%	510,115.55	3,856,041.31	1st High	10
	EPA Action Level	30-minute	48.00	48.00	0%	510,209.41	3,856,039.95	1-hour 1st High	57,000
TRS	MAAC	24-hour	77.25	76.63	-1%	511,151.13	3,856,648.40	1st High	140
	EPA Action Level	30-minute	385.32	385.32	0%	510,143.86	3,855,999.18	1-hour 1st High	837

(a) https://scdhec.gov/sites/default/files/media/document/BAQ_SC%20Modeling%20Guidelines_10.15.18_revised%204.15.19.pdf.

(b) 30-minute averaging period to be compared against maximum 1-hour modeled concentration, per DHEC October 6, 2021 request.

(c) TRS does not have a SC Standard - compare to H_2S.

(d) Methyl Mercaptan does not have an established AEGL-1 value due to insufficient data. Comparison of modeled concentrations are to the 30-minute AEGL-2 value for MMC only.

Modeled Source ID	UTM Easting (m)	UTM Northing (m)	Release Height (m)	Modeled Area (m^2)	Initial Vertical Dimension (m)	H_2S Emissions (g/s)	MMC Emissions (g/s)	TRS Emissions (g/s)	H_2S Emissions ($g/s/m^2$)	MMC Emissions ($g/s/m^2$)	TRS Emissions ($g/s/m^2$)
EQLBASIN	510,439.13	3,855,563.34	0.00	7,610.8	0.00	7.14E-03	--	7.14E-03	9.38E-07		9.38E-07
DITCH1	510,812.79	3,856,255.42	0.00	2,219.3	0.00	4.10E-03	2.33E-03	1.28E-01	1.85E-06	1.05E-06	5.78E-05
ASB1	510,803.40	3,856,319.69	6.10	87,039.3	0.00	1.37E-01	1.63E-02	7.28E-01	1.57E-06	1.87E-07	8.36E-06
ASB2	510,964.42	3,856,054.20	6.10	68,803.6	0.00	2.45E-03	2.92E-04	1.30E-02	3.55E-08	4.24E-09	1.90E-07
ASB3	511,052.13	3,855,887.21	6.10	70,796.1	0.00	6.17E-05	7.35E-06	3.29E-04	8.71E-10	1.04E-10	4.64E-09
DITCH2	510,992.97	3,855,727.21	0.00	1,844.2	0.00	9.28E-02	4.20E-03	1.01E-01	5.03E-05	2.28E-06	5.49E-05
SLDGLAGN	510,924.33	3,855,544.61	0.00	45,225.3	0.00	4.14E-02	--	4.14E-02	9.16E-07		9.16E-07
HOLDPOND	510,391.65	3,855,142.65	0.00	390,739.1	0.00	6.26E-02	1.75E-04	6.28E-02	1.60E-07	4.48E-10	1.61E-07
DITCH0	510,377.59	3,855,634.91	0.00	240.9	0.00	3.03E-04	3.72E-04	1.86E-02	1.26E-06	1.54E-06	7.72E-05

Modeled Source ID	UTM Easting (m)	UTM Northing (m)	Release Height (m)	Radius (m)	Modeled Area (m^2)	H_2S Emissions (g/s)	MMC Emissions (g/s)	TRS Emissions (g/s)	H_2S Emissions ($g/s/m^2$)	MMC Emissions ($g/s/m^2$)	TRS Emissions ($g/s/m^2$)
CLARIFY	510,342.42	3,855,604.87	0.00	42.00	5541.77	2.59E-04	7.26E-04	3.98E-02	4.67E-08	1.31E-07	7.18E-06

Emissions Rate Basis

Source	Pollutant	Actual g/s	Reference File Provided	Maximum g/s
Equalization Basin	H2S	4.56E-03	EQ Basin and Sludge Lagoon Calcs.xlsx	7.14E-03
	TRS	4.56E-03	TRS = H2S	7.14E-03
Ditch 0	H2S	1.94E-04	ALS AVG Ditch #0 Calcs.xlsx	3.03E-04
	MMC	2.38E-04	PC and Ditch 0-1_ALS AVG_WATER9.pdf Sum of Unit 3 Open Trench, Open Sum, and Closed Trench WATER9	3.72E-04
	TRS	1.19E-02	Sum of reduced sulfur compounds, as H2S	1.86E-02
Ditch 1	H2S	2.62E-03	ALS AVG Ditch #1 Calcs.xlsx	4.10E-03
	MMC	1.49E-03	PC and Ditch 0-1_ALS AVG_WATER9.pdf	2.33E-03
	TRS	8.19E-02	Sum of reduced sulfur compounds, as H2S	1.28E-01
Ditch 2	H2S	5.93E-02	ALS AVG Ditch #2 Calcs.xlsx	9.28E-02
	MMC	2.68E-03	Holding Pond_Ditch 2_ ALS AVG_WATER9	4.20E-03
	TRS	6.47E-02	Sum of reduced sulfur compounds, as H2S	1.01E-01
Sludge Lagoon	H2S	2.65E-02	EQ Basin and Sludge Lagoon Calcs.xlsx	4.14E-02
	MMC			
	TRS	2.65E-02	TRS = H2S	4.14E-02
Holding Pond	H2S	4.00E-02	No change.	6.26E-02
	MMC	1.12E-04	Holding Pond_Ditch 2_ ALS AVG_WATER9	1.75E-04
	TRS	4.01E-02	Sum of reduced sulfur compounds, as H2S	6.28E-02
Primary Clarifier	H2S	1.65E-04	PC ALS AVG H2SSIM.pdf	2.59E-04
	MMC	4.64E-04	PC and Ditch 0-1_ALS AVG_WATER9	7.26E-04
	TRS	2.54E-02	Sum of reduced sulfur compounds, as H2S	3.98E-02

2700 ADTP, max
1726 ADTP, actual July 2021 pulp production.

156%

ASB

Worst-case Emissions for Modeling	H_2S	MMC	TRS as H_2S
Total ASB lb/ODTP	0.0109	1.30E-03	5.81E-02
Total ASB lb/hr	1.10	0.13	5.88
Total ASB g/s	0.139	0.017	0.741
Zone 1 g/s	1.37E-01	1.63E-02	7.28E-01
Zone 2 g/s	2.45E-03	2.92E-04	1.30E-02
Zone 3 g/s	6.17E-05	7.35E-06	3.29E-04

REVISED Emissions Calculations (6-26-23)_Modeling Emissions Rates

June 27, 2023 Response to DHEC on New Stripper Application

Comparison to July 6 2023 Response to DHEC Provided Rates:

Original application emissions rates

H_2S Emissions (g/s/m^2)	MMC Emissions (g/s/m^2)	TRS Emissions (g/s/m^2)	H_2S	MMC	TRS	
			Percent Change vs. July 6 Response			
9.37E-07		9.37E-07	0.1%		0.1%	EQLBASIN
1.50E-07	3.21E-07	2.58E-05	1134%	226%	124%	DITCH1
2.69E-06	3.20E-07	1.43E-05	-41.7%	-41.6%	-41.5%	ASB1[(b)]
4.81E-08	5.74E-09	2.55E-07	-26%	-26%	-26%	ASB2[(b)]
1.21E-09	1.45E-10	6.47E-09	-28%	-28%	-28%	ASB3[(b)]
1.34E-06	3.17E-07	2.63E-06	3653%	619%	1989%	DITCH2[(c)]
9.37E-07		9.37E-07	-2%		-2%	SLDGLAGN
1.61E-07	6.20E-11	1.61E-07	-1%	622%	0%	HOLDPOND
1.11E-07	5.05E-07	3.75E-05	1037%	206%	106%	DITCH0

H_2S Emissions (g/s/m^2)	MMC Emissions (g/s/m^2)	TRS Emissions (g/s/m^2)	H_2S	MMC	TRS	
			Percent Change due to ALS			
3.70352E-06	3.96E-08	6.94E-06	-98.7%	231%	3.5%	CLARIFY

Comparison to DHEC Rates:

Emissions rates used by DHEC in modeling demonstration

H2S (g/s/m^2)	MMC (g/s/m^2)	TRS (g/s/m^2)	H_2S	MMC	TRS	
			Percent Change vs. DHEC			
5.99E-07	--	5.99E-07	56.5%		56.5%	EQLBASIN
1.18E-06	6.70E-07	3.69E-05	56.5%	56.5%	56.5%	DITCH1
1.05E-06	1.53E-06	4.69E-06				ASB1[(b)]
5.92E-07	3.26E-08	6.73E-07				ASB2[(b)]
3.29E-07	8.40E-10	3.32E-07				ASB3[(b)]
3.22E-05	1.46E-06	3.51E-05	56.4%	56.5%	56.4%	DITCH2[(c)]
5.85E-07	--	5.85E-07	56.5%		56.5%	SLDGLAGN
1.02E-07	2.86E-10	1.03E-07	56.7%	56.5%	56.5%	HOLDPOND
8.05E-07	9.87E-07	4.93E-05	56.1%	56.5%	56.4%	DITCH0

H2S (g/s/m^2)	MMC (g/s/m^2)	TRS (g/s/m^2)	H_2S	MMC	TRS	
			Percent Change due to ALS			
3.00E-08	8.38E-08	4.59E-06	55.6%	56.5%	56.5%	CLARIFY

RE: New-Indy Catawba LLC Construction Permit Application

McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>
Thu 10/26/2023 9:56 AM
To:Ryan Cleary <rcleary@all4inc.com>

McAvoy, Bryan P. reacted to your message:

From: Ryan Cleary <rcleary@all4inc.com>
Sent: Thursday, October 26, 2023 10:59:20 AM
To: Buckner, Katharine <bucknekk@dhec.sc.gov>; McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>
Cc: bob.tourville@new-indycb.com <BOB.TOURVILLE@NEW-INDYCB.COM>; rachel.davis@new-indycb.com <rachel.davis@new-indycb.com>; Caleb Fetner <cfetner@all4inc.com>; Sheryl Watkins <swatkins@all4inc.com>; Steven Moore <smoore@all4inc.com>
Subject: RE: New-Indy Catawba LLC Construction Permit Application

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***
Bryan,

On behalf of New-Indy Catawba LLC, ALL4 LLC has populated a shared file directory with air dispersion modeling files supporting the new condensate steam stripper application. The files are updated with modified ASB spatial footprints. In addition to an invitation message you should have received, the files may be accessed via the link below.

https://all4.box.com/s/okxys150e2qs73nyusl7lxkvm1x0p1uw

If you have any issues accessing the air dispersion modeling files, please let me know.

Regards,
Ryan

Ryan Cleary / Consulting Scientist
919.230.0716 (o) / Profile / LinkedIn
www.all4inc.com / Locations / Articles / Podcast / Training
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From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Friday, October 6, 2023 10:58 AM
To: Ryan Cleary <rcleary@all4inc.com>; McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>
Cc: bob.tourville@new-indycb.com; rachel.davis@new-indycb.com; Caleb Fetner <cfetner@all4inc.com>; Sheryl Watkins <swatkins@all4inc.com>; Steven Moore <smoore@all4inc.com>
Subject: RE: New-Indy Catawba LLC Construction Permit Application

Hey Ryan and/or Caleb,
Bryan and I have some questions about the ASB, particularly zone 1, and the air dispersion modeling. Which of you do we need to talk with? And are you available today for a Teams chat?

Thanks,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

Office: (803) 898-3213
bucknekk@dhec.sc.gov

S.C. Dept. of Health & Environmental Control
2600 Bull Street
Columbia, SC 29201

Connect: www.scdhec.gov Facebook Twitter

From: Ryan Cleary <rcleary@all4inc.com>
Sent: Thursday, October 5, 2023 9:53 AM
To: McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>; Buckner, Katharine <bucknekk@dhec.sc.gov>
Cc: bob.tourville@new-indycb.com; rachel.davis@new-indycb.com; Caleb Fetner <cfetner@all4inc.com>; Sheryl Watkins <swatkins@all4inc.com>; Steven Moore <smoore@all4inc.com>
Subject: New-Indy Catawba LLC Construction Permit Application

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***
Bryan,

On behalf of New-Indy Catawba LLC, ALL4 LLC has created the link below to access the revised air dispersion modeling files supporting the construction air permit application for the new condensate steam stripper. In addition to the link, you should have received an invitation this morning to access the shared file directory.

https://all4.box.com/s/yln0q56piag1exqm5qa7wv6720zzl1ze

If you have any issues accessing the air dispersion modeling files, please let me know.

Regards,
Ryan

Ryan Cleary / Consulting Scientist
919.230.0716 (o) / Profile / LinkedIn

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Ryan Cleary has invited you to work together in "AQM" folder on Box

Ryan Cleary <noreply@box.com>
Thu 10/26/2023 6:55 AM
To:McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***

Go to Folder

Ryan Cleary invited you to collaborate on:

AQM

"Good Morning Bryan, You are invited to access the shared directory for updated AERMOD modeling files in support of the New-Indy Catawba, LLC new condensate steam stripper application. If you encounter any issues accessing the files, please let me know. Regards, Ryan Cleary ALL4"

AERMAP

Meteorology

NIC_Strip_H2S_1_05b

NIC_Strip_H2S_24_05b

NIC_Strip_MMC_1_24_05b

NIC_Strip_TRS_1_24_05b

Delivered Modeling Files - 20231026.xlsx

Go to Folder

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About Box · Privacy Policy

Ryan Cleary has invited you to work together in "AQM" folder on Box

Ryan Cleary <noreply@box.com>
Thu 10/5/2023 9:51 AM
To:McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***

Go to Folder

Ryan Cleary invited you to collaborate on:

AQM

"Good Morning Bryan, You are invited to access the shared directory for revised modeling files in support of the New-Indy Catawba, LLC new condensate steam stripper application. If you encounter any issues accessing the directory or files, please contact me. Regards, Ryan Cleary ALL4 (919) 230-0716"

AERMAP

Meteorology

NIC_Strip_H2S_1_05

NIC_Strip_H2S_24_05

NIC_Strip_MMC_1_24_05

NIC_Strip_TRS_1_24_05

Delivered Modeling Files - 20231005.xlsx

Go to Folder

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RE: TRS rates in model

Buckner, Katharine <bucknekk@dhec.sc.gov>

Mon 7/17/2023 8:35 AM

To:McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>;Caleb Fetner <cfetner@all4inc.com>
Cc:Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>;Steven Moore <smoore@all4inc.com>;Sheryl Watkins <swatkins@all4inc.com>;Ryan Cleary <rcleary@all4inc.com>

2 attachments (15 MB)

Supporting Spreadsheets.zip; July 6 2022 modeled rates reviewed.xlsx;

Hey Caleb,

I have had several competing spreadsheets submitted the last couple of years for use in verifying the emission rates used in the modeling for H2S, TRS, and methyl mercaptan.

I have attached several versions. Here are the explanations of these.

On 6/30/2022, I received an email from Dan Mallet that (forwarded under separate email to you) had pdfs of the spreadsheets with the actual emissions shown. Somewhere along the way, these were expanded to include the maximum production rate and the maximum emission rates for H2S, TRS, and MM. These were the latest rates that were used in the modeling; attached and titled "July 6, 2022 modeled rates reviewed". The WATER9 results tab is the one in question. This appears to be a sheet I put together, but it uses the actual rates from the pdf spreadsheet from Dan Mallett and I suppose I scaled up those rates by the maximum production rate. The rates from this sheet were used in the last modeling. If these maximum rates are not accurate, please let me know and why. It is just a demonstration of the actual rates supplied by the facility and scaled to the maximum production.

I also have actual spreadsheets as supporting information around January 2022. These have lower rates than the 6/30/22 versions. The compressed folder of these is attached. See in the zip file titled "TRS and H2S Emission Rates".

Sorry for the confusion. Thank you for the help,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

Office: (803) 898-3213
bucknekk@dhec.sc.gov

S.C. Dept. of Health & Environmental Control
2600 Bull Street
Columbia, SC 29201

Connect: www.scdhec.gov Facebook Twitter

From: McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>
Sent: Friday, July 14, 2023 2:23 PM
To: Caleb Fetner <cfetner@all4inc.com>; Buckner, Katharine <bucknekk@dhec.sc.gov>
Cc: Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>; Steven Moore <smoore@all4inc.com>; Sheryl Watkins <swatkins@all4inc.com>; Ryan Cleary <rcleary@all4inc.com>
Subject: Re: TRS rates in model

Hi Caleb,

Sorry for the delay. It's been a busy day. Unfortunately, I'm just not as familiar with the emissions calculations as Katharine, nor do I know the exact documents that she used. Therefore I cannot provide the information. We'll have to wait for her return on Monday.

-Bryan @ BAQ

From: Caleb Fetner <cfetner@all4inc.com>
Sent: Friday, July 14, 2023 8:02 AM
To: McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>; Buckner, Katharine <bucknekk@dhec.sc.gov>
Cc: Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>; Steven Moore <smoore@all4inc.com>; Sheryl Watkins <swatkins@all4inc.com>; Ryan Cleary <rcleary@all4inc.com>
Subject: RE: TRS rates in model

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***
Good morning Bryan, happy Friday.

We are trying to look into Katharine's question below on the emissions rates from the ditches, but I believe Katharine is out yesterday/today. Can you please send the "outputs from H2SSIM model and Water 9 that were dated June 27, 2022" that she is referencing below, so we can verify the rates she is requesting?

Thanks in advance,
Caleb

Caleb Fetner / Consulting Engineer
678.293.9431 / Profile / LinkedIn

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From: Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Sent: Wednesday, July 12, 2023 3:43 PM
To: Caleb Fetner <cfetner@all4inc.com>; Sheryl Watkins <swatkins@all4inc.com>
Subject: Fw: TRS rates in model

Sheryl can you address?

From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Wednesday, July 12, 2023 3:39 PM
To: Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Cc: McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>
Subject: TRS rates in model

External Email

Hey Bob,
I left a voice mail earlier. I am following up with this email.

We are trying to verify the rates for H2S, TRS as H2S, and methyl mercaptan (MM) used in the modeling. Specifically, we are interested in the rates for the three ditches – Ditch 0 + splitter, Ditch 1, and Ditch 2. The last time modeling was done, rates from July 2022 were used. These rates are different from those used in Oct and Dec 2021 and they are different than those submitted as part of the new stripper project.

As I mentioned in the voice mail, I had outputs from H2SSIM model and Water 9 that were dated June 27, 2022. These rates were used in the last modeling.

Can you verify if the rates from June 27, 2022 are accurate and should be used in the model? Or are these not accurate and why?

Thanks,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

Office: (803) 898-3213
bucknekk@dhec.sc.gov

S.C. Dept. of Health & Environmental Control
2600 Bull Street
Columbia, SC 29201

Connect: www.scdhec.gov Facebook Twitter

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RE: SC DHEC Modeling Section comments on New Indy's stripper project application

Caleb Fetner <cfetner@all4inc.com>
Thu 7/6/2023 6:24 PM
To:Buckner, Katharine <bucknekk@dhec.sc.gov>;Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Cc:McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>;Steven Moore <smoore@all4inc.com>;Ryan Cleary <rcleary@all4inc.com>

2 attachments (72 KB)
Response to Comments - Modeling Tables - July 6 2023.xlsx; July 6 Response to BAQ Modeling Section's Comments.docx;

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***
Hi Katharine,

Please see attached documents with responses to your questions below. Please reach out if anything is unclear.

Thanks,
Caleb

Caleb Fetner / Consulting Engineer
678.293.9431 / Profile / LinkedIn
www.all4inc.com / Locations / Articles / Podcast / Training
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From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Friday, June 30, 2023 3:56 PM
To: Caleb Fetner <cfetner@all4inc.com>; Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Cc: McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>; Steven Moore <smoore@all4inc.com>; Ryan Cleary <rcleary@all4inc.com>
Subject: RE: SC DHEC Modeling Section comments on New Indy's stripper project application

Hey Caleb,
Thank you for the information on the splits. I will review and let you know if I have any questions.

I have been reviewing and verifying rates used in the modeling and have a couple questions/comments for you.

1. For all 3 Ditches, please provide the information used and the calculations for the rates used in the model.
2. On the Clarifier, an incorrect diameter may have been used. In Response to Comments – Modeling Tables sheet, the Vol Area tab, the diameter is listed as 42 m. Previously a diameter of 84 m has been used. Please review and either provide a revised table or explain why 42 m is correct.

Please submit this information by Thursday, July 6, 2023.

Thanks,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

Office: (803) 898-3213
bucknekk@dhec.sc.gov

S.C. Dept. of Health & Environmental Control
2600 Bull Street
Columbia, SC 29201

Connect: www.scdhec.gov Facebook Twitter

From: Caleb Fetner <cfetner@all4inc.com>
Sent: Friday, June 30, 2023 12:48 PM
To: Buckner, Katharine <bucknekk@dhec.sc.gov>; Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Cc: McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>; Steven Moore <smoore@all4inc.com>; Ryan Cleary <rcleary@all4inc.com>
Subject: RE: SC DHEC Modeling Section comments on New Indy's stripper project application

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***
Hi Katharine,

Apportioning the total ASB emissions between the three zones for the purposes of modeling was estimated based on the WATER9 results for the TRS compounds in the worst-case scenario (No Stripper Scenario) for TRS compounds. Based on the WATER9 results for each zone, ~98% of the total ASB emissions were apportioned to zone 1.

H2SSIM/WATER9 Results	DMDS, g/s	DMS, g/s	MMC, g/s
ASB Zone 1	0.57	0.22	8.40E-03
ASB Zone 2	9.43E-03	4.70E-03	1.56E-04
ASB Zone 3	1.85E-04	1.70E-04	5.26E-06
Total ASB	**0.58**	**0.22**	**8.56E-03**

This is a similar calculation to what you outlined in your question for H2S, but with the sum of the TRS compounds from the No Stripper Scenario (worst-case for TRS). The % splits were first developed for TRS as H2S, but was conservatively also applied to the H2S emissions rates as well due to the expected maximum receptor being closer to zone 1.

Please let me know if you have any further questions.

Caleb

Caleb Fetner / Consulting Engineer
678.293.9431 / Profile / LinkedIn

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From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Friday, June 30, 2023 8:23 AM
To: Caleb Fetner <cfetner@all4inc.com>; Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Cc: McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>
Subject: RE: SC DHEC Modeling Section comments on New Indy's stripper project application

Thank you. I was just making sure you saw the request.

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

Office: (803) 898-3213
bucknekk@dhec.sc.gov

S.C. Dept. of Health & Environmental Control
2600 Bull Street

Columbia, SC 29201

Connect: www.scdhec.gov Facebook Twitter

From: Caleb Fetner <cfetner@all4inc.com>
Sent: Friday, June 30, 2023 8:22 AM
To: Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>; Buckner, Katharine <bucknekk@dhec.sc.gov>
Cc: McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>
Subject: RE: SC DHEC Modeling Section comments on New Indy's stripper project application

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***
Hi all – pulled together the information to answer Katherine's question and will be sending later today.

Caleb Fetner / Consulting Engineer
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From: Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Sent: Friday, June 30, 2023 8:17 AM
To: Buckner, Katharine <bucknekk@dhec.sc.gov>
Cc: McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>; Caleb Fetner <cfetner@all4inc.com>
Subject: Re: SC DHEC Modeling Section comments on New Indy's stripper project application

I did.

Caleb
Please let me know where we stand with information to Katharine?

From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Friday, June 30, 2023 8:12 AM
To: Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Cc: McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>
Subject: RE: SC DHEC Modeling Section comments on New Indy's stripper project application

Hey Bob,
Resending this to make sure you saw this earlier this week.

Thanks,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

Office: (803) 898-3213
bucknekk@dhec.sc.gov

S.C. Dept. of Health & Environmental Control
2600 Bull Street
Columbia, SC 29201

Connect: www.scdhec.gov Facebook Twitter

From: Buckner, Katharine
Sent: Wednesday, June 28, 2023 3:50 PM
To: Robert Tourville <BOB.TOURVILLE@NEW-INDYCB.COM>
Cc: McAvoy, Bryan P. <MCAVOYBP@dhec.sc.gov>
Subject: FW: SC DHEC Modeling Section comments on New Indy's stripper project application

Hey Bob,
Thak you for all this information and responses. I have been working on verifying rates and stuff. I have one question. In the "Revised Emission Calculations (6-26-23)…", in the "WWTP Factors" tab, how were the Zone splits calculated? What data was used to determine this? Please explain the rationale on these. I tried to come up with these but did not follow how they were done, etc.

For instance, Backup Stripper is the worst for H2S. Using page B-76 from the app, if you total the H2S for all 3 zones, then divide zone 1 by the total, I get 62%.

Thanks,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

Office: (803) 898-3213
bucknekk@dhec.sc.gov

S.C. Dept. of Health & Environmental Control
2600 Bull Street
Columbia, SC 29201

Connect: www.scdhec.gov Facebook Twitter

From: Steven Moore <smoore@all4inc.com>
Sent: Tuesday, June 27, 2023 1:23 PM
To: McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>; Buckner, Katharine <bucknekk@dhec.sc.gov>; Bob Tourville <BOB.TOURVILLE@NEW-INDYCB.COM>
Cc: Sheryl Watkins <swatkins@all4inc.com>; Ryan Cleary <rcleary@all4inc.com>; Caleb Fetner <cfetner@all4inc.com>
Subject: FW: SC DHEC Modeling Section comments on New Indy's stripper project application

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***
On behalf of and at the request of New-Indy Catawba, please find the attached responses to the comments received on June 20, 2023.
If you have any additional questions please contact Bob Tourville at New-Indy Catawba.

Steven Moore / Senior Managing Consultant

D: 919.234.5981 / C: 864.616.4711 / Profile

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From: Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Sent: Tuesday, June 20, 2023 11:09 AM
To: Steven Moore <smoore@all4inc.com>; Sheryl Watkins <swatkins@all4inc.com>
Subject: FW: SC DHEC Modeling Section comments on New Indy's stripper project application

Just in. Can you follow up and respond by next Tuesday, June 27.

From: McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>
Sent: Tuesday, June 20, 2023 11:04 AM
To: Tourville, Bob <BOB.TOURVILLE@NEW-INDYCB.COM>
Cc: Buckner, Katharine <bucknekk@dhec.sc.gov>
Subject: SC DHEC Modeling Section comments on New Indy's stripper project application

External Email

Hello,

I'm in the modeling section of the SCDHEC's Bureau of Air Quality. We've reviewed the facility's application for the installation of a new condensate stripper. Attached are some comments related to that review.

The first two questions are simply a request for a more complete of the Standard 2 and Standard 8 emission rates data related to the project.

The third question points out an emission factor error. Correcting the error would result in lower methyl mercaptan emission rates from one source.

The final two questions relate to the Std. 8 air toxics emissions calculations from the ASB's and ditches. Katharine will be able to help with questions related to emission factors, and I can help with questions about the air compliance averaging period referenced in question 5.

I work from home a few days a week, so please try my cell if you cannot reach me in the office.

We request a reply to these questions by Tuesday, June 27th.

Bryan McAvoy

Meteorologist

S.C. Dept. of Health & Environmental Control

Office: (803) 898-1275

Cell: (864) 350-0930

Email: mcavoybp@dhec.sc.gov

Connect:
https://url.avanan.click/v2/___www.scdhec.gov___.YXAzOm5ld2luZHk6YTpvOjNiZjJjN2M2MmU4MmFhZWVmNWFjNDM2NzM2NTE2OTlmOjY6YjUyYjo1YjE3ZGZiODk2ODZlNmNhMWEwZmVhNTcxMjYxNDc3MjllMzllYzdhMjllN2E3ODZkODA1N2RkNDA2ZTY0YmI3OnQ6VA

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SCDHEC's Modeling Section Comments to New Indy Concerning the March 23, 2023 Construction Permit Application for the Installation of a New Condensate Stripper. Dated June 20, 2023.

1) We request that the facility provide a table, preferably in the form of a spreadsheet, listing the facility-wide, post stripper project maximum allowable South Carolina Standard 2 emission rates, and stack parameters, from each emission point ID which has been previously modeled. This list should include all sources found in the table labeled "STANDARD NO. 2 – AMBIENT AIR QUALITY STANDARDS EMISSION RATES (LBS/HR)" in the 7-10-2019 "Air Compliance Summary Sheet" (henceforth, Summary) composed by the Modeling Section of SCDHEC as part of the compliance demonstration for Project Columbia.

Note that this request does not include sources which have been removed from the facility. These are retained in the Summary to keep track of sources that have been used in previous Other Information compliance demonstrations. As listed in the Summary, the requested emission points are CAUST, FAUMU, FUTCB1, FUTCB2, FUTLK2, FUTNCG1, FUTRF2, FUTRF3, FUTST2, and FUTST3. Emission rates from FUTPM2 and FUTPM3 are not subject to this request if they remain 50% or more below the Standard 2 exemption threshold.

New-Indy Catawba Response: Updated modeled source parameters and Standard No. 2 emissions rates for the sources listed above are provided in the workbook, "June 27 Response to Question 1.xlsx". The workbook contains tables with relevant parameters based on source type.

2) Furthermore, we request that the facility also provide a table, preferably in the form of a spreadsheet, listing the facility-wide, post stripper project maximum allowable emission rates, and stack parameters, for the Standard 8 three air toxics for which modeling was submitted as part of the construction permit application. These toxics are Total Reduced Sulfur, Hydrogen Sulfide, and Methyl Mercaptan. These are the three air toxics subject to the consent order. While these emission rates were included in the modeling files, they were not included in the application.

New-Indy Catawba Response: Post stripper project modeled source parameters and maximum allowable emissions for Total Reduced Sulfur (TRS), Hydrogen Sulfide (H_2S), and Methyl Mercaptan (MMC) are provided in the workbook, "Response to Comments – Modeling Tables – June 27 2023.xlsx". The workbook contains tables with relevant parameters based on source type.

Unless otherwise noted, all source parameters and modeled emissions rates were provided by DHEC in a February 14, 2023 email from Bryan McAvoy to Ryan Cleary (ALL4). The DHEC-provided files reflect those used in the September 26, 2022 modeling conducted by DHEC as part of the Order to Correct Undesirable Level of Air Contaminants (May 7, 2021). DHEC directed that the post stripper project modeling demonstration should utilize the emissions rates and stack parameters as provided, including the incorporation of DHEC-modified vertices for the DITCH2 source for H_2S modeling with the 1-hour averaging period only.

3) The permit writer found an error in the calculation of the emissions from the LD and HD tanks for methyl mercaptan. An emission factor of 3.7E-2 was used, while the correct emission factor appears to be 3.7E-03. This would decrease the emission rate from source PULPSTOR by approximately 0.40 lb/hr. As the modeling still passed with the higher value, the results are conservative and do not require a

revision to the modeling analysis. However, SCDHEC would still like to bring the error to the facility's attention as the MM modeling was so close to the standard.

New-Indy Catawba response: New-Indy Catawba agrees that the methyl mercaptan emissions factor used to represent maximum emissions from the low and high density pulp storage tanks results in an overestimate of the maximum emissions from these sources. As the facility wide modeling impact is below the maximum ambient air concentration for methyl mercaptan, New-Indy Catawba will continue to use this conservative approach in support of the dispersion modeling demonstration for the New Steam Stripper air construction permit application. New-Indy Catawba will adjust the emissions factor as part of any future modeling demonstration.

4) The permit writer was not able to arrive at the same emission rates for the three ASB's that were submitted in the facility's compliance order mandated modeling for the three Standard 8 air toxics of Total Reduced Sulfur, Hydrogen Sulfide, and Methyl Mercaptan. This discrepancy should be resolved. The ditches should also be included in these calculations as the emission rates provided in the modeling files indicate potentially substantive differences in the emission rates used in the current modeling and those used in previous runs for some of the ditches.

New-Indy Catawba Response: – Modeled emissions rates for sources characterized as area sources, including the three ASBs and the ditches, incorporate the size of each respective source, in square meters (m^2), to provide the model with emissions rates in the appropriate units of grams per second per square meters ($g/s/m^2$). Refer to the workbook, "Response to Comments – Modeling Tables – June 27 2023.xlsx" for the sizes of each modeled area source.

5) As a modeling compliance demonstration for South Carolina Standard 8 is based on a 24 hour averaging period, we want to ensure that the worst case emission rates from the ASB and ditches are being calculated for Total Reduced Sulfur, Hydrogen Sulfide, and Methyl Mercaptan for the new stripper project. We request that the facility use, for its air compliance demonstration, the worst case emissions from the three operating scenarios (New Steam Stripper Operating Scenario; Backup Stripper Online Scenario; and No Stripper Online Scenario) for each respective air toxic, based on 24 hours of continuous operation for each scenario. This may not be necessary for a scenario which can be demonstrated to have a high likelihood of running for considerably less than 24 hours consecutively over the course of a year.

New-Indy Catawba Response: The WWTP Factors tab of the attached "REVISED Emissions Calculations (6-26-23)_Modeling Emissions Rates" spreadsheet show how the worst-case gram per second emissions rates were calculated.

Fw: New-Indy Catawba LLC Construction Permit Application

McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>

Fri 3/24/2023 10:08 AM

To:Quina III, Gregory <quinags@dhec.sc.gov>

The NI stripper project modeling has arrived! I have not looked at it yet. I suppose I might not even get the project, but I certainly wanted you to know they have sent it in.

-Bryan

From: Ryan Cleary <rcleary@all4inc.com>
Sent: Thursday, March 23, 2023 3:50 PM
To: McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>; Buckner, Katharine <bucknekk@dhec.sc.gov>
Cc: Pete Cleveland <pete.cleveland@new-indycb.com>; Sheryl Watkins <swatkins@all4inc.com>; Steven Moore <smoore@all4inc.com>
Subject: RE: New-Indy Catawba LLC Construction Permit Application

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Bryan,

On behalf of New-Indy Catawba LLC, ALL4 LLC has created the link below to access the air dispersion modeling files supporting the construction air permit application submitted today (March 23, 2023) for the new condensate steam stripper in accordance with the Consent Order to Correct Undesirable Levels of Air Contaminants signed on November 23, 2023.

https://all4.box.com/s/kjbaj7xiul8w4bsmqqt1pph6vqb77ppw

If you have any issues accessing the air dispersion modeling files, please let me know.

Ryan Cleary

Ryan Cleary / Consulting Scientist
919.230.0716 (o) / Profile / LinkedIn

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Fw: New-Indy Catawba LLC Construction Permit Application

McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>
Fri 3/24/2023 10:08 AM
To:Quina III, Gregory <quinags@dhec.sc.gov>

The NI stripper project modeling has arrived! I have not looked at it yet. I suppose I might not even get the project, but I certainly wanted you to know they have sent it in.

-Bryan

From: Ryan Cleary <rcleary@all4inc.com>
Sent: Thursday, March 23, 2023 3:50 PM
To: McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>; Buckner, Katharine <bucknekk@dhec.sc.gov>
Cc: Pete Cleveland <pete.cleveland@new-indycb.com>; Sheryl Watkins <swatkins@all4inc.com>; Steven Moore <smoore@all4inc.com>
Subject: RE: New-Indy Catawba LLC Construction Permit Application

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Bryan,

On behalf of New-Indy Catawba LLC, ALL4 LLC has created the link below to access the air dispersion modeling files supporting the construction air permit application submitted today (March 23, 2023) for the new condensate steam stripper in accordance with the Consent Order to Correct Undesirable Levels of Air Contaminants signed on November 23, 2023.

https://all4.box.com/s/kjbaj7xiul8w4bsmqqt1pph6vqb77ppw

If you have any issues accessing the air dispersion modeling files, please let me know.

Ryan Cleary

Ryan Cleary / Consulting Scientist
919.230.0716 (o) / Profile / LinkedIn

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Ryan Cleary has invited you to work together in "AQM" folder on Box

Box <noreply@box.com>
Thu 3/23/2023 3:49 PM
To:McAvoy, Bryan P. <mcavoybp@dhec.sc.gov>

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Go to Folder

Ryan Cleary invited you to view:

AQM

“Bryan, On behalf of New-Indy Catawba LLC, ALL4 LLC has created this file sharing directory to access the air dispersion modeling files supporting the construction air permit application submitted today (March 23, 2023) for the new condensate steam stripper in accordance with the Consent Order to Correct Undesirable Levels of Air Contaminants signed on November 23, 2023. ”

AERMAP

Meteorology

NIC_Strip_H2S_1_03

NIC_Strip_H2S_24_03

NIC_Strip_MMC_1_24_03

NIC_Strip_TRS_1_24_03

Delivered Modeling Files - 20230323.xlsx

Go to Folder

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Buckner, Katharine

From: Lowell, Randy <rlowell@burr.com>
Sent: Monday, December 18, 2023 12:49 PM
To: Buckner, Katharine
Cc: Cobery, Jim; Rachel Davis; Martinez, Sara; Stephanie Blackman (Schwarz); Parrish, Sara
Subject: New Indy Cmts
Attachments: 12-6-2023_2440-0005_c2 sob draft for facility (New-Indy Cmts).docx; Doc#_52603367 _v_1_12-6-2023_2440-0005_c2 cp draft for facility (New-Indy Cmts).DOCX

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Katherine:

Attached are comments to the documents related to the stripper construction for New-Indy.

I apologize for the delay in getting this to you today. One of my daughters had an outpatient procedure this morning and I got behind.

Please do not hesitate to contact me or Rachel about these comments, and it may be prudent for you and Rachel to have a discussion after the holidays about a number of outstanding issues, and I will leave that scheduling to you and Rachel for what is convenient for y'all.

If I do not get a chance to speak with you before the holidays, I hope you and your family have a Happy Holiday season and we will speak in the New Year!

Randy

Randolph R. Lowell
Partner

115 Fairchild St, Suite 300
Daniel Island, South Carolina 29492

direct 843-973-6801
mobile 803-361-4783
fax 843-805-5735
rlowell@burr.com
Web

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Buckner, Katharine

From: Buckner, Katharine
Sent: Wednesday, December 6, 2023 3:37 PM
To: Rachel Davis; Sheryl Watkins; Steve Moore (smoore@all4inc.com); Robert Tourville
Cc: Caleb Fetner; Hardee, Christopher; McCaslin, Steven
Subject: revised drafts of c/p and SOB for the new stripper project
Attachments: 12-6-2023_2440-0005_c2 cp draft for facility.docx; 12-6-2023_2440-0005_c2 sob draft for facility.docx

Hello Rachel and all,

Attached are the revised draft construction permit and revised statement of basis (SOB). Please review and provide comments by Wednesday, December 13, 2023.

In the SOB, the project emissions table is still be worked on.

I apologize for not getting these out earlier today. I had issues with downloading the drafts from ePermitting so I had to create a new c/p and SOB, then cut and paste from the old ones into the new ones. I reviewed the new ones and they seem to be in order. Please let me know if you see any issues with either the c/p or SOB.

A complete revised application may be needed before this project goes on public notice. If the application would change extensively based on the comments made, please provide a revised application. I know the emission calculations changed. Let me know what you think on if a revised application is necessary.

Thank you,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

Office: (803) 898-3213
bucknekk@dhec.sc.gov

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2600 Bull Street
Columbia, SC 29201

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Buckner, Katharine

From:	Sheryl Watkins <swatkins@all4inc.com>
Sent:	Friday, December 1, 2023 5:34 PM
To:	Buckner, Katharine; Rachel Davis; Robert Tourville; Steven Moore
Cc:	Caleb Fetner; Hardee, Christopher; McCaslin, Steven
Subject:	RE: Revised, draft c/p and SOB for the new stripper project
Attachments:	11-17-2023_2440-0005_c2 cp draft for facility NIC.docx; 11-17-2023_2440-0005_c2_sob draft for facility NIC.docx

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Hi, Katharine! On behalf and at the request of New-Indy Catawba LLC, please find the attached comments on the revised construction permit for the New Stripper and the associated statement of basis. The comments are in track changes and in the comment margins, including answers to your questions. Once you have had a chance to review, New-Indy Catawba can schedule a call to address any questions or where additional information, or discussion is needed. If it makes sense, we can discuss the revised drafts in the call that is already scheduled for Monday December 4th at 10:00 am. Thanks, and have a good weekend!

Sheryl Watkins, PE / Sr. Technical Manager / ATL Office
swatkins@all4inc.com / Direct: 678.293.9428 / Cell: 386.503.0266 / Profile / LinkedIn

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From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Friday, November 17, 2023 1:51 PM
To: Rachel Davis <Rachel.Davis@new-indycb.com>; Robert Tourville <BOB.TOURVILLE@NEW-INDYCB.COM>; Steven Moore <smoore@all4inc.com>; Sheryl Watkins <swatkins@all4inc.com>
Cc: Caleb Fetner <cfetner@all4inc.com>; Hardee, Christopher <hardeecd@dhec.sc.gov>; McCaslin, Steven <mccaslsd@dhec.sc.gov>
Subject: Revised, draft c/p and SOB for the new stripper project

Hello Everyone,

Attached is the revised draft construction permit and statement of basis for the new stripper project. Please review and provide comments by Friday, December 1, 2023.

Thank you for your assistance working through the comments.

I wish you all a Happy Thanksgiving.

Thanks,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

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bucknekk@dhec.sc.gov

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Buckner, Katharine

From: Rachel Davis <Rachel.Davis@new-indycb.com>
Sent: Friday, November 10, 2023 3:54 PM
To: Buckner, Katharine
Cc: Caleb Fetner; Sheryl Watkins; smoore@all4inc.com
Subject: RE: Question on new stripper app calculations

Importance: High

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Ms. Katharine, please see the answers to your questions.

Questions:

1. *I was looking over the construction application for the new stripper. Should NOx and CO emissions have been estimated from routing the existing LVHC gases to the No. 3 Recovery Furnace? NOx and CO were estimated from the new LVHC gases from the methanol condenser that will be routed to the No. 3 Recovery Furnace.*

2. *Should NOx and CO also be estimated from the Combination Boilers when the existing LVHCs are routed to them? Just like NOx and CO were estimated from the Combo Boilers when the new LVHC gases (from the methanol condenser) are routed to the boilers.*

   If it is determined that emissions do not need to be estimated from these scenarios for both the No. 3 Recovery Furnace and the Combinations Boilers, please provide an explanation why.

Answer: NOx and CO emissions have only been quantified from incinerating stripper off-gases (SOG), not normal kraft pulp mill LVHC gases. The new SRL LVHC gases are the non-condensable gases remaining after the SOG goes through the SRL condenser system, so emissions from SRL LVHC incineration were quantified based on the following:

- Combination Boilers:
  - NOx: SOG emissions factor (conservatively assuming ammonia isn't condensed into rectified methanol.)
  - CO: SOG emissions factor (assumes SRL LVHC is characteristic of SOG)
- RF3:
  - NOx: 1% increase to the established Title V emissions factor to account for small quantities of ammonia remaining in the SRL LVHC.
  - CO: SOG emissions factor (assumes SRL LVHC is characteristic of SOG)

Based on available published emissions factors, there is no appreciable difference in NOx/CO emissions expected from burning other fuels or incinerating the normal LVHC gases (consisting of the evaporators and turpentine system) with other fuels. For NOx, the ammonia is expected to condense out of the LVHC gases into the pulping condensates, which is why NOx emissions are expected from incinerating SOG, but not from kraft LVHCs.

If you have further questions, please don't hesitate to let me know.

Thanks and have a blessed weekend!

Rachel G. Davis
Environmental Manager
O: 803-981-8206
rachel.davis@new-indycb.com

ONE TEAM ONE MISSION
NEW-INDY CATAWBA

From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Thursday, November 2, 2023 4:15 PM
To: Rachel Davis <Rachel.Davis@new-indycb.com>
Subject: RE: Question on new stripper app calculations

No ma'am. I sent that "nevermind" to the wrong person. Sorry for the confusion.

Please do respond to the earlier questions and disregard the "nevermind"

Thanks,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

Office: (803) 898-3213
bucknekk@dhec.sc.gov

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From: Rachel Davis <Rachel.Davis@new-indycb.com>
Sent: Thursday, November 2, 2023 4:03 PM
To: Buckner, Katharine <bucknekk@dhec.sc.gov>
Subject: Re: Question on new stripper app calculations

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Ms. Katharine, you're good on both questions?

Rachel

From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Thursday, November 2, 2023 3:49:51 PM
To: Rachel Davis <Rachel.Davis@new-indycb.com>
Subject: RE: Question on new stripper app calculations

External Email

Nevermind. I see it now.

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

Office: (803) 898-3213
bucknekk@dhec.sc.gov

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Connect: www.scdhec.gov Facebook Twitter

From: Buckner, Katharine
Sent: Thursday, November 2, 2023 1:33 PM
To: Rachel Davis <Rachel.Davis@new-indycb.com>
Subject: Question on new stripper app calculations

Hey Rachel,

I was looking over the construction application for the new stripper. Should NOx and CO emissions have been estimated from routing the existing LVHC gases to the No. 3 Recovery Furnace? NOx and CO were estimated from the new LVHC gases from the methanol condenser that will be routed to the No. 3 Recovery Furnace.

Thanks,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

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Buckner, Katharine

From:	Sheryl Watkins <swatkins@all4inc.com>
Sent:	Friday, November 3, 2023 2:52 PM
To:	Buckner, Katharine; Hardee, Christopher
Cc:	Rachel Davis; Tourville, Bob; Steven Moore; Caleb Fetner
Subject:	New-Indy Catawba – Initial comments on the draft New Stripper c/p and SOB
Attachments:	Draft for facility_NIC comments (11-3-23).docx; 2023-10-30 Addendum to comments.docx; SOB Draft_NIC comments (11-3-23).docx

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Katharine:

On behalf and at the request of New-Indy Catawba LLC, please find the attached initial comments on the draft construction permit for the New Stripper and the associated statement of basis. The comments are in track changes and in the comment margins and we have also included an attachment with proposed alternative monitoring or compliance methodologies for the items discussed in the October 25th conference call with you. Once you have had a chance to review, New-Indy Catawba can schedule a call to address any questions or where additional information or discussion is needed. Thanks, and have a good weekend!

Sheryl Watkins, PE / Sr. Technical Manager / ATL Office
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In addition to the markup and comments provided in the Microsoft Word file back to DHEC, New-Indy Catawba is expanding on some comments in this document to provide additional information.

Proposed Conditions C.18 and C.19

No. 3 Recovery Furnace (RF3); LVHC combustion SO2 emissions.

As an alternative to the stack testing proposed by DHEC, New-Indy proposes to temporarily rent an SO2 CEMS (Method 6C) for RF3 that would be used to document:

1. Emissions from RF3 prior to combustion of any LVHC gases.

2. Emissions after beginning combusting the existing LVHC gases (includes turpentine recovery, Nos. 1-3 Evaporator, and the existing steam stripper feed tank)

3. Emissions after beginning combusting the new steam stripper system LVHC. (Note: once the new stripper is started up the Mill could operate in any of the three scenarios documented in the draft permit).

The duration of operation of the SO2 CEMS will be dependent upon the construction schedule; however, the Mill expects to gather approximately six months of SO2 CEMS data to document baseline SO2 emissions and that the sulfur from the existing LVHC gases or existing LVHC gases with new SRL LVHC is adequately captured in the recovery furnace and ESP.

For the placeholder Condition C.19. with respect to ongoing demonstration of the RF3 SO2 emissions rate, New-Indy proposes to:

1. Utilize the SO2 CEMS data (approximately 6 months of data) to establish the baseline and post-project emissions from the existing LVHC gases and the new steam stripper system.
2. Perform annual SO2 stack testing if SO2 > 50% of the permitted emission rate or biennial if SO2 < 50% of the permitted emission rate during the most recent stack test.
3. More frequent stack testing or installation of an SO2 CEMS could be required if the sulfur makeup exceeds an established baseline sulfur makeup value gathered as part of the SO2 testing under item No. 1.

Proposed Condition B.22

New Stripper; Daily sampling for TRS and methanol.

Speciated TRS testing on a daily basis is not practicable at this time. The RSC 02.02 method is only performed in Canada, and no other test method is performed by labs at this time (ALS liquid sulfur method no longer performed by ALS). New-Indy proposes the following:

1. Perform an initial performance test for the new steam stripper upon start up for methanol and speciated TRS compounds in and out of the steam stripper in order document the stripper can meet the design methanol and total TRS removal efficiency vendor guarantees. DI/MeOH 94.03 Method for methanol and NCASI RSC 02.02 Method for speciated TRS compounds.

2. Establish a relationship between the methanol removal efficiency and the TRS removal efficiency at varying steam to feed ratios.

3. Establish the minimum steam to feed ratio that will achieve 98% TRS removal efficiency.

Proposed ongoing compliance would be:

1. Based on daily methanol sampling in and out of the steam stripper until a methanol concentration or methanol factor can be established (inlet methanol) and a minimum steam to feed ratio can be established for the methanol removal efficiency.

2. Daily sampling is not required for TRS unless the steam to feed ratio falls below the minimum value set in the initial performance test that removes at least 98% TRS.

3. Quarterly verification testing for TRS using NCASI RSC 02.02 Method to confirm 98% removal efficiency is achieved at the minimum steam to feed ratio set in the original performance test.

Proposed Condition B.23

Existing Stripper; Daily sampling for TRS and methanol.

Speciated TRS testing is not practicable at this time (RSC 02.02 method only performed in Canada and no other test method performed by labs at this time. ALS liquid sulfur method no longer performed by ALS). The Mill proposes the following:

1. Perform an initial performance test for the existing steam stripper upon start up for methanol and speciated TRS compounds in and out of the steam stripper that would document the stripper can meet the design percent methanol and total TRS removal efficiency vendor guarantees. DI/MeOH 94.03 Method for methanol and NCASI RSC 02.02 Method for speciated TRS compounds.

2. Establish a minimum steam to feed ratio that will achieve 45% methanol removal efficiency and 98% TRS removal efficiency.

The existing steam stripper will become a back up to the new steam stripper and will only operate when the new stripper is not operational. Since Mill personnel will only be available to sample from 7 am to 4 pm during weekdays, the proposed ongoing compliance would be:

1. The Mill will run the existing steam stripper at or above the minimum steam to feed ratio established in the initial performance test.

2. Collect a sample for methanol in and out of the existing steam stripper (a) when the existing steam stripper is in operation between the hours of 7 am and 4 pm during weekdays; and (b) is in stable operation for a minimum of 6 hours.

3. Sampling is not required for TRS unless the steam to feed ratio falls below the value set in the initial performance test. In this case, testing in and out of the steam stripper the Mill will utilize the onsite HACH method for total sulfides provided (a) the existing steam stripper is in operation between the hours of 7 am and 4 pm during weekdays; and (b) is in stable operation for a minimum of 6 hours.

Buckner, Katharine

From: Caleb Fetner <cfetner@all4inc.com>
Sent: Thursday, January 11, 2024 3:30 PM
To: Buckner, Katharine
Cc: Sheryl Watkins; Steven Moore; Rachel Davis
Subject: RE: Anything you can send ahead of time
Attachments: REVISED Emissions Calculations (1-11-24).xlsx

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***

Hi Katharine – here are the updated emissions calculations with updates as follows:

1. Increased hardpipe (No Stripper) operating scenario to maximum allowable steam stripper downtime of 460 hours.
2. Increased from 1% to 2% SRL by volume mixed with BLS firing, resulting in small change in NOx emissions.
3. Added Project Emissions for Statement of Basis on each pollutant tab.

I'm unfortunately going to be out of office on Tuesday during our scheduled time to do final review of permits, but if you're able to review these tomorrow – I'm general available all day to discuss any questions or comments you have on these calculations.

Appreciate it! We are hard at work trying to get you the permit comments ASAP.

Caleb Fetner / Managing Consultant
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From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Thursday, January 11, 2024 11:52 AM
To: Sheryl Watkins <swatkins@all4inc.com>; Steven Moore <smoore@all4inc.com>; Caleb Fetner <cfetner@all4inc.com>; Rachel Davis <Rachel.Davis@new-indycb.com>
Subject: Anything you can send ahead of time

Hey Y'all,

Thanks for the time today. Just wanted to add if there is anything you can send to me before tomorrow that will be great – comments on one permit, etc.

Thanks,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

Office: (803) 898-3213
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NEW-INDY CATAWBA MILL STRIPPER PROJECT

Stripper Operating Scenario	Operating Time %	Operating Time hrs
New Stripper Online	90%	7,884.0
Backup Stripper Online	4.75%	416.0
No Stripper Online	5.25%	460.0

LVHC Control Operating Scenario	Operating Time %	Operating Time hrs
RF3 Available for LVHC	75%	6,570.0
LVHC to CB1/CB2	25%	2,190.0

	Baseline			
Existing Stripper Steam Demand	21.1	MMBtu/hr	was previously	23.9 MMBtu/hr

(Attachment A to May 22 Response to DHEC Comments on App 1)

Summary of PSD Applicability
(tons/year)

Added Project Emissions for Statement of Basis on each pollutant tab.

Pollutant[(A)]	PM	PM_{10}	$PM_{2.5}$	NO_X	SO_2	CO	H2SO4	TRS	VOC	Pb	H_2S	CO_2
Baseline Actual Emissions	1.11	1.02	0.959	124	737	25.2	1.23	12.8	233	1.10E-04	3.61	12,275
Projected Actual Emissions	13.3	10.3	8.37	147	605	62.8	2.43	16.2	253	2.06E-03	5.59	48,181
Net Emissions Changes (PAE - BAE)	12.2	9.32	7.41	23.8	-131.98	37.6	1.20	3.35	20.1	1.95E-03	1.98	35,906
PSD Significant Emissions Rates	**25**	**15**	**10**	**40**	**40**	**100**	**7**	**10**	**40**	**0.6**	**10**	**75,000**
PSD Significant?	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**

A - HF is not emitted from new, modified, or affected emissions units.

SO2 EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		SO2 Emissions Factor		Sulfur Capture[C]	SO2 Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100%	8,004.0	SOG to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	1.06	October 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	60.4	241.8
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	1.97	October 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	112.0	490.6
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B,E]	97.9%	7,835.7	NA	100.0%	7,835.7	26.0	mmBtu/hr	6.00E-04	AP-42 Table 1.4-2.	NA	0.02	0.1
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B,E]	2.1%	168.3	NA	100.0%	168.3	24.8	mmBtu/hr	2.20E+00	AP-42 Table 1.3-1. 2.1% Sulfur Content.	NA	54.6	4.6
SO2 BASELINE ACTUAL EMISSIONS (BAE)															**737.0**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90.0%	7,884.0	SRL Online	95%	7,489.8	SRL Methanol to RF2/3[G]	100.0%	7,489.8	2,700	ADTP/day	0.56	Vendor / Preliminary Design Information	99%	0.6	2.4
New Stripper Online	90.0%	7,884.0	SRL Online	95%	7,489.8	SRL LVHC to RF3[G]	75.0%	5,617.4	2,700	ADTP/day	0.84	Vendor / Preliminary Design Information	99%	0.9	2.7
New Stripper Online	90.0%	7,884.0	SRL Online	95%	7,489.8	SRL LVHC to CB1/CB2[G]	25.0%	1,872.5	2,700	ADTP/day	0.84	Vendor / Preliminary Design Information	50%	47.2	44.2
New Stripper Online	90.0%	7,884.0	SRL Offline	5%	394.2	SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	1.40	Vendor / Preliminary Design Information	0%	157.4	31.0
Backup Stripper Online	4.7%	416.0	NA	100%	416.0	SOG to CB1/CB2	100.0%	416.0	2,700	ADTP/day	1.40	Vendor / Preliminary Design Information	0%	157.4	32.7
No Stripper Online	5.3%	460.0	Foul Condensate to Hard Pipe	100%	460.0	Hydrogen Peroxide Addition	100.0%	460.0	NA	NA	NA	NA	NA	NA	NA
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	5.25	October 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. Pre-control emissions based on LVHC scrubber efficiency (50%) and estimated bark ash sulfur capture (20%) from 2012 stack test.	99%	5.9	19.4
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	5.25	October 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. Pre-control emissions based on LVHC scrubber efficiency (50%) and estimated bark ash sulfur capture (20%) from 2012 stack test.	50%	295.2	323.3
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5	NA	100.0%	985.5	1.0	mmBtu/hr	6.00E-04	AP-42 Table 1.4-2.	NA	0.00	0.0
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D,F]	81.6%	6,433.3	NA	100.0%	6,433.3	96.8	mmBtu/hr	6.00E-04	AP-42 Table 1.4-2.	NA	0.06	0.2
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D,F]	18.4%	1,450.7	NA	100.0%	1,450.7	92.2	mmBtu/hr	2.20E+00	AP-42 Table 1.3-1. 2.1% Sulfur Content.	NA	202.9	147.2
Backup Stripper Steam - Natural Gas	4.7%	416.0	Natural Gas[D,F]	81.6%	339.5	NA	100.0%	339.5	25.3	mmBtu/hr	6.00E-04	AP-42 Table 1.4-2.	NA	0.02	0.003
Backup Stripper Steam - No. 6 Oil	4.7%	416.0	No. 6 Oil[D,F]	18.4%	76.5	NA	100.0%	76.5	24.1	mmBtu/hr	2.20E+00	AP-42 Table 1.3-1. 2.1% Sulfur Content.	NA	53.1	2.0
SO2 PROJECTED ACTUAL EMISSIONS (PAE)															**605.04**
NET EMISSIONS CHANGE (PAE - BAE)															
NET EMISSIONS CHANGE (PAE - BAE)															**-131.98**

Project Emissio		
Uncontrolled		Contro
lb/hr	TPY	lb/hr
950.8	4164.3	655.5

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Sulfur capture in recovery furnace >99, sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

Worst-case short-term (lb/hr) emissions
operating, burning SOG and LVHC in CBs
burning oil.
Worst-case long-term (TPY) emissions c
operating all year, but SRL offline, burni
and if all of the new stripper steam cam

H2SO4 EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time %	Stripper Scenario Operating Time hrs	Operating Configuration	Operating Configuration Time %	Operating Configuration Time hrs	Controls	Controls Operating Time %	Controls Operating Time hrs	Production Rate Value	Production Rate UOM	H2SO4 Emissions Factor lb/ADTP	H2SO4 Emissions Factor Reference	Sulfur Capture %	H2SO4 Emissions lb/hr	H2SO4 Emissions tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	4.93E-03	NCASI Technical Bulletin 858, Table 10	NA	0.3	1.2
H2SO4 BASELINE ACTUAL EMISSIONS (BAE)															**1.2**
PROJECTED ACTUAL EMISSIONS															
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	4.93E-03	NCASI Technical Bulletin 858, Table 10	NA	0.55	1.82
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	4.93E-03	NCASI Technical Bulletin 858, Table 10	NA	0.55	0.61
H2SO4 PROJECTED ACTUAL EMISSIONS (PAE)															**2.43**
NET EMISSIONS CHANGE (PAE - BAE)															
NET EMISSIONS CHANGE (PAE - BAE)															**1.20**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boiliers No. 1 and No. 2 during baseline.

C - Sulfur capture in recovery furnace >99, sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

Project Emissio		
Uncontrolled		Contr
lb/hr	TPY	lb/hr
0.55	2.43	

No difference in worst-case short-term (
RF3 or CBs. Long-term (TPY) emissions b
No true control device (not including req
typical control device at stack) so no diff
controlled, or PTE.

NOX EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time %	Stripper Scenario Operating Time hrs	Operating Configuration	Operating Configuration Time %	Operating Configuration Time hrs	Controls	Controls Operating Time %	Controls Operating Time hrs	Production Rate Value	Production Rate UOM	NOX Emissions Factor lb/UOM	NOX Emissions Factor Reference	Ammonia Increase[C] %	NOX Emissions lb/hr	NOX Emissions tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	SOG to CB1/CB2	100%	8,004.0	1,365	ADTP/day	0.415	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	23.6	94.5
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B,E]	97.9%	7,835.7	NA	100%	7,835.7	26.0	mmBtu/hr	2.80E-01	AP-42 Table 1.4-2.	NA	7.3	28.6
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B,E]	2.1%	168.3	NA	100%	168.3	24.8	mmBtu/hr	3.13E-01	AP-42 Table 1.3-1.	NA	7.8	0.7
NOX BASELINE ACTUAL EMISSIONS															**123.7**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3[G]	100%	7,489.8	2,852	TBLS/day	1.500	NCASI Technical Bulletin 884, Table 4.12.	2.0%	3.6	13.4
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3[G]	75%	5,617.4	316.9	TBLS/day	1.500	NCASI Technical Bulletin 884, Table 4.12.	2.0%	0.4	1.1
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2[G]	25%	1,872.5	270.0	ADTP/day	0.415	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	4.7	4.4
New Stripper Online	90%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100%	394.2	2,700	ADTP/day	0.415	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	46.7	9.2
Backup Stripper Online	5%	416.0	NA	100.0%	416.0	SOG to CB1/CB2	100%	416.0	2,700	ADTP/day	0.415	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	46.7	9.7
No Stripper Online	5%	460.0	Foul Condensate to Hard Pipe	100.0%	460.0	Hydrogen Peroxide Addition	100%	460.0	NA	NA	NA	NA	NA	NA	NA
Recovery Furnace #3 LVHC Ignitor	75%	6,570.0	Natural Gas[I]	15.0%	985.5	NA	100%	985.5	1.0	mmBtu/hr	2.80E-01	AP-42 Table 1.4-2.	NA	0.3	0.1
New Stripper Steam - Natural Gas	90%	7,884.0	Natural Gas[D,F]	81.6%	6,433.3	NA	100%	6,433.3	96.8	mmBtu/hr	2.80E-01	AP-42 Table 1.4-2.	NA	27.1	87.2
New Stripper Steam - No. 6 Oil	90%	7,884.0	No. 6 Oil[D,F]	18.4%	1,450.7	NA	100%	1,450.7	92.2	mmBtu/hr	3.13E-01	AP-42 Table 1.3-1.	NA	28.9	20.9
Backup Stripper Steam - Natural Gas	5%	416.0	Natural Gas[D,F]	81.6%	339.5	NA	100%	339.5	25.3	mmBtu/hr	2.80E-01	AP-42 Table 1.4-2.	NA	7.1	1.2
Backup Stripper Steam - No. 6 Oil	5%	416.0	No. 6 Oil[D,F]	18.4%	76.5	NA	100%	76.5	24.1	mmBtu/hr	3.13E-01	AP-42 Table 1.3-1.	NA	7.5	0.3
NOX PROJECTED ACTUAL EMISSIONS															**147.5**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**23.8**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Ammonia input to recovery furnace increases >2% with maximum addition of SRL of 2% by volume (representative of ~1% by volume pure methanol.)

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - >90% of methanol condensed and burned in recovery furnace, < 10% of methanol vented into LVHC System.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

Project Emissior		
Uncontrolled		Contro
lb/hr	TPY	lb/hr
75.8	332.2	

Worst-case short-term (lb/hr) emissions
operating, burning SOG in CBs, with stea
Worst-case long-term (TPY) emissions co
operating all year, but SRL offline, and all
from oil.

CO EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		CO Emissions Factor		CO Control	CO Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	SOG to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	0.0728	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	4.1	16.6
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7	NA	100.0%	7,835.7	26.0	mmBtu/hr	8.40E-02	AP-42 Table 1.4-2.	NA	2.2	8.6
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3	NA	100.0%	168.3	24.8	mmBtu/hr	3.33E-02	AP-42 Table 1.3-1.	NA	0.8	0.1
CO BASELINE ACTUAL EMISSIONS															**25.2**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3	100.0%	7,489.8	NA	NA	NA	NA	NA	NA	NA
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3	75%	5,617.4	2,700	ADTP/day	0.0728	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	8.2	23.0
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2	25%	1,872.5	2,700	ADTP/day	0.0728	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	8.2	7.7
New Stripper Online	90%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	0.0728	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	8.2	1.6
Backup Stripper Online	5%	416.0	NA	100.0%	416.0	SOG to CB1/CB2	100.0%	416.0	2,700	ADTP/day	0.0728	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	8.2	1.7
No Stripper Online	5%	460.0	Foul Condensate to Hard Pipe	100.0%	460.0	Hydrogen Peroxide Addition	100.0%	460.0	NA	NA	NA	NA	NA	NA	NA
Recovery Furnace #3 LVHC Ignitor	75%	6,570.0	Natural Gas[I]	15.0%	985.5	NA	100.0%	985.5	1.0	mmBtu/hr	8.40E-02	AP-42 Table 1.4-2.	NA	0.1	0.0
New Stripper Steam - Natural Gas	90%	7,884.0	Natural Gas[D]	81.6%	6,433.3	NA	100.0%	6,433.3	96.8	mmBtu/hr	8.40E-02	AP-42 Table 1.4-2.	NA	8.1	26.2
New Stripper Steam - No. 6 Oil	90%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7	NA	100.0%	1,450.7	92.2	mmBtu/hr	3.33E-02	AP-42 Table 1.3-1.	NA	3.1	2.2
Backup Stripper Steam - Natural Gas	5%	416.0	Natural Gas[D]	81.6%	339.5	NA	100.0%	339.5	25.3	mmBtu/hr	8.40E-02	AP-42 Table 1.4-2.	NA	2.1	0.4
Backup Stripper Steam - No. 6 Oil	5%	416.0	No. 6 Oil[D]	18.4%	76.5	NA	100.0%	76.5	24.1	mmBtu/hr	3.33E-02	AP-42 Table 1.3-1.	NA	0.8	0.0
CO PROJECTED ACTUAL EMISSIONS															**62.8**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**37.6**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - reserved.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

Project Emissior		
Uncontrolled		Contrc
lb/hr	TPY	lb/hr
16.4	71.9	

Worst-case short-term (lb/hr) and long-
corresponds to New Stripper operating,
gas.

VOC EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		VOC Emissions Factor		Removal[C]	VOC Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	LVHC to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	4.35	Average daily methanol stripped based on daily Subpart S compliance through 2/28/2023.	98.0%	4.95	19.81
Aerated Stabilization Basin (ASB)	100.0%	8,760.0	Foul Condensate to Hard Pipe	100.0%	8,760.0	NA	100.0%	8,760.0	1,365	ADTP/day	8.51E-01	WATER9 Inputs and Outputs Provided.	NA	48.39	211.96
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	3.10E-03	July 2019 Project Columbia Application. Page C-3 for Total LVHC Emissions.	NA	0.18	0.77
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7	NA	100.0%	7,835.7	26.0	mmBtu/hr	5.50E-03	AP-42 Table 1.4-2.	NA	0.1	0.6
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3	NA	100.0%	168.3	24.8	mmBtu/hr	1.87E-03	AP-42 Table 1.3-3. NMTOC for no. 6 oil.	NA	0.0	0.0
VOC BASELINE ACTUAL EMISSIONS															**233.11**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3[G]	100%	7,489.8	2,700	ADTP/day	14.40	Vendor / Preliminary Design Information	99.9%	1.62	6.07
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3[G]	75%	5,617.4	2,700	ADTP/day	1.60	Vendor / Preliminary Design Information	98%	3.60	10.11
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2[G]	25%	1,872.5	2,700	ADTP/day	1.60	Vendor / Preliminary Design Information	98%	3.60	3.37
New Stripper Online	90%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100%	394.2	2,700	ADTP/day	16.00	Vendor / Preliminary Design Information	98%	36.00	7.10
Backup Stripper Online[H]	5%	416.0	NA	100.0%	416.0	SOG to CB1/CB2	100%	416.0	2,700	ADTP/day	7.20	Vendor / Preliminary Design Information	98%	16.20	3.37
ASB - New Stripper Online	90%	7,884.0	No Foul Condensate to Hard Pipe	100.0%	7,884.0	NA	100%	7,884.0	2,700	ADTP/day	0.29	WATER9 Inputs and Outputs Provided.	NA	32.85	129.50
ASB - Backup Stripper Online	5%	416.0	TRS Stripped From Foul Condensate	100.0%	416.0	NA	100%	416.0	2,700	ADTP/day	1.43	WATER9 Inputs and Outputs Provided.	NA	160.92	33.47
ASB - No Stripper Online	5%	460.0	Foul Condensate to Hard Pipe	100.0%	460.0	NA	100%	460.0	2,700	ADTP/day	2.20	WATER9 Inputs and Outputs Provided.	NA	247.14	56.84
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to RF3	75%	6,570.0	2,700	ADTP/day	3.10E-03	July 2019 Project Columbia Application. Page C-3 for Total LVHC Emissions.	NA	0.35	1.15
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	25%	2,190.0	2,700	ADTP/day	3.10E-03	July 2019 Project Columbia Application. Page C-3 for Total LVHC Emissions.	NA	0.35	0.38
Recovery Furnace #3 LVHC Ignitor	75%	6,570.0	Natural Gas[I]	15.0%	985.5	NA	100%	985.5	1.0	mmBtu/hr	5.50E-03	AP-42 Table 1.4-2.	NA	5.50E-03	2.71E-03
New Stripper Steam - Natural Gas	90%	7,884.0	Natural Gas[D]	81.6%	6,433.3	NA	100%	6,433.3	96.8	mmBtu/hr	5.50E-03	AP-42 Table 1.4-2.	NA	0.5	1.7
New Stripper Steam - No. 6 Oil	90%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7	NA	100%	1,450.7	92.2	mmBtu/hr	1.87E-03	AP-42 Table 1.3-3. NMTOC for no. 6 oil.	NA	0.2	0.1
Backup Stripper Steam - Natural Gas	5%	416.0	Natural Gas[D]	81.6%	339.5	NA	100%	339.5	25.3	mmBtu/hr	5.50E-03	AP-42 Table 1.4-2.	NA	0.1	0.0
Backup Stripper Steam - No. 6 Oil	5%	416.0	No. 6 Oil[D]	18.4%	76.5	NA	100%	76.5	24.1	mmBtu/hr	1.87E-03	AP-42 Table 1.3-3. NMTOC for no. 6 oil.	NA	0.0	0.0
VOC PROJECTED ACTUAL EMISSIONS															**253.22**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**20.11**

Project Emiss		
Uncontrolled		Contr
lb/hr	TPY	lb/hr
1800.5	7886.4	247.5

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - VOC destruction >98% in vapor phase, 99.9% in liquid phase.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - >90% of methanol condensed and burned in recovery furnace, < 10% of methanol vented into LVHC System.

H - Backup Stripper in TRS Mode removes 45% of the methanol from the foul condensate. The stripped condensate is discharged to the hardpipe for additional methanol treatment in the ASB.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

Worst-case short-term (lb/hr) emissions
Worst-case long-term (TPY) emissions c
maxed out at 460 hours, and New Stripp
Assumes 90% uptime on new stripper.

For uncontrolled, worst-case is new strip
steam from natural gas.

TRS EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		TRS Emissions Factor		Sulfur Capture[C]	TRS Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	LVHC to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	2.88E-03	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	0.16	0.65
Aerated Stabilization Basin (ASB)	100.0%	8,760.0	NA	100.0%	8,760.0	NA	100.0%	8,760.0	1,365	ADTP/day	4.08E-02	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	2.32	10.16
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	8.01E-03	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	0.46	2.00
TRS BASELINE ACTUAL EMISSIONS															**12.81**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3[G,H]	100.0%	7,489.8	2,700	ADTP/day	0.33	Vendor / Preliminary Design Information	99.9%	0.04	0.14
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3[G,H]	75.0%	5,617.4	2,700	ADTP/day	0.49	Vendor / Preliminary Design Information	99.9%	0.05	0.15
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2[G]	25.0%	1,872.5	2,700	ADTP/day	0.49	Vendor / Preliminary Design Information	99%	0.55	0.51
New Stripper Online	90.0%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	0.81	Vendor / Preliminary Design Information	99%	0.91	0.18
Backup Stripper Online	4.7%	416.0	NA	100.0%	416.0	SOG to CB1/CB2	100.0%	416.0	2,700	ADTP/day	0.81	Vendor / Preliminary Design Information	99%	0.91	0.19
ASB - New Stripper Online	90.0%	7,884.0	No Foul Condensate to Hard Pipe	100.0%	7,884.0	NA	100.0%	7,884.0	2,700	ADTP/day	2.42E-02	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	2.72	10.74
ASB - Backup Stripper Online	4.7%	416.0	TRS Stripped From Foul Condensate	100.0%	416.0	NA	100.0%	416.0	2,700	ADTP/day	2.72E-02	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	3.06	0.64
ASB - No Stripper Online	5.3%	460.0	Foul Condensate to Hard Pipe	100.0%	460.0	Hydrogen Peroxide Addition	100.0%	460.0	2,700	ADTP/day	7.28E-02	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	8.19	1.88
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	1.75E+00	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. Pre-control emissions based on LVHC scrubber efficiency (50%) and estimated 99% combustion efficiency in combination boilers.	99.9%	0.20	0.65
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	8.76E-03	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. DHEC Approved Test.	NA	0.99	1.08
TRS PROJECTED ACTUAL EMISSIONS															**16.16**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**3.35**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Sulfur capture in recovery furnace >99.9% (see note H), sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - Recovery Furnace captures 99% of sulfur and converts 99% of remaining uncaptured sulfur.

Project Emissior		
Uncontrolled		Contrc
lb/hr	TPY	lb/hr
288.7	1264.3	9.2

Worst-case short-term (lb/hr) emissions
scenario. Worst-case long-term (TPY) em
Stripper scenario maxed out at 460 hour
Stripper SOGs to CBs, along with LVHC. A
stripper.

For uncontrolled, worst-case is new strip
with steam from natural gas. LVHC vente

H2S EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time %	Stripper Scenario Operating Time hrs	Operating Configuration	Operating Configuration Time %	Operating Configuration Time hrs	Controls	Controls Operating Time %	Controls Operating Time hrs	Production Rate Value	Production Rate UOM	H2S Emissions Factor lb/UOM	H2S Emissions Factor Reference	Sulfur Capture[C] %	H2S Emissions lb/hr	H2S Emissions tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	LVHC to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	4.13E-04	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	0.02	0.09
Aerated Stabilization Basin (ASB)	100.0%	8,760.0	Foul Condensate to Hard Pipe	100.0%	8,760.0	Hydrogen Peroxide Addition	100.0%	8,760.0	1,365	ADTP/day	1.36E-02	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	0.77	3.39
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	5.03E-04	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	0.03	0.13
H2S BASELINE ACTUAL EMISSIONS															**3.61**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3[G,H]	100.0%	7,489.8	2,700	ADTP/day	0.24	Vendor / Preliminary Design Information	99.9%	0.03	0.10
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3[G,H]	75.0%	5,617.4	2,700	ADTP/day	0.37	Vendor / Preliminary Design Information	99.9%	0.04	0.12
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2[G]	25.0%	1,872.5	2,700	ADTP/day	0.37	Vendor / Preliminary Design Information	99%	0.41	0.39
New Stripper Online	90.0%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	0.61	Vendor / Preliminary Design Information	99%	0.69	0.14
Backup Stripper Online	4.7%	416.0	NA	100.0%	416.0	SOG to CB1/CB2	100.0%	416.0	2,700	ADTP/day	0.61	Vendor / Preliminary Design Information	99%	0.69	0.14
ASB - New Stripper Online	90.0%	7,884.0	No Foul Condensate to Hard Pipe	100.0%	7,884.0	NA	100.0%	7,884.0	2,700	ADTP/day	9.27E-03	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	1.04	4.11
ASB - Backup Stripper Online	4.7%	416.0	H2S Stripped From Foul Condensate	100.0%	416.0	NA	100.0%	416.0	2,700	ADTP/day	9.81E-03	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	1.10	0.23
ASB - No Stripper Online	5.3%	460.0	Foul Condensate to Hard Pipe	100.0%	460.0	Hydrogen Peroxide Addition	100.0%	460.0	2,700	ADTP/day	9.54E-03	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	1.07	0.25
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	1.17E-01	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. Pre-control emissions based on LVHC scrubber efficiency (50%) and estimated 99% combustion efficiency in combination boilers.	99.9%	0.01	0.04
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	5.87E-04	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. DHEC Approved Test.	NA	0.07	0.07
H2S PROJECTED ACTUAL EMISSIONS															**5.59**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**1.98**

Project Emissio		
Uncontrolled		Contr
lb/hr	TPY	lb/hr
82.1	359.6	1.9

Worst-case short-term (lb/hr) emissions corr
Worst-case long-term (TPY) emissions assum
460 hours, and New Stripper operating at 90
For uncontrolled, worst-case is new stripper
vented (i.e., no control in the CBs).

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Sulfur capture in recovery furnace >99.9% (see note H), sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - Recovery Furnace captures 99% of sulfur and converts 99% of remaining uncaptured sulfur.

PM EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		PM Emissions Factor		PM Control	PM Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	26.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.8
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	24.8	mmBtu/hr	1.61E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	4.0	0.3
PM BASELINE ACTUAL EMISSIONS															**1.1**
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	7.60E-03	3.74E-03
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.7	2.4
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	1.61E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	14.8	10.8
Backup Stripper Steam - Natural Gas	4.7%	416.0	Natural Gas[D]	81.6%	339.5		100.0%	339.5	25.3	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.0
Backup Stripper Steam - No. 6 Oil	4.7%	416.0	No. 6 Oil[D]	18.4%	76.5		100.0%	76.5	24.1	mmBtu/hr	1.61E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	3.9	0.1
PM PROJECTED ACTUAL EMISSIONS															**13.3**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**12.2**

Project Emissio		
Uncontrolled		Contro
lb/hr	TPY	lb/hr
14.9	65.1	

Worst-case short-term (lb/hr) and long-t
to New Stripper operating, with stripper

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - reserved.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

PM10 EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time %	Stripper Scenario Operating Time hrs	Operating Configuration	Operating Configuration Time %	Operating Configuration Time hrs	Controls	Controls Operating Time %	Controls Operating Time hrs	Production Rate Value	Production Rate UOM	PM10 Emissions Factor lb/UOM	PM10 Emissions Factor Reference	PM10 Control %	PM10 Emissions lb/hr	PM10 Emissions tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	26.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.8
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	24.8	mmBtu/hr	1.17E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	2.9	0.2
PM10 BASELINE ACTUAL EMISSIONS															**1.0**
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	7.60E-03	3.74E-03
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.7	2.4
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	1.17E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	10.8	7.8
Backup Stripper Steam - Natural Gas	4.7%	416.0	Natural Gas[D]	81.6%	339.5		100.0%	339.5	25.3	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.0
Backup Stripper Steam - No. 6 Oil	4.7%	416.0	No. 6 Oil[D]	18.4%	76.5		100.0%	76.5	24.1	mmBtu/hr	1.17E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	2.8	0.1
PM10 PROJECTED ACTUAL EMISSIONS															**10.3**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**9.3**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - reserved.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

Project Emissior		
Uncontrolled		Contrc
lb/hr	TPY	lb/hr
10.8	47.3	

Worst-case short-term (lb/hr) and long-t
to New Stripper operating, with stripper

PM2.5 EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time %	Stripper Scenario Operating Time hrs	Operating Configuration	Operating Configuration Time %	Operating Configuration Time hrs	Controls	Controls Operating Time %	Controls Operating Time hrs	Production Rate Value	Production Rate UOM	PM2.5 Emissions Factor lb/UOM	PM2.5 Emissions Factor Reference	PM2.5 Control %	PM2.5 Emissions lb/hr	PM2.5 Emissions tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	26.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.8
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	24.8	mmBtu/hr	8.80E-02	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	2.2	0.2
PM2.5 BASELINE ACTUAL EMISSIONS															**1.0**
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	7.60E-03	3.74E-03
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.7	2.4
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	8.80E-02	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	8.1	5.9
Backup Stripper Steam - Natural Gas	4.7%	416.0	Natural Gas[D]	81.6%	339.5		100.0%	339.5	25.3	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.0
Backup Stripper Steam - No. 6 Oil	4.7%	416.0	No. 6 Oil[D]	18.4%	76.5		100.0%	76.5	24.1	mmBtu/hr	8.80E-02	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	2.1	0.1
PM2.5 PROJECTED ACTUAL EMISSIONS															**8.4**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**7.4**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - reserved.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

Project Emission		
Uncontrolled		Contro
lb/hr	TPY	lb/hr
8.1	35.6	

Worst-case short-term (lb/hr) and long-t
to New Stripper operating, with stripper

LEAD EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		Lead Emissions Factor		Lead Control	Lead Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	26.0	mmBtu/hr	5.00E-07	AP-42 Table 1.4-2.	NA	1.30E-05	5.10E-05
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	24.8	mmBtu/hr	2.80E-05	U.S. EPA document "Estimating Air Toxic Emissions from Coal and Oil Combustion Sources" [EPA-450/2-89-001] for Uncontrolled Residual Oil-fired Utility Boilers (Table 4-1)	NA	6.95E-04	5.85E-05
LEAD BASELINE ACTUAL EMISSIONS															**1.10E-04**
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	5.00E-07	AP-42 Table 1.4-2.	NA	5.00E-07	2.46E-07
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	5.00E-07	AP-42 Table 1.4-2.	NA	4.84E-05	1.56E-04
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	2.80E-05	U.S. EPA document "Estimating Air Toxic Emissions from Coal and Oil Combustion Sources" [EPA-450/2-89-001] for Uncontrolled Residual Oil-fired Utility Boilers (Table 4-1)	NA	2.58E-03	1.87E-03
Backup Stripper Steam - Natural Gas	4.7%	416.0	Natural Gas[D]	81.6%	339.5		100.0%	339.5	25.3	mmBtu/hr	5.00E-07	AP-42 Table 1.4-2.	NA	1.27E-05	2.15E-06
Backup Stripper Steam - No. 6 Oil	4.7%	416.0	No. 6 Oil[D]	18.4%	76.5		100.0%	76.5	24.1	mmBtu/hr	2.80E-05	U.S. EPA document "Estimating Air Toxic Emissions from Coal and Oil Combustion Sources" [EPA-450/2-89-001] for Uncontrolled Residual Oil-fired Utility Boilers (Table 4-1)	NA	6.75E-04	2.58E-05
LEAD PROJECTED ACTUAL EMISSIONS															**2.06E-03**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**1.95E-03**

Project Emissio		
Uncontrolled		Contro
lb/hr	TPY	lb/hr
2.58E-03	1.13E-02	

Worst-case short-term (lb/hr) and long-t
to New Stripper operating, with stripper

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - reserved.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

CO2 EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time %	Stripper Scenario Operating Time hrs	Operating Configuration	Operating Configuration Time %	Operating Configuration Time hrs	Controls	Controls Operating Time %	Controls Operating Time hrs	Production Rate Value	Production Rate UOM	CO2 Emissions Factor lb/UOM	CO2 Emissions Factor Reference	CO2 Control %	CO2 Emissions lb/hr	CO2 Emissions tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	26.0	mmBtu/hr	1.17E+02	40 CFR Part 98, Table C-1	NA	3,044.8	11,929
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	24.8	mmBtu/hr	1.66E+02	40 CFR Part 98, Table C-1	NA	4,109.9	346
CO2 BASELINE ACTUAL EMISSIONS															**12,275**
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	1.17E+02	40 CFR Part 98, Table C-1	NA	116.9	58
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	1.17E+02	40 CFR Part 98, Table C-1	NA	11,313.5	36,392
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	1.66E+02	40 CFR Part 98, Table C-1	NA	15,270.9	11,076
Backup Stripper Steam - Natural Gas	4.7%	416.0	Natural Gas[D]	81.6%	339.5		100.0%	339.5	25.3	mmBtu/hr	1.17E+02	40 CFR Part 98, Table C-1	NA	2,958.3	502
Backup Stripper Steam - No. 6 Oil	4.7%	416.0	No. 6 Oil[D]	18.4%	76.5		100.0%	76.5	24.1	mmBtu/hr	1.66E+02	40 CFR Part 98, Table C-1	NA	3,993.0	153
CO2 PROJECTED ACTUAL EMISSIONS															**48,181**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**35,906**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - reserved.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

Project Emissior

Uncontrolled		Contrc
lb/hr	TPY	lb/hr
15,387.8	67,398.4	

Worst-case short-term (lb/hr) and long-t
to New Stripper operating, with stripper

SUMMARY OF ASB EMISSIONS FACTORS

Scenario	ASB Emissions Factors (lb/ODTP)							
	H_2S	DMDS	DMS	MMC	TRS as H_2S	Methanol	VOC[A]	TRS[B]
Baseline Actual Emissions	0.0151	0.0114	0.0185	3.28E-04	3.37E-02	0.89	0.95	0.0453
New Stripper Scenario	0.0103	0.0028	0.0136	1.88E-04	1.99E-02	0.30	0.32	0.0269
Backup Stripper Scenario	0.0109	0.0033	0.0147	1.30E-03	2.23E-02	1.53	1.59	0.0302
No Stripper Scenario	0.0106	0.0504	0.0192	7.42E-04	5.81E-02	2.31	2.44	0.0809

A - Includes VOC TRS compounds, methanol, acetaldehyde, methyl ethyl ketone, and propionaldehyde.

B - TRS as compounds

Stripper Inlet Foul Condensate - Table 2-17 (Weston report dated October 2, 2021, Work Order No. 15730.001.008)

		Concentration (ppm)				
Date	**Sample Time**	**Hydrogen Sulfide**	**Methyl Mercaptan**	**Dimethyl Sulfide**	**Dimethyl Disulfide**	**Total TRS**
6/24/2021	15:10	130	14	16	13	173
6/24/2021	15:10	140	14	16	17	187
6/24/2021	17:00	140	17	18	14	189
6/24/2021	18:45	150	19	18	16	203
6/25/2021	10:35	130	12	12	11	165
6/25/2021	12:05	120	10	12	9.6	151.6
6/25/2021	13:45	190	22	22	23	257
Average of all data		142.9	15.4	16.3	14.8	189.4
Max of 6/24 or 6/25		146.7	16.0	17.0	15.0	194.7

		MW	
H2S	Hydrogen Sulfide	34.08	g/mol
Ch4S	Methyl Mercaptan	48.11	g/mol
C2H6S	Dimethyl Sulfide	62.13	g/mol
C2H6S2	Dimethyl Disulfide	94.20	g/mol
S	Sulfur	32.07	g/mol

Convert compound to equivalent S (ppm)

Hydrogen Sulfide	Methyl Mercaptan	Dimethyl Sulfide	Dimethyl Disulfide
138.0	10.7	8.8	10.2
82.3%	6.4%	5.2%	6.1%

S (ppm)	168	Maximum feed to stripper (AHL)
Lb S/gallon FC	1.40E-03	
Lb S/hr @850 gpm	71.3	
Lb S/ADTP (@2200 ODTP)[a]	0.7001	

[a] Conservative Lb S/ADTP emissions factor using 2200 ODTP (2200 ODTP * ADTP/0.9 ODTP = 2444.4 ADTP) Emissions factor is representative of the lower end of the range of pulp production at the maximum steam stripper design of 850 gpm. Calculations are scaled to 2700 ADTP to represent worst case emissions.

Assumption
1. Assume no losses in feed tank
2. Assume 98% efficiency of S across stripper therefore 0.69 # S/ADTP in SOG

CONFIDENTIAL **TAB M - New-Indy Catawba Monthly Production**

Month	Kraft Mill ADTP	Combination Boiler No. 1 Natural Gas mmBtu	Combination Boiler No. 2 Natural Gas mmBtu	Total Natural Gas mmBtu	Combination Boiler No. 1 No. 6 Fuel Oil gallons	Combination Boiler No. 2 No. 6 Fuel Oil gallons	Total No. 6 Fuel Oil gallons	Total No. 6 Fuel Oil mmBtu		
Mar-21	42,474	61,175	99,507	160,683	0	2,057	2,057	309	1,370	
Apr-21	43,075	41,363	75,012	116,376	0	0	0	0	1,436	
May-21	46,962	38,834	63,467	102,301	0	0	0	0	1,515	
Jun-21	42,867	1,909	59,909	61,818	0	1,199	1,199	180	1,429	
Jul-21	49,371	67,565	55,824	123,389	3	97	100	15	1,593	
Aug-21	44,614	33,863	32,461	66,325	0	0	0	0	1,439	
Sep-21	40,177	40,779	41,811	82,590	86	0	86	13	1,339	
Oct-21	47,234	69,732	75,498	145,230	0	0	0	0	1,524	
Nov-21	39,185	60,664	80,397	141,061	0	0	0	0	1,306	
Dec-21	38,734	62,931	60,176	123,107	0	0	0	0	1,249	
Jan-22	43,690	84,088	82,251	166,339	69,200	66,720	135,920	20,388	1,409	
Feb-22	37,736	57,764	75,924	133,688	27,042	370	27,412	4,112	1,348	
Mar-22	43,944	62,423	82,083	144,506	335	0	335	50	1,418	
Apr-22	40,046	44,634	62,835	107,469	0	0	0	0	1,335	
May-22	38,896	39,982	73,918	113,900	0	0	0	0	1,255	
Jun-22	23,184	43,071	89,239	132,310	2,238	0	2,238	336	773	
Jul-22	39,890	64,532	86,134	150,666	0	0	0	0	1,287	
Aug-22	53,396	48,067	73,591	121,658	0	0	0	0	1,722	
Sep-22	45,044	60,782	65,899	126,681	24	0	24	4	1,501	
Oct-22	47,517	70,539	89,760	160,299	0	0	0	0	1,533	
Nov-22	40,133	82,534	114,164	196,698	0	0	0	0	1,338	
Dec-22	33,859	101,466	95,023	196,490	170,076	0	170,076	25,511	1,092	
Jan-23	35,464	95,982	92,733	188,715	102,558	0	102,558	15,384	1,144	996,766
Feb-23	39,276	78,431	96,813	175,244	21,626	53	21,679	3,252	1,403	498,383
Total	996,766			3,237,544				69,553		
Annual Average	498,383									
				97.9%				2.1%		

New Indy Catawba ASB BAE Methanol Emissions Factor **REVISED June 7 Response**

Month	Pulp Production ADTP	Pulp Production ODTP	Methanol Emissions Factor lb/ODTP	Emissions Factor Reference
Mar-21	42,474	38,226	1.50	Average of 2021 Subpart S Performance Tests. Representative of ASB operation from March 2021 to February 2022.
Apr-21	43,075	38,767	1.50	
May-21	46,962	42,266	1.50	
Jun-21	42,867	38,581	1.50	
Jul-21	49,371	44,434	1.50	
Aug-21	44,614	40,152	1.50	
Sep-21	40,177	36,159	1.50	
Oct-21	47,234	42,510	1.50	
Nov-21	39,185	35,266	1.50	
Dec-21	38,734	34,860	1.50	
Jan-22	43,690	39,321	1.50	
Feb-22	37,736	33,962	0.33	Average of 2022 Subpart S Performance Tests. Representative of ASB operation from February 2022 to February 2023.
Mar-22	43,944	39,549	0.33	
Apr-22	40,046	36,041	0.33	
May-22	38,896	35,006	0.33	
Jun-22	23,184	20,866	0.33	
Jul-22	39,890	35,901	0.33	
Aug-22	53,396	48,057	0.33	
Sep-22	45,044	40,539	0.33	
Oct-22	47,517	42,765	0.33	
Nov-22	40,133	36,120	0.33	
Dec-22	33,859	30,474	0.33	
Jan-23	35,464	31,918	0.33	
Feb-23	39,276	35,348	0.33	
Baseline Methanol Emissions Factor (Pulp Weighted Average)			**0.89**	**lb/ODTP**

Additional information added to spreadsheet on 6/16/2023.

BAE Other VOC Emissions Factors

Date of Subpart S Performance Testing	Acetadehyde, ppm	MEK, ppm	Prop., ppm
7/9/2021	24.3	7.7	1.1
7/10/2021	25.3	5.7	4.0
7/11/2021	25.0	6.5	7.0
10/26/2021	25.0	12.3	0.8
10/27/2021	27.5	13.3	1.0
10/28/2021	10.6	6.6	1.2
10/29/2021	15.0	8.6	0.9
2/14/2022	16.7	7.5	0.7
2/15/2022	17.0	9.5	0.6
2/16/2022	15.7	8.6	1.0
5/4/2022	20.7	7.1	1.0
5/5/2022	16.3	7.3	1.0
5/6/2022	15.0	6.8	1.0
8/9/2022	15.3	5.9	0.7
8/10/2022	25.0	7.2	1.1
8/11/2022	20.3	6.0	1.0
9/27/2022	14.3	5.3	0.7
9/28/2022	15.0	5.2	0.7
9/29/2022	18.0	5.6	0.9
10/18/2022	25.0	5.6	1.0
10/19/2022	23.7	5.5	1.1
10/20/2022	23.0	6.6	0.9
AVG ppm:	**19.72**	**7.28**	**1.34**
Lbs into ASB	55.48	20.49	3.78
Fair estimated from WATER9 properties	0.55	0.38	0.43
Lbs emitted	30.73	7.73	1.61
Average Pulp Production during Subpart S testing	1716		
lb/ODTP	**0.018**	**0.005**	**0.001**

PAE Other VOC Emissions Factors

	BAE lb/ODTP	New Stripper	PAE lb/ODTP Backup Stripper	No Stripper
Methanol	0.89	0.30	1.53	2.31
Acetadehyde	0.018	0.006	0.031	0.046
MEK	0.005	0.002	0.008	0.012
Propionaldehyde	0.001	0.000	0.002	0.002
DMDS	0.0114	0.0028	0.0033	0.0504
DMS	0.0185	0.0136	0.0147	0.0192
MMC	3.28E-04	1.88E-04	1.30E-03	7.42E-04
VOC:	**0.95**	**0.32**	**1.59**	**2.44**

October 2021 SO2 Testing - Weston

	Combination Boiler No. 1 Stack			Combination Boiler No. 2 Stack		
	NCG+SOG	NCG	SOG	NCG+SOG	NCG	SOG
ODTP/hr	77.3	79.0		91.1	92.9	
ADTP/hr	85.9	87.8		101.2	103.2	
lb SO2/hr	342.8	230.7		380.9	309.9	
lb SO2/ADTP	3.99	2.63	1.36	3.76	3.00	0.76

	Controlled Emissions		Sulfur Capture		Uncontrolled Emissions	
	Average lb SO2/ADTP	Maximum lb SO2/ADTP	Bark Ash[C] %	LVHC Scrubber %	Average lb SO2/ADTP	Maximum lb SO2/ADTP
SOG	1.06	1.36	20%	NA	1.33	1.70
NCG	2.82	3.00				
LVHC[A,B]	1.97	2.10	20%	50%	4.92	5.25
HVLC[A,B]	0.85	0.90	20%	NA	1.06	1.13

A - NCG gases include LVHC gases and HVLC gases.

B - NCG gases split using ratio of controlled SO2 emissions from LVHC (1.10 lb SO2/ADTP) and HVLC (0.473 lb SO2/ADTP) from Project Columbia Application (July 2019 and April 2020 Addendum - Attachment C).

C - Estimated sulfur capture based on 2012 stack test (NCASI data suggests ~32% capture).

TABLE 2-2
NO. 1 COMBINATION BOILER
CONDITION 1: NCG AND SOG GASES
SUMMARY OF SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	10/13/21	10/13/21	10/13/21	----
Time Began	0844	1029	1206	----
Time Ended	0944	1129	1306	----
Stack Gas Data				
Temperature, °F	430	435	438	434
Velocity, ft/sec	64	63	63	63
Moisture, %	17	17	17	17
CO_2 Concentration, %	8.8	9.0	8.6	8.8
O_2 Concentration, %	10.5	10.5	10.8	10.6
VFR, x 10^5 dscfm	1.46	1.45	1.44	1.45
Sulfur Dioxide				
Concentration, ppm	280	227	204	237
Emission Rate, lb/hr	407.4	328.3	292.6	342.8

TABLE 2-3
NO. 1 COMBINATION BOILER
CONDITION 2: NCG GASES ONLY
SUMMARY OF SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	10/13/21	10/13/21	10/13/21	----
Time Began	1407	1544	1714	----
Time Ended	1507	1644	1814	----
Stack Gas Data				
Temperature, °F	447	450	444	447
Velocity, ft/sec	61	62	63	62
Moisture, %	17	18	16	17
CO_2 Concentration, %	9.6	9.9	8.9	9.5
O_2 Concentration, %	10.1	9.8	10.7	10.2
VFR, x 10^5 dscfm	1.37	1.39	1.43	1.40
Sulfur Dioxide				
Concentration, ppm	140	176	180	165
Emission Rate, lb/hr	191.3	243.6	257.0	230.7

Combination Boiler #1

Condition 1: With NCGs, with SOGs
13-Oct-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	Pulp KAPPA
1	0844	262.3	29.9	126.9	1.23	40	10.9	511	230	1407	1103	10851	77.3	82.7
2	1029	266.3	33.0	109.1	1.23	40	10.9	505	213	1409	1200	10885	77.3	85.7
3	1206	257.2	32.6	100.4	1.23	40	10.9	504	2	1443	1206	10963	77.3	84.8
Average:		261.9	31.8	112.1	1.23	40	10.9	507	148	1420	1170	10900	77.3	84.4

Condition 2: With NCGs, without SOGs
13-Oct-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	Pulp KAPPA
1	1407	267.7	34.0	102.0	1.23	40	10.9	506	2	1416	[redacted]	11071	79.0	83.9
2	1544	272.9	34.8	101.3	1.23	40	10.9	504	252	1414	[redacted]	10976	79.0	81.6
3	1714	256.9	30.05	115.96	1.23	40	10.9	505	183	1430	[redacted]	11061	79.0	80.3
Average:		265.8	33.0	106.4	1.23	40	10.9	505	146	1420	[redacted]	11036	79.0	81.9

TABLE 2-4
NO. 2 COMBINATION BOILER
CONDITION 1: NCG AND SOG GASES
SUMMARY OF SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	10/14/21	10/14/21	10/14/21	----
Time Began	0830	1026	1222	----
Time Ended	0930	1126	1322	----
Stack Gas Data				
Temperature, °F	463	477	465	469
Velocity, ft/sec	63	68	61	64
Moisture, %	17	19	16	17
CO_2 Concentration, %	8.2	9.5	7.5	8.4
O_2 Concentration, %	10.8	10.1	11.5	10.8
VFR, x 10^5 dscfm	1.40	1.43	1.35	1.39
Sulfur Dioxide				
Concentration, ppm	275	262	286	274
Emission Rate, lb/hr	383.7	373.7	385.4	380.9

TABLE 2-5
NO. 2 COMBINATION BOILER
CONDITION 2: NCG GASES ONLY
SUMMARY OF SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	10/14/21	10/14/21	10/14/21	----
Time Began	1410	1547	1725	----
Time Ended	1510	1647	1825	----
Stack Gas Data				
Temperature, °F	457	461	460	459
Velocity, ft/sec	59	59	58	59
Moisture, %	15	15	15	15
CO_2 Concentration, %	7.2	7.6	7.0	7.3
O_2 Concentration, %	11.9	11.2	11.7	11.6
VFR, x 10^5 dscfm	1.33	1.33	1.33	1.33
Sulfur Dioxide				
Concentration, ppm	235	234	232	234
Emission Rate, lb/hr	311.3	311.0	307.4	309.9

Combination Boiler #2

Condition 1: With NCGs, with SOGs
14-Oct-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	Pulp KAPPA
1	0830	241	29.8	188.7	1.23	40	10.9	505	209	1409	1203	11071	91.1	94.5
2	1026	251	46.3	115.6	1.23	40	10.9	504	200	1420	1179	11160	91.1	88.2
3	1222	211	25.4	171.4	1.23	40	10.9	505	199	1429	1157	11090	91.1	80.7
Average:		234	33.8	158.6	1.23	40	10.9	505	203	1419	1180	11107	91.1	87.8

Condition 2: With NCGs, without SOGs
14-Oct-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	Pulp KAPPA
1	1410	198	21.7	174.8	1.23	40	10.9	505	209	1438	[redacted]	11109	92.9	78.8
2	1547	218	35.4	206.4	1.23	40	10.9	505	224	1435		11060	92.9	78.7
3	1725	214	49.6	220.6	0.65	40	10.9	505	262	1453		10977	92.9	79.3
Average:		210	35.6	200.6	1.04	40	10.9	505	232	1442		11049	92.9	

15730.001.009
#1-2 CBs SO_2
Emission Report

June 2021 TRS_H2S Testing - Weston

TRS as TRS	Combination Boiler No. 1 Stack NCG+SOG	NCG	SOG	Combination Boiler No. 2 Stack NCG+SOG	NCG	SOG
ODTP/hr	55.9	76.0		88.3	85.2	
ADTP/hr	62.1	84.4		98.1	94.7	
lb TRS (as H2S)/hr	0.75	0.68		0.85	0.92	
lb TRS (as TRS)/hr	1.07	0.97		1.22	1.32	
lb TRS (as TRS)/ADTP	1.73E-02	1.15E-02	5.75E-03	1.24E-02	1.39E-02	-1.51E-03

H2S	Combination Boiler No. 1 Stack NCG+SOG	NCG	SOG	Combination Boiler No. 2 Stack NCG+SOG	NCG	SOG
ODTP/hr	55.9	76.0		88.3	85.2	
ADTP/hr	62.1	84.4		98.1	94.7	
lb H2S/hr	0.07	0.05		0.07	0.04	
lb H2S/ADTP	1.13E-03	5.92E-04	5.35E-04	7.13E-04	4.23E-04	2.91E-04

TRS as TRS	Controlled Emissions Average lb TRS/ADTP	Maximum lb TRS/ADTP	Sulfur Conversion Combustion %	LVHC Scrubber %	Uncontrolled Emissions Average lb TRS/ADTP	Maximum lb TRS/ADTP
SOG[D]	2.88E-03	5.75E-03	99%	NA	0.29	0.58
NCG	1.27E-02	1.39E-02				
LVHC[A,B]	8.01E-03	8.76E-03	99%	50%	1.60	1.75
HVLC[A,B]	4.69E-03	5.13E-03	99%	NA	0.47	0.51

H2S	Controlled Emissions Average lb H2S/ADTP	Maximum lb H2S/ADTP	Sulfur Conversion Combustion %	LVHC Scrubber %	Uncontrolled Emissions Average lb H2S/ADTP	Maximum lb H2S/ADTP
SOG	4.13E-04	5.35E-04	99%	NA	4.13E-02	5.35E-02
NCG	5.07E-04	5.92E-04				
LVHC[A,C]	5.03E-04	5.87E-04	99%	50%	1.01E-01	1.17E-01
HVLC[A,C]	4.45E-06	5.19E-06	99%	NA	4.45E-04	5.19E-04

A - NCG gases include LVHC gases and HVLC gases.
B - NCG gases split using ratio of controlled TRS emissions from LVHC (8.97E-3 lb TRS/ADTP) and HVLC (5.25E-3 lb TRS/ADTP) from Project Columbia Application (July 2019 and April 2020 Addendum - Attachment C).
C - NCG gases split using ratio of controlled H2S emissions from LVHC (3.82E-3 lb H2S/ADTP) and HVLC (3.38E-5 lb H2S/ADTP) from Project Columbia Application (July 2019 and April 2020 Addendum - Attachment C).
D - Combination Boiler No. 2 SOG averaged as zero (0).

TRS as S		MW	CB1 NCG+SOG Run 1	Run 2	Run 3	CB1 NCG Run 1	Run 2	Run 3	CB2 NCG+SOG Run 1	Run 2	Run 3	CB2 NCG Run 1	Run 2	Run 3	AVG		PLC Cross Check back to TRS as H2S	
sulfur	S	32.065																
hydrogen sulfide	H_2S	34.081	0.08	0.07	0.1	0.07	0.07	0.07	0.08	0.08	0.08	0.05	0.05	0.05	0.07	8.0%	0.085742	0.085742
methyl mercaptan	CH_4S	48.107	0.55	0.53	0.49	0.52	0.52	0.53	0.77	0.63	0.64	0.94	0.91	0.69	0.64	72.6%	0.778738	0.55169
dimethyl sulfide	C_2H_6S	62.134	0.16	0.16	0.16	0.16	0.16	0.17	0.08	0.08	0.08	0.08	0.07	0.07	0.12	13.5%	0.144248	0.079121
dimethyl disulfide	$C_2H_6S_2$	94.199	0.07	0.07	0.07	0.07	0.07	0.07	0.04	0.04	0.04	0.03	0.03	0.03	0.05	5.9%	0.06355	0.045984
															0.89	Total TRS	1.072278	0.762538
															84.8%			

10^6 ACFM Flowrate Basis to lb/min													
H_2S	0.007081766	0.006196545	0.008852208	0.006196545	0.006196545	0.006196545	0.007081766	0.007081766	0.007081766	0.004426104	0.004426104	0.004426104	
CH_4S	0.068724286	0.066225221	0.061227091	0.064975688	0.064975688	0.066225221	0.096214	0.078720545	0.079970078	0.117456052	0.113707455	0.08621774	
C_2H_6S	0.025821922	0.025821922	0.025821922	0.025821922	0.025821922	0.027435792	0.012910961	0.012910961	0.012910961	0.012910961	0.011297091	0.011297091	
$C_2H_6S_2$	0.017127091	0.017127091	0.017127091	0.017127091	0.017127091	0.017127091	0.009786909	0.009786909	0.009786909	0.007340182	0.007340182	0.007340182	
TRS as H2S	0.082325532	0.07966987	0.078784649	0.078784649	0.078784649	0.080555091	0.089407299	0.077014208	0.077899429	0.100029948	0.096489065	0.077014208	
TRS as TRS	0.118755065	0.115370779	0.113028312	0.114121247	0.114121247	0.116984649	0.125993636	0.108500182	0.109749714	0.142133299	0.136770831	0.109281117	
Ratio TRS as H2S/TRS a	0.693238074	0.690555015	0.697034647	0.690359171	0.690359171	0.688595396	0.709617575	0.709807177	0.70979163	0.703775603	0.705479846	0.704734816	0.69944568
													1.43

TABLE 2-11
NO. 1 COMBINATION BOILER
CONDITION 1: NCG AND SOG GASES
SUMMARY OF H_2S, TOTAL TRS, AND SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	6/23/21	6/23/21	6/23/21	—
Time Began	1158	1400	1541	—
Time Ended	1258	1500	1641	—
Stack Gas Data				
Temperature, °F	415	418	415	416
Velocity, ft/sec	59	57	57	57
Moisture, %	17	18	16	17
CO_2 Concentration, %	7.8	8.4	7.7	8.0
O_2 Concentration, %	12.1	11.4	12.0	11.8
VFR, x 10^5 dscfm	1.35	1.31	1.33	1.33
Hydrogen Sulfide				
Concentration, ppm	0.09	0.08	0.12	0.10
Emission Rate, lb/hr	0.07	0.06	0.08	0.07
Total Reduced Sulfur				
Concentration, ppm	1.09	1.07	1.03	1.06
Emission Rate, lb/hr	0.78	0.74	0.73	0.75
Sulfur Dioxide				
Concentration, ppm	195	278	344	272
Emission Rate, lb/hr	262.7	362.5	457.4	360.9

TABLE 2-12
NO. 1 COMBINATION BOILER
CONDITION 2: NCG GASES ONLY
SUMMARY OF H_2S, TOTAL TRS, AND SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	6/23/21	6/23/21	6/23/21	—
Time Began	1824	2019	2202	—
Time Ended	1924	2119	2302	—
Stack Gas Data				
Temperature, °F	416	411	415	414
Velocity, ft/sec	56	56	56	56
Moisture, %	16	16	17	17
CO_2 Concentration, %	8.3	7.8	8.1	8.1
O_2 Concentration, %	11.4	11.9	11.6	11.6
VFR, x 10^5 dscfm	1.30	1.31	1.30	1.30
Hydrogen Sulfide				
Concentration, ppm	0.08	0.08	0.08	0.08
Emission Rate, lb/hr	0.05	0.05	0.05	0.05
Total Reduced Sulfur				
Concentration, ppm	0.97	0.98	0.99	0.98
Emission Rate, lb/hr	0.67	0.68	0.68	0.68
Sulfur Dioxide				
Concentration, ppm	313	348	349	337
Emission Rate, lb/hr	404.4	452.9	450.8	436.1

Combination Boiler #1

Condition 1: With NCGs, with SOGs
23-Jun-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	SO_2 Emissions (lbs/hr)	SO_2 Emissions (lbs/ODT Pulp)	TRS Emissions (lbs/hr)
1	1158	208	25.1	80.8	1.37	40	10.9	458	146	1585	621	11575	49.7	262.7	5.29	0.56
2	1400	225	29.3	68.8	1.37	40	10.9	491	152	1595	1219	11048	54.0	362.5	6.71	0.49
3	1541	207	24.8	81.2	1.37	40	10.9	491	45	1578	1136	11009	64.0	457.4	7.15	0.50
Average:		213	26.4	76.9	1.37	40	10.9	480	114	1586	992	11211	55.9	360.9	6.46	0.52

Condition 2: With NCGs, without SOGs
23-Jun-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	SO_2 Emissions (lbs/hr)	SO_2 Emissions (lbs/ODT Pulp)	TRS Emissions (lbs/hr)
1	1824	230	26.3	94.9	1.37	40	10.9	489	123	1587	[redacted]	10515	74.1	404.4	5.46	0.43
2	2019	216	23.7	97.5	1.37	40	10.9	491	184	1593		10377	74.7	452.9	6.06	0.42
3	2202	220	25.2	92.4	1.37	40	10.9	490	152	1570		10573	79.2	450.8	5.69	0.46
Average:		222	25.1	94.9	1.37	40	10.9	490	153	1583		10488	76.0	436.1	5.74	0.44

TABLE 2-13
NO. 2 COMBINATION BOILER
CONDITION 1: NCG AND SOG GASES
SUMMARY OF H_2S, TOTAL TRS, AND SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	6/24/21	6/24/21	6/24/21	----
Time Began	1445	1630	1806	----
Time Ended	1545	1730	1906	----
Stack Gas Data				
Temperature, °F	475	474	479	476
Velocity, ft/sec	69	69	69	69
Moisture, %	14	14	15	14
CO_2 Concentration, %	6.6	6.9	7.3	6.9
O_2 Concentration, %	13.1	12.7	12.3	12.7
VFR, x 10^5 dscfm	1.57	1.56	1.54	1.56
Hydrogen Sulfide				
Concentration, ppm	0.09	0.09	0.09	0.09
Emission Rate, lb/hr	0.07	0.07	0.07	0.07
Total Reduced Sulfur				
Concentration, ppm	1.13	0.97	0.97	1.02
Emission Rate, lb/hr	0.94	0.80	0.80	0.85
Sulfur Dioxide				
Concentration, ppm	324	327	322	324
Emission Rate, lb/hr	508.7	507.2	496.1	504.0

TABLE 2-14
NO. 2 COMBINATION BOILER
CONDITION 2: NCG GASES ONLY
SUMMARY OF H_2S, TOTAL TRS, AND SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	6/25/21	6/25/21	6/25/21	----
Time Began	1000	1135	1315	----
Time Ended	1100	1235	1415	----
Stack Gas Data				
Temperature, °F	468	470	481	473
Velocity, ft/sec	68	69	69	69
Moisture, %	14	14	14	14
CO_2 Concentration, %	6.9	6.8	7.3	7.0
O_2 Concentration, %	12.8	12.7	12.3	12.6
VFR, x 10^5 dscfm	1.56	1.55	1.56	1.56
Hydrogen Sulfide				
Concentration, ppm	0.05	0.05	0.05	0.05
Emission Rate, lb/hr	0.04	0.04	0.04	0.04
Total Reduced Sulfur				
Concentration, ppm	1.22	1.18	0.94	1.11
Emission Rate, lb/hr	1.01	0.97	0.78	0.92
Sulfur Dioxide				
Concentration, ppm	247	245	235	242
Emission Rate, lb/hr	383.2	380.0	366.2	376.4

Combination Boiler #2

Condition 1: With NCGs, with SOGs
24-Jun-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	SO_2 Emissions (lbs/hr)	SO_2 Emissions (lbs/ODT Pulp)	TRS Emissions (lbs/hr)
1	1445	219	39.0	125.3	1.37	40	10.9	491	190	1572	1231	10253	87.8	508.7	5.79	0.77
2	1630	224	31.1	146.4	1.37	40	10.9	490	186	1576	1231	10277	88.6	507.2	5.72	0.63
3	1806	241	33.6	146.4	1.37	40	10.9	490	190	1580	1231	10300	88.6	496.1	5.60	0.63
Average:		228	34.6	139.4	1.37	40	10.9	490	189	1576	1231	10277	88.3	504.0	5.71	0.68

Condition 2: With NCGs, without SOGs
25-Jun-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	SO_2 Emissions (lbs/hr)	SO_2 Emissions (lbs/ODT Pulp)	TRS Emissions (lbs/hr)
1	1000	234	35.7	132.7	1.37	40	10.9	482	155	1579	[redacted]	10475	87.2	383.2	4.39	0.86
2	1135	225	30.8	147.8	1.37	40	10.9	479	252	1573	[redacted]	10425	84.3	380.0	4.51	0.82
3	1315	245	30.6	141.7	1.37	40	10.9	482	97	1571	[redacted]	10500	84.2	366.2	4.35	0.63
Average:		235	32.4	140.7	1.37	40	10.9	481	168	1574	[redacted]	10467	85.2	376.4	4.42	0.77

NEW-INDY CATAWBA MILL STRIPPER PROJECT

Stripper Operating Scenario	Operating Time %	Operating Time hrs
New Stripper Online	90%	7,884.0
Backup Stripper Online	4.75%	416.0
No Stripper Online	5.25%	460.0

LVHC Control Operating Scenario	Operating Time %	Operating Time hrs
RF3 Available for LVHC	75%	6,570.0
LVHC to CB1/CB2	25%	2,190.0

Summary of PSD Applicability
(tons/year)

Pollutant[A]	PM	PM_{10}	$PM_{2.5}$	NO_X	SO_2	CO	H2SO4	TRS
Baseline Actual Emissions	1.11	1.02	0.959	124	737	25.2	1.23	12.8
Projected Actual Emissions	13.3	10.3	8.37	148	646	62.8	2.43	16.7
Net Emissions Changes (PAE - BAE)	12.2	9.32	7.41	23.8	-91.2	37.6	1.20	3.94
PSD Significant Emissions Rates	**25**	**15**	**10**	**40**	**40**	**100**	**7**	**10**
PSD Significant?	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**

A - HF is not emitted from new, modified, or affected emissions units.

VOC	Pb	H_2S	CO_2
233	1.10E-04	3.61	12,275
260	2.06E-03	5.59	48,200
26.8	1.95E-03	1.98	35,925
40	**0.6**	**10**	**75,000**
No	**No**	**No**	**No**

SO2 EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time	
	%	hrs		%	hrs
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100%	8,004.0
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B,E]	97.9%	7,835.7
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B,E]	2.1%	168.3
SO2 BASELINE ACTUAL EMISSIONS (BAE)					
New Stripper Online	90.0%	7,884.0	SRL Online	95%	7,489.8
New Stripper Online	90.0%	7,884.0	SRL Online	95%	7,489.8
New Stripper Online	90.0%	7,884.0	SRL Online	95%	7,489.8
New Stripper Online	90.0%	7,884.0	SRL Offline	5%	394.2
Backup Stripper Online [H]	4.75%	416.0	NA	100%	416.0
No Stripper Online	5.25%	460.0	Foul Condensate to Hard Pipe	100%	460.0
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D,F]	81.6%	6,433.3
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D,F]	18.4%	1,450.7
Backup Stripper Steam - Natural Gas [J]	4.75%	416.0	Natural Gas[D,F]	81.6%	339.5

Backup Stripper Steam - No. 6 Oil [J]	4.75%	416.0	No. 6 Oil[D,F]	18.4%	76.5
SO2 PROJECTED ACTUAL EMISSIONS (PAE)					
NET EMISSIONS CHANGE (PAE - BAE)					

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in

C - Sulfur capture in recovery furnace >99, sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - The Backup Stripper operating in Methanol Mode would potentially strip less sulfur, but SOG emissions are conservatively base

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

J - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

H - Project Columbia SO2 emissions factor from NCG Combustion applied to October 2021 stack test SO2 emissions distribution be

Controls	Controls Operating Time		Production Rate		
	%	hrs	Value	UOM	lb/UOM
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)					
SOG to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	1.06
LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	1.97
NA	100.0%	7,835.7	26.0	mmBtu/hr	6.00E-04
NA	100.0%	168.3	24.8	mmBtu/hr	2.20E+00

PROJECTED ACTUAL EMISSIONS					
SRL Methanol to RF2/3[G]	100.0%	7,489.8	2,700	ADTP/day	0.56
SRL LVHC to RF3[G]	75.0%	5,617.4	2,700	ADTP/day	0.84
SRL LVHC to CB1/CB2[G]	25.0%	1,872.5	2,700	ADTP/day	0.84
SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	1.40
SOG to CB1/CB2	100.0%	416.0	2,700	ADTP/day	1.40
Hydrogen Peroxide Addition	100.0%	460.0	NA	NA	NA
LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	5.87
LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	5.87
NA	100.0%	985.5	1.0	mmBtu/hr	6.00E-04
NA	100.0%	6,433.3	96.8	mmBtu/hr	6.00E-04
NA	100.0%	1,450.7	92.2	mmBtu/hr	2.20E+00
NA	100.0%	339.5	26.0	mmBtu/hr	6.00E-04

NA	100.0%	76.5	24.8	mmBtu/hr	2.20E+00

NET EMISSIONS CHANGE (PAE - BAE)

Combination Boiliers No. 1 and No. 2 during baseline.

:d upon all of the sulfur being captured in the SOG.

tween LVHC, HVLC, and SOG.

SO2 Emissions Factor Reference	Sulfur Capture[C] %	SO2 Emissions lb/hr	SO2 Emissions tpy
October 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	60.4	241.8
October 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	112.0	490.6
AP-42 Table 1.4-2.	NA	0.02	0.1
AP-42 Table 1.3-1. 2.1% Sulfur Content.	NA	54.6	4.6
			737.0
Vendor / Preliminary Design Information	99%	0.6	2.4
Vendor / Preliminary Design Information	99%	0.9	2.7
Vendor / Preliminary Design Information	50%	47.2	44.2
Vendor / Preliminary Design Information	0%	157.4	31.0
Vendor / Preliminary Design Information	0%	157.4	32.7
NA	NA	NA	NA
Project Columbia Projected Emissions Factor[H], Combination Boilers No. 1 and No. 2 maximum. Pre-control emissions based on LVHC scrubber efficiency (50%) and estimated bark ash sulfur capture (20%) from 2012 stack test.	99%	6.6	21.7
Project Columbia Projected Emissions Factor[H], Combination Boilers No. 1 and No. 2 maximum. Pre-control emissions based on LVHC scrubber efficiency (50%) and estimated bark ash sulfur capture (20%) from 2012 stack test.	50%	330.3	361.7
AP-42 Table 1.4-2.	NA	0.00	0.0
AP-42 Table 1.4-2.	NA	0.06	0.2
AP-42 Table 1.3-1. 2.1% Sulfur Content.	NA	202.9	147.2
AP-42 Table 1.4-2.	NA	0.02	0.003

AP-42 Table 1.3-1. 2.1% Sulfur Content.	NA	54.6	2.1
			645.80
			-91.21

H2SO4 EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time	
	%	hrs		%	hrs
					BASELINE
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0
H2SO4 BASELINE ACTUAL EMISSIONS (BAE)					
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0
H2SO4 PROJECTED ACTUAL EMISSIONS (PAE)					
NET EMISSIONS CHANGE (PAE - BAE)					

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in

C - Sulfur capture in recovery furnace >99, sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

Controls	Controls Operating Time		Production Rate		H2SO4 Emissions Factor		Sulfur Capture
	%	hrs	Value	UOM	lb/ADTP	Reference	%
ACTUAL EMISSIONS (March 2021 - February 2023)							
LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	4.93E-03	NCASI Technical Bulletin 858, Table 10	NA
PROJECTED ACTUAL EMISSIONS							
LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	4.93E-03	NCASI Technical Bulletin 858, Table 10	NA
LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	4.93E-03	NCASI Technical Bulletin 858, Table 10	NA
NET EMISSIONS CHANGE (PAE - BAE)							

Combination Boiliers No. 1 and No. 2 during baseline.

H2SO4 Emissions	
lb/hr	tpy
0.3	1.2
	1.2
0.55	1.82
0.55	0.61
	2.43
	1.20

NOX EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time	
	%	hrs		%	hrs
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B,E]	97.9%	7,835.7
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B,E]	2.1%	168.3
NOX BASELINE ACTUAL EMISSIONS					
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8
New Stripper Online	90%	7,884.0	SRL Offline	5.0%	394.2
Backup Stripper Online [H]	4.75%	416.0	NA	100.0%	416.0
No Stripper Online	5.25%	460.0	Foul Condensate to Hard Pipe	100.0%	460.0
Recovery Furnace #3 LVHC Ignitor	75%	6,570.0	Natural Gas[I]	15.0%	985.5
New Stripper Steam - Natural Gas	90%	7,884.0	Natural Gas[D,F]	81.6%	6,433.3
New Stripper Steam - No. 6 Oil	90%	7,884.0	No. 6 Oil[D,F]	18.4%	1,450.7
Backup Stripper Steam - Natural Gas [J]	4.75%	416.0	Natural Gas[D]	81.6%	339.5
Backup Stripper Steam - No. 6 Oil [J]	4.75%	416.0	No. 6 Oil[D]	18.4%	76.5
NOX PROJECTED ACTUAL EMISSIONS					
PAE - BAE					

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Co

C - Ammonia input to recovery furnace increases >2% with maximum addition of SRL of 2% by volume (representative of ~1% by volu

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - >90% of methanol condensed and burned in recovery furnace, < 10% of methanol vented into LVHC System.

H - No change in NO_x emissions factor between Backup Stripper TRS mode and Methanol mode.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

J - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

Controls	Controls Operating Time		Production Rate		
	%	hrs	Value	UOM	lb/UOM
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)					
SOG to CB1/CB2	100%	8,004.0	1,365	ADTP/day	0.415
NA	100%	7,835.7	26.0	mmBtu/hr	2.80E-01
NA	100%	168.3	24.8	mmBtu/hr	3.13E-01
PROJECTED ACTUAL EMISSIONS					
SRL Methanol to RF2/3[G]	100%	7,489.8	2,852	TBLS/day	1.500
SRL LVHC to RF3[G]	75%	5,617.4	316.9	TBLS/day	1.500
SRL LVHC to CB1/CB2[G]	25%	1,872.5	270.0	ADTP/day	0.415
SOG to CB1/CB2	100%	394.2	2,700	ADTP/day	0.415
SOG to CB1/CB2	100%	416.0	2,700	ADTP/day	0.415
Hydrogen Peroxide Addition	100%	460.0	NA	NA	NA
NA	100%	985.5	1.0	mmBtu/hr	2.80E-01
NA	100%	6,433.3	96.8	mmBtu/hr	2.80E-01
NA	100%	1,450.7	92.2	mmBtu/hr	3.13E-01
NA	100%	339.5	26.0	mmBtu/hr	2.80E-01
NA	100%	76.5	24.8	mmBtu/hr	3.13E-01
NET EMISSIONS CHANGE (PAE - BAE)					

mbination Boilers No. 1 and No. 2 during baseline.

ıme pure methanol.)

NOX Emissions Factor Reference	Ammonia Increase[c] %	NOX Emissions lb/hr	tpy
July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	23.6	94.5
AP-42 Table 1.4-2.	NA	7.3	28.6
AP-42 Table 1.3-1.	NA	7.8	0.7
			123.72
NCASI Technical Bulletin 884, Table 4.12.	2.0%	3.6	13.4
NCASI Technical Bulletin 884, Table 4.12.	2.0%	0.4	1.1
July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	4.7	4.4
July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	46.7	9.2
July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	46.7	9.7
NA	NA	NA	NA
AP-42 Table 1.4-2.	NA	0.3	0.1
AP-42 Table 1.4-2.	NA	27.1	87.2
AP-42 Table 1.3-1.	NA	28.9	20.9
AP-42 Table 1.4-2.	NA	7.3	1.2
AP-42 Table 1.3-1.	NA	7.8	0.3
			147.54
			23.82

CO EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time	
	%	hrs		%	hrs
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3
CO BASELINE ACTUAL EMISSIONS					
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8
New Stripper Online	90%	7,884.0	SRL Offline	5.0%	394.2
Backup Stripper Online [C]	4.75%	416.0	NA	100.0%	416.0
No Stripper Online	5.25%	460.0	Foul Condensate to Hard Pipe	100.0%	460.0
Recovery Furnace #3 LVHC Ignitor	75%	6,570.0	Natural Gas[I]	15.0%	985.5
New Stripper Steam - Natural Gas	90%	7,884.0	Natural Gas[D]	81.6%	6,433.3
New Stripper Steam - No. 6 Oil	90%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7
Backup Stripper Steam - Natural Gas [G]	4.75%	416.0	Natural Gas[D]	81.6%	339.5
Backup Stripper Steam - No. 6 Oil [G]	4.75%	416.0	No. 6 Oil[D]	18.4%	76.5
CO PROJECTED ACTUAL EMISSIONS					
PAE - BAE					

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combi

C - No change in CO emissions factor between Backup Stripper TRS mode and Methanol mode.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

Controls	Controls Operating Time		Production Rate		
	%	hrs	Value	UOM	lb/UOM
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)					
SOG to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	0.0728
NA	100.0%	7,835.7	26.0	mmBtu/hr	8.40E-02
NA	100.0%	168.3	24.8	mmBtu/hr	3.33E-02
PROJECTED ACTUAL EMISSIONS					
SRL Methanol to RF2/3	100.0%	7,489.8	NA	NA	NA
SRL LVHC to RF3	75%	5,617.4	2,700	ADTP/day	0.0728
SRL LVHC to CB1/CB2	25%	1,872.5	2,700	ADTP/day	0.0728
SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	0.0728
SOG to CB1/CB2	100.0%	416.0	2,700	ADTP/day	0.0728
Hydrogen Peroxide Addition	100.0%	460.0	NA	NA	NA
NA	100.0%	985.5	1.0	mmBtu/hr	8.40E-02
NA	100.0%	6,433.3	96.8	mmBtu/hr	8.40E-02
NA	100.0%	1,450.7	92.2	mmBtu/hr	3.33E-02
NA	100.0%	339.5	26.0	mmBtu/hr	8.40E-02
NA	100.0%	76.5	24.8	mmBtu/hr	3.33E-02
NET EMISSIONS CHANGE (PAE - BAE)					

ination Boilers No. 1 and No. 2 during baseline.

CO Emissions Factor Reference	CO Control %	CO Emissions lb/hr	tpy
July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	4.1	16.6
AP-42 Table 1.4-2.	NA	2.2	8.6
AP-42 Table 1.3-1.	NA	0.8	0.1
			25.22
NA	NA	NA	NA
July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	8.2	23.0
July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	8.2	7.7
July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	8.2	1.6
July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	8.2	1.7
NA	NA	NA	NA
AP-42 Table 1.4-2.	NA	0.1	0.0
AP-42 Table 1.4-2.	NA	8.1	26.2
AP-42 Table 1.3-1.	NA	3.1	2.2
AP-42 Table 1.4-2.	NA	2.2	0.4
AP-42 Table 1.3-1.	NA	0.8	0.0
			62.81
			37.60

VOC EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time	
	%	hrs		%	hrs
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0
Aerated Stabilization Basin (ASB)	100.0%	8,760.0	Foul Condensate to Hard Pipe	100.0%	8,760.0
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3
VOC BASELINE ACTUAL EMISSIONS					
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8
New Stripper Online	90%	7,884.0	SRL Offline	5.0%	394.2
Backup Stripper Online (TRS Mode) [H]	4.75%	416.0	NA	100.0%	416.0
Backup Stripper Online (Methanol Mode) [H]	4.75%	416.0	NA	100.0%	416.0
ASB - New Stripper Online	90%	7,884.0	No Foul Condensate to Hard Pipe	100.0%	7,884.0
ASB - Backup Stripper Online (TRS Mode) [J]	4.75%	416.0	TRS Stripped From Foul Condensate	100.0%	416.0
ASB - Backup Stripper Online (Methanol Mode) [J]	4.75%	416.0	500 gpm Foul Condensate to Hard Pipe	100.0%	416.0
ASB - No Stripper Online	5.25%	460.0	Foul Condensate to Hard Pipe	100.0%	460.0
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0
Recovery Furnace #3 LVHC Ignitor	75%	6,570.0	Natural Gas[I]	15.0%	985.5
New Stripper Steam - Natural Gas	90%	7,884.0	Natural Gas[D]	81.6%	6,433.3
New Stripper Steam - No. 6 Oil	90%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7
Backup Stripper Steam - Natural Gas [K]	4.75%	416.0	Natural Gas[D]	81.6%	339.5

Backup Stripper Steam - No. 6 Oil [K]	4.75%	416.0	No. 6 Oil[D]	18.4%	76.5
VOC PROJECTED ACTUAL EMISSIONS					
PAE - BAE					

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers N

C - VOC destruction >98% in vapor phase, 99.9% in liquid phase.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - >90% of methanol condensed and burned in recovery furnace, < 10% of methanol vented into LVHC System.

H - The Backup Stripper operating in Methanol Mode result in higher SOG emissions, since more VOC are stripped.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

J - When the Backup Stripper is operating, ASB emissions are higher if the stripper is operating in methanol mode. Both emissions factors are shown in tl

K - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

Controls	Controls Operating Time %	hrs	Production Rate Value	UOM	lb/UOM
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)					
LVHC to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	4.35
NA	100.0%	8,760.0	1,365	ADTP/day	8.51E-01
LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	3.10E-03
NA	100.0%	7,835.7	26.0	mmBtu/hr	5.50E-03
NA	100.0%	168.3	24.8	mmBtu/hr	1.87E-03
PROJECTED ACTUAL EMISSIONS					
SRL Methanol to RF2/3[G]	100%	7,489.8	2,700	ADTP/day	14.40
SRL LVHC to RF3[G]	75%	5,617.4	2,700	ADTP/day	1.60
SRL LVHC to CB1/CB2[G]	25%	1,872.5	2,700	ADTP/day	1.60
SOG to CB1/CB2	100%	394.2	2,700	ADTP/day	16.00
SOG to CB1/CB2	100%	416.0	2,700	ADTP/day	7.20
SOG to CB1/CB2	100%	416.0	2,700	ADTP/day	16.00
NA	100%	7,884.0	2,700	ADTP/day	0.29
NA	100%	416.0	2,700	ADTP/day	1.43
Hydrogen Peroxide Addition	100.0%	416.0	2,700	ADTP/day	1.54
NA	100%	460.0	2,700	ADTP/day	2.20
LVHC to RF3	75%	6,570.0	2,700	ADTP/day	3.10E-03
LVHC to CB1/CB2	25%	2,190.0	2,700	ADTP/day	3.10E-03
NA	100%	985.5	1.0	mmBtu/hr	5.50E-03
NA	100%	6,433.3	96.8	mmBtu/hr	5.50E-03
NA	100%	1,450.7	92.2	mmBtu/hr	1.87E-03
NA	100%	339.5	26.0	mmBtu/hr	5.50E-03

NA	100%	76.5	24.8	mmBtu/hr	1.87E-03

NET EMISSIONS CHANGE (PAE - BAE)

No. 1 and No. 2 during baseline.

he table, but ASB emissions are based on methanol mode operation.

VOC Emissions Factor Reference	Removal[C] %	VOC Emissions lb/hr	tpy
Average daily methanol stripped based on daily Subpart S compliance through 2/28/2023.	98.0%	4.95	19.81
WATER9 Inputs and Outputs Provided.	NA	48.39	211.96
July 2019 Project Columbia Application. Page C-3 for Total LVHC Emissions.	NA	0.18	0.77
AP-42 Table 1.4-2.	NA	0.1	0.6
AP-42 Table 1.3-3. NMTOC for no. 6 oil.	NA	0.0	0.0
			233.11
Vendor / Preliminary Design Information	99.9%	1.62	6.07
Vendor / Preliminary Design Information	98%	3.60	10.11
Vendor / Preliminary Design Information	98%	3.60	3.37
Vendor / Preliminary Design Information	98%	36.00	7.10
Vendor / Preliminary Design Information	98%		
Assume methanol mode captures all VOC in SOG	98%	36.00	7.49
WATER9 Inputs and Outputs Provided.	NA	32.85	129.50
WATER9 Inputs and Outputs Provided.	NA		
WATER9 Inputs and Outputs Provided.	NA	173.15	36.02
WATER9 Inputs and Outputs Provided.	NA	247.14	56.84
July 2019 Project Columbia Application. Page C-3 for Total LVHC Emissions.	NA	0.35	1.15
July 2019 Project Columbia Application. Page C-3 for Total LVHC Emissions.	NA	0.35	0.38
AP-42 Table 1.4-2.	NA	5.50E-03	2.71E-03
AP-42 Table 1.4-2.	NA	0.5	1.7
AP-42 Table 1.3-3. NMTOC for no. 6 oil.	NA	0.2	0.1
AP-42 Table 1.4-2.	NA	0.1	0.0

AP-42 Table 1.3-3. NMTOC for no. 6 oil.	NA	0.0	0.0
			259.88
			26.78

TRS EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time	
	%	hrs		%	hrs
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0
Aerated Stabilization Basin (ASB)	100.0%	8,760.0	NA	100.0%	8,760.0
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0
TRS BASELINE ACTUAL EMISSIONS					
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8
New Stripper Online	90.0%	7,884.0	SRL Offline	5.0%	394.2
Backup Stripper Online [I]	4.75%	416.0	NA	100.0%	416.0
ASB - New Stripper Online	90.0%	7,884.0	No Foul Condensate to Hard Pipe	100.0%	7,884.0
ASB - Backup Stripper Online (TRS Mode) [J]	4.75%	416.0	TRS Stripped From Foul Condensate	100.0%	416.0
ASB - Backup Stripper Online (Methanol Mode) [J]	4.75%	416.0	500 gpm Foul Condensate to Hard Pipe	100.0%	416.0
ASB - No Stripper Online	5.25%	460.0	Foul Condensate to Hard Pipe	100.0%	460.0
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0
TRS PROJECTED ACTUAL EMISSIONS					

PAE - BAE

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers N

C - Sulfur capture in recovery furnace >99.9% (see note H), sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - Recovery Furnace captures 99% of sulfur and converts 99% of remaining uncaptured sulfur.

I - Backup Stripper SOG emissions are conservatively based upon all of the sulfur being captured in the SOG for both TRS mode and Methanol mode.

J - When the Backup Stripper is operating, ASB emissions are higher if the stripper is operating in methanol mode. Both emissions factors are shown in th

Controls	Controls Operating Time		Production Rate		
	%	hrs	Value	UOM	lb/UOM
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)					
LVHC to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	2.88E-03
NA	100.0%	8,760.0	1,365	ADTP/day	4.08E-02
LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	8.01E-03
PROJECTED ACTUAL EMISSIONS					
SRL Methanol to RF2/3[G,H]	100.0%	7,489.8	2,700	ADTP/day	0.33
SRL LVHC to RF3[G,H]	75.0%	5,617.4	2,700	ADTP/day	0.49
SRL LVHC to CB1/CB2[G]	25.0%	1,872.5	2,700	ADTP/day	0.49
SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	0.81
SOG to CB1/CB2	100.0%	416.0	2,700	ADTP/day	0.81
NA	100.0%	7,884.0	2,700	ADTP/day	2.42E-02
NA	100.0%	416.0	2,700	ADTP/day	2.72E-02
Hydrogen Peroxide Addition	100.0%	416.0	2,700	ADTP/day	5.24E-02
Hydrogen Peroxide Addition	100.0%	460.0	2,700	ADTP/day	7.28E-02
LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	1.75E+00
LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	8.76E-03
NET EMISSIONS CHANGE (PAE - BAE)					

lo. 1 and No. 2 during baseline.

ne table, but ASB emissions are based on methanol mode operation.

TRS Emissions Factor Reference	Sulfur Capture[C] %	TRS Emissions lb/hr	TRS Emissions tpy
June 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	0.16	0.65
H2SSIM/WATER9 Inputs and Outputs Provided.	NA	2.32	10.16
June 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	0.46	2.00
			12.81
Vendor / Preliminary Design Information	99.9%	0.04	0.14
Vendor / Preliminary Design Information	99.9%	0.05	0.15
Vendor / Preliminary Design Information	99%	0.55	0.51
Vendor / Preliminary Design Information	99%	0.91	0.18
Vendor / Preliminary Design Information	99%	0.91	0.19
H2SSIM/WATER9 Inputs and Outputs Provided.	NA	2.72	10.74
H2SSIM/WATER9 Inputs and Outputs Provided.	NA		
H2SSIM/WATER9 Inputs and Outputs Provided.	NA	5.89	1.23
H2SSIM/WATER9 Inputs and Outputs Provided.	NA	8.19	1.88
June 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. Pre-control emissions based on LVHC scrubber efficiency (50%) and estimated 99% combustion efficiency in combination boilers.	99.9%	0.20	0.65
June 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. DHEC Approved Test.	NA	0.99	1.08
			16.75

H2S EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time	
	%	hrs		%	hrs
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0
Aerated Stabilization Basin (ASB)	100.0%	8,760.0	Foul Condensate to Hard Pipe	100.0%	8,760.0
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0
H2S BASELINE ACTUAL EMISSIONS					
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8
New Stripper Online	90.0%	7,884.0	SRL Offline	5.0%	394.2
Backup Stripper Online [I]	4.75%	416.0	NA	100.0%	416.0
ASB - New Stripper Online	90.0%	7,884.0	No Foul Condensate to Hard Pipe	100.0%	7,884.0
ASB - Backup Stripper Online (TRS Mode) [J]	4.75%	416.0	H2S Stripped From Foul Condensate	100.0%	416.0
ASB - Backup Stripper Online (Methanol Mode) [J]	4.75%	416.0	500 gpm Foul Condensate to Hard Pipe	100.0%	416.0
ASB - No Stripper Online	5.25%	460.0	Foul Condensate to Hard Pipe	100.0%	460.0
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0
H2S PROJECTED ACTUAL EMISSIONS					
PAE - BAE					

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers N

C - Sulfur capture in recovery furnace >99.9% (see note H), sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - Recovery Furnace captures 99% of sulfur and converts 99% of remaining uncaptured sulfur.

I - Backup Stripper SOG emissions are conservatively based upon all of the sulfur being captured in the SOG for both TRS mode and Methanol mode.

J - When the Backup Stripper is operating, H2S ASB emissions are higher if the stripper is operating in TRS mode. Both emissions factors are shown in the

Controls	Controls Operating Time		Production Rate		
	%	hrs	Value	UOM	lb/UOM
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)					
LVHC to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	4.13E-04
Hydrogen Peroxide Addition	100.0%	8,760.0	1,365	ADTP/day	1.36E-02
LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	5.03E-04
PROJECTED ACTUAL EMISSIONS					
SRL Methanol to RF2/3[G,H]	100.0%	7,489.8	2,700	ADTP/day	0.24
SRL LVHC to RF3[G,H]	75.0%	5,617.4	2,700	ADTP/day	0.37
SRL LVHC to CB1/CB2[G]	25.0%	1,872.5	2,700	ADTP/day	0.37
SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	0.61
SOG to CB1/CB2	100.0%	416.0	2,700	ADTP/day	0.61
NA	100.0%	7,884.0	2,700	ADTP/day	9.27E-03
NA	100.0%	416.0	2,700	ADTP/day	9.81E-03
Hydrogen Peroxide Addition	100.0%	416.0	2,700	ADTP/day	9.45E-03
Hydrogen Peroxide Addition	100.0%	460.0	2,700	ADTP/day	9.54E-03
LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	1.17E-01
LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	5.87E-04
NET EMISSIONS CHANGE (PAE - BAE)					

Io. 1 and No. 2 during baseline.

e table, but ASB emissions are based on TRS mode operation.

H2S Emissions Factor	Sulfur Capture[C]	H2S Emissions	
Reference	%	lb/hr	tpy
June 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	0.02	0.09
H2SSIM/WATER9 Inputs and Outputs Provided.	NA	0.77	3.39
June 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	0.03	0.13
			3.61
Vendor / Preliminary Design Information	99.9%	0.03	0.10
Vendor / Preliminary Design Information	99.9%	0.04	0.12
Vendor / Preliminary Design Information	99%	0.41	0.39
Vendor / Preliminary Design Information	99%	0.69	0.14
Vendor / Preliminary Design Information	99%	0.69	0.14
H2SSIM/WATER9 Inputs and Outputs Provided.	NA	1.04	4.11
H2SSIM/WATER9 Inputs and Outputs Provided.	NA	1.10	0.23
H2SSIM/WATER9 Inputs and Outputs Provided.	NA		
H2SSIM/WATER9 Inputs and Outputs Provided.	NA	1.07	0.25
June 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. Pre-control emissions based on LVHC scrubber efficiency (50%) and estimated 99% combustion efficiency in combination boilers.	99.9%	0.01	0.04
June 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. DHEC Approved Test.	NA	0.07	0.07
			5.59
			1.98

PM EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time	
	%	hrs		%	hrs
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3
PM BASELINE ACTUAL EMISSIONS					
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7
Backup Stripper Steam - Natural Gas [C]	4.75%	416.0	Natural Gas[D]	81.6%	339.5
Backup Stripper Steam - No. 6 Oil [C]	4.75%	416.0	No. 6 Oil[D]	18.4%	76.5
PM PROJECTED ACTUAL EMISSIONS					
PAE - BAE					

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution i

C - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

Controls	Controls Operating Time		Production Rate		PM Emissions Factor	
	%	hrs	Value	UOM	lb/UOM	Reference
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)						
	100.0%	7,835.7	26.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.
	100.0%	168.3	24.8	mmBtu/hr	1.61E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).
PROJECTED ACTUAL EMISSIONS						
	100.0%	985.5	1.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.
	100.0%	6,433.3	96.8	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.
	100.0%	1,450.7	92.2	mmBtu/hr	1.61E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).
	100.0%	339.5	26.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.
	100.0%	76.5	24.8	mmBtu/hr	1.61E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).
NET EMISSIONS CHANGE (PAE - BAE)						

n Combination Boilers No. 1 and No. 2 during baseline.

PM Control	PM Emissions	
%	lb/hr	tpy
NA	0.2	0.8
NA	4.0	0.3
		1.1
NA	7.60E-03	3.74E-03
NA	0.7	2.4
NA	14.8	10.8
NA	0.2	0.0
NA	4.0	0.2
		13.33
		12.22

PM10 EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time	
	%	hrs		%	hrs
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3
PM10 BASELINE ACTUAL EMISSIONS					
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7
Backup Stripper Steam - Natural Gas [C]	4.75%	416.0	Natural Gas[D]	81.6%	339.5
Backup Stripper Steam - No. 6 Oil [C]	4.75%	416.0	No. 6 Oil[D]	18.4%	76.5
PM10 PROJECTED ACTUAL EMISSIONS					
PAE - BAE					

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution

C - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

Controls	Controls Operating Time		Production Rate		
	%	hrs	Value	UOM	lb/UOM
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)					
	100.0%	7,835.7	26.0	mmBtu/hr	7.60E-03
	100.0%	168.3	24.8	mmBtu/hr	1.17E-01
PROJECTED ACTUAL EMISSIONS					
	100.0%	985.5	1.0	mmBtu/hr	7.60E-03
	100.0%	6,433.3	96.8	mmBtu/hr	7.60E-03
	100.0%	1,450.7	92.2	mmBtu/hr	1.17E-01
	100.0%	339.5	26.0	mmBtu/hr	7.60E-03
	100.0%	76.5	24.8	mmBtu/hr	1.17E-01
NET EMISSIONS CHANGE (PAE - BAE)					

in Combination Boilers No. 1 and No. 2 during baseline.

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PM10 Emissions Factor Reference	PM10 Control %	PM10 Emissions lb/hr	PM10 Emissions tpy
AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.8
AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	2.9	0.2
			1.02
AP-42 Table 1.4-2. Filterable and Condensable.	NA	7.60E-03	3.74E-03
AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.7	2.4
AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	10.8	7.8
AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.0
AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	2.9	0.1
			10.34
			9.32

PM2.5 EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time	
	%	hrs		%	hrs
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3
PM2.5 BASELINE ACTUAL EMISSIONS					
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7
Backup Stripper Steam - Natural Gas [C]	4.75%	416.0	Natural Gas[D]	81.6%	339.5
Backup Stripper Steam - No. 6 Oil [C]	4.75%	416.0	No. 6 Oil[D]	18.4%	76.5
PM2.5 PROJECTED ACTUAL EMISSIONS					
PAE - BAE					

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in

C - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

Controls	Controls Operating Time		Production Rate		
	%	hrs	Value	UOM	lb/UOM
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)					
	100.0%	7,835.7	26.0	mmBtu/hr	7.60E-03
	100.0%	168.3	24.8	mmBtu/hr	8.80E-02
PROJECTED ACTUAL EMISSIONS					
	100.0%	985.5	1.0	mmBtu/hr	7.60E-03
	100.0%	6,433.3	96.8	mmBtu/hr	7.60E-03
	100.0%	1,450.7	92.2	mmBtu/hr	8.80E-02
	100.0%	339.5	26.0	mmBtu/hr	7.60E-03
	100.0%	76.5	24.8	mmBtu/hr	8.80E-02
NET EMISSIONS CHANGE (PAE - BAE)					

Combination Boilers No. 1 and No. 2 during baseline.

PM2.5 Emissions Factor Reference	PM2.5 Control %	PM2.5 Emissions lb/hr	tpy
AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.8
AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	2.2	0.2
			0.96
AP-42 Table 1.4-2. Filterable and Condensable.	NA	7.60E-03	3.74E-03
AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.7	2.4
AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	8.1	5.9
AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.0
AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	2.2	0.1
			8.37
			7.41

LEAD EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time	
	%	hrs		%	hrs
					B
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3
LEAD BASELINE ACTUAL EMISSIONS					
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7
Backup Stripper Steam - Natural Gas [C]	4.75%	416.0	Natural Gas[D]	81.6%	339.5
Backup Stripper Steam - No. 6 Oil [C]	4.75%	416.0	No. 6 Oil[D]	18.4%	76.5
LEAD PROJECTED ACTUAL EMISSIONS					
PAE - BAE					

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Com

C - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

Controls	Controls Operating Time		Production Rate		Lead Emissions Factor	
	%	hrs	Value	UOM	lb/UOM	Reference
ASELINE ACTUAL EMISSIONS (March 2021 - February 2023)						
	100.0%	7,835.7	26.0	mmBtu/hr	5.00E-07	AP-42 Table 1.4-2.
	100.0%	168.3	24.8	mmBtu/hr	2.80E-05	U.S. EPA document "Estimating Air Toxic Emissions from Coal and Oil Combustion Sources" [EPA-450/2-89-001] for Uncontrolled Residual Oil-fired Utility Boilers (Table 4-1)
PROJECTED ACTUAL EMISSIONS						
	100.0%	985.5	1.0	mmBtu/hr	5.00E-07	AP-42 Table 1.4-2.
	100.0%	6,433.3	96.8	mmBtu/hr	5.00E-07	AP-42 Table 1.4-2.
	100.0%	1,450.7	92.2	mmBtu/hr	2.80E-05	U.S. EPA document "Estimating Air Toxic Emissions from Coal and Oil Combustion Sources" [EPA-450/2-89-001] for Uncontrolled Residual Oil-fired Utility Boilers (Table 4-1)
	100.0%	339.5	26.0	mmBtu/hr	5.00E-07	AP-42 Table 1.4-2.
	100.0%	76.5	24.8	mmBtu/hr	2.80E-05	U.S. EPA document "Estimating Air Toxic Emissions from Coal and Oil Combustion Sources" [EPA-450/2-89-001] for Uncontrolled Residual Oil-fired Utility Boilers (Table 4-1)
NET EMISSIONS CHANGE (PAE - BAE)						

bination Boilers No. 1 and No. 2 during baseline.

Lead Control	Lead Emissions	
%	lb/hr	tpy
NA	1.30E-05	5.10E-05
NA	6.95E-04	5.85E-05
		1.10E-04
NA	5.00E-07	2.46E-07
NA	4.84E-05	1.56E-04
NA	2.58E-03	1.87E-03
NA	1.30E-05	2.21E-06
NA	6.95E-04	2.66E-05
		2.06E-03
		1.95E-03

CO2 EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time	
	%	hrs		%	hrs
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3
CO2 BASELINE ACTUAL EMISSIONS					
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7
Backup Stripper Steam - Natural Gas [C]	4.75%	416.0	Natural Gas[D]	81.6%	339.5
Backup Stripper Steam - No. 6 Oil [C]	4.75%	416.0	No. 6 Oil[D]	18.4%	76.5
CO2 PROJECTED ACTUAL EMISSIONS					
PAE - BAE					

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in

C - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

Controls	Controls Operating Time		Production Rate		
	%	hrs	Value	UOM	lb/UOM
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)					
	100.0%	7,835.7	26.0	mmBtu/hr	1.17E+02
	100.0%	168.3	24.8	mmBtu/hr	1.66E+02
PROJECTED ACTUAL EMISSIONS					
	100.0%	985.5	1.0	mmBtu/hr	1.17E+02
	100.0%	6,433.3	96.8	mmBtu/hr	1.17E+02
	100.0%	1,450.7	92.2	mmBtu/hr	1.66E+02
	100.0%	339.5	26.0	mmBtu/hr	1.17E+02
	100.0%	76.5	24.8	mmBtu/hr	1.66E+02
NET EMISSIONS CHANGE (PAE - BAE)					

Combination Boilers No. 1 and No. 2 during baseline.

CO2 Emissions Factor Reference	CO2 Control %	CO2 Emissions lb/hr	CO2 Emissions tpy
40 CFR Part 98, Table C-1	NA	3,044.8	11,929
40 CFR Part 98, Table C-1	NA	4,109.9	346
			12,275
40 CFR Part 98, Table C-1	NA	116.9	58
40 CFR Part 98, Table C-1	NA	11,313.5	36,392
40 CFR Part 98, Table C-1	NA	15,270.9	11,076
40 CFR Part 98, Table C-1	NA	3,044.8	517
40 CFR Part 98, Table C-1	NA	4,109.9	157
			48,200
			35,925

SUMMARY OF ASB EMISSIONS FACTORS

Scenario	ASB Emissions Factors (lb/ODTP)					
	H_2S	DMDS	DMS	MMC	TRS as H_2S	Methanol
Baseline Actual Emissions	0.0151	0.0114	0.0185	3.28E-04	3.37E-02	0.89
New Stripper Scenario	0.0103	0.0028	0.0136	1.88E-04	1.99E-02	0.30
Backup Stripper Scenario - TRS Mode	0.0109	0.0033	0.0147	1.30E-03	2.23E-02	1.53
Backup Stripper Scenario - Methanol Mode	0.0105	0.0303	0.0169	5.12E-04	4.20E-02	1.62
No Stripper Scenario	0.0106	0.0504	0.0192	7.42E-04	5.81E-02	2.31

A - Includes VOC TRS compounds, methanol, acetaldehyde, methyl ethyl ketone, and propionaldehyde.

B - TRS as compounds

VOC[A]	TRS[B]
0.95	0.0453
0.32	0.0269
1.59	0.0302
1.71	0.0582
2.44	0.0809

BAE Other VOC Emissions Factors

Date of Subpart S Performance Testing	Acetadehyde, ppm	MEK, ppm	Prop., ppm
7/9/2021	24.3	7.7	1.1
7/10/2021	25.3	5.7	4.0
7/11/2021	25.0	6.5	7.0
10/26/2021	25.0	12.3	0.8
10/27/2021	27.5	13.3	1.0
10/28/2021	10.6	6.6	1.2
10/29/2021	15.0	8.6	0.9
2/14/2022	16.7	7.5	0.7
2/15/2022	17.0	9.5	0.6
2/16/2022	15.7	8.6	1.0
5/4/2022	20.7	7.1	1.0
5/5/2022	16.3	7.3	1.0
5/6/2022	15.0	6.8	1.0
8/9/2022	15.3	5.9	0.7
8/10/2022	25.0	7.2	1.1
8/11/2022	20.3	6.0	1.0
9/27/2022	14.3	5.3	0.7
9/28/2022	15.0	5.2	0.7
9/29/2022	18.0	5.6	0.9
10/18/2022	25.0	5.6	1.0
10/19/2022	23.7	5.5	1.1
10/20/2022	23.0	6.6	0.9
AVG ppm:	**19.72**	**7.28**	**1.34**
Lbs into ASB	55.48	20.49	3.78
Fair estimated from WATER9 properties	0.55	0.38	0.43
Lbs emitted	30.73	7.73	1.61
Average Pulp Production during Subpart S testing	1716		
lb/ODTP	**0.018**	**0.005**	**0.001**

PAE Other VOC Emissions Factors

		PAE lb/ODTP			
	BAE lb/ODTP	New Stripper	Backup Stripper	No Stripper	Methanol Mode
Methanol	0.89	0.30	1.53	2.31	1.62
Acetadehyde	0.018	0.006	0.031	0.046	0.033
MEK	0.005	0.002	0.008	0.012	0.008
Propionaldehyde	0.001	0.000	0.002	0.002	0.002
DMDS	0.0114	0.0028	0.0033	0.0504	0.0303
DMS	0.0185	0.0136	0.0147	0.0192	0.0169
MMC	3.28E-04	1.88E-04	1.30E-03	7.42E-04	5.12E-04
VOC:	**0.95**	**0.32**	**1.59**	**2.44**	**1.71**

New Indy Catawba ASB BAE Methanol Emissions Factor

Month	Pulp Production ADTP	Pulp Production ODTP	Methanol Emissions Factor lb/ODTP	Emissions Factor Reference
Mar-21	42,474	38,226	1.50	Average of 2021 Subpart S Performance Tests. Representative of ASB operation from March 2021 to February 2022.
Apr-21	43,075	38,767	1.50	
May-21	46,962	42,266	1.50	
Jun-21	42,867	38,581	1.50	
Jul-21	49,371	44,434	1.50	
Aug-21	44,614	40,152	1.50	
Sep-21	40,177	36,159	1.50	
Oct-21	47,234	42,510	1.50	
Nov-21	39,185	35,266	1.50	
Dec-21	38,734	34,860	1.50	
Jan-22	43,690	39,321	1.50	
Feb-22	37,736	33,962	0.33	Average of 2022 Subpart S Performance Tests. Representative of ASB operation from February 2022 to February 2023.
Mar-22	43,944	39,549	0.33	
Apr-22	40,046	36,041	0.33	
May-22	38,896	35,006	0.33	
Jun-22	23,184	20,866	0.33	
Jul-22	39,890	35,901	0.33	
Aug-22	53,396	48,057	0.33	
Sep-22	45,044	40,539	0.33	
Oct-22	47,517	42,765	0.33	
Nov-22	40,133	36,120	0.33	
Dec-22	33,859	30,474	0.33	
Jan-23	35,464	31,918	0.33	
Feb-23	39,276	35,348	0.33	
Baseline Methanol Emissions Factor (Pulp Weighted Average)			**0.89**	**lb/ODTP**

Stripper Inlet Foul Condensate - Table 2-17 (Weston report dated October 2, 2021, Work Order No. 15730.001.008)

		Concentration (ppm)				
Date	**Sample Time**	**Hydrogen Sulfide**	**Methyl Mercaptan**	**Dimethyl Sulfide**	**Dimethyl Disulfide**	**Total TRS**
6/24/2021	15:10	130	14	16	13	173
6/24/2021	15:10	140	14	16	17	187
6/24/2021	17:00	140	17	18	14	189
6/24/2021	18:45	150	19	18	16	203
6/25/2021	10:35	130	12	12	11	165
6/25/2021	12:05	120	10	12	9.6	151.6
6/25/2021	13:45	190	22	22	23	257
Average of all data		142.9	15.4	16.3	14.8	189.4
Max of 6/24 or 6/25		146.7	16.0	17.0	15.0	194.7

		MW	
H2S	Hydrogen Sulfide	34.08	g/mol
Ch4S	Methyl Mercaptan	48.11	g/mol
C2H6S	Dimethyl Sulfide	62.13	g/mol
C2H6S2	Dimethyl Disulfide	94.20	g/mol
S	Sulfur	32.07	g/mol

Convert compound to equivalent S (ppm)

Hydrogen Sulfide	Methyl Mercaptan	Dimethyl Sulfide	Dimethyl Disulfide
138.0	10.7	8.8	10.2
82.3%	6.4%	5.2%	6.1%

S (ppm)	168	Maximum feed to stripper (AHL)
Lb S/gallon FC	1.40E-03	
Lb S/hr @850 gpm	71.3	
Lb S/ADTP (@2200 ODTP)[a]	0.7001	

[a] Conservative Lb S/ADTP emissions factor using 2200 ODTP (2200 ODTP * ADTP/0.9 ODTP = 2444.4 ADTP)
Emissions factor is representative of the lower end of the range of pulp production at the maximum steam stripper design of 850 gpm. Calculations are scaled to 2700 ADTP to represent worst case emissions.

Assumption
1. Assume no losses in feed tank
2. Assume 98% efficiency of S across stripper therefore 0.69 # S/ADTP in SOG

New-Indy Catawba Monthly Production

Month	Kraft Mill ADTP	Combination Boiler No. 1 Natural Gas mmBtu	Combination Boiler No. 2 Natural Gas mmBtu	Total Natural Gas mmBtu	Combination Boiler No. 1 No. 6 Fuel Oil gallons	Combination Boiler No. 2 No. 6 Fuel Oil gallons	Total No. 6 Fuel Oil gallons
Mar-21	42,474	61,175	99,507	160,683	0	2,057	2,057
Apr-21	43,075	41,363	75,012	116,376	0	0	0
May-21	46,962	38,834	63,467	102,301	0	0	0
Jun-21	42,867	1,909	59,909	61,818	0	1,199	1,199
Jul-21	49,371	67,565	55,824	123,389	3	97	100
Aug-21	44,614	33,863	32,461	66,325	0	0	0
Sep-21	40,177	40,779	41,811	82,590	86	0	86
Oct-21	47,234	69,732	75,498	145,230	0	0	0
Nov-21	39,185	60,664	80,397	141,061	0	0	0
Dec-21	38,734	62,931	60,176	123,107	0	0	0
Jan-22	43,690	84,088	82,251	166,339	69,200	66,720	135,920
Feb-22	37,736	57,764	75,924	133,688	27,042	370	27,412
Mar-22	43,944	62,423	82,083	144,506	335	0	335
Apr-22	40,046	44,634	62,835	107,469	0	0	0
May-22	38,896	39,982	73,918	113,900	0	0	0
Jun-22	23,184	43,071	89,239	132,310	2,238	0	2,238
Jul-22	39,890	64,532	86,134	150,666	0	0	0
Aug-22	53,396	48,067	73,591	121,658	0	0	0
Sep-22	45,044	60,782	65,899	126,681	24	0	24
Oct-22	47,517	70,539	89,760	160,299	0	0	0
Nov-22	40,133	82,534	114,164	196,698	0	0	0
Dec-22	33,859	101,466	95,023	196,490	170,076	0	170,076
Jan-23	35,464	95,982	92,733	188,715	102,558	0	102,558
Feb-23	39,276	78,431	96,813	175,244	21,626	53	21,679
Total	996,766			3,237,544			
Annual Average	498,383						
				97.9%			

No. Total No. 6 Fuel Oil mmBtu
309
0
0
180
15
0
13
0
0
0
20,388
4,112
50
0
0
336
0
0
4
0
0
25,511
15,384
3,252
69,553
2.1%

October 2021 SO2 Testing - Weston

	Combination Boiler No. 1 Stack			Combination Boiler No. 2	
	NCG+SOG	NCG	SOG	NCG+SOG	NCG
ODTP/hr	77.3	79.0		91.1	92.9
ADTP/hr	85.9	87.8		101.2	103.2
lb SO2/hr	342.8	230.7		380.9	309.9
lb SO2/ADTP	3.99	2.63	1.36	3.76	3.00

	Controlled Emissions		Sulfur Capture		Uncontrolle
	Average	Maximum	Bark Ash[C]	LVHC Scrubber	Average
	lb SO2/ADTP	lb SO2/ADTP	%	%	lb SO2/ADTP
SOG	1.06	1.36	20%	NA	1.33
NCG	2.82	3.00			
LVHC[A,B]	1.97	2.10	20%	50%	4.92
HVLC[A,B]	0.85	0.90	20%	NA	1.06

A - NCG gases include LVHC gases and HVLC gases.

B - NCG gases split using ratio of controlled SO2 emissions from LVHC (1.10 lb SO2/ADTP) and HVL(

C - Estimated sulfur capture based on 2012 stack test (NCASI data suggests ~32% capture).

Stack
SOG
0.76

d Emissions
Maximum
lb SO2/ADTP
1.70
5.25
1.13

: (0.473 lb SO2/ADTP) from Project Columbia Application (July 2019 and April 2020 Addendum - Attachment C)

October 2021 SO2 Testing - Weston

	Combination Boiler No. 1 Stack			Combination Boiler No. 2	
	NCG+SOG	NCG	SOG	NCG+SOG	NCG
ODTP/hr	77.3	79.0		91.1	92.9
ADTP/hr	85.9	87.8		101.2	103.2
lb SO2/hr	342.8	230.7		380.9	309.9
lb SO2/ADTP	3.99	2.63	1.36	3.76	3.00
Columbia lb/ADTP[D]	**4.21**	2.77	1.44	**4.21**	3.36

	Controlled Emissions		Sulfur Capture		Uncontrolle
	Average	Maximum	Bark Ash[C]	LVHC Scrubber	Average
	lb SO2/ADTP	lb SO2/ADTP	%	%	lb SO2/ADTP
SOG	1.14	1.44	20%	NA	1.43
NCG	3.07	3.36			
LVHC[A,B]	2.14	2.35	20%	50%	5.36
HVLC[A,B]	0.92	1.01	20%	NA	1.15

A - NCG gases include LVHC gases and HVLC gases.

B - NCG gases split using ratio of controlled SO2 emissions from LVHC (1.10 lb SO2/ADTP) and HVLC (0.473

C - Estimated sulfur capture based on 2012 stack test (NCASI data suggests ~32% capture).

D - Columbia lb/ADTP factors denotes scaling up the October 2021 stack test results to the overall NCG+SC

Stack
SOG
0.76
0.85

d Emissions
Maximum
lb SO2/ADTP
1.80
5.87
1.26

lb SO2/ADTP) from Project Columbia Application (July 2019 and April 2020 Addendum - Attachment C).

)G emissions factor from Project Columbia application of 4.21 lb/ADTP.

TABLE 2-2
NO. 1 COMBINATION BOILER
CONDITION 1: NCG AND SOG GASES
SUMMARY OF SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	10/13/21	10/13/21	10/13/21	----
Time Began	0844	1029	1206	----
Time Ended	0944	1129	1306	----
Stack Gas Data				
Temperature, °F	430	435	438	434
Velocity, ft/sec	64	63	63	63
Moisture, %	17	17	17	17
CO_2 Concentration, %	8.8	9.0	8.6	8.8
O_2 Concentration, %	10.5	10.5	10.8	10.6
VFR, x 10^5 dscfm	1.46	1.45	1.44	1.45
Sulfur Dioxide				
Concentration, ppm	280	227	204	237
Emission Rate, lb/hr	407.4	328.3	292.6	342.8

TABLE 2-3
NO. 1 COMBINATION BOILER
CONDITION 2: NCG GASES ONLY
SUMMARY OF SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	10/13/21	10/13/21	10/13/21	----
Time Began	1407	1544	1714	----
Time Ended	1507	1644	1814	----
Stack Gas Data				
Temperature, °F	447	450	444	447
Velocity, ft/sec	61	62	63	62
Moisture, %	17	18	16	17
CO_2 Concentration, %	9.6	9.9	8.9	9.5
O_2 Concentration, %	10.1	9.8	10.7	10.2
VFR, x 10^5 dscfm	1.37	1.39	1.43	1.40
Sulfur Dioxide				
Concentration, ppm	140	176	180	165
Emission Rate, lb/hr	191.3	243.6	257.0	230.7

Combination Boiler

Condition 1: With N
13-Oct-21

Run #	Start Ti
1	0
2	1
3	1

Average:

Condition 2: With N
13-Oct-21

Run #	Start Ti
1	1
2	1
3	1

Average:

Combination Boiler #1

Condition 1: With NCGs, with SOGs
13-Oct-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	L
1	0844	262.3	29.9	126.9	1.23	40	10.9	511	230	
2	1029	266.3	33.0	109.1	1.23	40	10.9	505	213	
3	1206	257.2	32.6	100.4	1.23	40	10.9	504	2	
Average:		261.9	31.8	112.1	1.23	40	10.9	507	148	

Condition 2: With NCGs, without SOGs
13-Oct-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	L
1	1407	267.7	34.0	102.0	1.23	40	10.9	506	2	
2	1544	272.9	34.8	101.3	1.23	40	10.9	504	252	
3	1714	256.9	30.05	115.96	1.23	40	10.9	505	183	
Average:		265.8	33.0	106.4	1.23	40	10.9	505	146	

Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	Pulp KAPPA
511	230	1407	1103	10851	77.3	82.7
505	213	1409	1200	10885	77.3	85.7
504	2	1443	1206	10963	77.3	84.8
507	148	1420	1170	10900	77.3	84.4

Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	Pulp KAPPA
506	2	1416	[redacted]	11071	79.0	83.9
504	252	1414	[redacted]	10976	79.0	81.6
505	183	1430	[redacted]	11061	79.0	80.3
505	146	1420	[redacted]	11036	79.0	81.9

Combination Boi

Condition 1: Wit
14-Oct-21

Run # Star
1 0
2 1
3 1

Average:

Condition 2: Wit
14-Oct-21

Run # Start
1 1
2 1
3 1

Average:

TABLE 2-4
NO. 2 COMBINATION BOILER
CONDITION 1: NCG AND SOG GASES
SUMMARY OF SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	10/14/21	10/14/21	10/14/21	----
Time Began	0830	1026	1222	----
Time Ended	0930	1126	1322	----
Stack Gas Data				
Temperature, °F	463	477	465	469
Velocity, ft/sec	63	68	61	64
Moisture, %	17	19	16	17
CO_2 Concentration, %	8.2	9.5	7.5	8.4
O_2 Concentration, %	10.8	10.1	11.5	10.8
VFR, x 10^5 dscfm	1.40	1.43	1.35	1.39
Sulfur Dioxide				
Concentration, ppm	275	262	286	274
Emission Rate, lb/hr	383.7	373.7	385.4	380.9

TABLE 2-5
NO. 2 COMBINATION BOILER
CONDITION 2: NCG GASES ONLY
SUMMARY OF SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	10/14/21	10/14/21	10/14/21	----
Time Began	1410	1547	1725	----
Time Ended	1510	1647	1825	----
Stack Gas Data				
Temperature, °F	457	461	460	459
Velocity, ft/sec	59	59	58	59
Moisture, %	15	15	15	15
CO_2 Concentration, %	7.2	7.6	7.0	7.3
O_2 Concentration, %	11.9	11.2	11.7	11.6
VFR, x 10^5 dscfm	1.33	1.33	1.33	1.33
Sulfur Dioxide				
Concentration, ppm	235	234	232	234
Emission Rate, lb/hr	311.3	311.0	307.4	309.9

Combination Boiler #2

Condition 1: With NCGs, with SOGs
14-Oct-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)
1	0830	241	29.8	188.7	1.23	40	10.9	505	209
2	1026	251	46.3	115.6	1.23	40	10.9	504	200
3	1222	211	25.4	171.4	1.23	40	10.9	505	199
Average:		234	33.8	158.6	1.23	40	10.9	505	203

Condition 2: With NCGs, without SOGs
14-Oct-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)
1	1410	198	21.7	174.8	1.23	40	10.9	505	209
2	1547	218	35.4	206.4	1.23	40	10.9	505	224
3	1725	214	49.6	220.6	0.65	40	10.9	505	262
Average:		210	35.6	200.6	1.04	40	10.9	505	232

H	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	Pulp KAPPA
	505	209	1409	1203	11071	91.1	94.5
	504	200	1420	1179	11160	91.1	88.2
	505	199	1429	1157	11090	91.1	80.7
	505	203	1419	1180	11107	91.1	87.8

H	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	Pulp KAPPA
	505	209	1438	[redacted]	11109	92.9	78.8
	505	224	1435	[redacted]	11060	92.9	78.7
	505	262	1453	[redacted]	10977	92.9	79.3
	505	232	1442	[redacted]	11049	92.9	

June 2021 TRS_H2S Testing - Weston

	Combination Boiler No. 1 Stack			Combin
TRS as TRS	NCG+SOG	NCG	SOG	NCG+SOG
ODTP/hr	55.9	76.0		88.3
ADTP/hr	62.1	84.4		98.1
lb TRS (as H2S)/hr	0.75	0.68		0.85
lb TRS (as TRS)/hr	1.07	0.97		1.22
lb TRS (as TRS)/ADTP	1.73E-02	1.15E-02	5.75E-03	1.24E-02

	Controlled Emissions		Sulfur Conversion	
	Average	Maximum	Combustion	LVHC Scrubber
TRS as TRS	lb TRS/ADTP	lb TRS/ADTP	%	%
SOG[D]	2.88E-03	5.75E-03	99%	NA
NCG	1.27E-02	1.39E-02		
LVHC[A,B]	8.01E-03	8.76E-03	99%	50%
HVLC[A,B]	4.69E-03	5.13E-03	99%	NA

A - NCG gases include LVHC gases and HVLC gases.

B - NCG gases split using ratio of controlled TRS emissions from LVHC (8.97E-3 lb TRS/ADTP) and H\

C - NCG gases split using ratio of controlled H2S emissions from LVHC (3.82E-3 lb H2S/ADTP) and H

D - Combination Boiler No. 2 SOG averaged as zero (0).

			CB1
TRS as S		MW	NCG+SOG
sulfur	S	32.065	Run 1
hydrogen sulfide	H_2S	34.081	0.08
methyl mercaptan	CH_4S	48.107	0.55
dimethyl sulfide	C_2H_6S	62.134	0.16
dimethyl disulfide	$C_2H_6S_2$	94.199	0.07

10^6 ACFM Flowrate Basis to lb/min	
H_2S	0.0070817662

CH_4S	0.0687242857
C_2H_6S	0.0258219221
$C_2H_6S_2$	0.0171270909

TRS as H2S	0.0823255325
TRS as TRS	0.1187550649

Ratio TRS as H2S/TRS as	0.6932380738

ation Boiler No. 2 Stack			Combination Boiler No. 1 Stack		
NCG	SOG	H2S	NCG+SOG	NCG	SOG
85.2		ODTP/hr	55.9	76.0	
94.7		ADTP/hr	62.1	84.4	
0.92		lb H2S/hr	0.07	0.05	
1.32					
1.39E-02	-1.51E-03	lb H2S/ADTP	1.13E-03	5.92E-04	5.35E-04

Uncontrolled Emissions			Controlled Emissions		Sulfur Co
Average	Maximum		Average	Maximum	Combustion
lb TRS/ADTP	lb TRS/ADTP	H2S	lb H2S/ADTP	lb H2S/ADTP	%
0.29	0.58	SOG	4.13E-04	5.35E-04	99%
		NCG	5.07E-04	5.92E-04	
1.60	1.75	LVHC[A,C]	5.03E-04	5.87E-04	99%
0.47	0.51	HVLC[A,C]	4.45E-06	5.19E-06	99%

/LC (5.25E-3 lb TRS/ADTP) from Project Columbia Application (July 2019 and April 2020 Addendum - Attachmer
VLC (3.38E-5 lb H2S/ADTP) from Project Columbia Application (July 2019 and April 2020 Addendum - Attachme

		CB1			CB2	
		NCG			NCG+SOG	
Run 2	Run 3	Run 1	Run 2	Run 3	Run 1	Run 2
0.07	0.1	0.07	0.07	0.07	0.08	0.08
0.53	0.49	0.52	0.52	0.53	0.77	0.63
0.16	0.16	0.16	0.16	0.17	0.08	0.08
0.07	0.07	0.07	0.07	0.07	0.04	0.04
0.0061965455	0.0088522078	0.0061965455	0.0061965455	0.0061965455	0.0070817662	0.0070817662

0.0662252208	0.0612270909	0.0649756883	0.0649756883	0.0662252208	0.096214	0.0787205455
0.0258219221	0.0258219221	0.0258219221	0.0258219221	0.0274357922	0.012910961	0.012910961
0.0171270909	0.0171270909	0.0171270909	0.0171270909	0.0171270909	0.0097869091	0.0097869091
0.0796698701	0.0787846494	0.0787846494	0.0787846494	0.0805550909	0.0894072987	0.0770142078
0.1153707792	0.1130283117	0.1141212468	0.1141212468	0.1169846494	0.1259936364	0.1085001818
0.6905550146	0.6970346471	0.6903591714	0.6903591714	0.6885953957	0.709617575	0.7098071773

Combination Boiler No. 2 Stack		
NCG+SOG	NCG	SOG
88.3	85.2	
98.1	94.7	
0.07	0.04	
7.13E-04	4.23E-04	2.91E-04

›nversion	Uncontrolled Emissions	
LVHC Scrubber	Average	Maximum
%	lb H2S/ADTP	lb H2S/ADTP
NA	4.13E-02	5.35E-02
50%	1.01E-01	1.17E-01
NA	4.45E-04	5.19E-04

ıt C).
nt C).

	CB2				
	NCG				
Run 3	Run 1	Run 2	Run 3	AVG	
0.08	0.05	0.05	0.05	0.07	8.0%
0.64	0.94	0.91	0.69	0.64	72.6%
0.08	0.08	0.07	0.07	0.12	13.5%
0.04	0.03	0.03	0.03	0.05	5.9%
				0.89	Total TRS
				84.8%	
0.0070817662	0.0044261039	0.0044261039	0.0044261039		

0.0799700779	0.1174560519	0.1137074545	0.0862177403		
0.012910961	0.012910961	0.0112970909	0.0112970909		
0.0097869091	0.0073401818	0.0073401818	0.0073401818		
0.0778994286	0.1000299481	0.0964890649	0.0770142078		
0.1097497143	0.1421332987	0.1367708312	0.1092811169		
0.7097916298	0.7037756034	0.7054798462	0.7047348159	0.69944568	
					1.43

PLC Cross Check back to TRS as H2S

	0.0857419	0.0857419
	0.7787379	0.5516903
	0.1442481	0.0791212
	0.0635499	0.0459844
	1.0722777	0.7625378

TABLE 2-11
NO. 1 COMBINATION BOILER
CONDITION 1: NCG AND SOG GASES
SUMMARY OF H_2S, TOTAL TRS, AND SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	6/23/21	6/23/21	6/23/21	----
Time Began	1158	1400	1541	----
Time Ended	1258	1500	1641	----
Stack Gas Data				
Temperature, °F	415	418	415	416
Velocity, ft/sec	59	57	57	57
Moisture, %	17	18	16	17
CO_2 Concentration, %	7.8	8.4	7.7	8.0
O_2 Concentration, %	12.1	11.4	12.0	11.8
VFR, x 10^5 dscfm	1.35	1.31	1.33	1.33
Hydrogen Sulfide				
Concentration, ppm	0.09	0.08	0.12	0.10
Emission Rate, lb/hr	0.07	0.06	0.08	0.07
Total Reduced Sulfur				
Concentration, ppm	1.09	1.07	1.03	1.06
Emission Rate, lb/hr	0.78	0.74	0.73	0.75
Sulfur Dioxide				
Concentration, ppm	195	278	344	272
Emission Rate, lb/hr	262.7	362.5	457.4	360.9

TABLE 2-12
NO. 1 COMBINATION BOILER
CONDITION 2: NCG GASES ONLY
SUMMARY OF H_2S, TOTAL TRS, AND SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	6/23/21	6/23/21	6/23/21	----
Time Began	1824	2019	2202	----
Time Ended	1924	2119	2302	----
Stack Gas Data				
Temperature, °F	416	411	415	414
Velocity, ft/sec	56	56	56	56
Moisture, %	16	16	17	17
CO_2 Concentration, %	8.3	7.8	8.1	8.1
O_2 Concentration, %	11.4	11.9	11.6	11.6
VFR, x 10^5 dscfm	1.30	1.31	1.30	1.30
Hydrogen Sulfide				
Concentration, ppm	0.08	0.08	0.08	0.08
Emission Rate, lb/hr	0.05	0.05	0.05	0.05
Total Reduced Sulfur				
Concentration, ppm	0.97	0.98	0.99	0.98
Emission Rate, lb/hr	0.67	0.68	0.68	0.68
Sulfur Dioxide				
Concentration, ppm	313	348	349	337
Emission Rate, lb/hr	404.4	452.9	450.8	436.1

nbination Boiler #1

Combination Boiler #1

nbination Boiler #1

dition 1: With NCGs, with SOGs
-Jun-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	SO_2 Emissions (lbs/hr)	SO_2 Emissions (lbs/ODT Pulp)	TRS Emissions (lbs/hr)
1	1158	208	25.1	80.8	1.37	40	10.9	458	146	1585	621	11575	49.7	262.7	5.29	0.56
2	1400	225	29.3	68.8	1.37	40	10.9	491	152	1595	1219	11048	54.0	362.5	6.71	0.49
3	1541	207	24.8	81.2	1.37	40	10.9	491	45	1578	1136	11009	64.0	457.4	7.15	0.50
rage:		213	26.4	76.9	1.37	40	10.9	480	114	1586	992	11211	55.9	360.9	6.46	0.52

dition 2: With NCGs, without SOGs
-Jun-21

#	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	SO_2 Emissions (lbs/hr)	SO_2 Emissions (lbs/ODT Pulp)	TRS Emissions (lbs/hr)
1	1824	230	26.3	94.9	1.37	40	10.9	489	123	1587	[redacted]	10515	74.1	404.4	5.46	0.43
2	2019	216	23.7	97.5	1.37	40	10.9	491	184	1593		10377	74.7	452.9	6.06	0.42
3	2202	220	25.2	92.4	1.37	40	10.9	490	152	1570		10573	79.2	450.8	5.69	0.46
rage:		222	25.1	94.9	1.37	40	10.9	490	153	1583		10488	76.0	436.1	5.74	0.44

Combination Boiler #1

Condition 1: With NCGs, with SOGs
23-Jun-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark (Ton
1	1158	208	
2	1400	225	
3	1541	207	
Average:		213	

Condition 2: With NCGs, without SOGs
23-Jun-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark R (Tons/
1	1824	230	
2	2019	216	
3	2202	220	
Average:		222	

TABLE 2-13
NO. 2 COMBINATION BOILER
CONDITION 1: NCG AND SOG GASES
SUMMARY OF H_2S, TOTAL TRS, AND SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	6/24/21	6/24/21	6/24/21	----
Time Began	1445	1630	1806	----
Time Ended	1545	1730	1906	----
Stack Gas Data				
Temperature, °F	475	474	479	476
Velocity, ft/sec	69	69	69	69
Moisture, %	14	14	15	14
CO_2 Concentration, %	6.6	6.9	7.3	6.9
O_2 Concentration, %	13.1	12.7	12.3	12.7
VFR, x 10^5 dscfm	1.57	1.56	1.54	1.56
Hydrogen Sulfide				
Concentration, ppm	0.09	0.09	0.09	0.09
Emission Rate, lb/hr	0.07	0.07	0.07	0.07
Total Reduced Sulfur				
Concentration, ppm	1.13	0.97	0.97	1.02
Emission Rate, lb/hr	0.94	0.80	0.80	0.85
Sulfur Dioxide				
Concentration, ppm	324	327	322	324
Emission Rate, lb/hr	508.7	507.2	496.1	504.0

TABLE 2-14
NO. 2 COMBINATION BOILER
CONDITION 2: NCG GASES ONLY
SUMMARY OF H_2S, TOTAL TRS, AND SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	6/25/21	6/25/21	6/25/21	----
Time Began	1000	1135	1315	----
Time Ended	1100	1235	1415	----
Stack Gas Data				
Temperature, °F	468	470	481	473
Velocity, ft/sec	68	69	69	69
Moisture, %	14	14	14	14
CO_2 Concentration, %	6.9	6.8	7.3	7.0
O_2 Concentration, %	12.8	12.7	12.3	12.6
VFR, x 10^5 dscfm	1.56	1.55	1.56	1.56
Hydrogen Sulfide				
Concentration, ppm	0.05	0.05	0.05	0.05
Emission Rate, lb/hr	0.04	0.04	0.04	0.04
Total Reduced Sulfur				
Concentration, ppm	1.22	1.18	0.94	1.11
Emission Rate, lb/hr	1.01	0.97	0.78	0.92
Sulfur Dioxide				
Concentration, ppm	247	245	235	242
Emission Rate, lb/hr	383.2	380.0	366.2	376.4

Combination Boiler #2

Combination Boiler #2

Condition 1: With NCGs, with SOGs

Combination Boiler #2

Condition 1: With NCGs, with SOGs
24-Jun-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	SO_2 Emissions (lbs/hr)	SO_2 Emissions (lbs/ODT Pulp)	TRS Emissions (lbs/hr)
1	1445	219	39.0	125.3	1.37	40	10.9	491	190	1572	1231	10253	87.8	508.7	5.79	0.77
2	1630	224	31.1	146.4	1.37	40	10.9	490	186	1576	1231	10277	88.6	507.2	5.72	0.63
3	1806	241	33.6	146.4	1.37	40	10.9	490	190	1580	1231	10300	88.6	496.1	5.60	0.63
Average:		228	34.6	139.4	1.37	40	10.9	490	189	1576	1231	10277	88.3	504.0	5.71	0.68

Condition 2: With NCGs, without SOGs
25-Jun-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	SO_2 Emissions (lbs/hr)	SO_2 Emissions (lbs/ODT Pulp)	TRS Emissions (lbs/hr)
1	1000	234	35.7	132.7	1.37	40	10.9	482	155	1579	[redacted]	10475	87.2	383.2	4.39	0.86
2	1135	225	30.8	147.8	1.37	40	10.9	479	252	1573		10425	84.3	380.0	4.51	0.82
3	1315	245	30.6	141.7	1.37	40	10.9	482	97	1571		10500	84.2	366.2	4.35	0.63
Average:		235	32.4	140.7	1.37	40	10.9	481	168	1574		10467	85.2	376.4	4.42	0.77

Combination Boiler #2

Condition 1: With NCGs, with SOGs
24-Jun-21

Run #	Start Time	Steam Rat (10^3 lbs/h
1	1445	219
2	1630	224
3	1806	241
Average:		228

Condition 2: With NCGs, without SC
25-Jun-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)
1	1000	234
2	1135	225
3	1315	245
Average:		235

Buckner, Katharine

From:	Caleb Fetner <cfetner@all4inc.com>
Sent:	Saturday, March 16, 2024 1:37 PM
To:	Buckner, Katharine
Cc:	Rachel Davis; Steven Moore; Sheryl Watkins
Subject:	Stripper Permit - SOB/Annual Avg CEMS/Updated Calcs
Attachments:	2024-2-12_2440-0005_c2.sob NIC.docx; UPDATED Emissions Calculations (3-13-24).xlsx; Supporting Info for Methanol Mode ASB Emissions.pdf

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***

Hi Katharine,

On behalf of New-Indy Catawba, here are the following files for your review. Please let us know if you have any questions.

1. Updated Emissions Calculations
   a. Incorporated emissions calculations for the Backup Stripper operating in Methanol Mode.
   b. For the uncontrolled SO2 PAE emissions factor for LVHC incineration, we scaled up the October 2021 results to the Project Columbia NCG emissions factor of 4.21 lb/ton to add an additional level of conservatism. We still show a PSD decrease in SO2 emissions.
2. Supporting Info for Methanol Mode ASB emissions
   a. H2SSIM (for H2S), WATER9 (for other TRS), and Form XIII (for methanol) for the ASB when the backup stripper is in methanol mode.
   b. During methanol mode, we estimated 500 gpm of foul condensate down the hardpipe. Essentially, for the ASB when the backup stripper is in methanol mode, it is similar to the No Stripper scenario except with 500 gpm instead of 850 gpm.
3. Comments on the latest SOB provided. We also updated PSD and project emissions consistent with the updated calculations.
4. **Justification for the annual averaging period for compliance with the SO2 BACT limit (50 ppmvd @ 8% O2).**

   The 2006 SO2 best available control technology (BACT) limit for the No. 3 Recovery Furnace was proposed as good combustion practices during black liquor solids combustion. The BACT limit was not proposed during co-firing of fossil fuels. The SO2 BACT limit (condition DA.18) is 50 ppmvd @ 8% O2 and/or 551 tons per year (three 1-hour averages). The compliance demonstration method associated with the BACT limit (condition DA.18) is one source test every four years.

   The SO2 BACT limit is expressed as an annual average value (50 ppm which equates to 551 tpy) when firing black liquor solids. The basis for the 551 tpy emissions rate is as follows: 50 ppmvd × (20.9 – 5.5)/(20.9 – 8) × 64/385.3E6 × 211,600 dscf/min × 60 min/hr × 8,760 hr/yr × 1 ton/2,000 lb = 551 tons/yr

   The BACT limit does not reflect fossil-fuel firing, which was not impacted by the permitted modifications. The SO2 CEMS data should be treated in the same manner as the NOx CEMS data, as a reasonable assurance of continuous compliance with the SO2 BACT limit, and a representation of average emissions over a period of time during normal operation while burning black liquor solids.

The justification for the annual averaging period is provided below and is based on the expected variability in SO2 concentrations during startup and shutdown, planned maintenance (such as water washes), and inherent variability in the SO2 emissions that can occur with process upsets and variability in process conditions and/or operation. New-Indy Catawba expects periods of elevated SO2 emissions (i.e. greater than 50 ppmvd @ 8% O2 on a 3-hour average) to occur as a result of the following process/operating conditions:

- Lower temperature smelt bed and/or low black liquor solids loading to the furnace
- High black liquor sulfidity
- Low percent black liquor solids firing
- Unbalanced air distribution in the boiler

The following paragraphs describe each condition and the expected observed duration of high SO2 emissions, keeping in mind that these events are not mutually exclusive and can occur simultaneously or in close proximity in time.

<u>Lower temperature smelt bed and/or low black liquor solids loading to the furnace</u>

A lower temperature smelt bed can occur during abnormal or upset conditions, which are typically associated with black liquor firing loads below 50% of the maximum furnace load, which can occur when starting up from a cold shutdown (i.e., when there is little to no smelt in the bottom of the boiler upon startup), when shutting down (i.e., when the smelt bed is burned out), or during periods of low/lower black liquor inventories. Low black liquor loads have reduced air requirements which will naturally reduce the air pressure at each air level. This can dramatically decrease the air penetration, decrease air/gas mixing, decrease bed temperatures and/or bed height, and increase the amount of localized cold spots in the bed. To counter these impacts, corrective action is necessary to increase the ratio of primary and/or secondary air, firing of auxiliary fuel to maintain proper operation and steam load, and manage the smelt bed. Upset conditions can last anywhere from a few hours to more than several days in duration and startup operations from a cold smelt bed are typically 8 to 16 hours in duration.

<u>High black liquor sulfidity</u>

The sulfur to sodium ratio in the cooking liquor is important for maintaining the reaction rate and pulp quality in the digester. If the sulfidity is too low, then pulp yield and pulp quality will be reduced. To maintain the proper sulfidity, saltcake from the recovery furnace electrostatic precipitator (ESP) is recycled back into the liquor cycle for sodium and sulfur make-up. Additional make-up chemicals are also typically added (i.e., sodium hydrosulfide, emulsified sulfur, sodium hydroxide, etc.) when chemical imbalances occur that necessitate adding more sodium and/or sulfur makeup. When the sulfidity is elevated, SO2 emissions are also elevated. If sulfidity is determined to be above the target level, corrective action is to stop feeding saltcake and/or make-up sulfur chemicals. A sulfidity imbalance is typically corrected within two to three days.

Low percent black liquor solids firing

Low percent black liquor solids firing is most often caused by periodic, but routine, water washes to remove fouling on the recovery furnace steam tubes, water washes to remove fouling on the heat transfer surfaces in the evaporators, upsets to the evaporators, and/or an upset to upstream process areas. Water washes are necessary to remove inorganic scale and organic sticky material from heat transfer surfaces in the evaporators and to remove the saltcake fouling on the furnace steam tubes to maintain safe operation of the furnace. A water wash on the evaporators is typically performed 3-5 times per week and lasts for a period of two to eight hours (Note: includes the periods of startup, shutdown, and the water wash cycle) and a water wash on the recovery furnace is typically performed semi-annually and lasts for a period of two to three days (Note: includes the periods of startup, shutdown, and the water wash cycle). Reduced black liquor solids content can last anywhere from a few hours to more than 16 hours in duration.

Unbalanced air distribution in the furnace (primary, secondary, tertiary, and quaternary air)

Each recovery furnace design is unique. The New-Indy Catawba Mill has established air systems guidelines for the No. 3 Recovery Furnace that manage NOx and TRS emissions to achieve permitted emissions limits. These include targets for air splits on the primary, secondary, tertiary, and quaternary air ports, desired air duct pressures, and placement and angle of the liquor guns. In addition, the Mill has established guidelines for keeping the air ports and smelt spouts clean. With these guidelines air distribution imbalances are typically resolved within 6 to 12 hours. With feedback from the future SO2 CEMS, the Mill will need flexibility to manage the air distribution within the furnace to achieve the NOx, TRS, and SO2 permitted emissions limits.

Caleb Fetner / Managing Consultant
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Backup Stripper (Methanol Mode) Scenario - Projected Actual Emissions

H_2S, TRS Compounds, and VOC

New-Indy Catawba - Catawba, SC

Concentration Loadings	**H2S, ppm**	**DMDS, ppm**	**DMS, ppm**	**MMC, ppm**
Design Foul Condensate Loadings (prior to H2O2)	147	15.00	17.00	16.00
Predicted % Reduction from H_2O_2	0.99	MMC converted into DMDS	0.90	0.99
Foul Condensate (after H_2O_2)	1.47	30.51	1.70	0.16
Avg. ASB Inlet (2021 and 2022)	0.25	0.09	0.20	0.0026
Flow Weighted Loading:	0.29	0.92	0.24	6.93E-03
H2SSIM/WATER9 Results	**H2S, g/s**	**DMDS, g/s**	**DMS, g/s**	**MMC, g/s**
ASB Zone 1	0.07	0.35	0.19	5.81E-03
ASB Zone 2	0.03	5.66E-08	4.06E-03	1.06E-04
ASB Zone 3	0.02	1.09E-04	1.45E-04	3.51E-06
Total ASB	**0.12**	**0.35**	**0.19**	**5.92E-03**
PAE Emissions Factors	**H2S, lb/ODTP**	**DMDS, lb/ODTP**	**DMS, lb/ODTP**	**MMC, lb/ODTP**
Total ASB	**1.05E-02**	**3.03E-02**	**1.69E-02**	**5.12E-04**

Post-Project Foul Condensate Flow:	500	gpm
Post-Project Foul Condensate Flow:	0.72	MGD
Post-Project ASB Influent Flow:	25.48	MGD
Total ASB Flow:	26.20	MGD
Total ASB Flow:	1148	L/s
Pulp Production	2200	ODTP/day

	MW
H2S	34
DMDS	94
DMS	62
MMC	48

NCASI WASTEWATER HYDROGEN SULFIDE EMISSIONS SIMULATOR (H2SSIM)

Version 1.3

Data Type 1. Site Identification

Company Name	New-Indy
Facility Name	Catawba SC
Basin Name	ASB

Data Type 2. Model Zone Information

Number of Zones	3
Zone Location of Hardpipe	1
Type of Basin	ASB

Data Type 3. Load Characteristics

Loading Characteristics	Main Influent	Hardpipe	Units
Flow	25.48	0.72	MGD
Total Sulfide	0.252	1.47	mg/L
Sulfate	390	390	mg/L

Data Type 4. Atmospheric Conditions

Windspeed	3.55	mph
Ambient Temperature	79	F

Data Type 5. Zone Physical and Chemical Conditions

Zone Condition	Zone 1	Zone 2	Zone 3	Zone 4	Units
Dissolved Oxygen	1.57	4.63	4.66		mg/L
Temperature	93.34	89.74	86.02		F
pH	7.04	7.24	7.42		s.u.
Redox Condition	Aerobic	Aerobic	Aerobic	Aerobic	
Length	968	1208	1235		feet
Width	968	604	617		feet
Depth	4.5	3.2	3		feet
Mixing	Moderat	Moderat	Moderat		
Number of Aerators	31	15	6		
Total Horsepower	2325	1125	450		HP
Impellor Size	1.625	1.625	1.625		feet
Impellor RPM	1200	1200	1200		RPM
Diffused Air Flow	0	0	0		cms
Weir Height	0	0	0		feet

Model Controls

Run H2SSIM

View Parameters

Clear Input Sheet

H2SSIM Results

Backup Stripper Methanol Mode Scenario

Basin Emissions		Units
Total Emissions (H_2S)	0.121	gms/s
Total Emissions (H_2S)	8417.2	lbs/yr
Total Emissions (H_2S)	4.2	tons/yr
Total Emissions (H_2S)	3.8	tonnes/yr
Emission Flux (H_2S)	16.9	gms/m^2 yr

Zone Emissions	Zone 1	Zone 2	Zone 3	Zone 4	Units
Zone Emissions (H_2S)	0.07	0.03	0.02		gms/s
Zone Emissions (H_2S)	5132.3	1762.9	1521.9		lbs/yr
Emission Flux (H_2S)	26.7	11.8	9.8		gms/m^2 yr
Liquid Conc. (Total Sulfide)	0.003	0.001	0.000		mg/L
Liquid Sulfide Load (lbs/yr)	39.300	6.400	5.600		lbs/yr

Percent Inlet Sulfide Removed	63.0%

Current Parameters	
kgen	0.25
ThetaGen	1.06
KDO	0.05
KSO4	10
kanox	0.006
ThetaOx	1.05
m	1
n	0.2
MLVSS	272.2
O_2 Transfer Coeff.	2
alpha 1	0.83
alpha 2	0.6

SUMMARY FOR EMISSIONS AT UNIT 11 ASB Zone 1 aerated biotreatment
03-14-2024   09:38:13

COMPOUND NAME	conc in (ppmw)	fe air	fe bio	conc out (ppmw)	emissions (g/s)
DIMETHYL DISULFIDE	8.367e-1	0.36428	0.61827	1.46e-2	3.499e-1
DIMETHYL SULFIDE (DMS)	2.074e-1	0.80097	0.17688	4.593e-3	1.907e-1
HYDROGEN SULFIDE	2.835e-1	0.98155	0.	5.231e-3	3.195e-1
METHANETHIOL(methyl mercaptan)	5.699e-3	0.8877	0.09361	1.065e-4	5.808e-3
Total rate for all compounds					8.658e-1

SUMMARY FOR EMISSIONS AT UNIT 17 ASB Zone 3 aerated biotreatment
03-14-2024   09:38:13

COMPOUND NAME	conc in (ppmw)	fe air	fe bio	conc out (ppmw)	emissions (g/s)
DIMETHYL DISULFIDE	5.231e-4	0.18124	0.76948	2.578e-5	1.088e-4
DIMETHYL SULFIDE (DMS)	2.136e-4	0.58962	0.31941	1.943e-5	1.446e-4
HYDROGEN SULFIDE	2.231e-4	0.88747	0.	2.511e-5	2.273e-4
METHANETHIOL(methyl mercaptan)	4.197e-6	0.72787	0.18714	3.567e-7	3.507e-6
Total rate for all compounds					4.842e-4

SUMMARY FOR EMISSIONS AT UNIT 18 ASB Zone 2 aerated biotreatment
03-14-2024   09:38:13

COMPOUND NAME	conc in (ppmw)	fe air	fe bio	conc out (ppmw)	emissions (g/s)
DIMETHYL DISULFIDE	1.46e-2	0.3375	0.62668	5.231e-4	5.658e-3
DIMETHYL SULFIDE (DMS)	4.593e-3	0.7705	0.183	2.136e-4	4.063e-3
HYDROGEN SULFIDE	5.231e-3	0.95735	0.	2.231e-4	5.749e-3
METHANETHIOL(methyl mercaptan)	1.065e-4	0.86336	0.09723	4.197e-6	1.056e-4
Total rate for all compounds					1.558e-2

APPENDIX C FORMS - CALCULATING FRACTION BIODEGRADED

Data Date: PAE - Backup Stripper (Methanol Mode)

Instructions: Enter data in green shaded sections of this page of this spreadsheet only.

I. BIOTREATMENT UNIT DESCRIPTION

	Units	Zone 1	Zone 2	Zone 3
Number of 75 HP Aerators	#	31	15	6
Number of 100 HP Aerators	#	0	0	0
Total Horsepower	HP	2325	1125	450
Temperature	C	35.4	33.5	31.3
Length	ft	968	1,208	1,235
Width	ft	968	604	617
Average Depth	ft	4.5	3.2	3
Aerator Rotation	rpm	1200	1200	1200
Agitation Area per 75 HP aerator	ft2	1452	1452	1452
Agitation Area per 100 HP aerator	ft2	2206	2206	2206
Impellor Diameter	in	19.5	19.5	19.5

II. OVERALL PARAMS - individual flows

	Flow MGD	MeOH mg/L
Inlet Stream **	25.48	59.5
Condensate Stream	0.7	3,809
Outlet	26.2	5.1

** *except condensate flow*

NA - individual flow/conc data not available

II. OVERALL PARAMS - total flows

	Flow m3/sec	Flow MGD	MeOH mg/L
Influent Concentration		26.2	162.5
Effluent Concentration			5.09824
Wind Speed	mph		3.8

III. HAP DATA

Methanol

	Units	Inlet	Average Zone Concentration Zone 1	Zone 2	Zone 3	Detect Limit
Conc.	mg/L	162.5	44.6	25.8	8.1	0.5
Temp.	F		95.7	92.3	88.3	

Avg. 2021/2022 Zone Reductions	**27%**	**16%**	**5%**

IV. RESULTS

fbio - Methanol	%
Fraction biodegraded	86.8
Fraction air emissions	10.1
Fraction remaining in unit effluent	3.1

APPENDIX C FORMS - CALCULATING FRACTION BIODEGRADED
PARAMETERS FOR CALCULATING MASS TRANSFER COEFIICIENTS

Data Date: PAE - Backup Stripper (Methanol Mode)

	Diff in Water cm2/s	Diff in Air cm2/s	Henry's Law atm-m3/mol	Equil. Ratio (Hc) or (Keq) m3 liq to m3 gas	MW g/mol	ScG	Antoine Eqtn b	Antoine Eqtn c
Methanol	1.64E-05	0.150	5.19E-06	2.12E-04	32.0	1.006	1474	229.13
Acetaldehyde	1.41E-05	0.124	8.77E-05	3.58E-03	45.1	1.216	1600	291.8
MEK	9.80E-06	0.081	1.30E-04	5.31E-03	72.1	1.867	1305	229.27

General

	Units	Value	Name
viscosity of air	g/cm-s	0.000181	va
viscosity of water	g/cm-s	0.002	vw
density of air	g/cm3	0.0012	da
density of water	g/cm3	1	dw
MW of air	g/mol	29	Mwa
MW of water	g/mol	18	MWw
Diff of O2 in H2O	cm2/s	2.40E-05	DO2w
grav const.	lb-ft/s2/lb	32.17	g
R	atm-m3/mol K	8.21E-05	R_
Aerator Motor Eff	fraction	0.85	AerEff
O2 Trans Correct		0.83	Beta
Wind Speed	m/s	1.69	U
Diff of Ether	m/s	8.50E-06	Dether
O2 Trans	lb O2/HP-h	3	J

TURBULENT
KL Params

	Zone 1	Zone 2	Zone 3
w	126.3	126.3	126.3
Re	2.07E+06	2.07E+06	2.07E+06
PI	35063	35063	35063
Power Number, p	7.92E-04	7.92E-04	7.92E-04
Fr	8.06E+02	8.06E+02	8.06E+02
Total TurbArea (ft2)	45012	21780	8712
Total TurbArea (m2)	4181.6	2023.4	809.3
Frac. Agitated	0.048	0.030	0.011
(by surface aerators)			
QUIESCENT			
Depth	1.37	0.98	0.92
SurfArea (ft2)	937472	729750	762343
SurfArea (m2)	87208.33	67885.00	70916.98
F/D Ratio	243	301	328
ScL - Methanol	NA	NA	NA
ScL - Acetaldehyde	NA	NA	NA
ScL - MEK	NA	NA	NA
U* (Friction Velocity)	NA	NA	NA

These Parameters are used when F/D < 14 **AND** U > 3.25 m/s

DIFFUSED

	Zone 1	Zone 2	Zone 3
Air flow, cfm	0	0	0
Air flow, m3/s	0.000	0.000	0.000

APPENDIX C FORMS - CALCULATING FRACTION BIODEGRADED

Calculating Mass Transfer Coefficient KL for Various Zones

Data Date: **PAE - Backup Stripper (Methanol Mode)**

Surface Aeration												
		Turbulent Area			Quiescent Area							
						kL, m/s						
	Temp Adj H	kG m/s	kL m/s	KL turb m/s	kG m/s	U10 < 3.25	U10 > 3.25 F/D<14	U10 > 3.25 14<F/D<51.2	U10 > 3.25 F/D>51.2	kL m/s	KL quisc m/s	KL overall m/s
Zone1												
Methanol	8.77E-06	1.55E-01	2.27E-02	5.37E-05	3.82E-03	4.31E-06	NA	3.38E-06	1.16E-06	4.31E-06	1.01E-06	3.54E-06
Zone 2												
Methanol	7.99E-06	1.55E-01	2.17E-02	4.92E-05	3.88E-03	4.31E-06	NA	4.06E-06	1.16E-06	4.31E-06	9.57E-07	2.40E-06
Zone 3												
Methanol	7.16E-06	1.55E-01	2.06E-02	4.44E-05	3.87E-03	4.31E-06	NA	4.37E-06	1.16E-06	4.31E-06	8.82E-07	1.38E-06

FORM XIII. DATA FORM FOR THE ESTIMATION OF MULTIPLE ZONE BIODEGRADATION FROM UNIT CONCENTRATIONS

Data Date: PAE - Backup Stripper (Methanol Mode)

NAME OF THE FACILITY				
COMPOUND for site specific biorate determination		**Methanol**		
Number of zones in the biological treatment unit	1			
VOLUME of full-scale system (cubic meters)	2	250372.98		
Average DEPTH of the full-scale system (meters)	3	1.0878333		
FLOW RATE of wastewater to the unit (m3/s)	4	1.116		
FLOW RATE of condensate to the unit (m3/s)	5	0.032		
Total wastewater flowrate - (including condensates) (m3/s)	5-A	1.148		
ESTIMATE OF KL (m/s)	6	*see table*		
Concentration in the wastewater treated in the unit (mg/L)	7	59.511413		
Concentration in the condensates (mg/L)	8	3809		
Concentration in wastewater (total - inc. cond) in (mg/L)	8-A	162.53984		
Concentration in the effluent (mg/L)	9	5.0982378		
TOTAL INLET FLOW (m3/s) line 4 plus the number on line 5 (or 5-A)	10	1.148		
TOTAL RESIDENCE TIME (s) line 2 divided by line 10.	11	218116	2.52	days
TOTAL AREA OF IMPOUNDMENT (m2) line 2 divided by line 3	12	230157		

Lines 13 through 15 Not Used

Zone Number	Concentration for zone, Ci (mg/L)	Area of the zone, A (m2)	Estimate of KL in the zone (m/s)	AIR STRIPPING KL A Ci (g/s)	
1	44.62519102	87091.1501	3.54365E-06	13.7723	0.308621
2	25.78937099	67793.7816	2.39719E-06	4.1912	0.162515
3	8.06308953	70821.6825	1.37942E-06	0.788	0.097693
4					
5					
6					
TOTALS - sum for each zone.	15	225706.614	16	18.75	

Removal by air stripping (g/s). Line 16.	17	18.75
Loading in effluent (g/s). Line 9 times line 10.	18	5.85
Total loading (g/s). {(line 5*line 8)+(line 4*line 7)} or {line 5-A*line 8-A}.	19	186.6
Removal by biodegradation (g/s) Line 19 minus (line 17 + line 18).	20	162.0
Fraction biodegraded: Divide line 20 by line 19.	21	0.868
Fraction air emissions: Divide line 17 by line 19.	22	0.101
Fraction remaining in unit effluent. Divide line 18 by 19.	23	0.031

Buckner, Katharine

From: Sheryl Watkins <swatkins@all4inc.com>
Sent: Tuesday, February 6, 2024 6:08 PM
To: Buckner, Katharine; Rachel Davis; Steven Moore; Caleb Fetner
Subject: RE: production rates

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***

Hi, Katherine! Thanks for sending the updated testing conditions for the strippers – we will review and let you know if we have any questions or comments.

There is no difference between air dried tons of pulp and air dried tons of unbleached pulp (i.e., they mean the same thing/are interchangeable). You are also correct that ADTFP = air dried tons of finished paper. When the Mill produced bleached pulp, you may have also seen the unit of measure "air dried tons bleached pulp" (ADTBP) with some of the bleaching process equipment emissions factors and throughput.

Regarding the No. 2 Recovery Furnace (RF2): There are no modifications planned for RF2 with the new stripper project. RF2 is only impacted by combustion of the SRL, which will be added to the black liquor (BL) that is fired in both RF2 and RF3 at no more than 2% of the total volume of BL (Note: the original application indicated adding SRL at no more than 1% BL by volume, so we will be sending you revised emissions calculations at the 2% value). We have estimated that the total maximum emissions increase at RF2 and RF3 from combustion of the SRL @ 2% BL volume is 2.4 tpy SO_2 and 13.4 tpy NO_x. RF2 is not currently subject to any regulations that limit SO_2 or NO_x emissions and the emissions increase is small. Therefore, we do not believe that verification of the NO_x and SO_2 emissions increases at RF2 with an SO_2 and NO_x CEMS is necessary nor would that approach be effective/valuable.

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From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Tuesday, February 6, 2024 10:53 AM
To: Rachel Davis <Rachel.Davis@new-indycb.com>; Sheryl Watkins <swatkins@all4inc.com>; Steven Moore <smoore@all4inc.com>; Caleb Fetner <cfetner@all4inc.com>
Subject: production rates

Hey everyone,

We will show emissions from both rates in the SOB. An explanation of the current limit of 1825 and the expected emissions based on the 1825 ADTUP/day will be shown in addition to the rates at the projected actual production used in the application.

A side question, is there any difference between ADTP (air dried tons of pulp) and ADTUP (air dried tons of unbleached pulp)? If so, please explain. I know there is still another unit of ADTFP (air dried tons of finished paper (?)), right? I understand that this is based on the tons of finished paper

I have included as an attachment the latest version of the testing conditions for the strippers and the SOB write up for each.

Also, do you have some rationale you can provide for not requiring SO2 and NOx CEMs on #2 recovery furnace? We didn't mention this yesterday. This is one of the EPA's comments. When we discussed previously it was mentioned such a small increase would be hard to see on the CEMS for either pollutant.

Thanks,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

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Buckner, Katharine

From: Rachel Davis <Rachel.Davis@new-indycb.com>
Sent: Friday, February 2, 2024 5:10 PM
To: Buckner, Katharine
Cc: Martinez, Sara; jimc@thekraftgroup.com; Stephanie Blackman (Schwarz); Golden, Rebecca; Lowell, Randy
Subject: Construction Permit Discussion

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***

Ms. Katharine,

To follow-up on our conversation the other day regarding comments made on the draft stripper construction permit, I wanted to offer the following response.

There has been the suggestion that New-Indy Catawba should re-run emission factors for 1825 tons per day (TPD) in addition to the 2700 TPD that was run under the original 2019 construction application (as amended in 2020) for the mill and what was run for the stripper construction permit.

There seems to be some confusion over the appropriate TPD. Before New-Indy Catawba converted to using unbleached pulp to manufacture containerboard, the Mill used bleached pulp to make paper. The bleached pulp process was based on an 1825 TPD factor. However, this changed to 2700 TPD when the Mill converted to using unbleached pulp for containerboard. It's understandable that there may be some confusion over the correct limit given this history.

The original 2019 construction application (as amended in 2020) for unbleached pulp included a typo that referenced the old limit for bleached pulp operations of 1825 TPD. But all the calculations for the substantive analysis was based on 2700 TPD. While the typo was not formally corrected, everyone understood it was 2700 TPD since that was the substantive analysis. And New-Indy Catawba has operated at an emissions factor for 2700 TPD since commencement.

Because the 2700 TPD is greater than the 1825 TPD, it seems better for the agencies and the public to run the numbers at the higher limit and having two models – one of which (i.e., 1825 TPD) has no real meaning – would only lead to further confusion and provide no useful data.

Thus, New-Indy stands by the analysis done and requests that the Department issue the stripper construction permit as soon as possible based on the 2700 TPD. The installation of the new stripper was mandated by the Department and further delay only negatively impacts the public.

Have a wonderful weekend!

Rachel

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any attachments. Email transmission may not be secure and could contain errors. We accept no liability for any damage caused by any virus transmitted by this email. Please do not send to us by email any information containing personally identifiable information without appropriate encryption. Thank you.

Buckner, Katharine

From: Sheryl Watkins <swatkins@all4inc.com>
Sent: Wednesday, January 17, 2024 7:20 PM
To: Buckner, Katharine; Rachel Davis; Steven Moore; Caleb Fetner
Subject: RE: couple follow up questions

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***

Hi, Katharine. I spoke with Rachel this evening regarding your follow-up item below on the existing steam stripper, and we believe that you are on the right track. We would like to propose "periodic readiness testing" in lieu of periodic performance testing when the existing steam stripper becomes a back up to the new stripper. We would also propose that the readiness testing procedure and schedule be submitted as part of the initial performance test report. Justification for this approach is as follows:

- Since the existing stripper will be a back up to the new stripper, it will not be operating most of the time and will not have a firm preventative maintenance schedule, but rather will have a firm "readiness testing" schedule that ensures the system is in good operating condition when it is needed to operate. Think of an emergency fire pump engine, which only operates when there is a fire, but facilities are required to perform readiness testing periodically (I believe this is for insurance purposes) to ensure that when there is a fire and the pump is needed, that it will start-up and run properly to deliver water to fight the fire.
- Determination of the required readiness test items, and the procedures and schedule for each item, will require input from Mill personnel as well as the stripper vendor. We believe that some items may be required to be performed monthly, while others could be quarterly, for example.
- We are not aware of any other facility that operates a back-up steam stripper, and there are operational, and potentially safety, considerations that would need to be discussed, evaluated, and possibly trialed.

We wanted to get this out to you as soon as possible - Let us know if you would like to discuss in more detail tomorrow. Again, thank you for your time and consideration of these requests.

p.s. comments on the draft permit and sob for the dry ash system were provided in a separate email response.

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From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Tuesday, January 16, 2024 4:54 PM
To: Rachel Davis <Rachel.Davis@new-indycb.com>; Sheryl Watkins <swatkins@all4inc.com>; Steven Moore <smoore@all4inc.com>; Caleb Fetner <cfetner@all4inc.com>
Subject: couple follow up questions

Hey everyone,

For the existing stripper, is there preventative, periodic maintenance that can be done on the existing stripper to ensure it would be in good operating condition when it has to run? I don't mean maintenance right before it needs to be used. Is there anything that can be done month to month (or some other timing) to ensure it can operate properly when it needs to be operated? We would consider this in lieu of the periodic testing as long as the initial performance test and operating and monitoring parameters are established.

For the Ash Handling project, we can be more generic on the project description. The emission calculations in the consent decree application were based on amount conveyed from each boiler. The emission factors used are related to conveying the material to silos. Do these need to be revised to be consistent with how you plan to calculate the actual emissions?

Thank you,

Katharine K. Buckner
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Buckner, Katharine

From:	Sheryl Watkins <swatkins@all4inc.com>
Sent:	Wednesday, January 17, 2024 3:02 PM
To:	Caleb Fetner; Buckner, Katharine
Cc:	Steven Moore; Rachel Davis
Subject:	RE: Anything you can send ahead of time

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***

Katharine: Here is the next item (additional information around total VOC question) for your review:

VOC emissions from the pulping condensates are determined as the sum of the following pollutants: methanol, acetaldehyde, methyl ethyl ketone, propionaldehyde, and TRS VOCs [i.e., methyl mercaptan (MMC), dimethyl disulfide (DMDS), and dimethyl sulfide (DMS)]. New-Indy Catawba proposes that DHEC approve that the removal efficiency of methanol demonstrated across the steam stripper is representative of the removal efficiency for acetaldehyde, methyl ethyl ketone, and propionaldehyde based on the following information:

- Methanol and the TRS VOCs comprise more than 95% of the total VOC emissions in the pulping condensates treated in the Aerated Stabilization Basin (ASB). This is based on historical liquid concentration data, site-specific ASB configuration, and 40 CFR 63 Appendix C/Form XIII (Methanol) and EPA's WATER9 model (all other VOC).
- Methanol is highly soluble in water and is less volatile/more difficult to remove from water than acetaldehyde, methyl ethyl ketone, and propionaldehyde. This is evident from the henry's law constants that represent the volatility of each compound in water at lower concentrations (Note: Henry's Law states that the solubility of a gas in a liquid is directly proportional to the partial pressure of the gas above the liquid). The higher the Henry's Law value, the more volatile the compound is. From 40 CFR 63 Appendix C, the Henry's law constants in atm/mole fraction at 25 C are as follows, showing that methanol is the least volatile of these compounds:
  - Acetaldehyde: 4.87
  - Methanol: 0.289
  - Methyl ethyl ketone: 7.22
  - Propionaldehyde: 3.32
- Therefore, we can assume that the removal efficiency of acetaldehyde, methyl ethyl ketone, and propionaldehyde across the steam stripper will be at or above the removal efficiency of methanol.

Let us know if you have any questions or need additional information.

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From: Sheryl Watkins
Sent: Wednesday, January 17, 2024 12:01 PM
To: Caleb Fetner <cfetner@all4inc.com>; Buckner, Katharine <bucknekk@dhec.sc.gov>
Cc: Steven Moore <smoore@all4inc.com>; Rachel Davis <Rachel.Davis@new-indycb.com>
Subject: RE: Anything you can send ahead of time

Katharine: Attached are the proposed markups for condition B.20 per our discussion yesterday. Let us know if you have any questions.

Still working on the additional information around total VOC, periodic maintenance around the existing stripper, and comments on the ash handling system draft permit and sob.

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From: Caleb Fetner <cfetner@all4inc.com>
Sent: Wednesday, January 17, 2024 10:56 AM
To: Buckner, Katharine <bucknekk@dhec.sc.gov>
Cc: Sheryl Watkins <swatkins@all4inc.com>; Steven Moore <smoore@all4inc.com>; Rachel Davis <Rachel.Davis@new-indycb.com>
Subject: RE: Anything you can send ahead of time

Hi Katharine – here is the explanation. Let me know if you have any questions or need more information.

The New Stripper emissions calculations were updated in the version dated 1-11-24 as follows: (1) the hardpipe (no stripper online) operating scenario was increased to the maximum allowable steam stripper downtime of 460 hours to reflect worst-case annual emissions; (2) the recovery furnace NOX increase expected from mixing SRL and black liquor was increased from 1% to 2% to reflect up to 2% SRL by volume.

Neither of these changes impact the short-term hourly emissions rates of hydrogen sulfide (H2S), methyl mercaptan (MMC), or total reduced sulfur (TRS). Therefore, a revision to the ambient air dispersion modeling analysis (last provided to DHEC via email on 10/2/2023) is not necessary.

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From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Tuesday, January 16, 2024 5:18 PM
To: Caleb Fetner <cfetner@all4inc.com>
Cc: Sheryl Watkins <swatkins@all4inc.com>; Steven Moore <smoore@all4inc.com>; Rachel Davis <Rachel.Davis@new-indycb.com>
Subject: RE: Anything you can send ahead of time

Hello Caleb,
Forgot to include this. Will you explain why the modeling will not need to be updated based on the latest emissions changes?

Thank you,

Katharine K. Buckner
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From: Caleb Fetner <cfetner@all4inc.com>
Sent: Thursday, January 11, 2024 3:30 PM
To: Buckner, Katharine <bucknekk@dhec.sc.gov>
Cc: Sheryl Watkins <swatkins@all4inc.com>; Steven Moore <smoore@all4inc.com>; Rachel Davis <Rachel.Davis@new-indycb.com>
Subject: RE: Anything you can send ahead of time

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***

Hi Katharine – here are the updated emissions calculations with updates as follows:

1. Increased hardpipe (No Stripper) operating scenario to maximum allowable steam stripper downtime of 460 hours.
2. Increased from 1% to 2% SRL by volume mixed with BLS firing, resulting in small change in NOx emissions.
3. Added Project Emissions for Statement of Basis on each pollutant tab.

I'm unfortunately going to be out of office on Tuesday during our scheduled time to do final review of permits, but if you're able to review these tomorrow – I'm general available all day to discuss any questions or comments you have on these calculations.

Appreciate it! We are hard at work trying to get you the permit comments ASAP.

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From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Thursday, January 11, 2024 11:52 AM
To: Sheryl Watkins <swatkins@all4inc.com>; Steven Moore <smoore@all4inc.com>; Caleb Fetner <cfetner@all4inc.com>; Rachel Davis <Rachel.Davis@new-indycb.com>
Subject: Anything you can send ahead of time

Hey Y'all,

Thanks for the time today. Just wanted to add if there is anything you can send to me before tomorrow that will be great – comments on one permit, etc.

Thanks,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

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Buckner, Katharine

From: Buckner, Katharine
Sent: Friday, January 12, 2024 8:59 AM
To: Rachel Davis; Sheryl Watkins; Steve Moore (smoore@all4inc.com); Caleb Fetner
Subject: permit items

Hey y'all,

Thinking about the various projects we have going on. Here are some thoughts/items to be addressed:

- With the changes to the methanol to be combusted (1% to 2%) and the PSD review using the limit on the downtime hours of 460 hour , I believe the application will have to be updated accordingly.
- Based on the changes that get made to condition B.20, will B.21 need to be updated any?
- Also, I am revamping condition B.20. Going back to the drawing board, the purpose of the testing is to show that the performance guarantees are being met since these values were used in the PSD analysis. I could not find in the application where removal efficiencies were given for the new stripper. 98% for TRS was mentioned for the existing stripper. The video on how the new steam stripper will operate says 98% TRS and 95% methanol. If I missed where efficiencies were mentioned in the application please let me know where. So I don't think efficiencies are what need to be proven. The vendor guarantees need to be proven. How should the performance test be performed – grab sample? Or a composite sample over what period of time to catch fluctuations in the streams? It needs to be a meaningful test. Is there language in MACT S that can be used. Since compliance with MACT S is already required to be demonstrated, I thought we could use, where we can, MACT s as a basis so as not to require/include new or entirely different in the condition. Not sure I will have the condition completed today. I will send it to you for review when it is done.

I haven't seen anything else this morning.

Caleb, I will try to look at the calculations today. Thank you for sending those.

Thank you,

Katharine K. Buckner
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NEW-INDY CATAWBA MILL STRIPPER PROJECT

Stripper Operating Scenario	Operating Time	
	%	hrs
New Stripper Online	90%	7,884.0
Backup Stripper Online	4.75%	416.0
No Stripper Online	5.25%	460.0

LVHC Control Operating Scenario	Operating Time	
	%	hrs
RF3 Available for LVHC	75%	6,570.0
LVHC to CB1/CB2	25%	2,190.0

Summary of PSD Applicability
(tons/year)

Pollutant[(A)]	PM	PM_{10}	$PM_{2.5}$	NO_X	SO_2	CO	H2SO4	TRS
Baseline Actual Emissions	1.11	1.02	0.959	124	737	25.2	1.23	12.8
Projected Actual Emissions	13.3	10.3	8.37	148	646	62.8	2.43	16.8
Net Emissions Changes (PAE - BAE)	12.2	9.32	7.41	23.8	-91.2	37.6	1.20	3.95
PSD Significant Emissions Rates	**25**	**15**	**10**	**40**	**40**	**100**	**7**	**10**
PSD Significant?	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**

A - HF is not emitted from new, modified, or affected emissions units.

VOC	Pb	H_2S	CO_2
233	1.10E-04	3.61	12,275
260	2.06E-03	5.59	48,200
26.8	1.95E-03	1.98	35,925
40	**0.6**	**10**	**75,000**
No	**No**	**No**	**No**

SO2 EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time	
	%	hrs		%	hrs
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100%	8,004.0
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B,E]	97.9%	7,835.7
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B,E]	2.1%	168.3
SO2 BASELINE ACTUAL EMISSIONS (BAE)					
New Stripper Online	90.0%	7,884.0	SRL Online	95%	7,489.8
New Stripper Online	90.0%	7,884.0	SRL Online	95%	7,489.8
New Stripper Online	90.0%	7,884.0	SRL Online	95%	7,489.8
New Stripper Online	90.0%	7,884.0	SRL Offline	5%	394.2
Backup Stripper Online [H]	4.75%	416.0	NA	100%	416.0
No Stripper Online	5.25%	460.0	Foul Condensate to Hard Pipe	100%	460.0
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D,F]	81.6%	6,433.3
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D,F]	18.4%	1,450.7
Backup Stripper Steam - Natural Gas [J]	4.75%	416.0	Natural Gas[D,F]	81.6%	339.5

Backup Stripper Steam - No. 6 Oil [J]	4.75%	416.0	No. 6 Oil[D,F]	18.4%	76.5
SO2 PROJECTED ACTUAL EMISSIONS (PAE)					
NET EMISSIONS CHANGE (PAE - BAE)					

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in

C - Sulfur capture in recovery furnace >99, sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - The Backup Stripper operating in Methanol Mode would potentially strip less sulfur, but SOG emissions are conservatively base

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

J - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

H - Project Columbia SO2 emissions factor from NCG Combustion applied to October 2021 stack test SO2 emissions distribution be

Controls	Controls Operating Time		Production Rate		
	%	hrs	Value	UOM	lb/UOM
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)					
SOG to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	1.06
LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	1.97
NA	100.0%	7,835.7	26.0	mmBtu/hr	6.00E-04
NA	100.0%	168.3	24.8	mmBtu/hr	2.20E+00

PROJECTED ACTUAL EMISSIONS					
SRL Methanol to RF2/3[G]	100.0%	7,489.8	2,700	ADTP/day	0.56
SRL LVHC to RF3[G]	75.0%	5,617.4	2,700	ADTP/day	0.84
SRL LVHC to CB1/CB2[G]	25.0%	1,872.5	2,700	ADTP/day	0.84
SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	1.40
SOG to CB1/CB2	100.0%	416.0	2,700	ADTP/day	1.40
Hydrogen Peroxide Addition	100.0%	460.0	NA	NA	NA
LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	5.87
LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	5.87
NA	100.0%	985.5	1.0	mmBtu/hr	6.00E-04
NA	100.0%	6,433.3	96.8	mmBtu/hr	6.00E-04
NA	100.0%	1,450.7	92.2	mmBtu/hr	2.20E+00
NA	100.0%	339.5	26.0	mmBtu/hr	6.00E-04

NA	100.0%	76.5	24.8	mmBtu/hr	2.20E+00

NET EMISSIONS CHANGE (PAE - BAE)

Combination Boiliers No. 1 and No. 2 during baseline.

:d upon all of the sulfur being captured in the SOG.

tween LVHC, HVLC, and SOG.

SO2 Emissions Factor Reference	Sulfur Capture[C] %	SO2 Emissions lb/hr	SO2 Emissions tpy
October 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	60.4	241.8
October 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	112.0	490.6
AP-42 Table 1.4-2.	NA	0.02	0.1
AP-42 Table 1.3-1. 2.1% Sulfur Content.	NA	54.6	4.6
			737.0
Vendor / Preliminary Design Information	99%	0.6	2.4
Vendor / Preliminary Design Information	99%	0.9	2.7
Vendor / Preliminary Design Information	50%	47.2	44.2
Vendor / Preliminary Design Information	0%	157.4	31.0
Vendor / Preliminary Design Information	0%	157.4	32.7
NA	NA	NA	NA
Project Columbia Projected Emissions Factor[H], Combination Boilers No. 1 and No. 2 maximum. Pre-control emissions based on LVHC scrubber efficiency (50%) and estimated bark ash sulfur capture (20%) from 2012 stack test.	99%	6.6	21.7
Project Columbia Projected Emissions Factor[H], Combination Boilers No. 1 and No. 2 maximum. Pre-control emissions based on LVHC scrubber efficiency (50%) and estimated bark ash sulfur capture (20%) from 2012 stack test.	50%	330.3	361.7
AP-42 Table 1.4-2.	NA	0.00	0.0
AP-42 Table 1.4-2.	NA	0.06	0.2
AP-42 Table 1.3-1. 2.1% Sulfur Content.	NA	202.9	147.2
AP-42 Table 1.4-2.	NA	0.02	0.003

AP-42 Table 1.3-1. 2.1% Sulfur Content.	NA	54.6	2.1
			645.80
			-91.21

H2SO4 EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time	
	%	hrs		%	hrs
					BASELINE
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0
H2SO4 BASELINE ACTUAL EMISSIONS (BAE)					
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0
H2SO4 PROJECTED ACTUAL EMISSIONS (PAE)					
NET EMISSIONS CHANGE (PAE - BAE)					

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in

C - Sulfur capture in recovery furnace >99, sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

Controls	Controls Operating Time		Production Rate		H2SO4 Emissions Factor		Sulfur Capture
	%	hrs	Value	UOM	lb/ADTP	Reference	%
ACTUAL EMISSIONS (March 2021 - February 2023)							
LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	4.93E-03	NCASI Technical Bulletin 858, Table 10	NA

PROJECTED ACTUAL EMISSIONS							
LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	4.93E-03	NCASI Technical Bulletin 858, Table 10	NA
LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	4.93E-03	NCASI Technical Bulletin 858, Table 10	NA

NET EMISSIONS CHANGE (PAE - BAE)

Combination Boiliers No. 1 and No. 2 during baseline.

H2SO4 Emissions	
lb/hr	tpy
0.3	1.2
	1.2
0.55	1.82
0.55	0.61
	2.43
	1.20

NOX EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time	
	%	hrs		%	hrs
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B,E]	97.9%	7,835.7
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B,E]	2.1%	168.3
NOX BASELINE ACTUAL EMISSIONS					
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8
New Stripper Online	90%	7,884.0	SRL Offline	5.0%	394.2
Backup Stripper Online [H]	4.75%	416.0	NA	100.0%	416.0
No Stripper Online	5.25%	460.0	Foul Condensate to Hard Pipe	100.0%	460.0
Recovery Furnace #3 LVHC Ignitor	75%	6,570.0	Natural Gas[I]	15.0%	985.5
New Stripper Steam - Natural Gas	90%	7,884.0	Natural Gas[D,F]	81.6%	6,433.3
New Stripper Steam - No. 6 Oil	90%	7,884.0	No. 6 Oil[D,F]	18.4%	1,450.7
Backup Stripper Steam - Natural Gas [J]	4.75%	416.0	Natural Gas[D]	81.6%	339.5
Backup Stripper Steam - No. 6 Oil [J]	4.75%	416.0	No. 6 Oil[D]	18.4%	76.5
NOX PROJECTED ACTUAL EMISSIONS					
PAE - BAE					

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Co

C - Ammonia input to recovery furnace increases >2% with maximum addition of SRL of 2% by volume (representative of ~1% by volu

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - >90% of methanol condensed and burned in recovery furnace, < 10% of methanol vented into LVHC System.

H - No change in NO_x emissions factor between Backup Stripper TRS mode and Methanol mode.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

J - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

Controls	Controls Operating Time		Production Rate		
	%	hrs	Value	UOM	lb/UOM
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)					
SOG to CB1/CB2	100%	8,004.0	1,365	ADTP/day	0.415
NA	100%	7,835.7	26.0	mmBtu/hr	2.80E-01
NA	100%	168.3	24.8	mmBtu/hr	3.13E-01
PROJECTED ACTUAL EMISSIONS					
SRL Methanol to RF2/3[G]	100%	7,489.8	2,852	TBLS/day	1.500
SRL LVHC to RF3[G]	75%	5,617.4	316.9	TBLS/day	1.500
SRL LVHC to CB1/CB2[G]	25%	1,872.5	270.0	ADTP/day	0.415
SOG to CB1/CB2	100%	394.2	2,700	ADTP/day	0.415
SOG to CB1/CB2	100%	416.0	2,700	ADTP/day	0.415
Hydrogen Peroxide Addition	100%	460.0	NA	NA	NA
NA	100%	985.5	1.0	mmBtu/hr	2.80E-01
NA	100%	6,433.3	96.8	mmBtu/hr	2.80E-01
NA	100%	1,450.7	92.2	mmBtu/hr	3.13E-01
NA	100%	339.5	26.0	mmBtu/hr	2.80E-01
NA	100%	76.5	24.8	mmBtu/hr	3.13E-01
NET EMISSIONS CHANGE (PAE - BAE)					

mbination Boilers No. 1 and No. 2 during baseline.

ıme pure methanol.)

NOX Emissions Factor Reference	Ammonia Increase[c] %	NOX Emissions lb/hr	NOX Emissions tpy
July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	23.6	94.5
AP-42 Table 1.4-2.	NA	7.3	28.6
AP-42 Table 1.3-1.	NA	7.8	0.7
			123.72
NCASI Technical Bulletin 884, Table 4.12.	2.0%	3.6	13.4
NCASI Technical Bulletin 884, Table 4.12.	2.0%	0.4	1.1
July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	4.7	4.4
July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	46.7	9.2
July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	46.7	9.7
NA	NA	NA	NA
AP-42 Table 1.4-2.	NA	0.3	0.1
AP-42 Table 1.4-2.	NA	27.1	87.2
AP-42 Table 1.3-1.	NA	28.9	20.9
AP-42 Table 1.4-2.	NA	7.3	1.2
AP-42 Table 1.3-1.	NA	7.8	0.3
			147.54
			23.82

CO EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time	
	%	hrs		%	hrs
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3
CO BASELINE ACTUAL EMISSIONS					
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8
New Stripper Online	90%	7,884.0	SRL Offline	5.0%	394.2
Backup Stripper Online [C]	4.75%	416.0	NA	100.0%	416.0
No Stripper Online	5.25%	460.0	Foul Condensate to Hard Pipe	100.0%	460.0
Recovery Furnace #3 LVHC Ignitor	75%	6,570.0	Natural Gas[I]	15.0%	985.5
New Stripper Steam - Natural Gas	90%	7,884.0	Natural Gas[D]	81.6%	6,433.3
New Stripper Steam - No. 6 Oil	90%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7
Backup Stripper Steam - Natural Gas [G]	4.75%	416.0	Natural Gas[D]	81.6%	339.5
Backup Stripper Steam - No. 6 Oil [G]	4.75%	416.0	No. 6 Oil[D]	18.4%	76.5
CO PROJECTED ACTUAL EMISSIONS					
PAE - BAE					

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combi

C - No change in CO emissions factor between Backup Stripper TRS mode and Methanol mode.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

Controls	Controls Operating Time		Production Rate		
	%	hrs	Value	UOM	lb/UOM
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)					
SOG to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	0.0728
NA	100.0%	7,835.7	26.0	mmBtu/hr	8.40E-02
NA	100.0%	168.3	24.8	mmBtu/hr	3.33E-02
PROJECTED ACTUAL EMISSIONS					
SRL Methanol to RF2/3	100.0%	7,489.8	NA	NA	NA
SRL LVHC to RF3	75%	5,617.4	2,700	ADTP/day	0.0728
SRL LVHC to CB1/CB2	25%	1,872.5	2,700	ADTP/day	0.0728
SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	0.0728
SOG to CB1/CB2	100.0%	416.0	2,700	ADTP/day	0.0728
Hydrogen Peroxide Addition	100.0%	460.0	NA	NA	NA
NA	100.0%	985.5	1.0	mmBtu/hr	8.40E-02
NA	100.0%	6,433.3	96.8	mmBtu/hr	8.40E-02
NA	100.0%	1,450.7	92.2	mmBtu/hr	3.33E-02
NA	100.0%	339.5	26.0	mmBtu/hr	8.40E-02
NA	100.0%	76.5	24.8	mmBtu/hr	3.33E-02
NET EMISSIONS CHANGE (PAE - BAE)					

ination Boilers No. 1 and No. 2 during baseline.

CO Emissions Factor Reference	CO Control %	CO Emissions lb/hr	tpy
July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	4.1	16.6
AP-42 Table 1.4-2.	NA	2.2	8.6
AP-42 Table 1.3-1.	NA	0.8	0.1
			25.22
NA	NA	NA	NA
July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	8.2	23.0
July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	8.2	7.7
July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	8.2	1.6
July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	8.2	1.7
NA	NA	NA	NA
AP-42 Table 1.4-2.	NA	0.1	0.0
AP-42 Table 1.4-2.	NA	8.1	26.2
AP-42 Table 1.3-1.	NA	3.1	2.2
AP-42 Table 1.4-2.	NA	2.2	0.4
AP-42 Table 1.3-1.	NA	0.8	0.0
			62.81
			37.60

VOC EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time	
	%	hrs		%	hrs
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0
Aerated Stabilization Basin (ASB)	100.0%	8,760.0	Foul Condensate to Hard Pipe	100.0%	8,760.0
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3
VOC BASELINE ACTUAL EMISSIONS					
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8
New Stripper Online	90%	7,884.0	SRL Offline	5.0%	394.2
Backup Stripper Online (TRS Mode) [H]	4.75%	416.0	NA	100.0%	416.0
Backup Stripper Online (Methanol Mode) [H]	4.75%	416.0	NA	100.0%	416.0
ASB - New Stripper Online	90%	7,884.0	No Foul Condensate to Hard Pipe	100.0%	7,884.0
ASB - Backup Stripper Online (TRS Mode) [J]	4.75%	416.0	TRS Stripped From Foul Condensate	100.0%	416.0
ASB - Backup Stripper Online (Methanol Mode) [J]	4.75%	416.0	500 gpm Foul Condensate to Hard Pipe	100.0%	416.0
ASB - No Stripper Online	5.25%	460.0	Foul Condensate to Hard Pipe	100.0%	460.0
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0
Recovery Furnace #3 LVHC Ignitor	75%	6,570.0	Natural Gas[I]	15.0%	985.5
New Stripper Steam - Natural Gas	90%	7,884.0	Natural Gas[D]	81.6%	6,433.3
New Stripper Steam - No. 6 Oil	90%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7
Backup Stripper Steam - Natural Gas [K]	4.75%	416.0	Natural Gas[D]	81.6%	339.5

Backup Stripper Steam - No. 6 Oil [K]	4.75%	416.0	No. 6 Oil[D]	18.4%	76.5
VOC PROJECTED ACTUAL EMISSIONS					
PAE - BAE					

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers N

C - VOC destruction >98% in vapor phase, 99.9% in liquid phase.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - >90% of methanol condensed and burned in recovery furnace, < 10% of methanol vented into LVHC System.

H - The Backup Stripper operating in Methanol Mode result in higher SOG emissions, since more VOC are stripped.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

J - When the Backup Stripper is operating, ASB emissions are higher if the stripper is operating in methanol mode. Both emissions factors are shown in t

K - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

Controls	Controls Operating Time		Production Rate		
	%	hrs	Value	UOM	lb/UOM
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)					
LVHC to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	4.35
NA	100.0%	8,760.0	1,365	ADTP/day	8.51E-01
LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	3.10E-03
NA	100.0%	7,835.7	26.0	mmBtu/hr	5.50E-03
NA	100.0%	168.3	24.8	mmBtu/hr	1.87E-03

PROJECTED ACTUAL EMISSIONS					
SRL Methanol to RF2/3[G]	100%	7,489.8	2,700	ADTP/day	14.40
SRL LVHC to RF3[G]	75%	5,617.4	2,700	ADTP/day	1.60
SRL LVHC to CB1/CB2[G]	25%	1,872.5	2,700	ADTP/day	1.60
SOG to CB1/CB2	100%	394.2	2,700	ADTP/day	16.00
SOG to CB1/CB2	100%	416.0	2,700	ADTP/day	7.20
SOG to CB1/CB2	100%	416.0	2,700	ADTP/day	16.00
NA	100%	7,884.0	2,700	ADTP/day	0.29
NA	100%	416.0	2,700	ADTP/day	1.43
Hydrogen Peroxide Addition	100.0%	416.0	2,700	ADTP/day	1.54
NA	100%	460.0	2,700	ADTP/day	2.20
LVHC to RF3	75%	6,570.0	2,700	ADTP/day	3.10E-03
LVHC to CB1/CB2	25%	2,190.0	2,700	ADTP/day	3.10E-03
NA	100%	985.5	1.0	mmBtu/hr	5.50E-03
NA	100%	6,433.3	96.8	mmBtu/hr	5.50E-03
NA	100%	1,450.7	92.2	mmBtu/hr	1.87E-03
NA	100%	339.5	26.0	mmBtu/hr	5.50E-03

NA	100%	76.5	24.8	mmBtu/hr	1.87E-03

NET EMISSIONS CHANGE (PAE - BAE)

lo. 1 and No. 2 during baseline.

he table, but ASB emissions are based on methanol mode operation.

VOC Emissions Factor Reference	Removal[c] %	VOC Emissions lb/hr	tpy
Average daily methanol stripped based on daily Subpart S compliance through 2/28/2023.	98.0%	4.95	19.81
WATER9 Inputs and Outputs Provided.	NA	48.39	211.96
July 2019 Project Columbia Application. Page C-3 for Total LVHC Emissions.	NA	0.18	0.77
AP-42 Table 1.4-2.	NA	0.1	0.6
AP-42 Table 1.3-3. NMTOC for no. 6 oil.	NA	0.0	0.0
			233.11
Vendor / Preliminary Design Information	99.9%	1.62	6.07
Vendor / Preliminary Design Information	98%	3.60	10.11
Vendor / Preliminary Design Information	98%	3.60	3.37
Vendor / Preliminary Design Information	98%	36.00	7.10
Vendor / Preliminary Design Information	98%		
Assume methanol mode captures all VOC in SOG	98%	36.00	7.49
WATER9 Inputs and Outputs Provided.	NA	32.85	129.50
WATER9 Inputs and Outputs Provided.	NA		
WATER9 Inputs and Outputs Provided.	NA	173.20	36.03
WATER9 Inputs and Outputs Provided.	NA	247.14	56.84
July 2019 Project Columbia Application. Page C-3 for Total LVHC Emissions.	NA	0.35	1.15
July 2019 Project Columbia Application. Page C-3 for Total LVHC Emissions.	NA	0.35	0.38
AP-42 Table 1.4-2.	NA	5.50E-03	2.71E-03
AP-42 Table 1.4-2.	NA	0.5	1.7
AP-42 Table 1.3-3. NMTOC for no. 6 oil.	NA	0.2	0.1
AP-42 Table 1.4-2.	NA	0.1	0.0

AP-42 Table 1.3-3. NMTOC for no. 6 oil.	NA	0.0	0.0
			259.89
			26.79

TRS EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time	
	%	hrs		%	hrs
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0
Aerated Stabilization Basin (ASB)	100.0%	8,760.0	NA	100.0%	8,760.0
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0
TRS BASELINE ACTUAL EMISSIONS					
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8
New Stripper Online	90.0%	7,884.0	SRL Offline	5.0%	394.2
Backup Stripper Online [I]	4.75%	416.0	NA	100.0%	416.0
ASB - New Stripper Online	90.0%	7,884.0	No Foul Condensate to Hard Pipe	100.0%	7,884.0
ASB - Backup Stripper Online (TRS Mode) [J]	4.75%	416.0	TRS Stripped From Foul Condensate	100.0%	416.0
ASB - Backup Stripper Online (Methanol Mode) [J]	4.75%	416.0	500 gpm Foul Condensate to Hard Pipe	100.0%	416.0
ASB - No Stripper Online	5.25%	460.0	Foul Condensate to Hard Pipe	100.0%	460.0
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0
TRS PROJECTED ACTUAL EMISSIONS					

PAE - BAE

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers N

C - Sulfur capture in recovery furnace >99.9% (see note H), sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - Recovery Furnace captures 99% of sulfur and converts 99% of remaining uncaptured sulfur.

I - Backup Stripper SOG emissions are conservatively based upon all of the sulfur being captured in the SOG for both TRS mode and Methanol mode.

J - When the Backup Stripper is operating, ASB emissions are higher if the stripper is operating in methanol mode. Both emissions factors are shown in th

Controls	Controls Operating Time		Production Rate		
	%	hrs	Value	UOM	lb/UOM
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)					
LVHC to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	2.88E-03
NA	100.0%	8,760.0	1,365	ADTP/day	4.08E-02
LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	8.01E-03

PROJECTED ACTUAL EMISSIONS					
SRL Methanol to RF2/3[G,H]	100.0%	7,489.8	2,700	ADTP/day	0.33
SRL LVHC to RF3[G,H]	75.0%	5,617.4	2,700	ADTP/day	0.49
SRL LVHC to CB1/CB2[G]	25.0%	1,872.5	2,700	ADTP/day	0.49
SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	0.81
SOG to CB1/CB2	100.0%	416.0	2,700	ADTP/day	0.81
NA	100.0%	7,884.0	2,700	ADTP/day	2.42E-02
NA	100.0%	416.0	2,700	ADTP/day	2.72E-02
Hydrogen Peroxide Addition	100.0%	416.0	2,700	ADTP/day	5.28E-02
Hydrogen Peroxide Addition	100.0%	460.0	2,700	ADTP/day	7.28E-02
LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	1.75E+00
LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	8.76E-03

NET EMISSIONS CHANGE (PAE - BAE)

Io. 1 and No. 2 during baseline.

ne table, but ASB emissions are based on methanol mode operation.

TRS Emissions Factor	Sulfur Capture[C]	TRS Emissions	
Reference	%	lb/hr	tpy
June 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	0.16	0.65
H2SSIM/WATER9 Inputs and Outputs Provided.	NA	2.32	10.16
June 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	0.46	2.00
			12.81
Vendor / Preliminary Design Information	99.9%	0.04	0.14
Vendor / Preliminary Design Information	99.9%	0.05	0.15
Vendor / Preliminary Design Information	99%	0.55	0.51
Vendor / Preliminary Design Information	99%	0.91	0.18
Vendor / Preliminary Design Information	99%	0.91	0.19
H2SSIM/WATER9 Inputs and Outputs Provided.	NA	2.72	10.74
H2SSIM/WATER9 Inputs and Outputs Provided.	NA		
H2SSIM/WATER9 Inputs and Outputs Provided.	NA	5.94	1.24
H2SSIM/WATER9 Inputs and Outputs Provided.	NA	8.19	1.88
June 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. Pre-control emissions based on LVHC scrubber efficiency (50%) and estimated 99% combustion efficiency in combination boilers.	99.9%	0.20	0.65
June 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. DHEC Approved Test.	NA	0.99	1.08
			16.76

H2S EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time	
	%	hrs		%	hrs
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0
Aerated Stabilization Basin (ASB)	100.0%	8,760.0	Foul Condensate to Hard Pipe	100.0%	8,760.0
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0
H2S BASELINE ACTUAL EMISSIONS					
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8
New Stripper Online	90.0%	7,884.0	SRL Offline	5.0%	394.2
Backup Stripper Online [I]	4.75%	416.0	NA	100.0%	416.0
ASB - New Stripper Online	90.0%	7,884.0	No Foul Condensate to Hard Pipe	100.0%	7,884.0
ASB - Backup Stripper Online (TRS Mode) [J]	4.75%	416.0	H2S Stripped From Foul Condensate	100.0%	416.0
ASB - Backup Stripper Online (Methanol Mode) [J]	4.75%	416.0	500 gpm Foul Condensate to Hard Pipe	100.0%	416.0
ASB - No Stripper Online	5.25%	460.0	Foul Condensate to Hard Pipe	100.0%	460.0
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0
H2S PROJECTED ACTUAL EMISSIONS					
PAE - BAE					

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers N

C - Sulfur capture in recovery furnace >99.9% (see note H), sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - Recovery Furnace captures 99% of sulfur and converts 99% of remaining uncaptured sulfur.

I - Backup Stripper SOG emissions are conservatively based upon all of the sulfur being captured in the SOG for both TRS mode and Methanol mode.

J - When the Backup Stripper is operating, H2S ASB emissions are higher if the stripper is operating in TRS mode. Both emissions factors are shown in the

Controls	Controls Operating Time		Production Rate		
	%	hrs	Value	UOM	lb/UOM
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)					
LVHC to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	4.13E-04
Hydrogen Peroxide Addition	100.0%	8,760.0	1,365	ADTP/day	1.36E-02
LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	5.03E-04

PROJECTED ACTUAL EMISSIONS					
SRL Methanol to RF2/3[G,H]	100.0%	7,489.8	2,700	ADTP/day	0.24
SRL LVHC to RF3[G,H]	75.0%	5,617.4	2,700	ADTP/day	0.37
SRL LVHC to CB1/CB2[G]	25.0%	1,872.5	2,700	ADTP/day	0.37
SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	0.61
SOG to CB1/CB2	100.0%	416.0	2,700	ADTP/day	0.61
NA	100.0%	7,884.0	2,700	ADTP/day	9.27E-03
NA	100.0%	416.0	2,700	ADTP/day	9.81E-03
Hydrogen Peroxide Addition	100.0%	416.0	2,700	ADTP/day	9.45E-03
Hydrogen Peroxide Addition	100.0%	460.0	2,700	ADTP/day	9.54E-03
LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	1.17E-01
LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	5.87E-04

NET EMISSIONS CHANGE (PAE - BAE)

Io. 1 and No. 2 during baseline.

e table, but ASB emissions are based on TRS mode operation.

H2S Emissions Factor Reference	Sulfur Capture[C] %	H2S Emissions lb/hr	H2S Emissions tpy
June 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	0.02	0.09
H2SSIM/WATER9 Inputs and Outputs Provided.	NA	0.77	3.39
June 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	0.03	0.13
			3.61
Vendor / Preliminary Design Information	99.9%	0.03	0.10
Vendor / Preliminary Design Information	99.9%	0.04	0.12
Vendor / Preliminary Design Information	99%	0.41	0.39
Vendor / Preliminary Design Information	99%	0.69	0.14
Vendor / Preliminary Design Information	99%	0.69	0.14
H2SSIM/WATER9 Inputs and Outputs Provided.	NA	1.04	4.11
H2SSIM/WATER9 Inputs and Outputs Provided.	NA	1.10	0.23
H2SSIM/WATER9 Inputs and Outputs Provided.	NA		
H2SSIM/WATER9 Inputs and Outputs Provided.	NA	1.07	0.25
June 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. Pre-control emissions based on LVHC scrubber efficiency (50%) and estimated 99% combustion efficiency in combination boilers.	99.9%	0.01	0.04
June 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. DHEC Approved Test.	NA	0.07	0.07
			5.59
			1.98

PM EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time	
	%	hrs		%	hrs
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3
PM BASELINE ACTUAL EMISSIONS					
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7
Backup Stripper Steam - Natural Gas [C]	4.75%	416.0	Natural Gas[D]	81.6%	339.5
Backup Stripper Steam - No. 6 Oil [C]	4.75%	416.0	No. 6 Oil[D]	18.4%	76.5
PM PROJECTED ACTUAL EMISSIONS					
PAE - BAE					

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution i

C - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

Controls	Controls Operating Time		Production Rate		PM Emissions Factor	
	%	hrs	Value	UOM	lb/UOM	Reference
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)						
	100.0%	7,835.7	26.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.
	100.0%	168.3	24.8	mmBtu/hr	1.61E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).
PROJECTED ACTUAL EMISSIONS						
	100.0%	985.5	1.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.
	100.0%	6,433.3	96.8	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.
	100.0%	1,450.7	92.2	mmBtu/hr	1.61E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).
	100.0%	339.5	26.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.
	100.0%	76.5	24.8	mmBtu/hr	1.61E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).
NET EMISSIONS CHANGE (PAE - BAE)						

n Combination Boilers No. 1 and No. 2 during baseline.

PM Control	PM Emissions	
%	lb/hr	tpy
NA	0.2	0.8
NA	4.0	0.3
		1.1
NA	7.60E-03	3.74E-03
NA	0.7	2.4
NA	14.8	10.8
NA	0.2	0.0
NA	4.0	0.2
		13.33
		12.22

PM10 EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time	
	%	hrs		%	hrs
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3
PM10 BASELINE ACTUAL EMISSIONS					
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7
Backup Stripper Steam - Natural Gas [C]	4.75%	416.0	Natural Gas[D]	81.6%	339.5
Backup Stripper Steam - No. 6 Oil [C]	4.75%	416.0	No. 6 Oil[D]	18.4%	76.5
PM10 PROJECTED ACTUAL EMISSIONS					
PAE - BAE					

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution

C - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

Controls	Controls Operating Time		Production Rate		
	%	hrs	Value	UOM	lb/UOM
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)					
	100.0%	7,835.7	26.0	mmBtu/hr	7.60E-03
	100.0%	168.3	24.8	mmBtu/hr	1.17E-01
PROJECTED ACTUAL EMISSIONS					
	100.0%	985.5	1.0	mmBtu/hr	7.60E-03
	100.0%	6,433.3	96.8	mmBtu/hr	7.60E-03
	100.0%	1,450.7	92.2	mmBtu/hr	1.17E-01
	100.0%	339.5	26.0	mmBtu/hr	7.60E-03
	100.0%	76.5	24.8	mmBtu/hr	1.17E-01
NET EMISSIONS CHANGE (PAE - BAE)					

in Combination Boilers No. 1 and No. 2 during baseline.

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PM10 Emissions Factor Reference	PM10 Control %	PM10 Emissions lb/hr	tpy
AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.8
AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	2.9	0.2
			1.02
AP-42 Table 1.4-2. Filterable and Condensable.	NA	7.60E-03	3.74E-03
AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.7	2.4
AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	10.8	7.8
AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.0
AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	2.9	0.1
			10.34
			9.32

PM2.5 EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time	
	%	hrs		%	hrs
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3
PM2.5 BASELINE ACTUAL EMISSIONS					
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7
Backup Stripper Steam - Natural Gas [C]	4.75%	416.0	Natural Gas[D]	81.6%	339.5
Backup Stripper Steam - No. 6 Oil [C]	4.75%	416.0	No. 6 Oil[D]	18.4%	76.5
PM2.5 PROJECTED ACTUAL EMISSIONS					
PAE - BAE					

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in

C - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

Controls	Controls Operating Time		Production Rate		
	%	hrs	Value	UOM	lb/UOM
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)					
	100.0%	7,835.7	26.0	mmBtu/hr	7.60E-03
	100.0%	168.3	24.8	mmBtu/hr	8.80E-02
PROJECTED ACTUAL EMISSIONS					
	100.0%	985.5	1.0	mmBtu/hr	7.60E-03
	100.0%	6,433.3	96.8	mmBtu/hr	7.60E-03
	100.0%	1,450.7	92.2	mmBtu/hr	8.80E-02
	100.0%	339.5	26.0	mmBtu/hr	7.60E-03
	100.0%	76.5	24.8	mmBtu/hr	8.80E-02
NET EMISSIONS CHANGE (PAE - BAE)					

Combination Boilers No. 1 and No. 2 during baseline.

PM2.5 Emissions Factor Reference	PM2.5 Control %	PM2.5 Emissions lb/hr	PM2.5 Emissions tpy
AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.8
AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	2.2	0.2
			0.96
AP-42 Table 1.4-2. Filterable and Condensable.	NA	7.60E-03	3.74E-03
AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.7	2.4
AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	8.1	5.9
AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.0
AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	2.2	0.1
			8.37
			7.41

LEAD EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time	
	%	hrs		%	hrs
B					
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3
LEAD BASELINE ACTUAL EMISSIONS					
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7
Backup Stripper Steam - Natural Gas [C]	4.75%	416.0	Natural Gas[D]	81.6%	339.5
Backup Stripper Steam - No. 6 Oil [C]	4.75%	416.0	No. 6 Oil[D]	18.4%	76.5
LEAD PROJECTED ACTUAL EMISSIONS					
PAE - BAE					

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Com

C - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

Controls	Controls Operating Time		Production Rate		Lead Emissions Factor	
	%	hrs	Value	UOM	lb/UOM	Reference
ASELINE ACTUAL EMISSIONS (March 2021 - February 2023)						
	100.0%	7,835.7	26.0	mmBtu/hr	5.00E-07	AP-42 Table 1.4-2.
	100.0%	168.3	24.8	mmBtu/hr	2.80E-05	U.S. EPA document "Estimating Air Toxic Emissions from Coal and Oil Combustion Sources" [EPA-450/2-89-001] for Uncontrolled Residual Oil-fired Utility Boilers (Table 4-1)
PROJECTED ACTUAL EMISSIONS						
	100.0%	985.5	1.0	mmBtu/hr	5.00E-07	AP-42 Table 1.4-2.
	100.0%	6,433.3	96.8	mmBtu/hr	5.00E-07	AP-42 Table 1.4-2.
	100.0%	1,450.7	92.2	mmBtu/hr	2.80E-05	U.S. EPA document "Estimating Air Toxic Emissions from Coal and Oil Combustion Sources" [EPA-450/2-89-001] for Uncontrolled Residual Oil-fired Utility Boilers (Table 4-1)
	100.0%	339.5	26.0	mmBtu/hr	5.00E-07	AP-42 Table 1.4-2.
	100.0%	76.5	24.8	mmBtu/hr	2.80E-05	U.S. EPA document "Estimating Air Toxic Emissions from Coal and Oil Combustion Sources" [EPA-450/2-89-001] for Uncontrolled Residual Oil-fired Utility Boilers (Table 4-1)
NET EMISSIONS CHANGE (PAE - BAE)						

bination Boilers No. 1 and No. 2 during baseline.

Lead Control	Lead Emissions	
%	lb/hr	tpy
NA	1.30E-05	5.10E-05
NA	6.95E-04	5.85E-05
		1.10E-04
NA	5.00E-07	2.46E-07
NA	4.84E-05	1.56E-04
NA	2.58E-03	1.87E-03
NA	1.30E-05	2.21E-06
NA	6.95E-04	2.66E-05
		2.06E-03
		1.95E-03

CO2 EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time	
	%	hrs		%	hrs
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3
CO2 BASELINE ACTUAL EMISSIONS					
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7
Backup Stripper Steam - Natural Gas [C]	4.75%	416.0	Natural Gas[D]	81.6%	339.5
Backup Stripper Steam - No. 6 Oil [C]	4.75%	416.0	No. 6 Oil[D]	18.4%	76.5
CO2 PROJECTED ACTUAL EMISSIONS					
PAE - BAE					

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in

C - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

Controls	Controls Operating Time		Production Rate		
	%	hrs	Value	UOM	lb/UOM
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)					
	100.0%	7,835.7	26.0	mmBtu/hr	1.17E+02
	100.0%	168.3	24.8	mmBtu/hr	1.66E+02

PROJECTED ACTUAL EMISSIONS					
	100.0%	985.5	1.0	mmBtu/hr	1.17E+02
	100.0%	6,433.3	96.8	mmBtu/hr	1.17E+02
	100.0%	1,450.7	92.2	mmBtu/hr	1.66E+02
	100.0%	339.5	26.0	mmBtu/hr	1.17E+02
	100.0%	76.5	24.8	mmBtu/hr	1.66E+02

NET EMISSIONS CHANGE (PAE - BAE)

Combination Boilers No. 1 and No. 2 during baseline.

CO2 Emissions Factor Reference	CO2 Control %	CO2 Emissions lb/hr	CO2 Emissions tpy
40 CFR Part 98, Table C-1	NA	3,044.8	11,929
40 CFR Part 98, Table C-1	NA	4,109.9	346
			12,275
40 CFR Part 98, Table C-1	NA	116.9	58
40 CFR Part 98, Table C-1	NA	11,313.5	36,392
40 CFR Part 98, Table C-1	NA	15,270.9	11,076
40 CFR Part 98, Table C-1	NA	3,044.8	517
40 CFR Part 98, Table C-1	NA	4,109.9	157
			48,200
			35,925

SUMMARY OF ASB EMISSIONS FACTORS

Scenario	ASB Emissions Factors (lb/ODTP)					
	H_2S	DMDS	DMS	MMC	TRS as H_2S	Methanol
Baseline Actual Emissions	0.0151	0.0114	0.0185	3.28E-04	3.37E-02	0.89
New Stripper Scenario	0.0103	0.0028	0.0136	1.88E-04	1.99E-02	0.30
Backup Stripper Scenario - TRS Mode	0.0109	0.0033	0.0147	1.30E-03	2.23E-02	1.53
Backup Stripper Scenario - Methanol Mode	0.0105	0.0308	0.0169	5.12E-04	4.24E-02	1.62
No Stripper Scenario	0.0106	0.0504	0.0192	7.42E-04	5.81E-02	2.31

A - Includes VOC TRS compounds, methanol, acetaldehyde, methyl ethyl ketone, and propionaldehyde.

B - TRS as compounds

VOC[A]	TRS[B]
0.95	0.0453
0.32	0.0269
1.59	0.0302
1.71	0.0587
2.44	0.0809

BAE Other VOC Emissions Factors

Date of Subpart S Performance Testing	Acetadehyde, ppm	MEK, ppm	Prop., ppm
7/9/2021	24.3	7.7	1.1
7/10/2021	25.3	5.7	4.0
7/11/2021	25.0	6.5	7.0
10/26/2021	25.0	12.3	0.8
10/27/2021	27.5	13.3	1.0
10/28/2021	10.6	6.6	1.2
10/29/2021	15.0	8.6	0.9
2/14/2022	16.7	7.5	0.7
2/15/2022	17.0	9.5	0.6
2/16/2022	15.7	8.6	1.0
5/4/2022	20.7	7.1	1.0
5/5/2022	16.3	7.3	1.0
5/6/2022	15.0	6.8	1.0
8/9/2022	15.3	5.9	0.7
8/10/2022	25.0	7.2	1.1
8/11/2022	20.3	6.0	1.0
9/27/2022	14.3	5.3	0.7
9/28/2022	15.0	5.2	0.7
9/29/2022	18.0	5.6	0.9
10/18/2022	25.0	5.6	1.0
10/19/2022	23.7	5.5	1.1
10/20/2022	23.0	6.6	0.9
AVG ppm:	**19.72**	**7.28**	**1.34**
Lbs into ASB	55.48	20.49	3.78
Fair estimated from WATER9 properties	0.55	0.38	0.43
Lbs emitted	30.73	7.73	1.61
Average Pulp Production during Subpart S testing	1716		
lb/ODTP	**0.018**	**0.005**	**0.001**

PAE Other VOC Emissions Factors

	BAE lb/ODTP	PAE lb/ODTP			Methanol Mode
		New Stripper	Backup Stripper	No Stripper	
Methanol	0.89	0.30	1.53	2.31	1.62
Acetadehyde	0.018	0.006	0.031	0.046	0.033
MEK	0.005	0.002	0.008	0.012	0.008
Propionaldehyde	0.001	0.000	0.002	0.002	0.002
DMDS	0.0114	0.0028	0.0033	0.0504	0.0308
DMS	0.0185	0.0136	0.0147	0.0192	0.0169
MMC	3.28E-04	1.88E-04	1.30E-03	7.42E-04	5.12E-04
VOC:	**0.95**	**0.32**	**1.59**	**2.44**	**1.71**

New Indy Catawba ASB BAE Methanol Emissions Factor

Month	Pulp Production ADTP	Pulp Production ODTP	Methanol Emissions Factor lb/ODTP	Emissions Factor Reference
Mar-21	42,474	38,226	1.50	Average of 2021 Subpart S Performance Tests. Representative of ASB operation from March 2021 to February 2022.
Apr-21	43,075	38,767	1.50	
May-21	46,962	42,266	1.50	
Jun-21	42,867	38,581	1.50	
Jul-21	49,371	44,434	1.50	
Aug-21	44,614	40,152	1.50	
Sep-21	40,177	36,159	1.50	
Oct-21	47,234	42,510	1.50	
Nov-21	39,185	35,266	1.50	
Dec-21	38,734	34,860	1.50	
Jan-22	43,690	39,321	1.50	
Feb-22	37,736	33,962	0.33	Average of 2022 Subpart S Performance Tests. Representative of ASB operation from February 2022 to February 2023.
Mar-22	43,944	39,549	0.33	
Apr-22	40,046	36,041	0.33	
May-22	38,896	35,006	0.33	
Jun-22	23,184	20,866	0.33	
Jul-22	39,890	35,901	0.33	
Aug-22	53,396	48,057	0.33	
Sep-22	45,044	40,539	0.33	
Oct-22	47,517	42,765	0.33	
Nov-22	40,133	36,120	0.33	
Dec-22	33,859	30,474	0.33	
Jan-23	35,464	31,918	0.33	
Feb-23	39,276	35,348	0.33	
Baseline Methanol Emissions Factor (Pulp Weighted Average)			**0.89**	**lb/ODTP**

Stripper Inlet Foul Condensate - Table 2-17 (Weston report dated October 2, 2021, Work Order No. 15730.001.008)

		Concentration (ppm)				
Date	**Sample Time**	**Hydrogen Sulfide**	**Methyl Mercaptan**	**Dimethyl Sulfide**	**Dimethyl Disulfide**	**Total TRS**
6/24/2021	15:10	130	14	16	13	173
6/24/2021	15:10	140	14	16	17	187
6/24/2021	17:00	140	17	18	14	189
6/24/2021	18:45	150	19	18	16	203
6/25/2021	10:35	130	12	12	11	165
6/25/2021	12:05	120	10	12	9.6	151.6
6/25/2021	13:45	190	22	22	23	257
Average of all data		142.9	15.4	16.3	14.8	189.4
Max of 6/24 or 6/25		146.7	16.0	17.0	15.0	194.7

		MW	
H2S	Hydrogen Sulfide	34.08	g/mol
Ch4S	Methyl Mercaptan	48.11	g/mol
C2H6S	Dimethyl Sulfide	62.13	g/mol
C2H6S2	Dimethyl Disulfide	94.20	g/mol
S	Sulfur	32.07	g/mol

Convert compound to equivalent S (ppm)

Hydrogen Sulfide	Methyl Mercaptan	Dimethyl Sulfide	Dimethyl Disulfide
138.0	10.7	8.8	10.2
82.3%	6.4%	5.2%	6.1%

S (ppm)	168	Maximum feed to stripper (AHL)
Lb S/gallon FC	1.40E-03	
Lb S/hr @850 gpm	71.3	
Lb S/ADTP (@2200 ODTP)[a]	0.7001	

[a] Conservative Lb S/ADTP emissions factor using 2200 ODTP (2200 ODTP * ADTP/0.9 ODTP = 2444.4 ADTP)
Emissions factor is representative of the lower end of the range of pulp production at the maximum steam stripper design of 850 gpm. Calculations are scaled to 2700 ADTP to represent worst case emissions.

Assumption
1. Assume no losses in feed tank
2. Assume 98% efficiency of S across stripper therefore 0.69 # S/ADTP in SOG

New-Indy Catawba Monthly Production

Month	Kraft Mill ADTP	Combination Boiler No. 1 Natural Gas mmBtu	Combination Boiler No. 2 Natural Gas mmBtu	Total Natural Gas mmBtu	Combination Boiler No. 1 No. 6 Fuel Oil gallons	Combination Boiler No. 2 No. 6 Fuel Oil gallons	Total No. 6 Fuel Oil gallons
Mar-21	42,474	61,175	99,507	160,683	0	2,057	2,057
Apr-21	43,075	41,363	75,012	116,376	0	0	0
May-21	46,962	38,834	63,467	102,301	0	0	0
Jun-21	42,867	1,909	59,909	61,818	0	1,199	1,199
Jul-21	49,371	67,565	55,824	123,389	3	97	100
Aug-21	44,614	33,863	32,461	66,325	0	0	0
Sep-21	40,177	40,779	41,811	82,590	86	0	86
Oct-21	47,234	69,732	75,498	145,230	0	0	0
Nov-21	39,185	60,664	80,397	141,061	0	0	0
Dec-21	38,734	62,931	60,176	123,107	0	0	0
Jan-22	43,690	84,088	82,251	166,339	69,200	66,720	135,920
Feb-22	37,736	57,764	75,924	133,688	27,042	370	27,412
Mar-22	43,944	62,423	82,083	144,506	335	0	335
Apr-22	40,046	44,634	62,835	107,469	0	0	0
May-22	38,896	39,982	73,918	113,900	0	0	0
Jun-22	23,184	43,071	89,239	132,310	2,238	0	2,238
Jul-22	39,890	64,532	86,134	150,666	0	0	0
Aug-22	53,396	48,067	73,591	121,658	0	0	0
Sep-22	45,044	60,782	65,899	126,681	24	0	24
Oct-22	47,517	70,539	89,760	160,299	0	0	0
Nov-22	40,133	82,534	114,164	196,698	0	0	0
Dec-22	33,859	101,466	95,023	196,490	170,076	0	170,076
Jan-23	35,464	95,982	92,733	188,715	102,558	0	102,558
Feb-23	39,276	78,431	96,813	175,244	21,626	53	21,679
Total	996,766			3,237,544			
Annual Average	498,383						
				97.9%			

No.
Total No. 6 Fuel Oil mmBtu
309
0
0
180
15
0
13
0
0
0
20,388
4,112
50
0
0
336
0
0
4
0
0
25,511
15,384
3,252
69,553
2.1%

October 2021 SO2 Testing - Weston

	Combination Boiler No. 1 Stack			Combination Boiler No. 2	
	NCG+SOG	NCG	SOG	NCG+SOG	NCG
ODTP/hr	77.3	79.0		91.1	92.9
ADTP/hr	85.9	87.8		101.2	103.2
lb SO2/hr	342.8	230.7		380.9	309.9
lb SO2/ADTP	3.99	2.63	1.36	3.76	3.00

	Controlled Emissions		Sulfur Capture		Uncontrolle
	Average	Maximum	Bark Ash[C]	LVHC Scrubber	Average
	lb SO2/ADTP	lb SO2/ADTP	%	%	lb SO2/ADTP
SOG	1.06	1.36	20%	NA	1.33
NCG	2.82	3.00			
LVHC[A,B]	1.97	2.10	20%	50%	4.92
HVLC[A,B]	0.85	0.90	20%	NA	1.06

A - NCG gases include LVHC gases and HVLC gases.

B - NCG gases split using ratio of controlled SO2 emissions from LVHC (1.10 lb SO2/ADTP) and HVL(

C - Estimated sulfur capture based on 2012 stack test (NCASI data suggests ~32% capture).

Stack
SOG
0.76

d Emissions
Maximum
lb SO2/ADTP
1.70
5.25
1.13

: (0.473 lb SO2/ADTP) from Project Columbia Application (July 2019 and April 2020 Addendum - Attachment C)

October 2021 SO2 Testing - Weston

	Combination Boiler No. 1 Stack			Combination Boiler No. 2	
	NCG+SOG	NCG	SOG	NCG+SOG	NCG
ODTP/hr	77.3	79.0		91.1	92.9
ADTP/hr	85.9	87.8		101.2	103.2
lb SO2/hr	342.8	230.7		380.9	309.9
lb SO2/ADTP	3.99	2.63	1.36	3.76	3.00
Columbia lb/ADTP[D]	**4.21**	2.77	1.44	**4.21**	3.36

	Controlled Emissions		Sulfur Capture		Uncontrolle
	Average	Maximum	Bark Ash[C]	LVHC Scrubber	Average
	lb SO2/ADTP	lb SO2/ADTP	%	%	lb SO2/ADTP
SOG	1.14	1.44	20%	NA	1.43
NCG	3.07	3.36			
LVHC[A,B]	2.14	2.35	20%	50%	5.36
HVLC[A,B]	0.92	1.01	20%	NA	1.15

A - NCG gases include LVHC gases and HVLC gases.

B - NCG gases split using ratio of controlled SO2 emissions from LVHC (1.10 lb SO2/ADTP) and HVLC (0.473

C - Estimated sulfur capture based on 2012 stack test (NCASI data suggests ~32% capture).

D - Columbia lb/ADTP factors denotes scaling up the October 2021 stack test results to the overall NCG+SC

Stack

SOG
0.76
0.85

d Emissions

Maximum
lb SO2/ADTP
1.80
5.87
1.26

lb SO2/ADTP) from Project Columbia Application (July 2019 and April 2020 Addendum - Attachment C).

)G emissions factor from Project Columbia application of 4.21 lb/ADTP.

Combination Boiler

Condition 1: With N
13-Oct-21

Run # Start Ti
1
2
3

Average:

Condition 2: With N
13-Oct-21

Run # Start Ti
1
2
3

Average:

TABLE 2-2
NO. 1 COMBINATION BOILER
CONDITION 1: NCG AND SOG GASES
SUMMARY OF SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	10/13/21	10/13/21	10/13/21	----
Time Began	0844	1029	1206	----
Time Ended	0944	1129	1306	----
Stack Gas Data				
Temperature, °F	430	435	438	434
Velocity, ft/sec	64	63	63	63
Moisture, %	17	17	17	17
CO_2 Concentration, %	8.8	9.0	8.6	8.8
O_2 Concentration, %	10.5	10.5	10.8	10.6
VFR, x 10^5 dscfm	1.46	1.45	1.44	1.45
Sulfur Dioxide				
Concentration, ppm	280	227	204	237
Emission Rate, lb/hr	407.4	328.3	292.6	342.8

TABLE 2-3
NO. 1 COMBINATION BOILER
CONDITION 2: NCG GASES ONLY
SUMMARY OF SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	10/13/21	10/13/21	10/13/21	----
Time Began	1407	1544	1714	----
Time Ended	1507	1644	1814	----
Stack Gas Data				
Temperature, °F	447	450	444	447
Velocity, ft/sec	61	62	63	62
Moisture, %	17	18	16	17
CO_2 Concentration, %	9.6	9.9	8.9	9.5
O_2 Concentration, %	10.1	9.8	10.7	10.2
VFR, x 10^5 dscfm	1.37	1.39	1.43	1.40
Sulfur Dioxide				
Concentration, ppm	140	176	180	165
Emission Rate, lb/hr	191.3	243.6	257.0	230.7

Combination Boiler #1

Condition 1: With NCGs, with SOGs
13-Oct-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)
1	0844	262.3	29.9	126.9	1.23	40	10.9	511	230
2	1029	266.3	33.0	109.1	1.23	40	10.9	505	213
3	1206	257.2	32.6	100.4	1.23	40	10.9	504	2
Average:		261.9	31.8	112.1	1.23	40	10.9	507	148

Condition 2: With NCGs, without SOGs
13-Oct-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)
1	1407	267.7	34.0	102.0	1.23	40	10.9	506	2
2	1544	272.9	34.8	101.3	1.23	40	10.9	504	252
3	1714	256.9	30.05	115.96	1.23	40	10.9	505	183
Average:		265.8	33.0	106.4	1.23	40	10.9	505	146

Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	Pulp KAPPA
511	230	1407	1103	10851	77.3	82.7
505	213	1409	1200	10885	77.3	85.7
504	2	1443	1206	10963	77.3	84.8
507	148	1420	1170	10900	77.3	84.4

Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	Pulp KAPPA
506	2	1416	[redacted]	11071	79.0	83.9
504	252	1414	[redacted]	10976	79.0	81.6
505	183	1430	[redacted]	11061	79.0	80.3
505	146	1420	[redacted]	11036	79.0	81.9

Combination Boi

Condition 1: Wi
14-Oct-21

Run # Star
1 0
2 1
3 1

Average:

Condition 2: Wi
14-Oct-21

Run # Star
1 1
2 1
3 1

Average:

TABLE 2-4
NO. 2 COMBINATION BOILER
CONDITION 1: NCG AND SOG GASES
SUMMARY OF SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	10/14/21	10/14/21	10/14/21	----
Time Began	0830	1026	1222	----
Time Ended	0930	1126	1322	----
Stack Gas Data				
Temperature, °F	463	477	465	469
Velocity, ft/sec	63	68	61	64
Moisture, %	17	19	16	17
CO_2 Concentration, %	8.2	9.5	7.5	8.4
O_2 Concentration, %	10.8	10.1	11.5	10.8
VFR, x 10^5 dscfm	1.40	1.43	1.35	1.39
Sulfur Dioxide				
Concentration, ppm	275	262	286	274
Emission Rate, lb/hr	383.7	373.7	385.4	380.9

TABLE 2-5
NO. 2 COMBINATION BOILER
CONDITION 2: NCG GASES ONLY
SUMMARY OF SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	10/14/21	10/14/21	10/14/21	----
Time Began	1410	1547	1725	----
Time Ended	1510	1647	1825	----
Stack Gas Data				
Temperature, °F	457	461	460	459
Velocity, ft/sec	59	59	58	59
Moisture, %	15	15	15	15
CO_2 Concentration, %	7.2	7.6	7.0	7.3
O_2 Concentration, %	11.9	11.2	11.7	11.6
VFR, x 10^5 dscfm	1.33	1.33	1.33	1.33
Sulfur Dioxide				
Concentration, ppm	235	234	232	234
Emission Rate, lb/hr	311.3	311.0	307.4	309.9

Combination Boiler #2

Condition 1: With NCGs, with SOGs
14-Oct-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)
1	0830	241	29.8	188.7	1.23	40	10.9	505	209
2	1026	251	46.3	115.6	1.23	40	10.9	504	200
3	1222	211	25.4	171.4	1.23	40	10.9	505	199
Average:		234	33.8	158.6	1.23	40	10.9	505	203

Condition 2: With NCGs, without SOGs
14-Oct-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)
1	1410	198	21.7	174.8	1.23	40	10.9	505	209
2	1547	218	35.4	206.4	1.23	40	10.9	505	224
3	1725	214	49.6	220.6	0.65	40	10.9	505	262
Average:		210	35.6	200.6	1.04	40	10.9	505	232

H	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	Pulp KAPPA
	505	209	1409	1203	11071	91.1	94.5
	504	200	1420	1179	11160	91.1	88.2
	505	199	1429	1157	11090	91.1	80.7
	505	203	1419	1180	11107	91.1	87.8

H	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	Pulp KAPPA
	505	209	1438	[redacted]	11109	92.9	78.8
	505	224	1435	[redacted]	11060	92.9	78.7
	505	262	1453	[redacted]	10977	92.9	79.3
	505	232	1442	[redacted]	11049	92.9	

June 2021 TRS_H2S Testing - Weston

TRS as TRS	Combination Boiler No. 1 Stack NCG+SOG	NCG	SOG	Combin NCG+SOG
ODTP/hr	55.9	76.0		88.3
ADTP/hr	62.1	84.4		98.1
lb TRS (as H2S)/hr	0.75	0.68		0.85
lb TRS (as TRS)/hr	1.07	0.97		1.22
lb TRS (as TRS)/ADTP	1.73E-02	1.15E-02	5.75E-03	1.24E-02

	Controlled Emissions		Sulfur Conversion	
	Average	Maximum	Combustion	LVHC Scrubber
TRS as TRS	lb TRS/ADTP	lb TRS/ADTP	%	%
SOG[D]	2.88E-03	5.75E-03	99%	NA
NCG	1.27E-02	1.39E-02		
LVHC[A,B]	8.01E-03	8.76E-03	99%	50%
HVLC[A,B]	4.69E-03	5.13E-03	99%	NA

A - NCG gases include LVHC gases and HVLC gases.
B - NCG gases split using ratio of controlled TRS emissions from LVHC (8.97E-3 lb TRS/ADTP) and H\
C - NCG gases split using ratio of controlled H2S emissions from LVHC (3.82E-3 lb H2S/ADTP) and H
D - Combination Boiler No. 2 SOG averaged as zero (0).

TRS as S		MW	CB1 NCG+SOG
sulfur	S	32.065	Run 1
hydrogen sulfide	H_2S	34.081	0.08
methyl mercaptan	CH_4S	48.107	0.55
dimethyl sulfide	C_2H_6S	62.134	0.16
dimethyl disulfide	$C_2H_6S_2$	94.199	0.07

10^6 ACFM Flowrate Basis to lb/min

H_2S	0.0070817662

CH_4S	0.0687242857
C_2H_6S	0.0258219221
$C_2H_6S_2$	0.0171270909

TRS as H2S	0.0823255325
TRS as TRS	0.1187550649

Ratio TRS as H2S/TRS as	0.6932380738

ation Boiler No. 2 Stack			Combination Boiler No. 1 Stack		
NCG	SOG	H2S	NCG+SOG	NCG	SOG
85.2		ODTP/hr	55.9	76.0	
94.7		ADTP/hr	62.1	84.4	
0.92		lb H2S/hr	0.07	0.05	
1.32					
1.39E-02	-1.51E-03	lb H2S/ADTP	1.13E-03	5.92E-04	5.35E-04

Uncontrolled Emissions			Controlled Emissions		Sulfur Co
Average	Maximum		Average	Maximum	Combustion
lb TRS/ADTP	lb TRS/ADTP	H2S	lb H2S/ADTP	lb H2S/ADTP	%
0.29	0.58	SOG	4.13E-04	5.35E-04	99%
		NCG	5.07E-04	5.92E-04	
1.60	1.75	LVHC[A,C]	5.03E-04	5.87E-04	99%
0.47	0.51	HVLC[A,C]	4.45E-06	5.19E-06	99%

VLC (5.25E-3 lb TRS/ADTP) from Project Columbia Application (July 2019 and April 2020 Addendum - Attachmer
VLC (3.38E-5 lb H2S/ADTP) from Project Columbia Application (July 2019 and April 2020 Addendum - Attachme

		CB1			CB2	
		NCG			NCG+SOG	
Run 2	Run 3	Run 1	Run 2	Run 3	Run 1	Run 2
0.07	0.1	0.07	0.07	0.07	0.08	0.08
0.53	0.49	0.52	0.52	0.53	0.77	0.63
0.16	0.16	0.16	0.16	0.17	0.08	0.08
0.07	0.07	0.07	0.07	0.07	0.04	0.04
0.0061965455	0.0088522078	0.0061965455	0.0061965455	0.0061965455	0.0070817662	0.0070817662

0.0662252208	0.0612270909	0.0649756883	0.0649756883	0.0662252208	0.096214	0.0787205455
0.0258219221	0.0258219221	0.0258219221	0.0258219221	0.0274357922	0.012910961	0.012910961
0.0171270909	0.0171270909	0.0171270909	0.0171270909	0.0171270909	0.0097869091	0.0097869091
0.0796698701	0.0787846494	0.0787846494	0.0787846494	0.0805550909	0.0894072987	0.0770142078
0.1153707792	0.1130283117	0.1141212468	0.1141212468	0.1169846494	0.1259936364	0.1085001818
0.6905550146	0.6970346471	0.6903591714	0.6903591714	0.6885953957	0.709617575	0.7098071773

Combination Boiler No. 2 Stack		
NCG+SOG	NCG	SOG
88.3	85.2	
98.1	94.7	
0.07	0.04	
7.13E-04	4.23E-04	2.91E-04

ɩnversion	Uncontrolled Emissions	
LVHC Scrubber	Average	Maximum
%	lb H2S/ADTP	lb H2S/ADTP
NA	4.13E-02	5.35E-02
50%	1.01E-01	1.17E-01
NA	4.45E-04	5.19E-04

ɩt C).
nt C).

	CB2				
	NCG				
Run 3	Run 1	Run 2	Run 3	AVG	
0.08	0.05	0.05	0.05	0.07	8.0%
0.64	0.94	0.91	0.69	0.64	72.6%
0.08	0.08	0.07	0.07	0.12	13.5%
0.04	0.03	0.03	0.03	0.05	5.9%
				0.89	Total TRS
				84.8%	
0.0070817662	0.0044261039	0.0044261039	0.0044261039		

0.0799700779	0.1174560519	0.1137074545	0.0862177403	
0.012910961	0.012910961	0.0112970909	0.0112970909	
0.0097869091	0.0073401818	0.0073401818	0.0073401818	
0.0778994286	0.1000299481	0.0964890649	0.0770142078	
0.1097497143	0.1421332987	0.1367708312	0.1092811169	
0.7097916298	0.7037756034	0.7054798462	0.7047348159	0.69944568

1.43

PLC Cross Check back to TRS as H2S

0.0857419	0.0857419
0.7787379	0.5516903
0.1442481	0.0791212
0.0635499	0.0459844
1.0722777	0.7625378

TABLE 2-11
NO. 1 COMBINATION BOILER
CONDITION 1: NCG AND SOG GASES
SUMMARY OF H_2S, TOTAL TRS, AND SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	6/23/21	6/23/21	6/23/21	----
Time Began	1158	1400	1541	----
Time Ended	1258	1500	1641	----
Stack Gas Data				
Temperature, °F	415	418	415	416
Velocity, ft/sec	59	57	57	57
Moisture, %	17	18	16	17
CO_2 Concentration, %	7.8	8.4	7.7	8.0
O_2 Concentration, %	12.1	11.4	12.0	11.8
VFR, x 10^5 dscfm	1.35	1.31	1.33	1.33
Hydrogen Sulfide				
Concentration, ppm	0.09	0.08	0.12	0.10
Emission Rate, lb/hr	0.07	0.06	0.08	0.07
Total Reduced Sulfur				
Concentration, ppm	1.09	1.07	1.03	1.06
Emission Rate, lb/hr	0.78	0.74	0.73	0.75
Sulfur Dioxide				
Concentration, ppm	195	278	344	272
Emission Rate, lb/hr	262.7	362.5	457.4	360.9

TABLE 2-12
NO. 1 COMBINATION BOILER
CONDITION 2: NCG GASES ONLY
SUMMARY OF H_2S, TOTAL TRS, AND SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	6/23/21	6/23/21	6/23/21	----
Time Began	1824	2019	2202	----
Time Ended	1924	2119	2302	----
Stack Gas Data				
Temperature, °F	416	411	415	414
Velocity, ft/sec	56	56	56	56
Moisture, %	16	16	17	17
CO_2 Concentration, %	8.3	7.8	8.1	8.1
O_2 Concentration, %	11.4	11.9	11.6	11.6
VFR, x 10^5 dscfm	1.30	1.31	1.30	1.30
Hydrogen Sulfide				
Concentration, ppm	0.08	0.08	0.08	0.08
Emission Rate, lb/hr	0.05	0.05	0.05	0.05
Total Reduced Sulfur				
Concentration, ppm	0.97	0.98	0.99	0.98
Emission Rate, lb/hr	0.67	0.68	0.68	0.68
Sulfur Dioxide				
Concentration, ppm	313	348	349	337
Emission Rate, lb/hr	404.4	452.9	450.8	436.1

nbination Boiler #1

Combination Boiler #1

nbination Boiler #1

dition 1: With NCGs, with SOGs

-Jun-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	SO_2 Emissions (lbs/hr)	SO_2 Emissions (lbs/ODT Pulp)	TRS Emissions (lbs/hr)
1	1158	208	25.1	80.8	1.37	40	10.9	458	146	1585	621	11575	49.7	262.7	5.29	0.56
2	1400	225	29.3	68.8	1.37	40	10.9	491	152	1595	1219	11048	54.0	362.5	6.71	0.49
3	1541	207	24.8	81.2	1.37	40	10.9	491	45	1578	1136	11009	64.0	457.4	7.15	0.50
rage:		213	26.4	76.9	1.37	40	10.9	480	114	1586	992	11211	55.9	360.9	6.46	0.52

dition 2: With NCGs, without SOGs

-Jun-21

#	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	SO_2 Emissions (lbs/hr)	SO_2 Emissions (lbs/ODT Pulp)	TRS Emissions (lbs/hr)
1	1824	230	26.3	94.9	1.37	40	10.9	489	123	1587	[redacted]	10515	74.1	404.4	5.46	0.43
2	2019	216	23.7	97.5	1.37	40	10.9	491	184	1593		10377	74.7	452.9	6.06	0.42
3	2202	220	25.2	92.4	1.37	40	10.9	490	152	1570		10573	79.2	450.8	5.69	0.46
rage:		222	25.1	94.9	1.37	40	10.9	490	153	1583		10488	76.0	436.1	5.74	0.44

Combination Boiler #1

Condition 1: With NCGs, with SOGs
23-Jun-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)
1	1158	208
2	1400	225
3	1541	207
Average:		213

Condition 2: With NCGs, without SOGs
23-Jun-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)
1	1824	230
2	2019	216
3	2202	220
Average:		222

TABLE 2-13
NO. 2 COMBINATION BOILER
CONDITION 1: NCG AND SOG GASES
SUMMARY OF H_2S, TOTAL TRS, AND SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	6/24/21	6/24/21	6/24/21	----
Time Began	1445	1630	1806	----
Time Ended	1545	1730	1906	----
Stack Gas Data				
Temperature, °F	475	474	479	476
Velocity, ft/sec	69	69	69	69
Moisture, %	14	14	15	14
CO_2 Concentration, %	6.6	6.9	7.3	6.9
O_2 Concentration, %	13.1	12.7	12.3	12.7
VFR, x 10^5 dscfm	1.57	1.56	1.54	1.56
Hydrogen Sulfide				
Concentration, ppm	0.09	0.09	0.09	0.09
Emission Rate, lb/hr	0.07	0.07	0.07	0.07
Total Reduced Sulfur				
Concentration, ppm	1.13	0.97	0.97	1.02
Emission Rate, lb/hr	0.94	0.80	0.80	0.85
Sulfur Dioxide				
Concentration, ppm	324	327	322	324
Emission Rate, lb/hr	508.7	507.2	496.1	504.0

TABLE 2-14
NO. 2 COMBINATION BOILER
CONDITION 2: NCG GASES ONLY
SUMMARY OF H_2S, TOTAL TRS, AND SO_2 EMISSION RESULTS

	Run 1	Run 2	Run 3	Mean
Date	6/25/21	6/25/21	6/25/21	----
Time Began	1000	1135	1315	----
Time Ended	1100	1235	1415	----
Stack Gas Data				
Temperature, °F	468	470	481	473
Velocity, ft/sec	68	69	69	69
Moisture, %	14	14	14	14
CO_2 Concentration, %	6.9	6.8	7.3	7.0
O_2 Concentration, %	12.8	12.7	12.3	12.6
VFR, x 10^5 dscfm	1.56	1.55	1.56	1.56
Hydrogen Sulfide				
Concentration, ppm	0.05	0.05	0.05	0.05
Emission Rate, lb/hr	0.04	0.04	0.04	0.04
Total Reduced Sulfur				
Concentration, ppm	1.22	1.18	0.94	1.11
Emission Rate, lb/hr	1.01	0.97	0.78	0.92
Sulfur Dioxide				
Concentration, ppm	247	245	235	242
Emission Rate, lb/hr	383.2	380.0	366.2	376.4

Combination Boiler #2
Condition 1: With NCGs with SOGs

Combination Boiler #2

Condition 1: With NCGs, with SOGs

Combination Boiler #2

Condition 1: With NCGs, with SOGs
24-Jun-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	SO_2 Emissions (lbs/hr)	SO_2 Emissions (lbs/ODT Pulp)	TRS Emissions (lbs/hr)
1	1445	219	39.0	125.3	1.37	40	10.9	491	190	1572	1231	10253	87.8	508.7	5.79	0.77
2	1630	224	31.1	146.4	1.37	40	10.9	490	186	1576	1231	10277	88.6	507.2	5.72	0.63
3	1806	241	33.6	146.4	1.37	40	10.9	490	190	1580	1231	10300	88.6	496.1	5.60	0.63
Average:		228	34.6	139.4	1.37	40	10.9	490	189	1576	1231	10277	88.3	504.0	5.71	0.68

Condition 2: With NCGs, without SOGs
25-Jun-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)	Bark Rate (Tons/Hr)	Gas Flow (10^3 SCF/Hr)	TDF (TPH)	NCG Scrubber Flow (GPM)	NCG Scrubber pH (SU)	Stripper Foul Condensate Flow (GPM)	Hard Pipe Foul Condensate Flow (GPM)	LVHC Flow to Boilers (SCFM)	SOG Flow to Boilers (SCFM)	HVLC Flow to Boilers (SCFM)	Pulp Production (ODT/Hr)	SO_2 Emissions (lbs/hr)	SO_2 Emissions (lbs/ODT Pulp)	TRS Emissions (lbs/hr)
1	1000	234	35.7	132.7	1.37	40	10.9	482	155	1579	[redacted]	10475	87.2	383.2	4.39	0.86
2	1135	225	30.8	147.8	1.37	40	10.9	479	252	1573		10425	84.3	380.0	4.51	0.82
3	1315	245	30.6	141.7	1.37	40	10.9	482	97	1571		10500	84.2	366.2	4.35	0.63
Average:		235	32.4	140.7	1.37	40	10.9	481	168	1574		10467	85.2	376.4	4.42	0.77

Combination Boiler #2

Condition 1: With NCGs, with SOGs
24-Jun-21

Run #	Start Time	Steam Rat (10^3 lbs/h
1	1445	219
2	1630	224
3	1806	241
Average:		228

Condition 2: With NCGs, without SC
25-Jun-21

Run #	Start Time	Steam Rate (10^3 lbs/hr)
1	1000	234
2	1135	225
3	1315	245
Average:		235

Buckner, Katharine

From:	Caleb Fetner <cfetner@all4inc.com>
Sent:	Thursday, March 28, 2024 6:00 PM
To:	Buckner, Katharine
Cc:	Steven Moore; Sheryl Watkins; Rachel Davis
Subject:	RE: Stripper Permit - SOB/Annual Avg CEMS/Updated Calcs
Attachments:	Revised table.pdf; UPDATED Emissions Calculations (3-13-24) R1.xlsx

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***

Katharine – I'm responding to your questions on the calculations. I'm sorry it's taken me so long to get back to you. Here are responses to your questions. Please let me know if this sparks follow-up:

1. **Why is the pulp production used 2,200 ODTP/day?**

   The maximum post-project foul condensate flow of 850 gpm, which is the basis for the PSD applicability calculations, is based on a range of pulp production rates up to a maximum of 2430 ODTP/day, or 2700 ADTP/day.

   For all of the post-project ASB emissions scenarios, New-Indy conservatively:
   1. Calculated gram/second (g/s) ASB emissions rates based on 850 gpm total foul condensate generated as follows:
      a. New Stripper: no HP flow.
      b. No Stripper: 850 gpm of foul condensate through hard pipe (HP)
      c. Existing Stripper (TRS mode): 850 gpm of TRS-stripped condensate through HP.
      d. Existing Stripper (MeOH mode): 500 gpm of foul condensate through HP.
   2. Convert the g/s emissions rates to a lb/ODTP basis using the lower end of pulp production (2200 ODTP/day) in order to develop a more conservative lb/ODTP emissions factor than if 2430 ODTP/day (2700 ADTP/day) was used.
   3. Calculated post-project emissions by multiplying the lb/ODTP emissions factor by 2430 ODTP.

2. **DMDS emissions rate from Zone 2:**

You are correct that the value should have been 5.66E-03 rather than 5.66E-08. This results in a very small incremental increase in the TRS and VOC emissions factor from the ASB, but no change to conclusions. Updated PDF and emissions calculations spreadsheet is attached.

Caleb Fetner / Managing Consultant
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ALL4 // ***STRATEGY WITH SOLUTION. PARTNERSHIP WITH A PURPOSE.***

From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Wednesday, March 27, 2024 2:52 PM

To: Rachel Davis <Rachel.Davis@new-indycb.com>; Caleb Fetner <cfetner@all4inc.com>
Cc: Steven Moore <smoore@all4inc.com>; Sheryl Watkins <swatkins@all4inc.com>
Subject: RE: Stripper Permit - SOB/Annual Avg CEMS/Updated Calcs

Hello Everyone,
I am checking in on the comment I made last week on the latest version of the calculations. What have you determined?

Also, I am checking in on the review of the drafts c/ps and SOBs for the EPA Consent Decree and the Ash Handling System I sent 2 weeks ago. I really don't expect there to be any comments. I sent them so you could see the restructuring of the SOBs. I do need an email that states you have no comments for the record.

I am also looking for your proposal on the SO2 CEMS for the No. 3 Recovery Furnace.

Please provide a status update on the items above.

Thank you,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

Office: (803) 898-3213
bucknekk@dhec.sc.gov

S.C. Dept. of Health & Environmental Control
2600 Bull Street
Columbia, SC 29201

Connect: www.scdhec.gov Facebook Twitter

From: Buckner, Katharine
Sent: Thursday, March 21, 2024 2:51 PM
To: Rachel Davis <Rachel.Davis@new-indycb.com>; Caleb Fetner <cfetner@all4inc.com>
Cc: Steven Moore <smoore@all4inc.com>; Sheryl Watkins <swatkins@all4inc.com>
Subject: RE: Stripper Permit - SOB/Annual Avg CEMS/Updated Calcs

Hello All,
I have finished reviewing the calculations. I do not have any further comments. I just want to make note of one more place where the DMDS value that is in question was used, on the PAE Other VOC Emission Factors sheet for the methanol mode.

Thanks,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

Office: (803) 898-3213
bucknekk@dhec.sc.gov

S.C. Dept. of Health & Environmental Control
2600 Bull Street
Columbia, SC 29201

Connect: www.scdhec.gov Facebook Twitter

From: Rachel Davis <Rachel.Davis@new-indycb.com>
Sent: Thursday, March 21, 2024 8:50 AM
To: Buckner, Katharine <bucknekk@dhec.sc.gov>; Caleb Fetner <cfetner@all4inc.com>
Cc: Steven Moore <smoore@all4inc.com>; Sheryl Watkins <swatkins@all4inc.com>
Subject: Re: Stripper Permit - SOB/Annual Avg CEMS/Updated Calcs

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Thanks Ms. Katharine!

Rachel

From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Thursday, March 21, 2024 7:56:26 AM
To: Caleb Fetner <cfetner@all4inc.com>
Cc: Rachel Davis <Rachel.Davis@new-indycb.com>; Steven Moore <smoore@all4inc.com>; Sheryl Watkins <swatkins@all4inc.com>
Subject: RE: Stripper Permit - SOB/Annual Avg CEMS/Updated Calcs

I have not finished going through the calculations yet. I will let you know if I have any other questions on these.

Thanks,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

Office: (803) 898-3213
bucknekk@dhec.sc.gov

S.C. Dept. of Health & Environmental Control
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From: Caleb Fetner <cfetner@all4inc.com>
Sent: Wednesday, March 20, 2024 12:30 PM

To: Buckner, Katharine <bucknekk@dhec.sc.gov>
Cc: Rachel Davis <Rachel.Davis@new-indycb.com>; Steven Moore <smoore@all4inc.com>; Sheryl Watkins <swatkins@all4inc.com>
Subject: RE: Stripper Permit - SOB/Annual Avg CEMS/Updated Calcs

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Got it downloaded. I'll take a look and get back to you. Thanks!

Caleb Fetner / Managing Consultant
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From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Wednesday, March 20, 2024 12:15 PM
To: Caleb Fetner <cfetner@all4inc.com>
Cc: Rachel Davis <Rachel.Davis@new-indycb.com>; Steven Moore <smoore@all4inc.com>; Sheryl Watkins <swatkins@all4inc.com>
Subject: RE: Stripper Permit - SOB/Annual Avg CEMS/Updated Calcs

Sorry about that. Here it is. I verified the circle and comments are there. Not sure why it wants to insert it here in the email instead of like a regular attachment.

MeOH mode - concentration loadings page.pdf

Let me know if you can see.

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

Office: (803) 898-3213
bucknekk@dhec.sc.gov

S.C. Dept. of Health & Environmental Control
2600 Bull Street
Columbia, SC 29201

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From: Caleb Fetner <cfetner@all4inc.com>
Sent: Wednesday, March 20, 2024 12:10 PM
To: Buckner, Katharine <bucknekk@dhec.sc.gov>
Cc: Rachel Davis <Rachel.Davis@new-indycb.com>; Steven Moore <smoore@all4inc.com>; Sheryl Watkins

<swatkins@all4inc.com>
Subject: RE: Stripper Permit - SOB/Annual Avg CEMS/Updated Calcs

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Hi Katharine- I don't see any comments or circles on this PDF. Maybe it didn't save.

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From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Wednesday, March 20, 2024 12:07 PM
To: Caleb Fetner <cfetner@all4inc.com>
Cc: Rachel Davis <Rachel.Davis@new-indycb.com>; Steven Moore <smoore@all4inc.com>; Sheryl Watkins <swatkins@all4inc.com>
Subject: RE: Stripper Permit - SOB/Annual Avg CEMS/Updated Calcs

Hello everyone,
I am reviewing the revised calculations and have a couple of questions.

See attached:
MeOH mode – Concentration loadings sheet. I have circled a value and made two comments.

Thanks,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

Office: (803) 898-3213
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From: Caleb Fetner <cfetner@all4inc.com>
Sent: Saturday, March 16, 2024 1:37 PM
To: Buckner, Katharine <bucknekk@dhec.sc.gov>
Cc: Rachel Davis <Rachel.Davis@new-indycb.com>; Steven Moore <smoore@all4inc.com>; Sheryl Watkins <swatkins@all4inc.com>
Subject: Stripper Permit - SOB/Annual Avg CEMS/Updated Calcs

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Hi Katharine,

On behalf of New-Indy Catawba, here are the following files for your review. Please let us know if you have any questions.

1. Updated Emissions Calculations
    a. Incorporated emissions calculations for the Backup Stripper operating in Methanol Mode.
    b. For the uncontrolled SO2 PAE emissions factor for LVHC incineration, we scaled up the October 2021 results to the Project Columbia NCG emissions factor of 4.21 lb/ton to add an additional level of conservatism. We still show a PSD decrease in SO2 emissions.
2. Supporting Info for Methanol Mode ASB emissions
    a. H2SSIM (for H2S), WATER9 (for other TRS), and Form XIII (for methanol) for the ASB when the backup stripper is in methanol mode.
    b. During methanol mode, we estimated 500 gpm of foul condensate down the hardpipe. Essentially, for the ASB when the backup stripper is in methanol mode, it is similar to the No Stripper scenario except with 500 gpm instead of 850 gpm.
3. Comments on the latest SOB provided. We also updated PSD and project emissions consistent with the updated calculations.
4. **Justification for the annual averaging period for compliance with the SO2 BACT limit (50 ppmvd @ 8% O2).**

    The 2006 SO2 best available control technology (BACT) limit for the No. 3 Recovery Furnace was proposed as good combustion practices during black liquor solids combustion. The BACT limit was not proposed during co-firing of fossil fuels. The SO2 BACT limit (condition DA.18) is 50 ppmvd @ 8% O2 and/or 551 tons per year (three 1-hour averages). The compliance demonstration method associated with the BACT limit (condition DA.18) is one source test every four years.

    The SO2 BACT limit is expressed as an annual average value (50 ppm which equates to 551 tpy) when firing black liquor solids. The basis for the 551 tpy emissions rate is as follows: 50 ppmvd × (20.9 – 5.5)/(20.9 – 8) × 64/385.3E6 × 211,600 dscf/min × 60 min/hr × 8,760 hr/yr × 1 ton/2,000 lb = 551 tons/yr

    The BACT limit does not reflect fossil-fuel firing, which was not impacted by the permitted modifications. The SO2 CEMS data should be treated in the same manner as the NOx CEMS data, as a reasonable assurance of continuous compliance with the SO2 BACT limit, and a representation of average emissions over a period of time during normal operation while burning black liquor solids.

    The justification for the annual averaging period is provided below and is based on the expected variability in SO2 concentrations during startup and shutdown, planned maintenance (such as water washes), and inherent variability in the SO2 emissions that can occur with process upsets and variability in process conditions and/or operation. New-Indy Catawba expects periods of elevated SO2 emissions (i.e. greater than 50 ppmvd @ 8% O2 on a 3-hour average) to occur as a result of the following process/operating conditions:
    - Lower temperature smelt bed and/or low black liquor solids loading to the furnace
    - High black liquor sulfidity

- Low percent black liquor solids firing
- Unbalanced air distribution in the boiler

The following paragraphs describe each condition and the expected observed duration of high SO2 emissions, keeping in mind that these events are not mutually exclusive and can occur simultaneously or in close proximity in time.

Lower temperature smelt bed and/or low black liquor solids loading to the furnace

A lower temperature smelt bed can occur during abnormal or upset conditions, which are typically associated with black liquor firing loads below 50% of the maximum furnace load, which can occur when starting up from a cold shutdown (i.e., when there is little to no smelt in the bottom of the boiler upon startup), when shutting down (i.e., when the smelt bed is burned out), or during periods of low/lower black liquor inventories. Low black liquor loads have reduced air requirements which will naturally reduce the air pressure at each air level. This can dramatically decrease the air penetration, decrease air/gas mixing, decrease bed temperatures and/or bed height, and increase the amount of localized cold spots in the bed. To counter these impacts, corrective action is necessary to increase the ratio of primary and/or secondary air, firing of auxiliary fuel to maintain proper operation and steam load, and manage the smelt bed. Upset conditions can last anywhere from a few hours to more than several days in duration and startup operations from a cold smelt bed are typically 8 to 16 hours in duration.

High black liquor sulfidity

The sulfur to sodium ratio in the cooking liquor is important for maintaining the reaction rate and pulp quality in the digester. If the sulfidity is too low, then pulp yield and pulp quality will be reduced. To maintain the proper sulfidity, saltcake from the recovery furnace electrostatic precipitator (ESP) is recycled back into the liquor cycle for sodium and sulfur make-up. Additional make-up chemicals are also typically added (i.e., sodium hydrosulfide, emulsified sulfur, sodium hydroxide, etc.) when chemical imbalances occur that necessitate adding more sodium and/or sulfur makeup. When the sulfidity is elevated, SO2 emissions are also elevated. If sulfidity is determined to be above the target level, corrective action is to stop feeding saltcake and/or make-up sulfur chemicals. A sulfidity imbalance is typically corrected within two to three days.

Low percent black liquor solids firing

Low percent black liquor solids firing is most often caused by periodic, but routine, water washes to remove fouling on the recovery furnace steam tubes, water washes to remove fouling on the heat transfer surfaces in the evaporators, upsets to the evaporators, and/or an upset to upstream process areas. Water washes are necessary to remove inorganic scale and organic sticky material from heat transfer surfaces in the evaporators and to remove the saltcake fouling on the furnace steam tubes to maintain safe operation of the furnace. A water wash on the evaporators is typically performed 3-5 times per week and lasts for a period of two to eight hours (Note: includes the periods of startup, shutdown, and the water wash cycle) and a water wash on the recovery furnace is typically performed semi-annually and lasts for a period of two to three days (Note: includes the periods of startup, shutdown, and the water wash cycle). Reduced black liquor solids content can last anywhere from a few hours to more than 16 hours in duration.

Unbalanced air distribution in the furnace (primary, secondary, tertiary, and quaternary air)

Each recovery furnace design is unique. The New-Indy Catawba Mill has established air systems guidelines for the No. 3 Recovery Furnace that manage NOx and TRS emissions to achieve permitted emissions limits. These include targets for air splits on the primary, secondary, tertiary, and quaternary air ports, desired air duct pressures, and placement and angle of the liquor guns. In addition, the Mill has established guidelines for keeping the air ports and smelt spouts clean. With these guidelines air distribution imbalances are typically resolved within 6 to 12 hours. With feedback from the future SO2 CEMS, the Mill will need flexibility to manage the air distribution within the furnace to achieve the NOx, TRS, and SO2 permitted emissions limits.

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Backup Stripper (Methanol Mode) Scenario - Projected Actual Emissions

H_2S, TRS Compounds, and VOC

New-Indy Catawba - Catawba, SC

Concentration Loadings	**H2S, ppm**	**DMDS, ppm**	**DMS, ppm**	**MMC, ppm**
Design Foul Condensate Loadings (prior to H2O2)	147	15.00	17.00	16.00
Predicted % Reduction from H_2O_2	0.99	MMC converted into DMDS	0.90	0.99
Foul Condensate (after H_2O_2)	1.47	30.51	1.70	0.16
Avg. ASB Inlet (2021 and 2022)	0.25	0.09	0.20	0.0026
Flow Weighted Loading:	0.29	0.92	0.24	6.93E-03
H2SSIM/WATER9 Results	**H2S, g/s**	**DMDS, g/s**	**DMS, g/s**	**MMC, g/s**
ASB Zone 1	0.07	0.35	0.19	5.81E-03
ASB Zone 2	0.03	5.66E-03	4.06E-03	1.06E-04
ASB Zone 3	0.02	1.09E-04	1.45E-04	3.51E-06
Total ASB	**0.12**	**0.36**	**0.19**	**5.92E-03**
PAE Emissions Factors	**H2S, lb/ODTP**	**DMDS, lb/ODTP**	**DMS, lb/ODTP**	**MMC, lb/ODTP**
Total ASB	**1.05E-02**	**3.08E-02**	**1.69E-02**	**5.12E-04**

Post-Project Foul Condensate Flow:	500	gpm
Post-Project Foul Condensate Flow:	0.72	MGD
Post-Project ASB Influent Flow:	25.48	MGD
Total ASB Flow:	26.20	MGD
Total ASB Flow:	1148	L/s
Pulp Production	2200	ODTP/day

	MW
H2S	34
DMDS	94
DMS	62
MMC	48

Buckner, Katharine

From:	Caleb Fetner <cfetner@all4inc.com>
Sent:	Monday, April 29, 2024 1:46 PM
To:	Buckner, Katharine
Cc:	Steven Moore; Sheryl Watkins; Rachel Davis; Chris Loach
Subject:	New-Indy Updated New Stripper Construction permit application
Attachments:	UPDATED New Stripper Construction Permit Application (4-29-24).pdf

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***

Hi Katharine,

Attached is the electronic version of the updated stripper construction permit application. Rachel plans to hand you the wet-ink hard copy tomorrow while you're visiting the mill.

All of the changes in the application are updates that we've discussed before, so nothing should be a surprise, but we wanted to send you this electronic version so that you could review and let us know if anything is unclear.

Also – another quick request on the Ash Hndlg and Consent Decree permits – **can you send us the compiled permit packages that you plan to put on public notice for these two permits once you have them?** We just want to confirm that we have the correct attachments to the permit.

Thank you much!
Caleb

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NEW CONDENSATE STRIPPER CONSTRUCTION PERMIT APPLICATION

NEW-INDY CATAWBA LLC – CATAWBA, SC MILL

MARCH 2023

UPDATED APRIL 2024

Submitted by:

New-Indy Catawba LLC – Catawba, SC Mill
5300 Cureton Ferry Road
Catawba, SC 29704

Submitted to:

SC Department of Health and Environmental Control
Bureau of Air Quality – Division of Air Permitting
2600 Bull Street
Columbia, SC 29201

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1. INTRODUCTION AND APPLICATION OVERVIEW

New-Indy Catawba LLC (New-Indy Catawba) operates a pulp and paper mill located in Catawba, South Carolina (Mill or the Mill) and currently operates under Title V Operating Permit No. TV-2440-005 (TVOP or TV-2440-0005), effective on July 1, 2019.

New-Indy Catawba has prepared this construction permit application as required by the Consent Order to Correct Undesirable Levels of Air Contaminants ("Consent Order"), issued on November 23, 2022, by the South Carolina Department of Health and Environmental Control (SCDHEC)[1]. For compliance with the provisions of the Consent Order, New-Indy Catawba is proposing a modification to their current foul condensate treatment system (condensate treatment system) to install a new foul condensate stripper (new steam stripper) and demote the existing steam stripper [existing steam stripper (ID 9801)] strictly to backup operation during periods of downtime experienced by the new steam stripper (Project). The Project also includes the installation of a stripper feed tank, methanol storage tank, and hot water tank to serve the new steam stripper. The stripper feed tank and methanol storage tank will be controlled in the LVHC system. The hot water tank is not expected to be a source of emissions. The Project will also satisfy the requirements of Item I.a. of Appendix A of Consent Decree Civil No. 0:21-cv-02053-SAL, United States of America v. New-Indy Catawba, LLC, dated November 16, 2022 (EPA Consent Decree).

This document represents the construction permit application for this Project (Application). This application was originally submitted in March 2023. This application has been updated in April 2024 to reflect the final project description and project emissions calculations at the request of SCDHEC.

[1] The November 23, 2022, Consent Order amends and replaces the Order to Correct Undesirable Level of Air Contaminants issued by SCDHEC on May 7, 2021.

2. PROCESS AND PROJECT DESCRIPTION

New-Indy Catawba is comprised of seven distinct process areas that include the following: the woodyard area, the kraft pulp mill area, the paper mill area, the chemical recovery area, the utilities area, the waste treatment area, and a miscellaneous area. A simplified process flow diagram for these process areas is included as Figure 2-1. A description of the process areas is presented below, with more detail provided in the areas that are impacted by the Project.

Southern pine logs and chips are received at the woodyard. Logs are debarked, chipped, and the chips are screened prior to storage for use within the pulping process. Likewise, purchased wood chips received are screened, and processed as needed, prior to use within the pulping processes.

The kraft (sulfate) process area is used to produce pulp. Pulp from the kraft process is produced from “cooking” wood chips in the continuous digester in a caustic solution at an elevated temperature and pressure. The pulp slurry from the continuous digester is sent to the blow tank, then to one of two parallel pulping lines, each consisting of an enclosed deshive refiner and a three-stage drum displacement washer system and associated filtrate tanks. Weak black liquor from the washer filtrate tanks is stored before being recycled to chemical recovery. Rejects from the refiners are sent to the screw presses, with the filtrate being screened and stored before being recycled to chemical recovery. Washed pulp is stored and then sent to the paper mill area. With the exception of the pulp storage tanks after pulp washing, the kraft pulp mill sources are currently collected and routed to the high volume low concentration (HVLC) or low volume, high concentration (LVHC) systems, and emissions are controlled through combustion in the Nos. 1 or 2 Combination Boilers.

Linerboard (the outside layer of a corrugated container) is produced in the paper mill area on one state-of-the-art paper machine. Unbleached market pulp is produced on one pulp dryer. A second paper machine at the Mill is currently idled.

Weak black liquor is concentrated in the Nos. 1-3 Evaporator Sets and is then fired in the recovery furnaces (chemical recovery area) that burn the organics extracted from the chips and recover cooking chemicals. The causticizing area utilizes the chemicals recovered by the recovery furnaces, and after adding lime, provides the cooking chemicals for the kraft process.

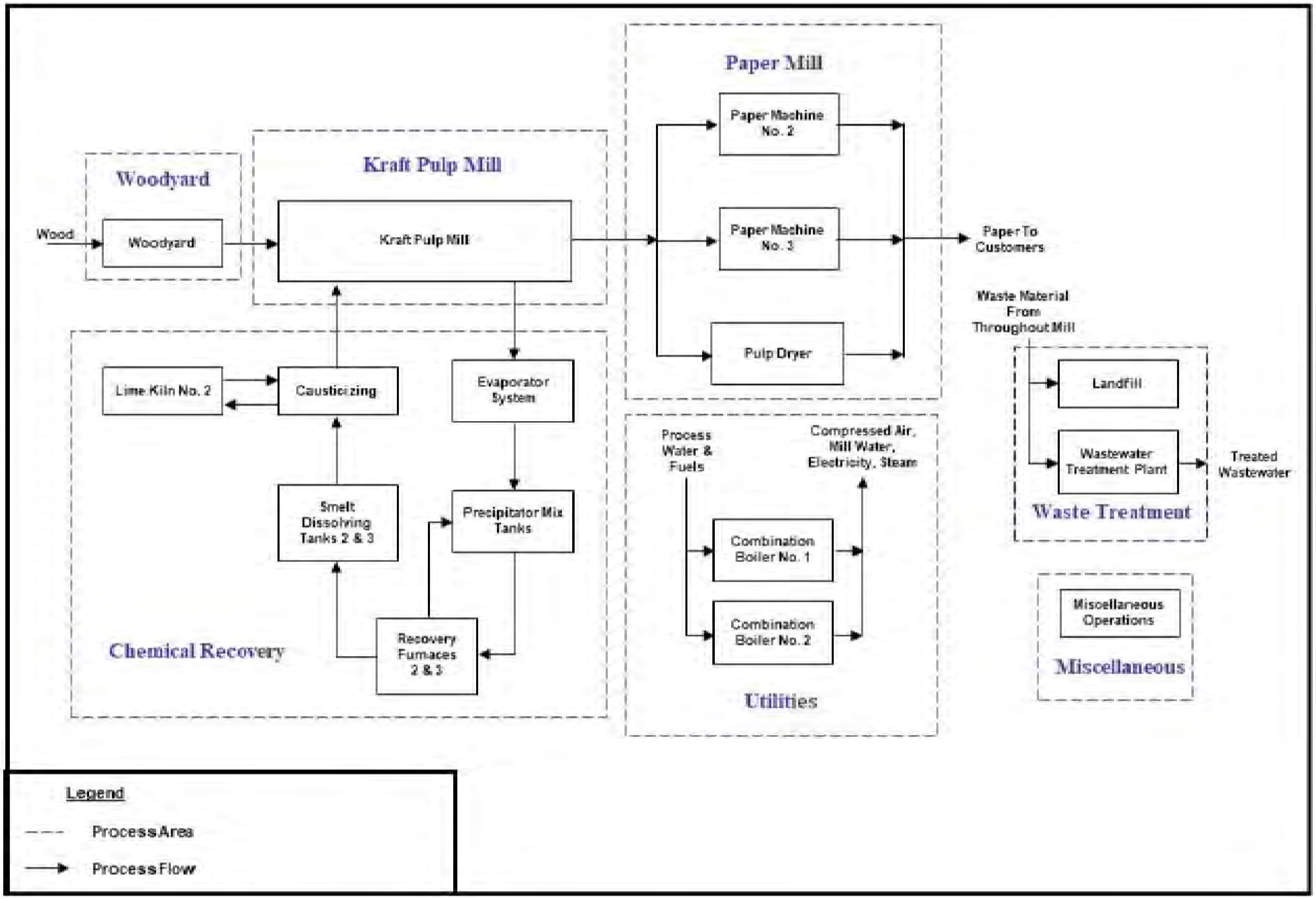
Emissions from the Evaporator Sets and Turpentine Recovery System are collected in the LVHC gas collection system and combusted in the Nos. 1 or 2 Combination Boilers. Several weak black liquor tanks are collected in the HVLC system and combusted in the Nos. 1 or 2 Combination Boilers. Evaporator condensates are segregated, with the combined condensates being recycled to the Brownstock washer system or sewered. The foul condensates are treated in a dual control device configuration: foul condensates are preferentially treated in the existing condensate steam stripper system, with the remaining flow being directed to the aerated stabilization basin (ASB) via the Hardpipe (ID 9802).

Steam and electricity are produced for facility-wide use by two combination boilers. The recovery furnaces also generate steam.

A waste treatment area receives wastewater and mill waste (solid waste) from the various previously mentioned areas of the facility. Wastewater undergoes biological treatment to remove the dissolved organic wastes prior to discharge into the receiving stream. Mill solid waste is deposited in an on-site landfill.

The miscellaneous areas include everything that is not captured in one of the aforementioned process operating areas, such as facility roads and the pulp storage tanks.

Figure 2-1 Simplified Mill Flow Diagram

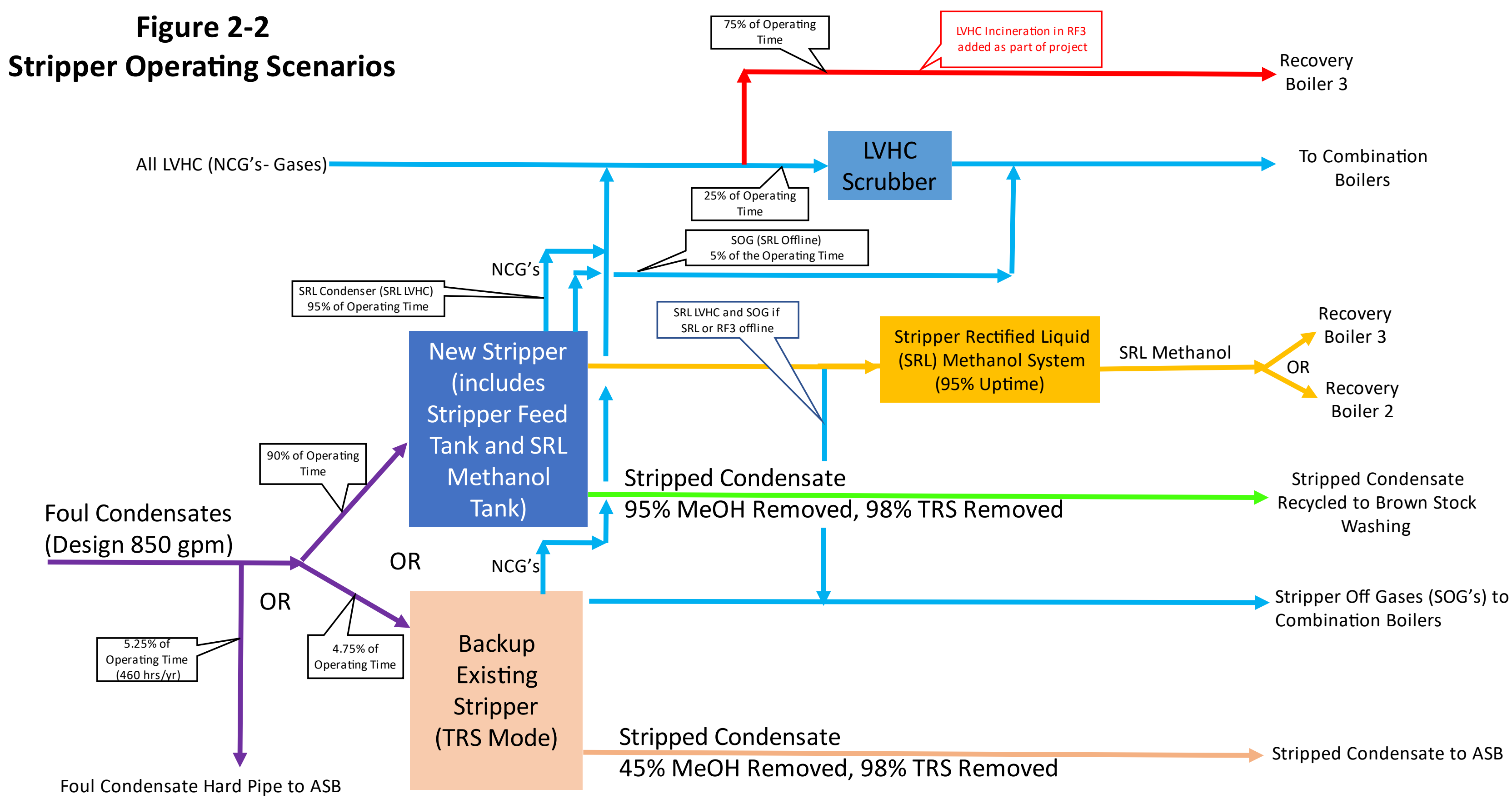


This document represents the construction permit application for this Project in accordance with the SCDHEC Consent Order. The Project consists of the following new equipment and proposed changes to the existing treatment scenarios:

1. Construct and operate a new low-pressure steam foul condensate stripper system that will process the pulping process condensates (foul condensate) for compliance with 40 CFR Part 63, Subpart S. The resultant stripped methanol will be condensed into a liquid [called stripper rectified liquid (SRL)] and combusted along with the black liquor in the Nos. 2 and 3 Recovery Furnaces (ID Nos. 2505 and 5105). The SRL will be added to the black liquor at a maximum amount of 2% by volume. There are no anticipated changes in black liquor firing as a result of the project. The LVHC gases from the SRL condenser system, stripper feed tank, and SRL tank will be combusted in the No. 3 Recovery Furnace. The LVHC system will include a 1.0 mmBtu/hr natural gas ignitor for combustion of the LVHC gases when black liquor firing is less than 50% of capacity. The existing Nos. 1 and 2 Combination Boilers (ID Nos. 2605 and 3705) will serve as back-up control for the new Stripper's LVHC gases when the SRL condenser system is not in operation. Stripped condensates will be recycled to the Brownstock washers (ID 5230), as needed;
2. Operate the existing steam stripper (ID 9801) as a backup to the new low-pressure steam stripper. The existing steam stripper will be operated to process the foul condensate and remove 98% of the total reduced sulfur (TRS) compounds; although with reduced methanol removal efficiency (referred to as "TRS Mode"). Further methanol treatment through biological destruction will be accomplished by routing the stripped condensates to the existing Hardpipe system that discharges the foul condensates below the liquid surface of the existing ASB; and
3. Modify the No. 3 Recovery Furnace to combust gases collected in the LVHC system. The Nos. 1 and 2 Combination Boilers will serve as backup control for the LVHC gases following the Project. When these LVHC gases are combusted in the combination boilers, a caustic scrubber will be operated to provide 50% removal of the sulfur prior to combustion.

Figure 2-2 presents a simplified process flow with the possible operating scenarios for treatment of the foul condensates and the associated control scenarios for the new and existing steam stripper vent gases. Section 3.2.2.3 presents the prevention of significant deterioration (PSD) analysis that details the basis for the projected actual emissions (PAE) calculations for the proposed future operating scenarios.

Figure 2-2 Stripper Operating Scenarios



3. REGULATORY REVIEW

This section summarizes Federal and State air quality regulations that potentially apply to the Project. Discussions pertaining to applicable regulatory requirements are separated into three categories:

- Federal Air Quality Regulations
- South Carolina Air Quality Regulations
- Provisions of the SCDHEC Consent Order and EPA Consent Decree

3.1 FEDERAL AIR QUALITY REGULATIONS

For the purpose of this Application, potentially applicable Federal regulations consist of:

- Standards of Performance for New Stationary Sources (NSPS)
- National Emission Standards for Hazardous Air Pollutants (NESHAP)
- New Source Review (NSR) and PSD
- Compliance Assurance Monitoring (CAM)
- Requirements for Preparation, Adoption, and Submittal of Implementation Plans
- Title V Operating Permits

A discussion of each specific Federal air quality regulation is provided in the following subsections.

3.1.1 Standards of Performance for New Stationary Sources

U.S. EPA has promulgated NSPS at 40 CFR Part 60. NSPS requirements are promulgated under 40 CFR 60 pursuant to Section 111 of the Clean Air Act.

3.1.1.1 40 CFR Part 60, Subparts BB and BBa – Standards of Performance for Kraft Pulp Mills

40 CFR Part 60, Subpart BB – Standards of Performance for Kraft Pulp Mills applies to TRS emissions from digesters, brownstock washers, multiple-effect evaporators, recovery furnaces, smelt dissolving tanks, lime kilns, and condensate strippers that commenced construction, reconstruction, or modification after September 24, 1976, and on or before May 23, 2013.

Subpart BBa applies to the same sources that commence construction, reconstruction, or modification after May 23, 2013.

The No. 3 Multi-effect Evaporator Set with Concentrator is currently subject to 40 CFR 60, Subpart BB for TRS (Standards of Performance for Kraft Pulp Mills). The existing condensate stripper system and No. 1 Multi-effect Evaporator Set with Concentrator are currently subject to 40 CFR 60, Subpart BBa for TRS. Compliance with the TRS standards at §60.283(a)(1) and §60.283a(a)(1) is currently demonstrated by combusting the stripper off-gases and evaporator vent gases in the Nos. 1 and 2 Combination Boilers per §60.283(a)(1)(iii) [combust the gases at a minimum temperature of 650 °C (1200 °F) for at least 0.5 seconds] and §60.283a(a)(1)(iii) [collect the gases in the existing low volume high concentration (LVHC) closed-vent collection system meeting the requirements of §63.450 and combust the gases at a minimum temperature of 650 °C (1200 °F) for at least 0.5 seconds]. As there are no physical modifications to the existing condensate stripper and Nos. 1-3 Multi-effect Evaporator Sets with Concentrators, the Mill will continue to combust the existing stripper off-gases in the Nos. 1 and 2 Combination Boilers; however, following the Project, the vent gases from the Nos. 1-3 Multi-effect Evaporator Sets with Concentrators will be combusted in the No. 3 Recovery Furnace per §60.283a(a)(1)(ii) [gases are collected in the existing LVHC closed-vent collection system meeting the requirements of §63.450 and combusted in a recovery furnace subject to §60.283(a)(2)] or in the Nos. 1 and 2 Combination Boilers per §60.283a(a)(1)(iii). The No. 2 Multi-effect Evaporator Set with Concentrator is not subject to either Subpart BB or Subpart BBa but gases are collected and controlled in the same manner as the other evaporator sets.

Upon completion of the Project, the new condensate stripper system will be subject to 40 CFR Part 60, Subpart BBa for TRS (Standards of Performance for Kraft Pulp Mill Affected Sources for Which Construction, Reconstruction, or Modification Commenced After May 23, 2013). Compliance with the TRS standard at 60.283a(a)(1) will be demonstrated through collection of the stripper off-gases (SOG) in the existing SOG collection system and SRL gases in the existing LVHC closed-vent collection system meeting the requirements of §63.450. The SOG will continue to be combusted in the Nos. 1 and 2 Combination Boilers per §60.283a(a)(1)(iii). The LVHC collection system gases will be combusted in the No. 3 Recovery Furnace per §60.283a(a)(1)(ii) or in the Nos. 1 and 2 Combination Boilers per §60.283a(a)(1)(iii). Emissions from the stripper feed tank will also be collected in the LVHC collection system. The Mill will continuously monitor the incineration of SOG and LVHC gases in the No. 3 recovery furnace, each combination boiler, and venting of the SOG and LVHC closed-vent systems as required by §60.284a(d)(3)(iii) and currently utilized for monitoring compliance with Subpart BB.

New-Indy Catawba will maintain records of excess emissions and malfunctions for the new stripper as required by §60.287a(b)(7) and (c), respectively. The Mill will report periods of excess emissions and malfunctions as required by §60.288a(a) and (d), respectively. As defined in §60.284a(e)(1)(vi), periods of excess emissions from the LVHC closed-vent system (condensate stripper system) that are less than one percent (1%) of operating time during a semi-annual period are not a violation of §60.283a(a)(1)(iii).

The stripper feed tank, methanol tank, hot water tank, Hardpipe, and ASB are not included in the definition of condensate stripper system under §60.281 or §60.281a and are not affected sources under Subparts BB or BBa.

3.1.1.2 40 CFR Part 60, Subpart Kb - Standards of Performance for Volatile Organic Liquid Storage Vessels (Including Petroleum Liquid Storage Vessels) for Which Construction, Reconstruction, or Modification Commenced After July 23, 1984

The Project includes a new stripper feed tank, new methanol tank, and a new hot water tank. 40 CFR Part 60, Subpart Kb includes standards of performance for new storage tanks. However, per 60.111b, the definition of storage tank does not include process tanks (tanks that collect material from one part of a process before sending it to another part of the process). Therefore, the new tanks are not subject to Subpart Kb.

3.1.2 National Emission Standards for Hazardous Air Pollutants

NESHAP found in 40 CFR Part 61 apply to specific compounds emitted from certain listed processes. 40 CFR Part 61 subparts do not apply to the Mill, and there are no Part 61 subparts that apply to the proposed Project. Applicability of Part 63 NESHAP is discussed below.

3.1.2.1 40 CFR Part 63, Subpart S – National Emission Standards for Hazardous Air Pollutants from the Pulp and Paper Industry

New-Indy Catawba is subject to 40 CFR Part 63, Subpart S, also referred to as Maximum Achievable Control Technology (MACT) I for the pulp and paper industry. This standard regulates hazardous air pollutant (HAP) emissions from pulping and bleaching systems. The affected source under this standard is the total of all HAP emission points in the pulping and bleaching systems. The Mill does not produce bleached pulp and is therefore not subject to the requirements of §63.445.

The Nos. 1-3 Multi-effect Evaporator Sets with Concentrators and Turpentine Recovery System were constructed prior to 1993 and are existing affected sources, while the existing condensate stripper was constructed after 1993, making it a new source under 40 CFR Part 63, Subpart S. Compliance is currently demonstrated by collecting the gases in the existing LVHC closed-vent system meeting the requirements of §63.450 and combustion of the SOG and LVHC system gases in the Nos. 1 and 2 Combination Boilers per §63.443(d)(4)(i) (introduce the HAP emission stream with the primary fuel or into the flame zone). The Mill currently complies with the pulping condensates collection requirements in §63.446(c)(3) [collect the pulping process condensates from equipment systems listed in §63.446(b)(1) through (b)(5) that in total contain a minimum of 7.2 lb HAP per ton oven dried ton of pulp (lb HAP/ODTP)] and the treatment requirements in §63.446(e)(4) [treat a minimum of 6.6 lb HAP/ODTP]. The Mill has utilized concurrent use of the existing steam stripper and Hardpipe for compliance with §63.446(e)(4).

Subpart S requires collection of LVHC gases from steam stripper systems, defined to include the stripper column, associated feed tanks, condensers, and any methanol rectification process. The new condensate stripper, stripper feed tank, methanol condenser, and methanol tank will be subject to this rule upon startup.

Following the completion of the proposed Project, SOG from the existing condensate stripper and vent gases from the existing Nos. 1-3 Multi-effect Evaporator Sets with Concentrators and Turpentine system will continue to be collected in the existing LVHC closed-vent system meeting the requirements of §63.450 and §63.453(k)(1-6). The existing SOG will continue to be combusted in the Nos. 1 and 2 Combination Boilers per §63.443(d)(4)(i). However, the vent gases from the LVHC collection system will be combusted in the No. 3 Recovery Furnace or in the Nos. 1 and 2 Combination Boilers (as backup) per §63.443(d)(4)(i). The Mill will update the leak detection and repair (LDAR) site inspection plan as appropriate per §63.454(b).

The Mill plans to demonstrate compliance with the pulping condensates collection requirements in §63.446(c)(3) [collect the pulping process condensates from equipment systems listed in §63.446(b)(1) through (b)(5) that in total contain 7.2 lb HAP/ODTP] and the treatment requirements in §63.446(e)(4) [treat a minimum of 6.6 lb HAP/ODTP]. The Mill will utilize the new condensate stripper for compliance with §63.446(e)(4) and will operate a continuous monitoring system for the parameters in §63.453(g)(1-3). Vents from the new condensate stripper (including the stripper feed tank, SRL condenser, and SRL tank) will be collected in the existing LVHC closed-vent system meeting the requirements of §63.450 and combusted in the No. 3 Recovery Furnace or Nos. 1 and 2 Combination Boilers per §63.443(d)(4)(i). The Mill will update the LDAR site inspection plan as appropriate per §63.454(b) and will perform the required inspection and monitoring requirements per §63.453(k)(1-6). The new stripper will be included in semi-annual excess emission reports under §63.455. Per §63.446(g), periods of excess emissions reported under §63.455 are not considered a violation of §63.446(e)(4) provided that the time of excess emissions divided by the total process operating time in a semi-annual reporting period does not exceed 10 percent.

At the request of SCDHEC, the Mill is providing additional information regarding plans to demonstrate continuous compliance with the pulping condensate collection and treatment in the new steam stripper. These are as follows:

- Pulping condensate collection emissions limit of 7.2 lb HAP/ODTP:
  - HAP will be measured "as methanol" per §63.457(f)(2);
  - Daily sampling of foul condensates for methanol concentration representative of the inlet to the new stripper;
  - Continuous measurement of new steam stripper inlet foul condensate feed flow (gpm);
  - Daily measurement of pulp production (ODTP); and
  - Daily calculation of a 15-day rolling average collection (lbs methanol/ODTP) [Note: The Mill may use historical and/or collect future foul condensate sampling data to support a longer averaging period].
- Pulping condensate treatment in the new steam stripper to remove 6.6 lb HAP/ODTP:
  - HAP will be measured "as methanol" per §63.457(f)(2); and
  - Daily sampling of stripped condensates for methanol concentration representative of the outlet of the new stripper.
  - Continuous measurement of:
    - New steam stripper inlet foul condensate feed flow (gpm);
    - New steam stripper steam feed flow (lbs/hr);
    - Foul condensate to new steam stripper feed temperature (˚F); and
    - New steam stripper stripped condensate flow (gpm).
  - Daily measurement of pulp production (ODTP).
  - Daily calculation of the percent methanol removed in the steam stripper .
  - Daily calculation of the treatment in the new steam stripper [15-day (or other averaging period, as justified) rolling average methanol collected (lbs methanol/ODTP) multiplied by the calculated daily methanol percent removal in the new stripper].

Please note that the Mill may choose to establish a methanol concentration factor in lieu of daily methanol sampling at the inlet to the new steam stripper once sufficient data has been collected demonstrating consistency in the foul condensate methanol concentration. In addition, the Mill may choose to establish an effective steam to feed ratio (ESFR) curve for the new stripper system to be used to establish the methanol removal efficiency across the stripper in lieu of the method described above. The compliance approach will be delineated in the Notification of Compliance Status (NOCS) that will be submitted with the results of the initial compliance demonstration to be conducted within 180 days of startup of the new stripper system.

3.1.2.2 40 CFR Part 63, Subpart MM National Emission Standards for Hazardous Air Pollutants (NESHAP) for Chemical Recovery Combustion Sources at Kraft, Soda, Sulfite, and Stand-Alone Semichemical Pulp Mills

New-Indy Catawba is subject to 40 CFR Part 63, Subpart MM, also referred to as MACT II for the pulp and paper industry. This standard regulates particulate matter (PM) emissions from existing recovery boilers, smelt tanks, and lime kilns when processing black liquor or calcium oxide. The Nos. 2 and 3 Recovery Furnaces are currently subject to the existing source requirements of this regulation. The proposed Project will modify the LVHC collection system that delivers the LVHC gases to the No. 3 Recovery Furnace for combustion, but no changes in black liquor firing are expected for the recovery furnaces and PM emissions from black liquor combustion are not expected to increase. The Mill will continue to meet the existing PM emission limits under Subpart MM after completion of the Project.

3.1.2.3 40 CFR Part 63, Subpart EEEE – National Emission Standards for Hazardous Air Pollutants: Organic Liquids Distribution (non-Gasoline)

Subpart EEEE applies to organic liquids distribution (OLD) operations at major sources of HAP. The Project includes installation of a new methanol tank and a new hot water tank. However, these new tanks are not subject to this rule because they are part of the Mill's pulping system as defined under Subpart S. EPA confirmed that tanks in pulp and paper mills that are part of the pulping or bleaching systems are not subject to Subpart EEEE in a December 2004 determination (ADI Control Number M050008).

3.1.2.4 40 CFR Part 63, Subpart DDDDD – National Emission Standards for Hazardous Air Pollutants for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters.

New-Indy Catawba is subject to 40 CFR Part 63, Subpart DDDDD, also referred to as Boiler MACT. Boiler MACT sets forth emissions limits and work practice standards; testing and fuel analyses requirements; and monitoring, recordkeeping, notification, and reporting requirements that apply to boilers and process heaters located at major sources of HAP. The Nos. 1 and 2 Combination Boilers are subject to the requirements of 40 CFR Part 63, Subpart DDDDD. The

Nos. 2 and 3 Recovery Furnaces are not subject to the rule per §63.7491(b). The Project will not affect the regulatory applicability of 40 CFR Part 63, Subpart DDDDD, for either combination boiler and will not affect compliance with the applicable emissions limits. The Mill will continue to comply with the currently applicable provisions of 40 CFR Part 63, Subpart DDDDD, in the same manner after completion of the Project.

3.1.3 New Source Review

The Mill is located in York County which is classified as in attainment of or unclassifiable for the National Ambient Air Quality Standards (NAAQS) for regulated NSR pollutants. Therefore, Nonattainment New Source Review (NNSR) regulations do not apply to this Project and the Project is analyzed for applicability as it relates to the PSD requirements. Implementation of the PSD regulations (i.e., 40 CFR §51.166) has been delegated in full to the State of South Carolina. Refer to Section 3.2.2.3 for a discussion of PSD applicability.

3.1.4 Compliance Assurance Monitoring

U.S. EPA developed the CAM rule at 40 CFR Part 64 as a means for providing reasonable assurance that continuous compliance with applicable requirements is achieved for certain emissions units located at major stationary sources subject to Title V permitting. CAM applies to pollutant-specific emissions units (PSEUs) that (1) are subject to an emissions limit or standard (2) use a control device to achieve compliance with that emissions limit or standard, and (3) have potential pre-control device emissions in the amount required to classify the unit as a major source under Part 70 of the Clean Air Act (CAA). Part 64 does not apply to emissions limitations or standards proposed after November 15, 1990 pursuant to Section 111 or 112 of the Clean Air Act (e.g., post-1990 NSPS or NESHAP). The proposed Project is not subject to CAM requirements because the new steam stripper is subject to 40 CFR Part 60, Subpart BBa and 40 CFR Part 63, Subpart S, which are standards proposed after November 15, 1990.

3.1.5 Requirements for Preparation, Adoption, and Submittal of Implementation Plans

U.S. EPA requires air agencies to develop and submit air quality data characterizing maximum 1-hour ambient concentrations of sulfur dioxide (SO_2) through ambient air quality monitoring or air quality modeling analysis at the air agency's election. These requirements are promulgated under 40 CFR Part 51.

3.1.5.1 40 CFR Part 51, Subpart BB—Data Requirements for Characterizing Air

Quality for the Primary SO_2 NAAQS (SO_2 Data Requirements Rule or SO_2 DRR)

The Mill submitted facility-wide air dispersion modeling in November 2016 to comply with 40 CFR 51.1203(d). The Mill updated the facility-wide air dispersion modeling in October 2021. The actual SO_2 emissions following the Project are expected to remain below the SO_2 emission rates included in the modeling analysis submitted in 2016 and 2021. The Mill will continue to perform an annual review of the actual SO_2 emission rates against the 2016 and 2021 model emission rates to determine if an updated modeling demonstration is necessary.

3.1.6 Title V Operating Permits

New-Indy Catawba operates under TVOP TV-2440-0005 issued on May 7, 2019, with an effective date of July 1, 2019, and an expiration date of December 31, 2023. New-Indy Catawba submitted a Title V operating permit renewal application on December 1, 2023. SCDHEC determined the Title V operating permit renewal application was complete on December 18, 2023. Through this Application, New-Indy Catawba is requesting a construction permit to perform the Project. Construction permit application forms required by SCDHEC are included in Appendix A. New-Indy Catawba will request a modification to the TVOP within 15 days of startup of the Project, which is required by the Consent Order to be no later than June 30, 2025.

3.2 SOUTH CAROLINA AIR QUALITY REGULATIONS

This section addresses the applicability of state air regulatory requirements to the Project.

3.2.1 Regulation 61-62.1: Section II, Permit Requirements

This regulation specifies the construction and operating permit requirements for new or modified sources. This permit application is intended to satisfy the construction permitting requirements of Regulation 62.1 Section II. Completed SCDHEC construction permit application forms are included in Appendix A. The original application was submitted in March 2023, prior to implementation of the current SCDHEC ePermitting system. This updated application has been re-submitted in the original hardcopy form and is not in the ePermitting system.

3.2.2 Regulation 61-62.5: Air Pollution Control Standards

The list below identifies potentially applicable SC air pollution control regulations and standards associated with the Project.

- Standard No. 2 – Ambient Air Quality Standards

- Standard No. 3 – Waste Combustion and Reduction
- Standard No. 4 – Emissions from Process Industries
- Standard No. 7 – Prevention of Significant Deterioration
- Standard No. 8 – Toxic Air Pollutants

3.2.2.1 Standard No. 2 – Ambient Air Quality Standards

SCDHEC Standard No. 2 addresses the National Ambient Air Quality Standards (NAAQS). Except for an ambient air quality standard for gaseous fluorides, the SCHDEC ambient air quality standards are equivalent to the Federal NAAQS. New-Indy Catawba has previously submitted facility-wide air dispersion modeling evaluations to demonstrate compliance with Standard No. 2.

The Project may slightly increase the actual emissions of SO_2, nitrogen oxides (NO_X), and carbon monoxide (CO) from the No. 3 Recovery Furnace when burning LVHC gases. However, the maximum SO_2 and NO_X emissions from the No.3 Recovery Furnace when burning LVHC gases will be less than 10 percent of the emissions from burning the LVHC gases in the Nos. 1 and 2 Combination Boilers. The maximum SO_2 and NO_X emissions from LVHC combustion in the combination boilers are not expected to change as a result of the project. The CO emissions from burning LVHC gases will be unchanged when combusted in the recovery furnace or the combination boilers.

The emissions of SO_2, NO_X, CO, particulate matter (PM), PM less than 10 microns (PM_{10}), and PM less than 2.5 microns ($PM_{2.5}$) from the LVHC System natural gas ignitor in the No. 3 Recovery Furnace are well below the 1.14 pounds per hour modeling exemption threshold in the South Carolina Modeling Guidelines[2], Section 2.2.3. Therefore, the very small emissions increases from the LVHC natural gas ignitor have not been modeled for this permit application.

The additional steam potentially required from the combination boilers to operate the new condensate stripper will not exceed the current steaming capacity of each combination boiler, as reflected in the SO_2, NO_X, CO, PM, PM_{10}, $PM_{2.5}$ and CO emissions rates modeled previously.

[2] South Carolina Modeling Guidelines for Air Quality Permits (Revised April 15, 2019).

Therefore, no updates to the modeled emissions rates from the combination boilers are required for this permit application.

The SO_2 emissions from the Project will decrease by approximately 90 tons per year. The reduction in SO_2 emissions meets the single factor emissions netting option 2 in the South Carolina Other Information Guidance[3]. The modeled SO_2 Emissions Rate from black liquor combustion in the 2016 and 2021 SO_2 DRR modeling is 18.70 lb/hr from the No. 3 Recovery Furnace. The maximum SO_2 emissions rate from burning black liquor in the 2023 Title V renewal application is 5.95 pounds per hour. The additional SO_2 emissions from LVHC gases and methanol combustion is 7.4 pounds per hour, making the new total SO_2 emissions 13.35 pounds per hour, more than 5 pounds per hour lower than the modeled SO_2 emissions rate from black liquor combustion. Therefore, no updates to the SO_2 modeling submitted previously in 2016 and 2021 have been prepared for this permit application.

The NO_X emissions will increase from the Project approximately 24 tpy, which is slightly over one-half the Prevention of Significant Deterioration (PSD) significance threshold, due primarily to increased steam usage by the new condensate stripper. The NO_X emissions due to the Project meet weight of evidence approach 1 in the South Carolina Other Information. The modeled NO_X Emissions Rate for Ambient Air Standards in the current Title V permit is 146.03 lb/hr from the No. 3 Recovery Furnace. The maximum NO_X emissions rate from burning black liquor in the 2023 Title V renewal application is 122.4 pounds per hour. The additional NO_X emissions from LVHC gases and methanol combustion is 4.3 pounds per hour, making the new total NO_X emissions 126.7 pounds per hour, more than 19 pounds per hour lower than the modeled NO_X emissions rate . Therefore, no updates to the NO_X modeling submitted previously have been prepared for this permit application.

The CO emissions will increase from the Project less than one-half the Prevention of Significant Deterioration (PSD) significance threshold, due primarily to increased steam usage by the new condensate stripper. The CO emissions due to the Project meet weight of evidence approach 1 in the South Carolina Other Information. The CO emissions from burning LVHC gases will be unchanged when combusted in the recovery furnace or the combination boilers. The modeled CO Emissions Rate for Ambient Air Standards in the current Title V permit is 330.96 lb/hr from

[3] Guidance Concerning Other Information Used for Permitting Requirements in Demonstrating Emissions Do Not Interfere With Attainment or Maintenance of any State of Federal Standard (Updated December 12, 2018).

the No. 3 Recovery Furnace. The maximum CO emissions rate from burning black liquor in the 2023 Title V renewal application is 102.9 pounds per hour. The additional CO emissions from LVHC gases and methanol combustion is 8.3 pounds per hour, making the new total CO emissions 111.1 pounds per hour, more than 200 pounds per hour lower than the modeled CO emissions rate. Therefore, no updates to the CO modeling submitted previously have been prepared for this permit application.

Therefore, no updates to the previous Standard No. 2 modeling demonstration are required.

3.2.2.1 Standard No. 3 – Waste Combustion and Reduction

Standard No. 3 applies to any source that burns any waste other than virgin fuels for any purpose. The standard contains various exemptions for the pulp and paper source category. Section I.J.1 specifies that recovery furnaces burning black liquor and TRS compounds are not subject to the standard. Section I.J.1 also specifies that gaseous process streams containing TRS compounds that are regulated in accordance with Section XI of Regulation 61-62.5, Standard No. 4, or NSPS are not subject to Standard No. 3. Because the SOG and LVHC collection system gases containing TRS that are regulated in accordance with Standard No. 4 or NSPS Subpart BB/BBa, combustion of those gases in combination boilers or recovery furnaces is not subject to Standard No. 3.

Standard No. 3 specifically states that any "facility with an emission unit and/or control device that complies with all the requirements of an applicable Maximum Achievable Control Technology (MACT) Standard under 40 CFR 63, including the testing and reporting requirements, may request an exemption from this standard." (61 -62.5, Section l.J.3.)

During development of the Pulp and Paper MACT regulations at 40 CFR 63, Subpart S, U.S. EPA reviewed the practice of combusting methanol condensed from stripper-off-gases. The U.S. EPA determined that the methanol condensate "does not appear to contain metal or chlorinated organic HAP's ..." (61 Fed. Reg. 9397) (emphasis added). The U.S. EPA also found that burning methanol condensate "will not increase the potential environmental risk over the burning of the steam stripper vent gases prior to condensation." U.S. EPA reaffirmed this conclusion in 2011 during its Residual Risk and Technology Review (RTR) of the Pulp and Paper (Subpart S) MACT. In the final RTR rule, U.S. EPA stated: "We conclude based on the Residual Risk Assessment cited here that the risks from the subpart S pulp and papermaking source category are acceptable and that the current standard protects the public health with an ample margin of safety. Consequently, we are re-adopting the MACT standards for subpart S pursuant to our 112(f)(2) review." (77 Fed. Reg. 55705)

Therefore, the combustion of black liquor and condensed methanol from stripper-off-gases in the recovery furnaces mill qualifies for the exemption from Standard No. 3 provided in Section I.J.3.

3.2.2.2 Standard No. 4 – Emissions from Process Industries

SCDHEC Regulation 61-62.5, Standard No. 4 establishes standards for opacity and certain other pollutants for specific sources in specific industries and establishes PM and opacity standards for industrial processes not otherwise regulated. The new steam stripper and the new tanks do not cause visible emissions into the atmosphere; therefore, this standard does not apply.

Section XI regulates emissions of TRS from Kraft Pulp Mills where construction or modification commenced prior to September 24, 1976 from recovery furnaces, digester systems, multiple-effect evaporator systems, lime kilns, and condensate stripper systems. The No. 2 Recovery Furnace is currently subject to Standard 4 and will continue to comply with the TRS limits after completion of the Project. The TRS emissions from the No. 3 Recovery Furnace and No. 3 Evaporator Set with Concentrator are subject to 40 CFR Part 60, Subpart BB. The TRS emissions from the No. 1 Evaporator Set with Concentrator, the existing steam stripper, and the new condensate steam stripper are/will be subject to 40 CFR Part 60, Subpart BBa.

3.2.2.3 Standard No. 7 – Prevention of Significant Deterioration – Permit Requirements

PSD requirements apply to major stationary sources of regulated NSR pollutants that are located in areas that are in attainment with the NAAQS or unclassifiable. Implementation of the PSD regulations has been delegated in full to the State of South Carolina. These air quality regulations are contained in SCDHEC Regulation 61-62.5, Standard No. 7. The PSD regulations apply to major modifications at major stationary sources, which are considered those sources belonging to any one of the 28 source categories listed in the regulations that have the potential to emit (PTE) 100 tons per year (tpy) or more of an NSR-regulated pollutant, or any other source that has the PTE 250 tpy or more of an NSR-regulated pollutant. The Mill is considered a major stationary source because it emits or has the PTE 100 tpy or more of a regulated NSR pollutant. Because it includes physical changes to the Mill, the installation of the new steam stripper is a “project” as defined in Standard No. 7(b)(40).

New-Indy Catawba has assessed the applicability of PSD to this Project by performing the hybrid test as prescribed under U.S. EPA’s PSD rules (as adopted by South Carolina) at 40 CFR 52.21(a)(2)(iv)(f), described as the hybrid test for projects that involve multiple types of emissions units. The future emissions from the backup steam stripper system, existing foul condensate Hardpipe, existing ASB, existing evaporator and turpentine recovery system LVHC gases, and steam required for the existing steam stripper system are calculated as PAE per SCDHEC Regulation 61-62.5, Standard No. 7, paragraph (B)(41). The future emissions from the new steam stripper and the generation of steam to operate the new steam stripper are PTE per SCDHEC Regulation 61-62.5, Standard No. 7, paragraph (B)(37).

The PSD applicability analysis has been completed for the applicable NSR regulated air pollutants, including SO_2, NO_x, CO, volatile organic compounds (VOC), TRS, H_2S, PM, PM_{10}, $PM_{2.5}$, lead (Pb), sulfuric acid mist, and carbon dioxide (CO_2). There are no increases in emissions of fluorides from the Project. Emissions calculations used for determining PSD applicability are included in Appendix B.

At this time, New-Indy Catawba has not excluded emissions the mill was capable of accommodating during the baseline period or excluded demand growth from the projected actual emissions as allowed under SCDHEC Regulation 61-62.5, Standard No. 7, paragraph (B)(41)(b)(iii). New-Indy Catawba may decide to utilize these two exclusions from PAE during this or future permitting if desirable.

3.2.2.3.1 Baseline Actual Emissions

Baseline actual emissions (BAE) from an existing source are defined by Standard No. 7, paragraph (B)(4)(b) as:

> "*the average rate, in tpy, at which the emissions unit actually emitted the pollutant during any consecutive 24-month period selected by the owner or operator within the 10-year period immediately preceding either the date the owner or operator begins actual construction of the project, or the date a complete permit application is received by the Department for a permit required under this section or under a plan approved by the Administrator, whichever is earlier, except that the 10-year period shall not include any period earlier than November 15, 1990.*"

BAE for all existing sources and pollutants are based on the 24-month period following conversion of the mill to manufacturing unbleached paper grades starting in March 2021 and extending through February 2023. For simplicity, baseline annual production rates are assumed to occur over 8,760 operating hours. The BAE for the existing steam stripper (aka future backup stripper) off gases (and the required steam) are adjusted using the actual operating days to reflect that the stripper did not return to service until May 3, 2021.

Sulfur Dioxide

The baseline actual SO_2 emissions from burning the SOG from the existing steam stripper and LVHC collection system gases are based on the average emissions factors developed from the most recent (October 2021) source testing for SO_2. The emissions are further sub-divided between LVHC and HVLC streams using the post-Project Columbia SO_2 emissions factors presented in Appendix C – Tab A of the July 2019 and April 2020 permit applications approved by SCDHEC in Construction Permit DF.

Nitrogen Oxides and Carbon Monoxide

The baseline actual NO_X and CO emissions from burning the SOG from the existing steam stripper are based on the post-Project Columbia NO_X emissions factors presented in Appendix C – Tab A of the July 2019 and April 2020 permit applications approved by SCDHEC in Construction Permit DF.

Volatile Organic Compounds

The baseline actual VOC emissions from the existing condensate stripper system are based on the actual amount of methanol stripped from the foul condensate during the baseline period for which records are available. The non-methanol VOC emissions (including the TRS compounds that are also VOC as further described in the next section) from the ASB from treatment of Mill process wastewater and the foul condensate not treated in the existing steam stripper are calculated using the U.S. EPA WATER9 Model. To calculate methanol emissions from the ASB, New-Indy Catawba used a spreadsheet version of the WATER9 calculations from the National Council for Air and Stream Improvement (NCASI) to calculate the fractions biodegraded and emitted developed from Procedure 5 (Multiple Zone Concentration Measurements) in 40 CFR Part 63, Appendix C, Form XIII ("NCASI Form XIII calculation spreadsheet"). The WATER9 Model and Form XIII calculation utilize site-specific liquid concentration data, the site-specific configuration of the treatment unit [including the area or length of unit, liquid depth, wind speed, aeration type (i.e., mechanical aeration)], and the total amount of aeration to calculate the emissions rate in grams per second (g/s).

Baseline actual methanol emissions from the ASB are based on the NCASI Form XIII calculations for NESHAP Subpart S performance testing conducted during the baseline period. The baseline actual VOC emissions from the LVHC collection system are based on the post-Project Columbia VOC emissions factors presented in Appendix C – Tab A of the July 2019 and April 2020 permit applications approved by SCDHEC in Construction Permit DF.

Hydrogen Sulfide and Total Reduced Sulfur Compounds

The baseline hydrogen sulfide (H_2S) and total reduced sulfur (TRS) emissions from burning the SOG from the existing steam stripper and the LVHC collection system gases are based on the average emissions factors developed from the June 2021 source testing for H_2S and TRS. The emissions are further sub-divided between LVHC and HVLC streams using the post-Project Columbia H_2S and TRS emissions factors presented in Appendix C – Tab A of the July 2019 and April 2020 permit applications approved by SCDHEC in Construction Permit DF.

The baseline actual H_2S emissions from the ASB from treatment of Mill process wastewater and the foul condensate not treated in the existing steam stripper are calculated using the NCASI Hydrogen Sulfide Emissions Simulator, or "H2SSIM" Model, which utilizes site-specific wastewater configuration, site-specific liquid test results for H_2S, and site-specific data inputs [e.g., temperature, dissolved oxygen (DO), pH]. H2SSIM inputs are based on May and July 2022 sampling data for H_2S in the foul condensate, as well as dissolved oxygen (DO) data for the ASB taken during NESHAP Subpart S performance testing during the baseline period. The baseline emissions for methyl mercaptan (MMC), dimethyl disulfide (DMDS), and dimethyl sulfide (DMS) are calculated using WATER9 based on May and July 2022 sampling of the foul condensate. During the May and July 2022 testing, foul condensate sample results were representative of the concentrations before chemical oxidant was added. The Mill has been chemically oxidizing the contents of the Hardpipe prior to entry into the ASB since June 2021. For calculating BAE of H_2S and TRS emissions from the ASB, the May and July 2022 foul condensate samples were adjusted as follows to account for the effects of the chemical oxidant:

- H_2S concentrations in the Hardpipe effluent were reduced by 99%.
- DMS concentrations in the Hardpipe effluent were reduced by 90%.
- MMC concentrations in the Hardpipe effluent were reduced by 99% and assumed to be converted to DMDS.
- DMDS concentrations are assumed to not be reduced by chemical oxidant. DMDS concentrations in the Hardpipe effluent were increased to account for the oxidation of MMC to DMDS.

These adjustments are based on NCASI Technical Bulletin No. 949, Section 5.3.1 for Hydrogen Peroxide and additional bench scale study results and curves provided by NCASI. Pertinent pages from NCASI Technical Bulletin No. 949 and the bench scale study are attached as supporting information in Appendix B.

Steam Baseline

The BAE of products of combustion (NO_X, CO, VOC, PM, PM_{10}, $PM_{2.5}$, Lead, and CO_2e) for the steam required by the existing steam stripper are based on the actual heat input from fossil fuels to both combination boilers during the baseline period. New-Indy Catawba operates the two recovery furnaces as base-loaded steam generators with the combination boilers handling most swings in steam load. New-Indy Catawba burns all the biomass available in the combination boilers because biomass is the most cost-effective fuel on an MMBtu basis. Additional steam is generated from burning natural gas and No. 6 fuel oil as needed. During the baseline period, natural gas accounted for 97.9% of the fossil fuel heat input to both combination boilers, with No. 6 fuel oil constituting the remaining 2.1% of the fossil fuel heat input.

3.2.2.3.2 Projected Actual Emissions and Potential to Emit

PAE is defined by the SCDHEC Regulation 61-62.5, Standard No. 7, paragraph (B)(41) as:

> *"the maximum annual rate, in tpy, at which an existing emissions unit is projected to emit a regulated NSR pollutant in any one of the five (5) years (12-month period) following the date the unit resumes regular operation after the project, or in any one of the ten (10) years following that date, if the project involves increasing the emissions unit's design capacity or its potential to emit that regulated NSR pollutant and full utilization of the unit would result in a significant emissions increase or a significant net emissions increase at the major stationary source."*

As described previously, PAE are calculated from the existing steam stripper, existing foul condensate Hardpipe, existing ASB, existing LVHC collection system gases, and steam required for the existing steam stripper.

PTE is defined by the SCDHEC Regulation 61-62.5, Standard No Standard No. 7, paragraph (B)(37) as:

> *"the maximum capacity of a stationary source to emit a pollutant under its physical and operational design. Any physical or operational limitation on the capacity of the source to emit a pollutant, including air pollution control equipment and restrictions on hours of operation or on the type or amount of material combusted, stored, or processed, shall be treated as part of its design if the limitation or the effect it would have on emissions is federally enforceable."*

The future emissions from the new steam stripper system and the generation of steam to operate the new steam stripper system are PTE.

PAE and PTE were calculated for three different stripper operating scenarios as shown below in Table 3-1. The new stripper is expected to be online at least 90% of the annual operating time. The backup steam stripper is expected to be online 4.75% of the annual operating time. There will also be periods when the new stripper may need to go offline and the backup stripper brought into service. During these transition periods until a stripper is returned to service, untreated foul condensate will be discharged through the Hardpipe to the ASB. While in the Hardpipe prior to entering the ASB, the TRS compounds in the condensates will be chemically oxidized to reduce the potential for odors from the ASB when operating during these brief transition periods, which are required by Part I of Appendix A of the November 16, 2022 EPA Consent Decree to be equal to or less than 460 hours (5.25%) of annual operating time.

The PAE and PTE for all scenarios are based on the design foul condensate sulfur loading [168 parts per million by weight (ppmw)] and maximum design foul condensate flow [850 gallons per minute (gpm)]. Emissions factors [on a pound per air-dried ton of pulp (lb/ADTP) basis] are calculated based on 2,444 ADTP/day, which is at the lower range of production for which the maximum design foul condensate flow is expected. The design foul condensate sulfur loading is based on liquid samples taken during the June 2021 site-specific testing. The sulfur concentration of 168 ppmw at the design foul condensate flow is equivalent to 0.70 pound of TRS as sulfur per ADTP. PAE are calculated for each of the three stripper operating scenarios based on 8,760 hours per year and a maximum pulp production of 2,700 ADTP/day.

The following sections provide further detail and different operating configurations within particular scenarios.

New Steam Stripper Online Scenario

While the new steam stripper is operating, the stripped condensate from the new steam stripper will be recycled to the brownstock washers, as needed.

The new stripper has two operating configurations, with and without the rectified methanol system operating. The rectified methanol system will separate methanol from the new stripper's offgases. The rectified methanol is referred to as SRL. As stated previously, the new steam stripper is expected to be online at least 90% of the annual operating time. The rectified methanol system is expected to be online 95% of the time that the new stripper is operating. A summary of the different operating control configurations for when the new stripper is operating is summarized in Table 3-2 below.

Table 3-1 Stripper Operating Scenarios

Stripper Operating Scenario	Operating Time	
	%	hrs
New Stripper Online	90%	7,884.0
Backup Stripper Online	4.75%	416.0
No Stripper Online	5.25%	460.0

Table 3-2 New Stripper System Operating Scenarios

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time	
	%	hrs		%	hrs		%	hrs
New Stripper Online	90%	7,884.0	SRL Online	95%	7,489.8	SRL Methanol to RF2/3	100.0%	7,489.8
			SRL Online	95%	7,489.8	SRL LVHC to RF3	75.0%	5,617.4
			SRL Online	95%	7,489.8	SRL LVHC to CB1/CB2	25.0%	1,872.5
			SRL Offline	5%	394.2	SOG to CB1/CB2	100.0%	394.2

The SRL is expected to contain approximately 40% of the TRS, with the remaining 60% in the LVHC off-gases from the rectified methanol system. The SRL will be blended with black liquor and burned in both recovery furnaces at a maximum concentration of 2%. The sodium fume inside the recovery furnace absorbs the sulfur from combustion of the black liquor and will also absorb the sulfur from combustion of the SRL. We conservatively assumed 99% absorption within the salt fume based on information provided in NCASI Technical Bulletin No. 604. This is expected to occur 100% of the time the rectified methanol system is operating (SRL mode).

When operating in SRL mode, the LVHC off-gases from the rectified methanol system will be vented into the LVHC System. In addition, the LVHC gases from the evaporators and turpentine recovery system will be vented to the No. 3 Recovery Furnace as part of this project. The No. 3 Recovery Furnace is expected to be available for LVHC combustion at least 75% of the operating time. When the No. 3 Recovery Furnace cannot receive these gases, the LVHC will be combusted in the combination boilers the remaining 25% of the time. The LVHC gases will pass through the LVHC caustic scrubber prior to being combusted in the combination boilers. The LVHC scrubber removes approximately 50% of the sulfur from the gas stream. The LVHC gas scrubber is not necessary and will not be used when the LVHC gases are being combusted in the No. 3 Recovery Furnace because the salt fume in the recovery furnace provides the expected sulfur control.

Sulfur Dioxide, Hydrogen Sulfide, and Total Reduced Sulfur Compounds

As previously stated, the SRL is expected to contain approximately 40% of the TRS as sulfur foul condensate loading of 0.70 lb S/ADTP. The sodium fume inside the recovery furnace absorbs the sulfur produced from combusting black liquor and will also absorb the sulfur produced by combusting the foul condensate present in the methanol. It is conservatively assumed that 99% of the sulfur from combusting the SRL is absorbed by the sodium fume (NCASI Technical Bulletin 604), and the remaining 1% is oxidized to SO_2. This is expected to occur 100% of the time in SRL mode.

To calculate TRS and H_2S emissions from burning the SRL in the recovery furnaces, a sulfur capture of 99% is applied with a 99% conversion factor to SO_2, for a combined capture and conversion factor of 99.9%.

Similarly, the LVHC gases from the rectified methanol system are expected to contain approximately 60% of the TRS as sulfur foul condensate loading of 0.70 lb S/ADTP and will be vented into the LVHC System. When the LVHC is combusted in the No. 3 Recovery Furnace, the sodium fume inside the recovery furnace is also expected to absorb 99% of the sulfur from the

LVHC gases before it can be converted to SO_2. When the LVHC is combusted in the combination boilers, the LVHC scrubber will capture 50% of the sulfur before conversion to SO_2. H_2S and TRS emissions from the rectified methanol system LVHC are calculated based on conservatively assuming 99.9% capture or conversion to SO_2 in the recovery furnace and 99% conversion to SO_2 in the combination boilers.

When the rectified methanol system is not operating, SOG from the new stripper will be vented to the combination boilers, and the TRS as sulfur foul condensate loading of 0.70 lb S/ADTP is assumed to be 100% converted to SO_2 to calculate SO_2 emissions. H_2S and TRS emissions from combusting SOGs in the combination boilers are based on conservatively assuming a 99% conversion to SO_2.

When the new stripper is operating, regardless of SRL status, there will be no foul or stripped condensate flow to the Hardpipe. Projected emissions of TRS compounds (excluding H_2S) from the ASB are calculated based on the WATER9 Model. Projected emissions of H_2S from the ASB are calculated based on the H2SSIM Model. Both WATER9 and H2SSIM emissions calculations are based on the average ASB influent concentrations from data collected during the 2021 and 2022 TRS testing efforts.

Nitrogen Oxides

When the rectified methanol system is operating, the methanol condenser is expected to condense more than 90% of the methanol in the SOG. The SOG also contains ammonia, which is also expected to be condensed with the methanol. The remaining ammonia will be vented with the SRL off-gases into the LVHC system. As a result, there will be an increase in ammonia when (1) SRL is mixed with liquor and burned in the recovery furnaces and (2) the SRL LVHC off-gases are combusted in the No. 3 Recovery Furnace.

The ammonia in the methanol is expected to contribute less than 2% of the total nitrogen in the black liquor. The NO_X emissions from the recovery furnaces have been conservatively assumed to increase 2% when burning SRL and the SRL LVHC.

The NO_X emissions from combustion of the SRL LVHC and SOG in the combination boilers are based on the post-Project Columbia NO_X emissions factors presented in Appendix C – Tab A of the July 2019 and April 2020 permit applications approved by SCDHEC in Construction Permit DF.

Carbon Monoxide

In SRL mode, the SRL will be blended with the black liquor and burned in both recovery furnaces at a maximum concentration of 2%. There is no information to suggest the CO emissions will change when the SRL is burned in the recovery furnaces.

The CO emissions from combustion of the SRL LVHC and SOG are based on the post-Project Columbia CO emissions factors presented in Appendix C – Tab A of the July 2019 and April 2020 permit applications approved by SCDHEC in Construction Permit DF.

Volatile Organic Compounds

The projected actual VOC emissions for the new steam stripper system are based on the theoretical maximum methanol collection (16 lb/ODTP) at the maximum pulp production (2,700 ADTP/day).

In SRL mode, the SRL will be blended with the black liquor and burned in both recovery furnaces at a maximum concentration of 2%. The SRL will be combusted in the recovery furnace to an expected 99.9% VOC destruction in the liquid phase.

When the new stripper is operating, there will be no foul or stripped condensate flow to the Hardpipe. Non-methanol VOC emissions (acetaldehyde, methyl ethyl ketone, propionaldehyde, and TRS VOCs) from the ASB are calculated based on WATER9, using the average ASB influent concentrations from data collected during 2021 and 2022 TRS and NESHAP Subpart S testing efforts. Methanol emissions from the ASB are based on the NCASI Form XIII calculation spreadsheet using the average ASB influent and effluent methanol concentrations from all data collected during 2021 and 2022 and the average zone treatment profiles from 2021 and 2022 NESHAP Subpart S performance tests.

Backup Stripper Online Scenario

As stated previously, once the new stripper is installed, the existing stripper will be demoted to the backup steam stripper role. For the purposes of calculating projected actual emissions (PAE), the backup steam stripper is projected to be online a minimum of 4.75% of the annual operating time. The backup steam stripper will be operated in “TRS mode” to remove TRS from the foul condensate. In TRS mode, the backup stripper will also remove approximately 45% of the methanol from the foul condensate. The SOG from the backup steam stripper will be vented to the combination boilers. The stripped condensate from the backup steam stripper will be discharged to the Hardpipe where the remaining unstripped methanol will be biologically treated in the ASB.

After the original submittal of this application and further discussions with SCDHEC, an alternate operating scenario for the backup stripper operating in “methanol mode” was established in addition to the “TRS mode” operation described above. Upon completion of the Project, the Mill can operate the existing stripper in either “TRS mode” or “methanol mode” during the periods the backup stripper is projected to operate. The calculations provided in Appendix B of this application include the emissions rates of each pollutant for both the TRS mode and methanol mode backup stripper operating scenarios. For each pollutant, the worst-case backup stripper operating mode was used to determine PSD applicability. For simplicity, this section will only discuss the TRS mode emissions calculations, consistent with the original submittal. Appendix D to this application provides a detailed description of the backup stripper operating in “methanol mode” as well as the supporting calculation documentation provided to SCDHEC after submittal of the original application.

Sulfur Dioxide

The backup steam stripper will be operated in “TRS mode” to remove TRS from the foul condensate. SO_2 emissions from combustion of the backup stripper SOG in the combination boilers are conservatively calculated assuming all of the 0.70 lb S/ADTP of sulfur present in the foul condensate will be captured in the SOG and converted to SO_2 during combustion.

Nitrogen Oxides and Carbon Monoxide

The NO_X and CO emissions from combustion of SOG are based on the post-Project Columbia NO_X emissions factors presented in Appendix C – Tab A of the July 2019 and April 2020 permit applications approved by SCDHEC in Construction Permit DF.

Volatile Organic Compounds

The projected actual VOC emissions for the backup stripper are based on the maximum expected methanol collection (16 lb/ODTP) at the maximum pulp production (2,700 ADTP/day). To calculate VOC emissions from backup stripper SOG combustion, it is conservatively assumed that the methanol present in the foul condensate will be captured with the SOG and combusted with 98% control at the combination boilers.

Methanol emissions from the ASB are based on the NCASI Form XIII calculation spreadsheet using the average ASB influent and effluent methanol concentrations from all data collected during 2021 and 2022 and the average zone treatment profiles from 2021 and 2022 NESHAP Subpart S performance tests. The methanol concentration in the stripped condensate from the backup stripper is based on the theoretical maximum methanol collection (16 lb/ODTP) in the foul condensate and an expected 45% removal efficiency from the backup stripper operating in "TRS mode."

Acetaldehyde, methyl ethyl ketone, and propionaldehyde are assumed to be emitted at the same ratio to methanol as compared to the baseline. Emissions of TRS compounds that are also VOC are calculated using WATER9 with the design foul condensate loadings of TRS compounds being reduced by 98% in the backup stripper operating in "TRS mode" before entering the ASB.

Hydrogen Sulfide and Total Reduced Sulfur Compounds

To calculate TRS and H_2S emissions from backup stripper SOG combustion, it is conservatively assumed that the design foul condensate sulfur loading will be captured with the SOG and only 99% will be converted to SO_2 at the combination boilers.

Projected emissions of TRS compounds (excluding H_2S) from the ASB are based on WATER9. Projected emissions of H_2S from the ASB are calculated based on H2SSIM. Both WATER9 and H2SSIM emissions are based on the average ASB influent concentrations from data collected during 2021 and 2022 TRS testing and the design foul condensate sulfur loadings of TRS compounds being reduced by 98% in the backup stripper operating in "TRS mode."

No Stripper Online Scenario

The post-Project emissions also account for brief periods when the new stripper may need to go offline and the backup stripper brought into service. During these transition periods, untreated foul condensate will be discharged through the Hardpipe to the ASB. While in the Hardpipe prior to entering the ASB, the TRS compounds will be chemically oxidized to reduce the potential for odors from the ASB when operating during these transition periods, which are required by Item I.a of Appendix A of the November 16, 2022 EPA Consent Decree to be less than 460 hours (5.25%) of annual operating time.

When there is no SOG being created by either stripper, there are no emissions of SO_2, NOx, or CO corresponding to the periods when all foul condensate is treated in the ASB.

Volatile Organic Compounds, Hydrogen Sulfide, and Total Reduced Sulfur Compounds

Methanol emissions from the ASB are based on NCASI Form XIII calculation spreadsheet using the average ASB influent and effluent methanol concentrations from all data collected during 2021 and 2022 and the average zone treatment profiles from 2021 and 2022 NESHAP Subpart S performance tests. The methanol concentration in the foul condensate is based on the maximum methanol collection (16 lb/ODTP).

Acetaldehyde, methyl ethyl ketone, and propionaldehyde are assumed to be emitted at the same ratio to methanol as compared to the baseline.

Emissions of TRS compounds are calculated using WATER9 and H2SSIM (H_2S) with the design foul condensate sulfur loadings of TRS compounds being adjusted based on NCASI Technical Bulletin No. 949 to account for the effects of the chemical oxidant, consistent with how baseline actual emissions are calculated.

- H_2S concentrations in the Hardpipe were reduced by 99%.
- DMS concentrations in the Hardpipe were reduced by 90%.
- MMC concentrations in the Hardpipe were reduced by 99% and assumed to be converted to DMDS.
- DMDS concentrations are assumed not reduced by chemical oxidant. DMDS concentrations of the Hardpipe were increased to account for the MMC oxidized into DMDS.

PAE and PTE Independent from Stripper Operating Scenario

LVHC Collection System

As stated previously, the No. 3 Recovery Furnace is expected to provide LVHC combustion at least 75% of the operating time. When the No. 3 Recovery Furnace cannot receive the LVHC gases, the LVHC gases will then be combusted in the combination boilers the remaining 25% of the time. The emissions from combusting LVHC gases are unaffected by the stripper operating scenario. PAE of SO_2, H_2S, and TRS are based on 2021 stack testing and SCDHEC approved emissions factors from Construction Permit DF. The VOC PAE from the LVHC collection system are based on the post-project Columbia VOC emissions factors presented Appendix C – Tab A of the July 2019 and April 2020 permit applications approved by SCDHEC in Construction Permit DF. The New Stripper Project does not impact the generation of HVLC gases and associated emissions (i.e., HVLC sources are not affected or modified as a result of the project); therefore, emissions associated with the combustion of HVLC gases are not included in the PAE (or BAE) emissions.

No. 3 Recovery Furnace LVHC Ignitor

The No. 3 Recovery Furnace will also have a 1 MMBtu/hr natural gas-fired LVHC ignitor to be used when the black liquor load is less than 50%. The natural gas ignitor is expected to be required no more than 15% of the time the No. 3 Recovery Furnace is in operation. PAE of products of combustion from the ignitor are based on AP-42 emissions factors.

Steam for New Stripper and Backup Stripper

The steam requirements for the new stripper and the backup stripper were provided by the vendor and adjusted for the thermal efficiency of the combination boilers firing natural gas and No. 6 fuel oil. The projected fossil fuel usage reflects the highest No. 6 fuel oil usage occurring during the previous 10 years. The highest fuel oil usage was during calendar year 2014 and accounted for 18.4% of the fossil fuel heat input. The PAE and PTE of products of combustion are based on AP-42 emissions factors.

3.2.2.3.3 PSD Non-Applicability

The changes in emissions from the Mill as a result of the Project were compared to the significant emission rates in Standard No. 7, paragraph (B)(49). Based on the emissions calculations described above, presented in Appendix B, and summarized in Table 3-3, the Project is not subject to the PSD permitting requirements in paragraphs (J) through (R) of Standard No. 7.

Table 3-3 Summary of PSD Applicability for the Project (tpy)

Pollutant[A]	PM	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	H2SO4	TRS	VOC	Pb	H_2S	CO_2
Baseline Actual Emissions	1.11	1.02	0.959	124	737	25.2	1.23	12.8	233	1.10E-04	3.61	12,275
Projected Actual Emissions	13.3	10.3	8.37	148	646	62.8	2.43	16.8	260	2.06E-03	5.59	48,200
Net Emissions Changes (PAE - BAE)	12.2	9.32	7.41	23.8	-91.2	37.6	1.20	3.95	26.8	1.95E-03	1.98	35,925
PSD Significant Emissions Rates	**25**	**15**	**10**	**40**	**40**	**100**	**7**	**10**	**40**	**0.6**	**10**	**75,000**
PSD Significant?	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**

A - HF is not emitted from new, modified, or affected emissions units.

3.2.2.4 Standard No. 7 – Prevention of Significant Deterioration – Air Dispersion Modeling Requirements

Standard No. 7 also includes PSD air quality increments that apply to all increases and decreases in PSD pollutant emissions following the PSD minor source baseline date. In York County the minor source baseline dates are December 1, 1981, for PM10 and March 3, 2017 for PM2.5. This Application does not trigger PSD review as discussed above; therefore, the project is unlikely to interfere with attainment or maintenance of State or Federal ambient air quality standards.

3.2.2.5 Standard No. 8 – Toxic Air Pollutants

SCDHEC Standard No. 8 regulates emissions of air toxics from new and existing sources. The Standard does not apply to fuel burning sources that burn only virgin fuel or specification used oil. Section I.D(1) of Standard No. 8 exempts sources subject to a Federal NESHAP. The Mill is subject to the Federal NESHAP for the pulp and paper source category (Subparts S and MM), industrial boilers (Subpart DDDDD), and reciprocating internal combustion engines (Subpart ZZZZ). Section I.D(2) of Standard No. 8 exempts non-NESHAP sources after a facility-wide residual risk analysis is completed. U.S. EPA published the results of facility-wide residual risk analyses for Subpart S sources on December 27, 2011, and for Subpart MM sources on December 30, 2017. The residual risk analyses completed by U.S. EPA concluded that there was no unacceptable risk from pulp and paper mills. Therefore, all emissions sources of HAP at New-Indy Catawba are exempt from Standard No. 8 under sections I.D(1) and/or I.D(2).

New-Indy Catawba emits two South Carolina toxic air pollutants (TAP) that are not listed HAP, H_2S and methyl mercaptan. Both compounds are generated by the Kraft pulping process and are components of TRS gases that are contained in LVHC and HVLC gases and in the pulping process condensates. Section I.D(3) allows sources to request an exemption for non-HAPs controlled by MACT controls to reduce HAP. This Project will improve emissions of H_2S and MMC from the Mill. However, because SCDHEC recently modeled emissions of H_2S and MMC and to demonstrate that emissions from these two TAPs following the Project remain below the maximum allowable ambient concentrations (MAAC) in Standard No. 8, the Mill has included an updated modeling demonstration in Appendix C.

The updated modeling analysis for TRS (as H_2S), H_2S and MMC in Appendix C focused on the changes to the emissions from the aerated stabilization basin. The TRS, H_2S and MMC emissions from the No. 3 Recovery furnace were not updated due to the insignificant maximum modeled concentrations from the No. 3 Recovery Furnace when compared to the overall maximum modeled concentrations for the Mill. The TRS (as H_2S) maximum modeled concentrations from the No. 3 Recovery Furnace were approximately 0.12% of the maximum modeled concentrations from the Mill. Similarly, the MMC concentrations were approximately 0.08% of the maximum concentrations from the Mill, and the TRS (as H_2S) maximum concentrations from the No. 3 Recovery Furnace were approximately 0.04% of the maximum mill concentrations.

3.2.3 Regulation 61-62.60: South Carolina Designated Facility Plan and New Source Performance Standard

Regulation 61-62.60 incorporates the 40 CFR Part 60 Subparts by reference. Refer to Section 3.1.1 for a discussion of 40 CFR Part 60.

3.2.4 Regulation 61-62.61 and 61-62.62: National Emission Standards for Hazardous Air Pollutants

Regulation 61-62.61 incorporates the 40 CFR Part 61 Subparts by reference. Refer to Section 3.1.2 for a discussion of the non-applicability of 40 CFR Part 61. Regulation 61-62.63 incorporates the 40 CFR Part 63 Subparts by reference. Refer to Section 3.1.2 for a discussion of applicability of 40 CFR Part 63.

3.2.5 Regulation 61-62.70 – Title V Operating Permit Program

Refer to Section 3.1.6 for discussion of the TVOP Program.

3.3 PROVISIONS OF THE SCDHEC CONSENT ORDER AND EPA CONSENT DECREE

This section addresses the provisions of the November 23, 2022 SCDHEC Consent Order and Part I of Appendix A of the November 16, 2022 EPA Consent Decree.

3.3.1 November 23, 2022 SCDHEC Consent Order

Items 4 through 6 of the Consent Order require that New-Indy Catawba:

- Install, operate, and maintain a primary stripper that is adequately sized to collect and treat all foul condensate streams in accordance with applicable state and federal air quality regulations. *The proposed new stripper will be sized at 850 gpm, which is designed to process foul condensates generated from producing the maximum pulp production of 2,700 ADTP/d, and New-Indy Catawba will operate the unit in accordance with applicable state and federal air quality regulations.*
- The primary stripper shall use low-pressure steam and must be designed for both methanol and sulfur compound removal with the off gases being treated in the recovery boilers to

absorb the sulfur compounds in the stripper off gas. The proposed new stripper will utilize 60 pounds per square inch gauge (psig) steam. *The new stripper off-gases and SRL will be incinerated in the No. 2 or 3 Recovery Furnace, with the exception of when the SRL system is unavailable (5% of the operating time of the new stripper).*

- Complete preliminary engineering and submit a construction permit application for the primary stripper within one hundred and twenty (120) days of the execution of this order. *Preliminary engineering is complete and this application is being submitted by March 23, 2023.*
- New-Indy must optimize, operate, and maintain the existing stripper at its current design capacity to allow it to be operated independently of the primary stripper. To optimize the existing stripper at its current design, it will be operated in "TRS mode" to remove 98% of the TRS and approximately 45% of the methanol from the foul condensate or in "methanol mode" (see Appendix D).
- The following required events have or will be completed in the future:
    - Order the primary stripper within 30 days of submitting the application for the air construction permit.
    - Within 30 days of receiving the air construction permit, New-Indy Catawba must start civil engineering preparation.
    - Within 30 days of receiving the primary stripper, New-Indy Catawba must start installation and testing.
    - New-Indy Catawba must complete startup operations and place the primary stripper into operation no later than June 30, 2025.
    - New-Indy shall operate its steam stripper system, comprised of the primary stripper and the existing stripper, in accordance with all applicable state and federal air quality regulations.
    - In the event the stripping system is out of service and foul condensate must be discharged to the ASB, New-Indy Catawba must use automated control of addition of a chemical oxidant, hydrogen peroxide, to treat the unstripped foul condensate prior to discharging into the ASB to maintain a rolling 90-minute average oxidation reduction potential (ORP) of the foul condensate above 0 millivolts.
    - New-Indy Catawba must notify SCDHEC at least 48 hours prior to any planned downtime and within 24 hours of unplanned downtime for which the primary stripper will not be operational (and for the existing stripper when it should be operating but will not be).

- New-Indy Catawba must submit reports to the Department regarding the implementation of the Consent Order to NewIndyOrderReports@dhec.sc.gov. For twelve consecutive months after execution of this order, the reports shall be submitted monthly on the 1st business day of the month. Thereafter, reports shall only be submitted every three months on the 1st business day of the month until the order terminates.

3.3.2 November 16, 2022 EPA Consent Decree

Item I(a) of Appendix A

Item I(a) of Appendix A of the Consent Decree contains requirements related to the uptime and monitoring of the foul condensate steam stripper at the Mill.

- New-Indy Catawba will operate their foul condensate treatment system (inclusive of the new and existing steam strippers) during all times that unbleached kraft pulp is being produced and foul condensate is being generated at the Mill.
- During periods the new steam stripper is experiencing downtime the existing steam stripper will be used.
- Periods of downtime in which both strippers are down will not exceed 576 hours for the first year and 460 hours annually thereafter.
- Peroxide will be added to the non-stripped condensate during the transition to the existing steam stripper and will continue to be added throughout the period in which the existing steam stripper is in operation as necessary to maintain a rolling 90-minute average ORP of the foul condensate above 0 millivolts.
- The Mill will notify the necessary authorities forty-eight (48) hours prior to any scheduled downtime and within twenty-four (24) hours of any unscheduled downtime and will operate both steam strippers, as applicable, for compliance with 40 CFR Part 63, Subpart S.

Item I(b) of Appendix A of the Consent Decree

Item I(b) of Appendix A of the Consent Decree covers the maintenance, operation, and calibration of the system used to treat the unstripped foul condensate by the Mill. The Mill's foul condensate treatment system (inclusive of the new equipment to be installed with this application) will be capable of continuously measuring the ORP of the foul condensate, automatically controlling the dosage of hydrogen peroxide to maintain a rolling ninety-minute average of the ORP of the foul condensate above 0 millivolts (mV) before it is discharged to the ASB, and treating the maximum amount of foul condensate produced when both steam strippers are down and when untreated foul condensate is discharged to the Hardpipe.

Item I(c) of Appendix A of the Consent Decree

Item I(c) of Appendix A of the Consent Decree contains recordkeeping requirements for data obtained by the ORP monitoring system used by the Mill. The Mill will maintain continuous records of the ORP monitoring system used by the Mill and will provide data to U.S. EPA upon request.

Item I(d) of Appendix A of the Consent Decree

Item I(d) of Appendix A of the Consent Decree includes reporting requirements for the ORP monitoring system used by the Mill. When untreated foul condensate is discharged to the Hardpipe, New-Indy Catawba will include the date, time, and value of any instance of a rolling ninety-minute average of the ORP falling below 0 mV in the Mill’s semi-annual report for the previous six months.

APPENDIX A -
PERMIT APPLICATION FORMS

SECTION 1 - FACILITY IDENTIFICATION

SC Air Permit Number (8-digits only) *(Leave blank if one has never been assigned)* 2440 - 0005	Application Date March 2023, updated April 2024

Facility Name/Legal Identity *(This should be the official legal name under which the facility is owned/operated and should be consistent with the name registered with the S.C. Secretary of State's office, as applicable.)*
New-Indy Catawba LLC

Facility Site Name (Optional) *(Please provide any alternative or additional identifier of the facility, such as a specific plant identifier (e.g., Columbia plant) or any applicable "doing business as" (DBA) identity. This name will be listed on the permit and used to identify the facility at the physical address listed below.)*

Facility Federal Tax Identification Number *(Established by the U.S. Internal Revenue Service to identify a business entity)*
83-1904423

REQUEST TYPE (Check all that apply)

Exemption Request: ☐
Complete Section 1 and attach documentation to support exemption request.

Construction Application:
☒ Minor New Source Review Project
☐ Synthetic Minor Project
☐ Prevention of Significant Deterioration Project
☐ 112(g) Project

Expedited Review Request: ☐
If checked, include Expedited Form D-2212 in the construction application package.

Construction Permit Modification: ☐
Provide the construction permit ID (e.g. CA, CB, etc.) for which modification is requested:

Application Revision: ☐

CONSTRUCTION PERMIT APPLICATION FORMS BEING REVISED
(Amended construction permit forms must be filled out completely and attached to this modification request.)

Form #	Date of Original Submittal	Brief Description of Revision
D-2566	March 2023	Updated Faciltiy Air Contact, Owner or Operator, Application Narrative and Appendix B
D-2573	March 2023	Updated Faciltiy Air Contact

FACILITY PHYSICAL ADDRESS

Physical Address: 5300 Cureton Ferry Road		County: York
City: Catawba	State: SC	Zip Code: 29704

Facility Coordinates *(Facility coordinates should be based at the front door or main entrance of the facility)*
Latitude: 34°50’37”N Longitude: 80°53’25”W

FACILITY'S PRODUCTS / SERVICES	
Primary Products / Services *(List the primary product and/or service)* Linerboard / Pulp Manufacturing	
Primary SIC Code *(Standard Industrial Classification Codes)* 2631	Primary NAICS Code *(North American Industry Classification System)* 322130
Other Products / Services *(List other products and/or services)*	
Other SIC Code(s):	Other NAICS Code(s):

PROJECT DESCRIPTION
Project Description (What, why, how, etc.): Installation of a new steam stripper system to treat foul condensate prior to being hard piped to the aeration stabilization basin. The new steam stripper will include a new stripper feed tank, new methanol tank, new hot water tank, and a new methanol rectification condenser. The rectified methanol will be burned in the recovery furnaces with the black liquor. The LVHC gases from the methanol condenser system, stripper feed tank, and methanol tank will be combusted in the No. 3 Recovery Furnace. The hot water tank is not expected to be a source of air emissions. The existing steam stripper will serve as a backup to the new steam stripper.

AIR PERMIT FACILITY CONTACT *(Person listed will be in our files as the point of contact for all air permitting related questions and will receive all air permitting notifications.)*			
Title/Position: Environmental Manager	Salutation: Ms.	First Name: Rachel	Last Name: Davis
Mailing Address: P.O. Box 7			
City: Catawba		State: SC	Zip Code: 29704
E-mail Address: rachel.davis@new-indycb.com		Primary Phone No.: (803) 981-8206	Alternate Phone No.:

The signed permit will be e-mailed to the designated Air Permit Contact. If additional individuals need copies of the permit, please provide their names and e-mail addresses.	
Name	**E-mail Address**
Steven Moore	smoore@all4inc.com

CONFIDENTIAL INFORMATION / DATA
Is confidential information or data being submitted under separate cover? ☒ No ☐ Yes*

If yes, submit **ONLY ONE COMPLETE CONFIDENTIAL APPLICATION , with original signature, along with the public version of the application.*

CO-LOCATION DETERMINATION
Are there other facilities in close proximity that could be considered collocated? ☒ No ☐ Yes*
If yes, list potential collocated facilities, including air permit numbers if applicable:

**If yes, please submit collocation applicability determination details in an attachment to this application.*

OWNER OR OPERATOR			
Title/Position: Mill Manager	Salutation: Mr.	First Name: Chris	Last Name: Loach
Mailing Address: P.O. Box 7			
City: Catawba		State: SC	Zip Code: 29704
E-mail Address: chris.loach@new-indycb.com		Primary Phone No.: 803-981-8000	Alternate Phone No.:

OWNER OR OPERATOR SIGNATURE

I certify, to the best of my knowledge and belief, that no applicable standards and/or regulations will be contravened or violated. I certify that any application form, supporting documentation, report, or compliance certification submitted in this permit application is true, accurate, and complete based on information and belief formed after reasonable inquiry. I understand that any statements and/or descriptions, which are found to be incorrect, may result in the immediate revocation of any permit issued for this application.

Chris Loach
Signature of Owner or Operator

4-29-24
Date

APPLICATION PREPARER (if other than Professional Engineer below)			
Title/Position: Senior Managing Consultant	Salutation: Mr.	First Name: Steven	Last Name: Moore
Mailing Address: 630 Davis Drive, Suite 203			
City: Durham		State: NC	Zip Code: 27560
E-mail Address: smoore@all4inc.com		Phone No.: (919) 234-5981	Cell No.: (864) 616-4711

PROFESSIONAL ENGINEER INFORMATION			
Consulting Firm Name: ALL4 LLC		SC Certificate of Authority License No.: 6409	
Title/Position: PE	Salutation: Ms.	First Name: Sheryl	Last Name: Watkins
Mailing Address: 300 Chastain Center Blvd, Suite 395			
City: Kennesaw		State: Georgia	Zip Code: 30144
E-mail Address: swatkins@all4inc.com		Phone No.: (678) 293-9428	Cell No.: (386) 503-0266
SC License/Registration No.: 34347			

PROFESSIONAL ENGINEER SIGNATURE

I have placed my signature and seal on the engineering documents submitted, signifying that I have reviewed this construction permit application as it pertains to the requirements of *South Carolina Regulation 61-62, Air Pollution Control Regulations and Standards*.

Sheryl Watkins
Signature of Professional Engineer

4-26-24
Date

SOUTH CAROLINA LICENSED PROFESSIONAL ENGINEER No. 34347 SHERYL WATKINS

EQUIPMENT / PROCESS INFORMATION					
Equipment ID/ Process ID	**Action**	**Equipment / Process Description**	**Maximum Design Capacity (Units)**	**Control Device ID(s)**	**Emission Point ID(s)**
9801	☐ Add ☐ Remove ☒ Modify ☐ Existing	Existing Steam Stripper	850 gallons/minute	9820, 2605, 3705, 2901	2610S2, 2610S1, Fugitive
9802	☐ Add ☐ Remove ☒ Modify ☐ Existing	Hardpipe	850 gallons/minute	2901	Fugitive
9803	☒ Add ☐ Remove ☐ Modify ☐ Existing	New Steam Stripper (Methanol Condenser)	6.5 gallons/minute	5260, 5260C, 2605, 3705, 5105	5105S, 2610S2, 2610S1
9803	☒ Add ☐ Remove ☐ Modify ☐ Existing	New Steam Stripper (Condensed Methanol)	6.5 gallons/minute	2505, 5105	2505S, 5105S
9803	☒ Add ☐ Remove ☐ Modify ☐ Existing	New Steam Stripper (Stripper Off Gases)	850 gallons/minute	9820, 2605, 3705	2610S2, 2610S1
9804	☒ Add ☐ Remove ☐ Modify ☐ Existing	New Steam Stripper Feed Tank	80,400 gallons	5260, 5260C, 5105, 2605, 3705	2610S2, 2610S1, 5105S
9805	☒ Add ☐ Remove ☐ Modify ☐ Existing	New Steam Stripper Rectified Liquid Methanol Tank	1,300 gallons	5260, 5260C, 5105, 2605, 3705	2610S2, 2610S1, 5105S

This form is subject to Retention Schedule 16303.

CONTROL DEVICE INFORMATION								
Control Device ID	Action	Control Device Description	Maximum Design Capacity (Units)	Inherent/ Required/ Voluntary	Pollutants Controlled (Include CAS #)	Capture Efficiency	Destruction/ Removal Efficiency	Emission Point ID(s)
2505	☐ Add ☐ Remove ☐ Modify ☒ Existing	No. 2 Recovery Furnace	412,140 tons BLS/year	Required	See Appendix B/Narrative			2505S
2605	☐ Add ☐ Remove ☐ Modify ☒ Existing	No. 1 Combination Boiler	405 MMBtu/hr	Required	See Appendix B/Narrative			2610S2
2901	☐ Add ☐ Remove ☐ Modify ☒ Existing	Aerated Biotreatment (Aerated Stabilization Basin)	N/A	Required	See Appendix B/Narrative			Fugitive
3705	☐ Add ☐ Remove ☐ Modify ☒ Existing	No. 2 Combination Boiler	720 MMBtu/hr	Required	See Appendix B/Narrative			2610S1
5105	☐ Add ☐ Remove ☐ Modify ☒ Existing	No. 3 Recovery Furnace	744,600 tons BLS/year	Required	See Appendix B/Narrative			5105S
9820	☐ Add ☐ Remove ☒ Modify ☐ Existing	Stripper Off Gases Collection System	2,700 ADTP/day	Required	See Appendix B/Narrative			2610S1, 2610S2
5260	☐ Add ☐ Remove ☒ Modify ☐ Existing	LVHC Collection System	2,700 ADTP/day	Required	See Appendix B/Narrative			2610S1, 2610S2, 5105S
5260C	☐ Add ☐ Remove ☐ Modify ☒ Existing	LVHC Collection System Caustic Scrubber	2,700 ADTP/day	Required	See Appendix B/Narrative			2610S1, 2610S2, 5105S

This form is subject to Retention Schedule 16303.

Check Box for information addressed	Required Information
Source identification and emissions:	
☒	• Name of each source, process, and control device.
☒	• Assign each source an Equipment ID. The IDs must match the IDs listed in Section 2 of this application.
☒	• Assign an Emission Point ID for each source.
☒	• Assign a Control Device ID for each control device.
☒	• List each pollutant the source will emit.
☒	• List the Uncontrolled, Controlled, and PTE emissions for each source or equipment in lb/hr and tons/year.
☒	• Emission rates for each pollutant should be totaled and listed in lb/hr and tons/year.
☒	• Provide the CAS# for each Hazardous Air Pollutant (HAP) and/or Toxic Air Pollutant (TAP).
Information to support emission rates:	
☒	• Sample calculations.
☒	• Emission factors. Include the source, revision date, specific table and/or chapters. Include source test data if factors were derived from source testing.
☒	• Explanation of assumptions, bottlenecks, etc.
☐	• Source test information: A copy of the source test results may be requested. If the test results are not included in the application, the application should cite whether this was a DHEC approved test, and if not, explain where the test was conducted and other identifying information.
☐	• Manufacturer’s data.
☐	• Vendor guarantees that support control device efficiencies.
☒	• New Source Review (NSR) analysis.
☒	• Other (e.g. example particle size analysis)

Existing (Permitted) Facilities		
Check Box	**Required Information**	**Location in Application**
☒	Facility-wide emissions prior to construction/modification: • Include an explanation if these emissions do not match the facility-wide emissions submitted in the last application.	Appendix B
☒	Facility-wide emissions after construction/modification: • Include net change, if applicable.	Appendix B
As applicable for the construction/ modification:		
☒	• Name of each source.	See Equipment/Process Information Above

Existing (Permitted) Facilities		
Check Box	**Required Information**	**Location in Application**
☒	• Assign each source an Equipment ID. The IDs must match the IDs listed in Section 2 of this application or on your current construction / operating permit.	See Equipment/Process Information Above
☒	• Assign a Control Device ID for each control device.	See Equipment/Process Information Above
☒	• Assign an Emission Point ID for each source.	See Equipment/Process Information Above
☒	• List each pollutant the source will emit.	Appendix B
☒	• List the Uncontrolled, Controlled, and PTE (if applicable) emissions for each source or equipment.	Appendix B
☒	• Emission rates for each pollutant should be totaled and listed in lb/hr and tons/year.	Appendix B
☒	• Provide the CAS# for each HAP and/or TAP.	Appendix B
Information to support facility-wide emission rates:		
☒	• Sample calculations.	Appendix B
☒	• Emission factors. Include the source, revision date, specific table and/or chapters. Include source test data if factors were derived from source testing.	Narrative, Appendix B
☒	• Explanation of assumptions, bottlenecks, etc.	Narrative
☒	• Source test information: A copy of source the test results may be requested. If the results are not included in the application, the application should cite whether this was a DHEC approved test and if not, explain where the test was conducted and other identifying information.	Appendix B
☐	• Manufacturer's data.	
☐	• Vendor guarantees that support control device efficiencies.	
☒	• NSR analysis.	Narrative
☒	• Other (please explain)	Appendix B

Check Box	State and Federal Air Pollution Control Regulations and Standards
☒	S.C. Regulation 61-62.1 Section II.E Synthetic Minor Construction Permits
☒	S.C. Regulation 61-62.5 Air Pollution Control Standards
☐	• Standard No. 1 Emissions from Fuel Combustion
☒	• Standard No. 2 Ambient Air Quality
☒	• Standard No. 3 Waste Combustion and Reduction (state only)
☒	• Standard No. 4 Emissions from Process Industries *(Note: If Section VIII of this Standard applies, include the process weight rate (PWR) in ton per hour for each applicable source or process.)*
☐	• Standard No. 5 Volatile Organic Compounds
☐	• Standard No. 5.2 Nitrogen Oxides Lowest Achievable Emission Rate
☒	• Standard No. 7 Prevention of Significant Deterioration (PSD)
☐	• Standard No. 7.1 Nonattainment New Source Review (NSR)
☒	• Standard No. 8 Toxic Air Pollutants (TAPs) (state only)
☐	S.C. Regulation 61-62.6 Control of Fugitive Particulate Matter
☒	S.C. Regulation 61-62.60 and 40 CFR Part 60 New Source Performance Standards (NSPS)
☒	S.C. Regulation 61-62.61 and 40 CFR Part 61 National Emission Standards for Hazardous Air Pollutants (NESHAP)
☒	S.C. Regulation 61-62.63 and 40 CFR Part 63 National Emission Standards for Hazardous Air Pollutants (NESHAP) for Source Categories
☒	40 CFR Part 64 Compliance Assurance Monitoring (CAM)
☐	S.C. Regulation 61-62.68 and 40 CFR Part 68 Chemical Accident Prevention Provisions
☒	S.C. Regulation 61-62.70 and 40 CFR Part 70 Title V Operating Program
☐	Other S.C. Air Pollution Control Regulations, as applicable.
☐	Other Federal Air Pollution Control Regulations, as applicable.
☐	40 CFR 98 Green House Gas (GHG) emissions *(Note: Quantify GHG emissions, if S.C. Regulation 61-62.5, Standard No. 7 or S.C. Regulation 61-62.5, Standard No. 7.1 is triggered.)*

Check Box	Completeness Checklist:
Applicability Determination:	
☒	• Is this regulation *applicable, reasonably applicable, potentially applicable,* or *not applicable?*
☒	• Is the basis for the applicability determination explained?
Affected Sources:	
☒	• Is the name and identification of each emission source or process included?
Compliance Demonstration:	
☒	• How will compliance be demonstrated?
☒	• Are specific methods or activities to be utilized by the facility to demonstrate compliance with each specific limitation and/or requirement provided?
☒	• Are control devices and control device requirements included?
☒	• Are monitoring, recordkeeping, and reporting requirements necessary to demonstrate compliance included?
Regulatory Citations:	
☒	• Are the regulatory citations identified?

A. APPLICATION IDENTIFICATION	
1. Facility Name: New-Indy Catawba LLC	
2. SC Air Permit Number (if known; 8-digits only): 2440 - 0005	3. Application Date: March 2023, updated April 2024
4. Project Description: New Condensate Stripper Permit Application	
5. Are other facilities collocated for air compliance? ☐ Yes ☒ No	6. If Yes, provide permit numbers of collocated facilities:

B. AIR CONTACT			
Consulting Firm Name (if applicable):			
Title/Position: Environmental Manager	Salutation: Ms.	First Name: Rachel	Last Name: Davis
Mailing Address: P.O. Box 7			
City: Catawba		State: SC	Zip Code: 29704
E-mail Address: rachel.davis@new-indycb.com		Phone No.: (803) 981-8206	Cell No.:

C. EMISSION POINT DISPERSION PARAMETERS

- Source data requirements are based on the appropriate source classification.
- Each emission point is classified as a point, flare, area, area circular, area polygon, volume, open pit, line, or buoyant line source.
- Contact the Bureau of Air Quality for clarification of data requirements.
- Include sources on a scaled site map. Also, a picture of area or volume sources would be helpful but is not required.
- A user generated document or spreadsheet may be substituted in lieu of this form provided all of the required emission point parameters are submitted in the same order, units, etc. as presented in these tables.

Abbreviations / Units of Measure:

- AGL = Above Ground Level
- BTU/hr = British Thermal Unit per hour
- º = Degrees
- ºF = Degrees Fahrenheit
- ft = feet
- ft/s = feet per second
- K = Kelvin
- m = meters
- UTM = Universal Transverse Mercator

Bureau of Air Quality
Emission Point Information

Reminder: For all Emission Points, list the unique Emission Point ID for that source. Use the same emission point ID as shown in the current permit and provided in the last modeling submittal (as applicable). If the emission point ID has been changed from what was previously submitted, please list the current emission point ID with the old emission point ID in parenthesis

D. POINT SOURCE													
Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height AGL (ft)	Exit Temp. (ºF)	Exit Velocity (ft/s)	Inside Diameter (ft)	Discharge Orienta-tion	Rain Cap? (Y/N)	Distance To Nearest Property Boundary (ft)	Building		
		Easting (m)	Northing (m)								Height (ft)	Length (ft)	Width (ft)
2610S1	No. 2 Combination Boiler Stack	510039.32	3855689.18	228	364	47.2	10.0	Vert.	N	3,937	N/A	N/A	N/A
2610S2	No. 1 Combination Boiler Stack	510020.32	3855678.18	228	405	62.3	10.0	Vert.	N	3,937	N/A	N/A	N/A
2505S	No. 2 Recovery Furnace	510095.85	3855743.58	195	365	99.1	7.0	Vert.	N	3,953	N/A	N/A	N/A
5105S	No. 3 Recovery Furnace	510032.37	3855802.28	225	342	61.7	10.5	Vert.	N	4,134	N/A	N/A	N/A

E. FLARE SOURCE													
Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height AGL (ft)	Heat Release Rate (BTU/hr)	Exit Velocity (ft/s)	Exit Temp. (ºF)	Heat Loss Fraction	Distance To Nearest Property Boundary (ft)	Building		
		Easting (m)	Northing (m)							Height (ft)	Length (ft)	Width (ft)

F. AREA SOURCE										
Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height AGL (ft)	Easterly Length (ft)	Northerly Length (ft)	Angle From North (º)	Initial Vertical Dimension σ_z (ft)	Distance To Nearest Property Boundary (ft)
		Easting (m)	Northing (m)						

G. AREA CIRCULAR SOURCE								
Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height AGL (ft)	Radius of Area (ft)	Number of Vertices	Initial Vertical Dimension σ_z (ft)	Distance To Nearest Property Boundary (ft)
		Easting (m)	Northing (m)					

H. AREA POLYGON SOURCE								
Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height AGL (ft)	Initial Vertical Dimension (ft)	Number of Vertices	Area (ft^2)	Distance To Nearest Property Boundary (ft)
		Easting-1 (m)	Northing-1 (m)					
Fugitive	Aerated Stabilization Basin (Zone 1)	510803.40	3856319.69	20	0	15	547,769	1,969
Fugitive	Aerated Stabilization Basin (Zone 2)	510964.42	3856054.20	20	0	18	733,653	1,510
Fugitive	Aerated Stabilization Basin (Zone 3)	511052.13	3855887.21	20	0	10	783,500	1,180

I. VOLUME SOURCE									
Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height AGL (ft)	Physical Horizontal Dimension (ft)	Initial Horizontal Dimension σ_y (ft)	Physical Vertical Dimension (ft)	Initial Vertical Dimension σ_z (ft)	Distance To Nearest Property Boundary (ft)
		Easting (m)	Northing (m)						

J. OPEN PIT SOURCE								
Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height AGL (ft)	Easterly Length (ft)	Northerly Length (ft)	Pit Volume (ft^3)	Angle From North (º)
		Easting (m)	Northing (m)					

K. LINE SOURCE									
Emission Point ID	Description/Name	UTM Coordinates (NAD83)				Release Height AGL (ft)	Line Length (ft)	Line Width (ft)	Initial Vertical Dimension σ_z (ft)
		Start Easting (m)	Start Northing (m)	End Easting (m)	End Northing (m)				

L. BUOYANT LINE SOURCE (must complete Line Source and Buoyant Line Source tables)							
Emission Point ID	Description/Name	Average Building Length (ft)	Average Building Height (ft)	Average Building Width (ft)	Average Line Source Width (ft)	Average Building Separation (ft)	Average Buoyancy Parameter (m^4/s^3)

M. EMISSION RATES						
Emission Point ID	Pollutant Name	CAS #	Emission Rate (lb/hr)	Same as Permitted? (1)	Controlled or Uncontrolled	Averaging Period
2610S2, 2610S1	Refer to Appendix B					
2505S						
5105S						
Fugitive						

(1) Any difference between the rates used for permitting and the air compliance demonstration must be explained in the application report.

APPENDIX B -
EMISSIONS CALCULATIONS

NEW-INDY CATAWBA MILL STRIPPER PROJECT

Stripper Operating Scenario	Operating Time %	Operating Time hrs
New Stripper Online	90%	7,884.0
Backup Stripper Online	4.75%	416.0
No Stripper Online	5.25%	460.0

LVHC Control Operating Scenario	Operating Time %	Operating Time hrs
RF3 Available for LVHC	75%	6,570.0
LVHC to CB1/CB2	25%	2,190.0

Summary of PSD Applicability
(tons/year)

Pollutant[A]	PM	PM_{10}	$PM_{2.5}$	NO_X	SO_2	CO	H2SO4	TRS	VOC	Pb	H_2S	CO_2
Baseline Actual Emissions	1.11	1.02	0.959	124	737	25.2	1.23	12.8	233	1.10E-04	3.61	12,275
Projected Actual Emissions	13.3	10.3	8.37	148	646	62.8	2.43	16.8	260	2.06E-03	5.59	48,200
Net Emissions Changes (PAE - BAE)	12.2	9.32	7.41	23.8	-91.2	37.6	1.20	3.95	26.8	1.95E-03	1.98	35,925
PSD Significant Emissions Rates	**25**	**15**	**10**	**40**	**40**	**100**	**7**	**10**	**40**	**0.6**	**10**	**75,000**
PSD Significant?	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**

A - HF is not emitted from new, modified, or affected emissions units.

SO2 EMISSIONS REFERENCES

	Stripper Scenario Operating Time			Operating Configuration Time			Controls Operating Time		Production Rate		SO2 Emissions Factor		Sulfur Capture[C]	SO2 Emissions	
Stripper Operating Scenario	%	hrs	**Operating Configuration**	%	hrs	**Controls**	%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100%	8,004.0	SOG to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	1.06	October 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	60.4	241.8
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	1.97	October 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	112.0	490.6
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B,E]	97.9%	7,835.7	NA	100.0%	7,835.7	26.0	mmBtu/hr	6.00E-04	AP-42 Table 1.4-2.	NA	0.02	0.1
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B,E]	2.1%	168.3	NA	100.0%	168.3	24.8	mmBtu/hr	2.20E+00	AP-42 Table 1.3-1. 2.1% Sulfur Content.	NA	54.6	4.6
SO2 BASELINE ACTUAL EMISSIONS (BAE)															**737.0**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90.0%	7,884.0	SRL Online	95%	7,489.8	SRL Methanol to RF2/3[G]	100.0%	7,489.8	2,700	ADTP/day	0.56	Vendor / Preliminary Design Information	99%	0.6	2.4
New Stripper Online	90.0%	7,884.0	SRL Online	95%	7,489.8	SRL LVHC to RF3[G]	75.0%	5,617.4	2,700	ADTP/day	0.84	Vendor / Preliminary Design Information	99%	0.9	2.7
New Stripper Online	90.0%	7,884.0	SRL Online	95%	7,489.8	SRL LVHC to CB1/CB2[G]	25.0%	1,872.5	2,700	ADTP/day	0.84	Vendor / Preliminary Design Information	50%	47.2	44.2
New Stripper Online	90.0%	7,884.0	SRL Offline	5%	394.2	SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	1.40	Vendor / Preliminary Design Information	0%	157.4	31.0
Backup Stripper Online [H]	4.75%	416.0	NA	100%	416.0	SOG to CB1/CB2	100.0%	416.0	2,700	ADTP/day	1.40	Vendor / Preliminary Design Information	0%	157.4	32.7
No Stripper Online	5.25%	460.0	Foul Condensate to Hard Pipe	100%	460.0	Hydrogen Peroxide Addition	100.0%	460.0	NA	NA	NA	NA	NA	NA	NA
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	5.87	Project Columbia Projected Emissions Factor[H], Combination Boilers No. 1 and No. 2 maximum. Pre-control emissions based on LVHC scrubber efficiency (50%) and estimated bark ash sulfur capture (20%) from 2012 stack test.	99%	6.6	21.7
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	5.87	Project Columbia Projected Emissions Factor[H], Combination Boilers No. 1 and No. 2 maximum. Pre-control emissions based on LVHC scrubber efficiency (50%) and estimated bark ash sulfur capture (20%) from 2012 stack test.	50%	330.3	361.7
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5	NA	100.0%	985.5	1.0	mmBtu/hr	6.00E-04	AP-42 Table 1.4-2.	NA	0.00	0.0
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D,F]	81.6%	6,433.3	NA	100.0%	6,433.3	96.8	mmBtu/hr	6.00E-04	AP-42 Table 1.4-2.	NA	0.06	0.2
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D,F]	18.4%	1,450.7	NA	100.0%	1,450.7	92.2	mmBtu/hr	2.20E+00	AP-42 Table 1.3-1. 2.1% Sulfur Content.	NA	202.9	147.2
Backup Stripper Steam - Natural Gas [J]	4.75%	416.0	Natural Gas[D,F]	81.6%	339.5	NA	100.0%	339.5	26.0	mmBtu/hr	6.00E-04	AP-42 Table 1.4-2.	NA	0.02	0.003
Backup Stripper Steam - No. 6 Oil [J]	4.75%	416.0	No. 6 Oil[D,F]	18.4%	76.5	NA	100.0%	76.5	24.8	mmBtu/hr	2.20E+00	AP-42 Table 1.3-1. 2.1% Sulfur Content.	NA	54.6	2.1
SO2 PROJECTED ACTUAL EMISSIONS (PAE)															**645.80**
NET EMISSIONS CHANGE (PAE - BAE)															
NET EMISSIONS CHANGE (PAE - BAE)															**-91.21**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boiliers No. 1 and No. 2 during baseline.

C - Sulfur capture in recovery furnace >99, sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - The Backup Stripper operating in Methanol Mode would potentially strip less sulfur, but SOG emissions are conservatively based upon all of the sulfur being captured in the SOG.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

J - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

H - Project Columbia SO2 emissions factor from NCG Combustion applied to October 2021 stack test SO2 emissions distribution between LVHC, HVLC, and SOG.

H2SO4 EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		**Operating Configuration**	Operating Configuration Time		**Controls**	Controls Operating Time		Production Rate		H2SO4 Emissions Factor		Sulfur Capture	H2SO4 Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/ADTP	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	4.93E-03	NCASI Technical Bulletin 858, Table 10	NA	0.3	1.2
H2SO4 BASELINE ACTUAL EMISSIONS (BAE)															**1.2**
PROJECTED ACTUAL EMISSIONS															
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	4.93E-03	NCASI Technical Bulletin 858, Table 10	NA	0.55	1.82
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	4.93E-03	NCASI Technical Bulletin 858, Table 10	NA	0.55	0.61
H2SO4 PROJECTED ACTUAL EMISSIONS (PAE)															**2.43**
NET EMISSIONS CHANGE (PAE - BAE)															
NET EMISSIONS CHANGE (PAE - BAE)															**1.20**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boiliers No. 1 and No. 2 during baseline.

C - Sulfur capture in recovery furnace >99, sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

NOX EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		NOX Emissions Factor		Ammonia Increase[C]	NOX Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	SOG to CB1/CB2	100%	8,004.0	1,365	ADTP/day	0.415	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	23.6	94.5
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B,E]	97.9%	7,835.7	NA	100%	7,835.7	26.0	mmBtu/hr	2.80E-01	AP-42 Table 1.4-2.	NA	7.3	28.6
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B,E]	2.1%	168.3	NA	100%	168.3	24.8	mmBtu/hr	3.13E-01	AP-42 Table 1.3-1.	NA	7.8	0.7
NOX BASELINE ACTUAL EMISSIONS															**123.72**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3[G]	100%	7,489.8	2,852	TBLS/day	1.500	NCASI Technical Bulletin 884, Table 4.12.	2.0%	3.6	13.4
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3[G]	75%	5,617.4	316.9	TBLS/day	1.500	NCASI Technical Bulletin 884, Table 4.12.	2.0%	0.4	1.1
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2[G]	25%	1,872.5	270.0	ADTP/day	0.415	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	4.7	4.4
New Stripper Online	90%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100%	394.2	2,700	ADTP/day	0.415	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	46.7	9.2
Backup Stripper Online [H]	4.75%	416.0	NA	100.0%	416.0	SOG to CB1/CB2	100%	416.0	2,700	ADTP/day	0.415	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	46.7	9.7
No Stripper Online	5.25%	460.0	Foul Condensate to Hard Pipe	100.0%	460.0	Hydrogen Peroxide Addition	100%	460.0	NA	NA	NA	NA	NA	NA	NA
Recovery Furnace #3 LVHC Ignitor	75%	6,570.0	Natural Gas[I]	15.0%	985.5	NA	100%	985.5	1.0	mmBtu/hr	2.80E-01	AP-42 Table 1.4-2.	NA	0.3	0.1
New Stripper Steam - Natural Gas	90%	7,884.0	Natural Gas[D,F]	81.6%	6,433.3	NA	100%	6,433.3	96.8	mmBtu/hr	2.80E-01	AP-42 Table 1.4-2.	NA	27.1	87.2
New Stripper Steam - No. 6 Oil	90%	7,884.0	No. 6 Oil[D,F]	18.4%	1,450.7	NA	100%	1,450.7	92.2	mmBtu/hr	3.13E-01	AP-42 Table 1.3-1.	NA	28.9	20.9
Backup Stripper Steam - Natural Gas [J]	4.75%	416.0	Natural Gas[D]	81.6%	339.5	NA	100%	339.5	26.0	mmBtu/hr	2.80E-01	AP-42 Table 1.4-2.	NA	7.3	1.2
Backup Stripper Steam - No. 6 Oil [J]	4.75%	416.0	No. 6 Oil[D]	18.4%	76.5	NA	100%	76.5	24.8	mmBtu/hr	3.13E-01	AP-42 Table 1.3-1.	NA	7.8	0.3
NOX PROJECTED ACTUAL EMISSIONS															**147.54**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**23.82**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Ammonia input to recovery furnace increases >2% with maximum addition of SRL of 2% by volume (representative of ~1% by volume pure methanol.)

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - >90% of methanol condensed and burned in recovery furnace, < 10% of methanol vented into LVHC System.

H - No change in NO_x emissions factor between Backup Stripper TRS mode and Methanol mode.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

J - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

CO EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		CO Emissions Factor		CO Control	CO Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	SOG to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	0.0728	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	4.1	16.6
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7	NA	100.0%	7,835.7	26.0	mmBtu/hr	8.40E-02	AP-42 Table 1.4-2.	NA	2.2	8.6
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3	NA	100.0%	168.3	24.8	mmBtu/hr	3.33E-02	AP-42 Table 1.3-1.	NA	0.8	0.1
CO BASELINE ACTUAL EMISSIONS															**25.22**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3	100.0%	7,489.8	NA	NA	NA	NA	NA	NA	NA
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3	75%	5,617.4	2,700	ADTP/day	0.0728	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	8.2	23.0
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2	25%	1,872.5	2,700	ADTP/day	0.0728	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	8.2	7.7
New Stripper Online	90%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	0.0728	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	8.2	1.6
Backup Stripper Online [C]	4.75%	416.0	NA	100.0%	416.0	SOG to CB1/CB2	100.0%	416.0	2,700	ADTP/day	0.0728	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	8.2	1.7
No Stripper Online	5.25%	460.0	Foul Condensate to Hard Pipe	100.0%	460.0	Hydrogen Peroxide Addition	100.0%	460.0	NA	NA	NA	NA	NA	NA	NA
Recovery Furnace #3 LVHC Ignitor	75%	6,570.0	Natural Gas[I]	15.0%	985.5	NA	100.0%	985.5	1.0	mmBtu/hr	8.40E-02	AP-42 Table 1.4-2.	NA	0.1	0.0
New Stripper Steam - Natural Gas	90%	7,884.0	Natural Gas[D]	81.6%	6,433.3	NA	100.0%	6,433.3	96.8	mmBtu/hr	8.40E-02	AP-42 Table 1.4-2.	NA	8.1	26.2
New Stripper Steam - No. 6 Oil	90%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7	NA	100.0%	1,450.7	92.2	mmBtu/hr	3.33E-02	AP-42 Table 1.3-1.	NA	3.1	2.2
Backup Stripper Steam - Natural Gas [G]	4.75%	416.0	Natural Gas[D]	81.6%	339.5	NA	100.0%	339.5	26.0	mmBtu/hr	8.40E-02	AP-42 Table 1.4-2.	NA	2.2	0.4
Backup Stripper Steam - No. 6 Oil [G]	4.75%	416.0	No. 6 Oil[D]	18.4%	76.5	NA	100.0%	76.5	24.8	mmBtu/hr	3.33E-02	AP-42 Table 1.3-1.	NA	0.8	0.0
CO PROJECTED ACTUAL EMISSIONS															**62.81**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**37.60**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - No change in CO emissions factor between Backup Stripper TRS mode and Methanol mode.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

VOC EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		VOC Emissions Factor		Removal[C]	VOC Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	LVHC to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	4.35	Average daily methanol stripped based on daily Subpart S compliance through 2/28/2023.	98.0%	4.95	19.81
Aerated Stabilization Basin (ASB)	100.0%	8,760.0	Foul Condensate to Hard Pipe	100.0%	8,760.0	NA	100.0%	8,760.0	1,365	ADTP/day	8.51E-01	WATER9 Inputs and Outputs Provided.	NA	48.39	211.96
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	3.10E-03	July 2019 Project Columbia Application. Page C-3 for Total LVHC Emissions.	NA	0.18	0.77
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7	NA	100.0%	7,835.7	26.0	mmBtu/hr	5.50E-03	AP-42 Table 1.4-2.	NA	0.1	0.6
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3	NA	100.0%	168.3	24.8	mmBtu/hr	1.87E-03	AP-42 Table 1.3-3. NMTOC for no. 6 oil.	NA	0.0	0.0
VOC BASELINE ACTUAL EMISSIONS															**233.11**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3[G]	100%	7,489.8	2,700	ADTP/day	14.40	Vendor / Preliminary Design Information	99.9%	1.62	6.07
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3[G]	75%	5,617.4	2,700	ADTP/day	1.60	Vendor / Preliminary Design Information	98%	3.60	10.11
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2[G]	25%	1,872.5	2,700	ADTP/day	1.60	Vendor / Preliminary Design Information	98%	3.60	3.37
New Stripper Online	90%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100%	394.2	2,700	ADTP/day	16.00	Vendor / Preliminary Design Information	98%	36.00	7.10
Backup Stripper Online (TRS Mode)[H]	4.75%	416.0	NA	100.0%	416.0	SOG to CB1/CB2	100%	416.0	2,700	ADTP/day	7.20	Vendor / Preliminary Design Information	98%		
Backup Stripper Online (Methanol Mode)[H]	4.75%	416.0	NA	100.0%	416.0	SOG to CB1/CB2	100%	416.0	2,700	ADTP/day	16.00	Assume methanol mode captures all VOC in SOG	98%	36.00	7.49
ASB - New Stripper Online	90%	7,884.0	No Foul Condensate to Hard Pipe	100.0%	7,884.0	NA	100%	7,884.0	2,700	ADTP/day	0.29	WATER9 Inputs and Outputs Provided.	NA	32.85	129.50
ASB - Backup Stripper Online (TRS Mode)[J]	4.75%	416.0	TRS Stripped From Foul Condensate	100.0%	416.0	NA	100%	416.0	2,700	ADTP/day	1.43	WATER9 Inputs and Outputs Provided.	NA		
ASB - Backup Stripper Online (Methanol Mode)[J]	4.75%	416.0	500 gpm Foul Condensate to Hard Pipe	100.0%	416.0	Hydrogen Peroxide Addition	100.0%	416.0	2,700	ADTP/day	1.54	WATER9 Inputs and Outputs Provided.	NA	173.20	36.03
ASB - No Stripper Online	5.25%	460.0	Foul Condensate to Hard Pipe	100.0%	460.0	NA	100%	460.0	2,700	ADTP/day	2.20	WATER9 Inputs and Outputs Provided.	NA	247.14	56.84
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to RF3	75%	6,570.0	2,700	ADTP/day	3.10E-03	July 2019 Project Columbia Application. Page C-3 for Total LVHC Emissions.	NA	0.35	1.15
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	25%	2,190.0	2,700	ADTP/day	3.10E-03	July 2019 Project Columbia Application. Page C-3 for Total LVHC Emissions.	NA	0.35	0.38
Recovery Furnace #3 LVHC Ignitor	75%	6,570.0	Natural Gas[I]	15.0%	985.5	NA	100%	985.5	1.0	mmBtu/hr	5.50E-03	AP-42 Table 1.4-2.	NA	5.50E-03	2.71E-03
New Stripper Steam - Natural Gas	90%	7,884.0	Natural Gas[D]	81.6%	6,433.3	NA	100%	6,433.3	96.8	mmBtu/hr	5.50E-03	AP-42 Table 1.4-2.	NA	0.5	1.7
New Stripper Steam - No. 6 Oil	90%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7	NA	100%	1,450.7	92.2	mmBtu/hr	1.87E-03	AP-42 Table 1.3-3. NMTOC for no. 6 oil.	NA	0.2	0.1
Backup Stripper Steam - Natural Gas[K]	4.75%	416.0	Natural Gas[D]	81.6%	339.5	NA	100%	339.5	26.0	mmBtu/hr	5.50E-03	AP-42 Table 1.4-2.	NA	0.1	0.0
Backup Stripper Steam - No. 6 Oil[K]	4.75%	416.0	No. 6 Oil[D]	18.4%	76.5	NA	100%	76.5	24.8	mmBtu/hr	1.87E-03	AP-42 Table 1.3-3. NMTOC for no. 6 oil.	NA	0.0	0.0
VOC PROJECTED ACTUAL EMISSIONS															**259.89**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**26.79**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - VOC destruction >98% in vapor phase, 99.9% in liquid phase.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - >90% of methanol condensed and burned in recovery furnace, < 10% of methanol vented into LVHC System.

H - The Backup Stripper operating in Methanol Mode result in higher SOG emissions, since more VOC are stripped.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

J - When the Backup Stripper is operating, ASB emissions are higher if the stripper is operating in methanol mode. Both emissions factors are shown in the table, but ASB emissions are based on methanol mode operation.

K - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

TRS EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		TRS Emissions Factor		Sulfur Capture[C]	TRS Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	LVHC to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	2.88E-03	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	0.16	0.65
Aerated Stabilization Basin (ASB)	100.0%	8,760.0	NA	100.0%	8,760.0	NA	100.0%	8,760.0	1,365	ADTP/day	4.08E-02	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	2.32	10.16
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	8.01E-03	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	0.46	2.00
TRS BASELINE ACTUAL EMISSIONS															**12.81**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3[G,H]	100.0%	7,489.8	2,700	ADTP/day	0.33	Vendor / Preliminary Design Information	99.9%	0.04	0.14
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3[G,H]	75.0%	5,617.4	2,700	ADTP/day	0.49	Vendor / Preliminary Design Information	99.9%	0.05	0.15
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2[G]	25.0%	1,872.5	2,700	ADTP/day	0.49	Vendor / Preliminary Design Information	99%	0.55	0.51
New Stripper Online	90.0%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	0.81	Vendor / Preliminary Design Information	99%	0.91	0.18
Backup Stripper Online[I]	4.75%	416.0	NA	100.0%	416.0	SOG to CB1/CB2	100.0%	416.0	2,700	ADTP/day	0.81	Vendor / Preliminary Design Information	99%	0.91	0.19
ASB - New Stripper Online	90.0%	7,884.0	No Foul Condensate to Hard Pipe	100.0%	7,884.0	NA	100.0%	7,884.0	2,700	ADTP/day	2.42E-02	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	2.72	10.74
ASB - Backup Stripper Online (TRS Mode)[J]	4.75%	416.0	TRS Stripped From Foul Condensate	100.0%	416.0	NA	100.0%	416.0	2,700	ADTP/day	2.72E-02	H2SSIM/WATER9 Inputs and Outputs Provided.	NA		
ASB - Backup Stripper Online (Methanol Mode)[J]	4.75%	416.0	500 gpm Foul Condensate to Hard Pipe	100.0%	416.0	Hydrogen Peroxide Addition	100.0%	416.0	2,700	ADTP/day	5.28E-02	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	5.94	1.24
ASB - No Stripper Online	5.25%	460.0	Foul Condensate to Hard Pipe	100.0%	460.0	Hydrogen Peroxide Addition	100.0%	460.0	2,700	ADTP/day	7.28E-02	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	8.19	1.88
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	1.75E+00	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. Pre-control emissions based on LVHC scrubber efficiency (50%) and estimated 99% combustion efficiency in combination boilers.	99.9%	0.20	0.65
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	8.76E-03	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. DHEC Approved Test.	NA	0.99	1.08
TRS PROJECTED ACTUAL EMISSIONS															**16.76**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**3.95**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Sulfur capture in recovery furnace >99.9% (see note H), sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - Recovery Furnace captures 99% of sulfur and converts 99% of remaining uncaptured sulfur.

I - Backup Stripper SOG emissions are conservatively based upon all of the sulfur being captured in the SOG for both TRS mode and Methanol mode.

J - When the Backup Stripper is operating, ASB emissions are higher if the stripper is operating in methanol mode. Both emissions factors are shown in the table, but ASB emissions are based on methanol mode operation.

H2S EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		H2S Emissions Factor		Sulfur Capture[C]	H2S Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	LVHC to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	4.13E-04	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	0.02	0.09
Aerated Stabilization Basin (ASB)	100.0%	8,760.0	Foul Condensate to Hard Pipe	100.0%	8,760.0	Hydrogen Peroxide Addition	100.0%	8,760.0	1,365	ADTP/day	1.36E-02	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	0.77	3.39
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	5.03E-04	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	0.03	0.13
H2S BASELINE ACTUAL EMISSIONS															**3.61**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3[G,H]	100.0%	7,489.8	2,700	ADTP/day	0.24	Vendor / Preliminary Design Information	99.9%	0.03	0.10
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3[G,H]	75.0%	5,617.4	2,700	ADTP/day	0.37	Vendor / Preliminary Design Information	99.9%	0.04	0.12
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2[G]	25.0%	1,872.5	2,700	ADTP/day	0.37	Vendor / Preliminary Design Information	99%	0.41	0.39
New Stripper Online	90.0%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	0.61	Vendor / Preliminary Design Information	99%	0.69	0.14
Backup Stripper Online [I]	4.75%	416.0	NA	100.0%	416.0	SOG to CB1/CB2	100.0%	416.0	2,700	ADTP/day	0.61	Vendor / Preliminary Design Information	99%	0.69	0.14
ASB - New Stripper Online	90.0%	7,884.0	No Foul Condensate to Hard Pipe	100.0%	7,884.0	NA	100.0%	7,884.0	2,700	ADTP/day	9.27E-03	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	1.04	4.11
ASB - Backup Stripper Online (TRS Mode) [J]	4.75%	416.0	H2S Stripped From Foul Condensate	100.0%	416.0	NA	100.0%	416.0	2,700	ADTP/day	9.81E-03	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	1.10	0.23
ASB - Backup Stripper Online (Methanol Mode) [J]	4.75%	416.0	500 gpm Foul Condensate to Hard Pipe	100.0%	416.0	Hydrogen Peroxide Addition	100.0%	416.0	2,700	ADTP/day	9.45E-03	H2SSIM/WATER9 Inputs and Outputs Provided.	NA		
ASB - No Stripper Online	5.25%	460.0	Foul Condensate to Hard Pipe	100.0%	460.0	Hydrogen Peroxide Addition	100.0%	460.0	2,700	ADTP/day	9.54E-03	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	1.07	0.25
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	1.17E-01	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. Pre-control emissions based on LVHC scrubber efficiency (50%) and estimated 99% combustion efficiency in combination boilers.	99.9%	0.01	0.04
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	5.87E-04	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. DHEC Approved Test.	NA	0.07	0.07
H2S PROJECTED ACTUAL EMISSIONS															**5.59**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**1.98**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Sulfur capture in recovery furnace >99.9% (see note H), sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - Recovery Furnace captures 99% of sulfur and converts 99% of remaining uncaptured sulfur.

I - Backup Stripper SOG emissions are conservatively based upon all of the sulfur being captured in the SOG for both TRS mode and Methanol mode.

J - When the Backup Stripper is operating, H2S ASB emissions are higher if the stripper is operating in TRS mode. Both emissions factors are shown in the table, but ASB emissions are based on TRS mode operation.

PM EMISSIONS REFERENCES

	Stripper Scenario Operating Time			Operating Configuration Time			Controls Operating Time		Production Rate		PM Emissions Factor		PM Control	PM Emissions	
Stripper Operating Scenario	%	hrs	**Operating Configuration**	%	hrs	**Controls**	%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	26.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.8
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	24.8	mmBtu/hr	1.61E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	4.0	0.3
PM BASELINE ACTUAL EMISSIONS															**1.1**
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	7.60E-03	3.74E-03
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.7	2.4
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	1.61E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	14.8	10.8
Backup Stripper Steam - Natural Gas [C]	4.75%	416.0	Natural Gas[D]	81.6%	339.5		100.0%	339.5	26.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.0
Backup Stripper Steam - No. 6 Oil [C]	4.75%	416.0	No. 6 Oil[D]	18.4%	76.5		100.0%	76.5	24.8	mmBtu/hr	1.61E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	4.0	0.2
PM PROJECTED ACTUAL EMISSIONS															**13.33**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**12.22**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

PM10 EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time %	Stripper Scenario Operating Time hrs	Operating Configuration	Operating Configuration Time %	Operating Configuration Time hrs	Controls	Controls Operating Time %	Controls Operating Time hrs	Production Rate Value	Production Rate UOM	PM10 Emissions Factor lb/UOM	PM10 Emissions Factor Reference	PM10 Control %	PM10 Emissions lb/hr	PM10 Emissions tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	26.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.8
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	24.8	mmBtu/hr	1.17E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	2.9	0.2
PM10 BASELINE ACTUAL EMISSIONS															**1.02**
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	7.60E-03	3.74E-03
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.7	2.4
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	1.17E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	10.8	7.8
Backup Stripper Steam - Natural Gas [C]	4.75%	416.0	Natural Gas[D]	81.6%	339.5		100.0%	339.5	26.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.0
Backup Stripper Steam - No. 6 Oil [C]	4.75%	416.0	No. 6 Oil[D]	18.4%	76.5		100.0%	76.5	24.8	mmBtu/hr	1.17E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	2.9	0.1
PM10 PROJECTED ACTUAL EMISSIONS															**10.34**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**9.32**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

PM2.5 EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		PM2.5 Emissions Factor		PM2.5 Control	PM2.5 Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	26.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.8
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	24.8	mmBtu/hr	8.80E-02	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	2.2	0.2
PM2.5 BASELINE ACTUAL EMISSIONS															**0.96**
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	7.60E-03	3.74E-03
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.7	2.4
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	8.80E-02	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	8.1	5.9
Backup Stripper Steam - Natural Gas[C]	4.75%	416.0	Natural Gas[D]	81.6%	339.5		100.0%	339.5	26.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.0
Backup Stripper Steam - No. 6 Oil[C]	4.75%	416.0	No. 6 Oil[D]	18.4%	76.5		100.0%	76.5	24.8	mmBtu/hr	8.80E-02	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	2.2	0.1
PM2.5 PROJECTED ACTUAL EMISSIONS															**8.37**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**7.41**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

LEAD EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		Lead Emissions Factor		Lead Control	Lead Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	26.0	mmBtu/hr	5.00E-07	AP-42 Table 1.4-2.	NA	1.30E-05	5.10E-05
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	24.8	mmBtu/hr	2.80E-05	U.S. EPA document "Estimating Air Toxic Emissions from Coal and Oil Combustion Sources" [EPA-450/2-89-001] for Uncontrolled Residual Oil-fired Utility Boilers (Table 4-1)	NA	6.95E-04	5.85E-05
LEAD BASELINE ACTUAL EMISSIONS															**1.10E-04**
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	5.00E-07	AP-42 Table 1.4-2.	NA	5.00E-07	2.46E-07
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	5.00E-07	AP-42 Table 1.4-2.	NA	4.84E-05	1.56E-04
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	2.80E-05	U.S. EPA document "Estimating Air Toxic Emissions from Coal and Oil Combustion Sources" [EPA-450/2-89-001] for Uncontrolled Residual Oil-fired Utility Boilers (Table 4-1)	NA	2.58E-03	1.87E-03
Backup Stripper Steam - Natural Gas [C]	4.75%	416.0	Natural Gas[D]	81.6%	339.5		100.0%	339.5	26.0	mmBtu/hr	5.00E-07	AP-42 Table 1.4-2.	NA	1.30E-05	2.21E-06
Backup Stripper Steam - No. 6 Oil [C]	4.75%	416.0	No. 6 Oil[D]	18.4%	76.5		100.0%	76.5	24.8	mmBtu/hr	2.80E-05	U.S. EPA document "Estimating Air Toxic Emissions from Coal and Oil Combustion Sources" [EPA-450/2-89-001] for Uncontrolled Residual Oil-fired Utility Boilers (Table 4-1)	NA	6.95E-04	2.66E-05
LEAD PROJECTED ACTUAL EMISSIONS															**2.06E-03**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**1.95E-03**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

CO2 EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		CO2 Emissions Factor		CO2 Control	CO2 Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	26.0	mmBtu/hr	1.17E+02	40 CFR Part 98, Table C-1	NA	3,044.8	11,929
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	24.8	mmBtu/hr	1.66E+02	40 CFR Part 98, Table C-1	NA	4,109.9	346
CO2 BASELINE ACTUAL EMISSIONS															**12,275**
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	1.17E+02	40 CFR Part 98, Table C-1	NA	116.9	58
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	1.17E+02	40 CFR Part 98, Table C-1	NA	11,313.5	36,392
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	1.66E+02	40 CFR Part 98, Table C-1	NA	15,270.9	11,076
Backup Stripper Steam - Natural Gas [C]	4.75%	416.0	Natural Gas[D]	81.6%	339.5		100.0%	339.5	26.0	mmBtu/hr	1.17E+02	40 CFR Part 98, Table C-1	NA	3,044.8	517
Backup Stripper Steam - No. 6 Oil [C]	4.75%	416.0	No. 6 Oil[D]	18.4%	76.5		100.0%	76.5	24.8	mmBtu/hr	1.66E+02	40 CFR Part 98, Table C-1	NA	4,109.9	157
CO2 PROJECTED ACTUAL EMISSIONS															**48,200**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**35,925**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

SUMMARY OF ASB EMISSIONS FACTORS

Scenario	ASB Emissions Factors (lb/ODTP)							
	H_2S	DMDS	DMS	MMC	TRS as H_2S	Methanol	VOC[A]	TRS[B]
Baseline Actual Emissions	0.0151	0.0114	0.0185	3.28E-04	3.37E-02	0.89	0.95	0.0453
New Stripper Scenario	0.0103	0.0028	0.0136	1.88E-04	1.99E-02	0.30	0.32	0.0269
Backup Stripper Scenario - TRS Mode	0.0109	0.0033	0.0147	1.30E-03	2.23E-02	1.53	1.59	0.0302
Backup Stripper Scenario - Methanol Mode	0.0105	0.0308	0.0169	5.12E-04	4.24E-02	1.62	1.71	0.0587
No Stripper Scenario	0.0106	0.0504	0.0192	7.42E-04	5.81E-02	2.31	2.44	0.0809

A - Includes VOC TRS compounds, methanol, acetaldehyde, methyl ethyl ketone, and propionaldehyde.

B - TRS as compounds

BAE Other VOC Emissions Factors

Date of Subpart S Performance Testing	Acetadehyde, ppm	MEK, ppm	Prop., ppm
7/9/2021	24.3	7.7	1.1
7/10/2021	25.3	5.7	4.0
7/11/2021	25.0	6.5	7.0
10/26/2021	25.0	12.3	0.8
10/27/2021	27.5	13.3	1.0
10/28/2021	10.6	6.6	1.2
10/29/2021	15.0	8.6	0.9
2/14/2022	16.7	7.5	0.7
2/15/2022	17.0	9.5	0.6
2/16/2022	15.7	8.6	1.0
5/4/2022	20.7	7.1	1.0
5/5/2022	16.3	7.3	1.0
5/6/2022	15.0	6.8	1.0
8/9/2022	15.3	5.9	0.7
8/10/2022	25.0	7.2	1.1
8/11/2022	20.3	6.0	1.0
9/27/2022	14.3	5.3	0.7
9/28/2022	15.0	5.2	0.7
9/29/2022	18.0	5.6	0.9
10/18/2022	25.0	5.6	1.0
10/19/2022	23.7	5.5	1.1
10/20/2022	23.0	6.6	0.9
AVG ppm:	**19.72**	**7.28**	**1.34**
Lbs into ASB	55.48	20.49	3.78
Fair estimated from WATER9 properties	0.55	0.38	0.43
Lbs emitted	30.73	7.73	1.61
Average Pulp Production during Subpart S testing	1716		
lb/ODTP	**0.018**	**0.005**	**0.001**

PAE Other VOC Emissions Factors

	BAE lb/ODTP	PAE lb/ODTP			
		New Stripper	Backup Stripper TRS Mode	No Stripper	Backup Stripper Methanol Mode
Methanol	0.89	0.30	1.53	2.31	1.62
Acetadehyde	0.018	0.006	0.031	0.046	0.033
MEK	0.005	0.002	0.008	0.012	0.008
Propionaldehyde	0.001	0.000	0.002	0.002	0.002
DMDS	0.0114	0.0028	0.0033	0.0504	0.0308
DMS	0.0185	0.0136	0.0147	0.0192	0.0169
MMC	3.28E-04	1.88E-04	1.30E-03	7.42E-04	5.12E-04
VOC:	**0.95**	**0.32**	**1.59**	**2.44**	**1.71**

New Indy Catawba ASB BAE Methanol Emissions Factor

Month	Pulp Production ADTP	Pulp Production ODTP	Methanol Emissions Factor lb/ODTP	Emissions Factor Reference
Mar-21	42,474	38,226	1.50	Average of 2021 Subpart S Performance Tests. Representative of ASB operation from March 2021 to February 2022.
Apr-21	43,075	38,767	1.50	
May-21	46,962	42,266	1.50	
Jun-21	42,867	38,581	1.50	
Jul-21	49,371	44,434	1.50	
Aug-21	44,614	40,152	1.50	
Sep-21	40,177	36,159	1.50	
Oct-21	47,234	42,510	1.50	
Nov-21	39,185	35,266	1.50	
Dec-21	38,734	34,860	1.50	
Jan-22	43,690	39,321	1.50	
Feb-22	37,736	33,962	0.33	Average of 2022 Subpart S Performance Tests. Representative of ASB operation from February 2022 to February 2023.
Mar-22	43,944	39,549	0.33	
Apr-22	40,046	36,041	0.33	
May-22	38,896	35,006	0.33	
Jun-22	23,184	20,866	0.33	
Jul-22	39,890	35,901	0.33	
Aug-22	53,396	48,057	0.33	
Sep-22	45,044	40,539	0.33	
Oct-22	47,517	42,765	0.33	
Nov-22	40,133	36,120	0.33	
Dec-22	33,859	30,474	0.33	
Jan-23	35,464	31,918	0.33	
Feb-23	39,276	35,348	0.33	
Baseline Methanol Emissions Factor (Pulp Weighted Average)			**0.89**	**lb/ODTP**

Stripper Inlet Foul Condensate - Table 2-17 (Weston report dated October 2, 2021, Work Order No. 15730.001.008)

		Concentration (ppm)				
Date	**Sample Time**	**Hydrogen Sulfide**	**Methyl Mercaptan**	**Dimethyl Sulfide**	**Dimethyl Disulfide**	**Total TRS**
6/24/2021	15:10	130	14	16	13	173
6/24/2021	15:10	140	14	16	17	187
6/24/2021	17:00	140	17	18	14	189
6/24/2021	18:45	150	19	18	16	203
6/25/2021	10:35	130	12	12	11	165
6/25/2021	12:05	120	10	12	9.6	151.6
6/25/2021	13:45	190	22	22	23	257
Average of all data		142.9	15.4	16.3	14.8	189.4
Max of 6/24 or 6/25		146.7	16.0	17.0	15.0	194.7

		MW	
H2S	Hydrogen Sulfide	34.08	g/mol
Ch4S	Methyl Mercaptan	48.11	g/mol
C2H6S	Dimethyl Sulfide	62.13	g/mol
C2H6S2	Dimethyl Disulfide	94.20	g/mol
S	Sulfur	32.07	g/mol

Convert compound to equivalent S (ppm)

Hydrogen Sulfide	Methyl Mercaptan	Dimethyl Sulfide	Dimethyl Disulfide
138.0	10.7	8.8	10.2
82.3%	6.4%	5.2%	6.1%

S (ppm)	168	Maximum feed to stripper (AHL)
Lb S/gallon FC	1.40E-03	
Lb S/hr @850 gpm	71.3	
Lb S/ADTP (@2200 ODTP)[a]	0.7001	

[a] Conservative Lb S/ADTP emissions factor using 2200 ODTP (2200 ODTP * ADTP/0.9 ODTP = 2444.4 ADTP) Emissions factor is representative of the lower end of the range of pulp production at the maximum steam stripper design of 850 gpm. Calculations are scaled to 2700 ADTP to represent worst case emissions.

Assumption
1. Assume no losses in feed tank
2. Assume 98% efficiency of S across stripper therefore 0.69 # S/ADTP in SOG

New-Indy Catawba Monthly Production

Month	Kraft Mill ADTP	Combination Boiler No. 1 Natural Gas mmBtu	Combination Boiler No. 2 Natural Gas mmBtu	Total Natural Gas mmBtu	Combination Boiler No. 1 No. 6 Fuel Oil gallons	Combination Boiler No. 2 No. 6 Fuel Oil gallons	Total No. 6 Fuel Oil gallons	Total No. 6 Fuel Oil mmBtu
Mar-21	42,474	61,175	99,507	160,683	0	2,057	2,057	309
Apr-21	43,075	41,363	75,012	116,376	0	0	0	0
May-21	46,962	38,834	63,467	102,301	0	0	0	0
Jun-21	42,867	1,909	59,909	61,818	0	1,199	1,199	180
Jul-21	49,371	67,565	55,824	123,389	3	97	100	15
Aug-21	44,614	33,863	32,461	66,325	0	0	0	0
Sep-21	40,177	40,779	41,811	82,590	86	0	86	13
Oct-21	47,234	69,732	75,498	145,230	0	0	0	0
Nov-21	39,185	60,664	80,397	141,061	0	0	0	0
Dec-21	38,734	62,931	60,176	123,107	0	0	0	0
Jan-22	43,690	84,088	82,251	166,339	69,200	66,720	135,920	20,388
Feb-22	37,736	57,764	75,924	133,688	27,042	370	27,412	4,112
Mar-22	43,944	62,423	82,083	144,506	335	0	335	50
Apr-22	40,046	44,634	62,835	107,469	0	0	0	0
May-22	38,896	39,982	73,918	113,900	0	0	0	0
Jun-22	23,184	43,071	89,239	132,310	2,238	0	2,238	336
Jul-22	39,890	64,532	86,134	150,666	0	0	0	0
Aug-22	53,396	48,067	73,591	121,658	0	0	0	0
Sep-22	45,044	60,782	65,899	126,681	24	0	24	4
Oct-22	47,517	70,539	89,760	160,299	0	0	0	0
Nov-22	40,133	82,534	114,164	196,698	0	0	0	0
Dec-22	33,859	101,466	95,023	196,490	170,076	0	170,076	25,511
Jan-23	35,464	95,982	92,733	188,715	102,558	0	102,558	15,384
Feb-23	39,276	78,431	96,813	175,244	21,626	53	21,679	3,252
Total	996,766			3,237,544				69,553
Annual Average	498,383							
				97.9%				2.1%

WASTEWATER TREATMENT PLANT – SUPPORTING INFORMATION PEROXIDE ADDITION

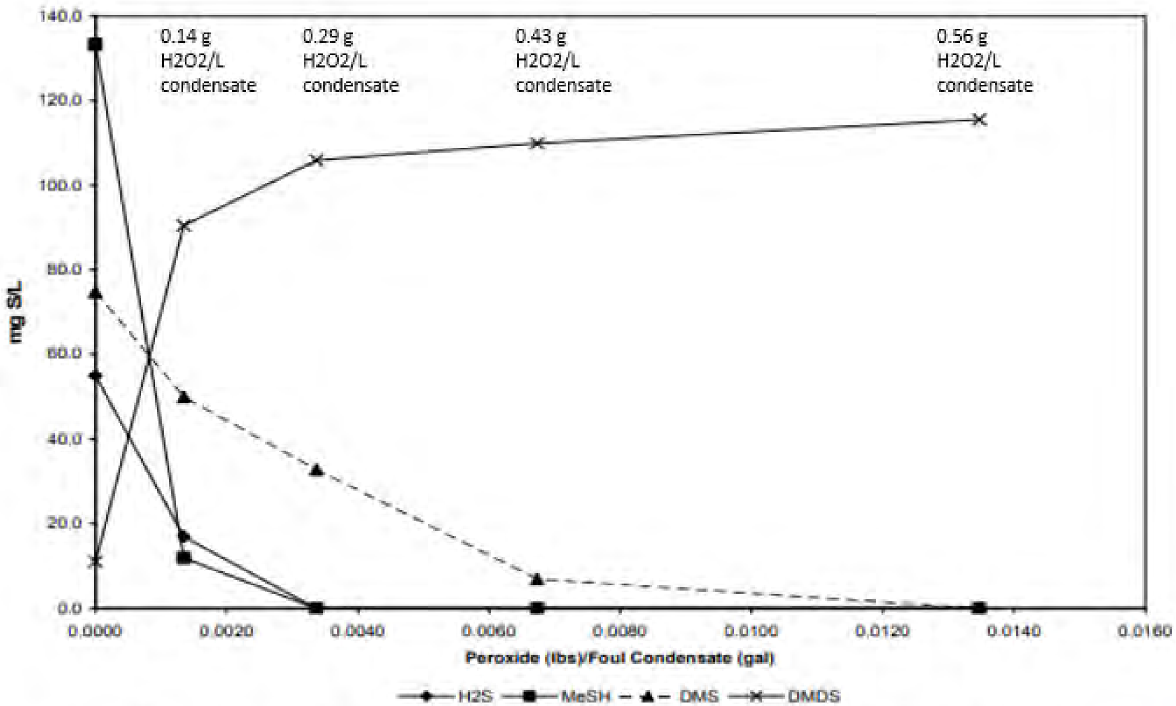


Figure 5.6 Hydrogen Peroxide Dose-Response Curve for Treatment of Foul Condensates

Source: TB949 H2O2 Mill Bench Scale Study

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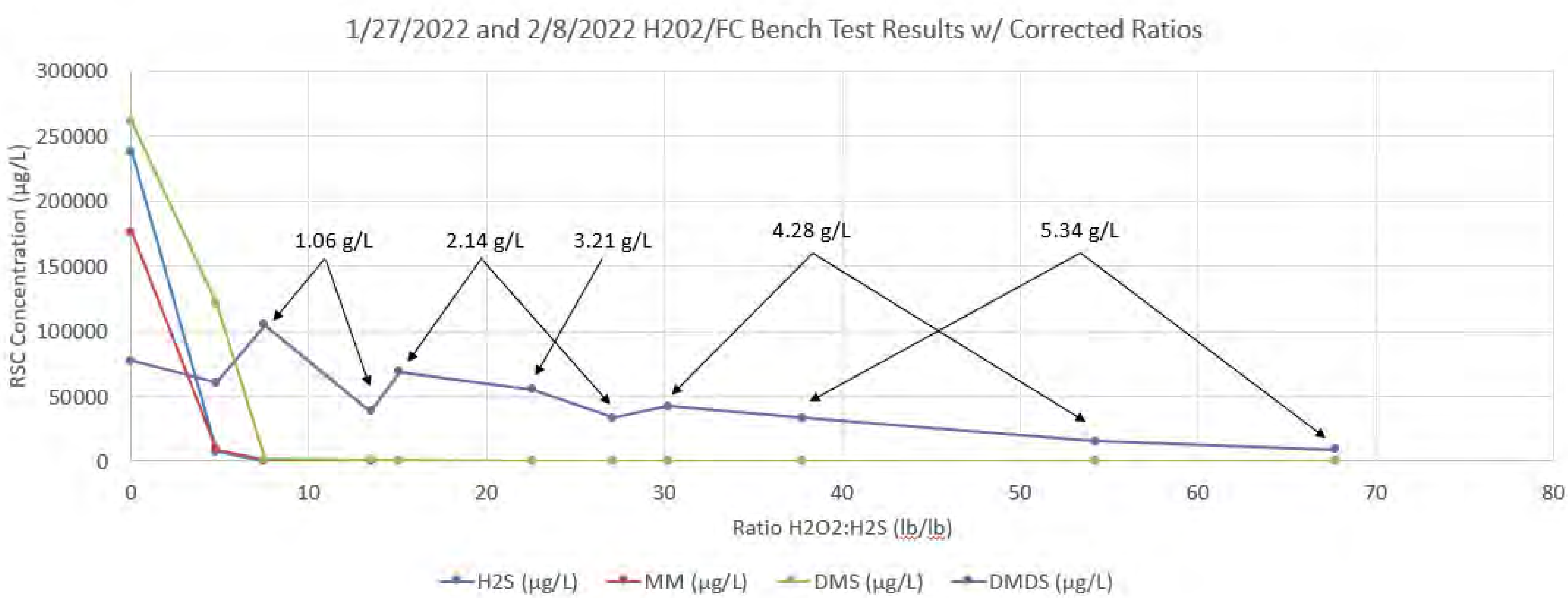
1/27/2022 and 2/8/2022 H202/FC Bench Test Results w/ Corrected Ratios
RSC Concentration (µg/L)
300000
250000
200000
150000
100000
50000
0
1.06 g/L
2.14 g/L
3.21 g/L
4.28 g/L
5.34 g/L
0
10
20
30
40
50
60
70
80
Ratio H2O2:H2S (lb/lb)
H2S (µg/L)
MM (µg/L)
DMS (µg/L)
DMDS (µg/L)

ncasi

NATIONAL COUNCIL FOR AIR AND STREAM IMPROVEMENT

SUMMARY OF INDUSTRY EXPERIENCE WITH ODOR MINIMIZATION AT WASTEWATER TREATMENT PLANTS

TECHNICAL BULLETIN NO. 949

MAY 2008

by
Diana Cook
NCASI West Coast Regional Center
Corvallis, Oregon

5.3 Oxidation

Several oxidizing agents have been used for destruction of odors resulting from H_2S. The approach is to oxidize the sulfide into nonvolatile forms such as elemental sulfur, thiosulfate, sulfite, and sulfate. Chemical oxidation reactions are generally slower than biochemical oxidation reactions (ASCE 1989). In the presence of large organic loads, as with industrial wastewaters, the economics of oxidizing agent use can be prohibitive due to competitive reactions with organic materials. Some of the commonly used oxidizing agents are chlorine, chlorine dioxide, hypochlorite, oxygen, and hydrogen peroxide. Industry experience with use of oxidizing agents is summarized herein.

5.3.1 *Hydrogen Peroxide*

Hydrogen peroxide (H_2O_2) can be used to chemically oxidize H_2S into either elemental sulfur or sulfate (the former at pH <8 to 9; the latter at pH >8 to 9), as shown in Equations 5.6 and 5.7. In the range of pH 7 to 9, both reactions may occur. Excess H_2O_2 can oxidize other wastewater components or decompose to release oxygen and water.

$$H_2O_2 + H_2S \rightarrow S + 2H_2O \qquad \text{(Eq. 5.6)}$$

$$4H_2O_2 + S^{2-} \rightarrow SO_4^{2-} + 4H_2O \qquad \text{(Eq. 5.7)}$$

H_2O_2 is a clear, colorless, nonflammable compound that is miscible with water in all proportions and is normally sold as a solution expressed as a percentage of the solution's weight (e.g., a 35% solution contains 35% H_2O_2 and 65% water by weight). Solutions of >8% are classified as oxidizers by the U.S. Department of Transportation. H_2O_2 can be obtained in small drums or tanks equipped with metering pumps and plumbed to the addition point. Storage containers must be properly vented because contamination or excess heat can accelerate decomposition to oxygen and water. Special safety handling is required, including eye protection and protective clothing.

Davies, Christy, and O'Connor (2000) reported on the effectiveness of using H_2O_2 to control odors resulting from release of H_2S at four locations around the WWTP at a pulp and paper mill in Canada. The specific objectives were to reduce H_2S concentration in an anaerobic spill basin effluent returned to the effluent clarification and treatment system; treat anaerobic sludge from the spill basin; minimize odors arising from sewering condensates; and treat all foul condensates from the mill during a scheduled shutdown of the steam stripper.

H_2O_2 was found to be effective for odor reduction at all the locations. It was added to the anaerobic spill basin effluent at a location that promoted good mixing prior to introduction into the clarifier. The residence time associated with transfer of effluent from the spill basin to the clarifier was sufficient to oxidize H_2S and minimize odor. Sludge dewatering equipment consisted of a screen, an agitation tank, a centrifuge, and a belt press. H_2O_2 was added to the agitation tank. In addition, an odor-controlling spray (Ecosorb) was applied to the air around the screens to capture any residual odors. H_2O_2 was also used to reduce odors during occasional sewering of condensates. Dosage levels were selected based on laboratory studies that indicated that ~200 mg H_2O_2/L of treated condensate was sufficient to remove odors. A solution containing 50% H_2O_2 was also used to reduce odors during steam stripper downtime events when foul condensates were piped directly into the aeration pond.

H_2O_2 and calcium peroxide (CaO_2) have been used in the presence of peroxidase, an enzyme found in horseradish, to remove odors in swine manure. Swine manure is known to contain large amounts of VFAs, phenolic compounds, and indolic compounds that have been implicated in odor. Peroxidase, in the presence of peroxides, has been found to polymerize phenolic odorants, thereby reducing associated odors (Govere et al. 2007).

H_2O_2 has also been used successfully as one element of a multi-pronged approach to control odor attributed to VFA generation in anaerobic environments (Davis and Smith 2001). H_2O_2 would be particularly beneficial for use in mills with high levels of water reuse (e.g., some recycle mills). Oxygen-limited environments in the process water transport system at those facilities can be ideal for anaerobic bacterial growth. Traditional oxidizers such as sodium hypochlorite, chlorine, and chlorine dioxide increase total chloride and conductivity in the reused effluent, which can disrupt process performance and cause corrosion. The multi-pronged approach used at a 100% recycled corrugating medium mill focused on good operating practices aimed at oxygenation, biocide application to control the amount of aerobic bacteria, and H_2O_2 use to prevent anaerobic environments in the secondary treatment system (Davis and Smith 2001).

NCASI assisted a bleached kraft mill that conducted a trial to investigate the effects of adding H_2O_2 to foul condensates. Foul condensates were piped directly to the first basin of a multi-stage ASB. Samples were collected at two locations (just prior to addition of peroxide and just following the addition point) over a five-day period to assess impacts on sulfide concentrations. Samples were analyzed using direct injection GC/PFPD (NCASI Method RSC-02.02; NCASI 2007). H_2O_2 was added as a 50% solution at a rate of 1.78 gallons per minute (GPM) to the foul condensate stream, which had a flow rate of 3 MGD, resulting in a concentration of approximately 0.51 g H_2O_2/L of foul condensate. The average reduction in sulfide concentration was over 79%, as illustrated in Figure 5.3.

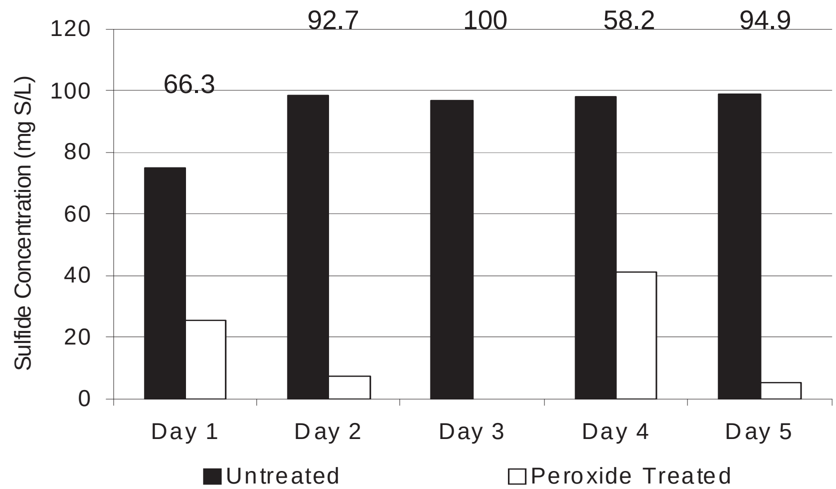

Figure 5.3 Sulfide Concentrations after Peroxide Addition (0.51 g/L) to a Foul Condensate [numbers above bars represent percent reductions in total sulfide observed each day]

Dosage and retention time trends were evaluated using a screening technique that involved collecting 25-mL samples in a 500-mL bottle that was closed and agitated for one minute. The cap was removed and a Jerome air monitor was used to measure volatile H_2S in the headspace. The effect of peroxide dose and retention time are illustrated in Figure 5.4. Reductions of >90% were observed after the first minute, and at some dosage rates they increased modestly with additional retention time. Figure 5.5 illustrates trends for doses of 0.5 and 1.0 GPM of a 50% H_2O_2 solution to the 3 MGD foul condensate at the four sampling locations (drop legs 1 through 4). Although some variability was observed, a significant reduction in sulfide was observed at the first drop leg under both addition rates investigated and increased gradually as the foul condensate progressed through the drop legs.

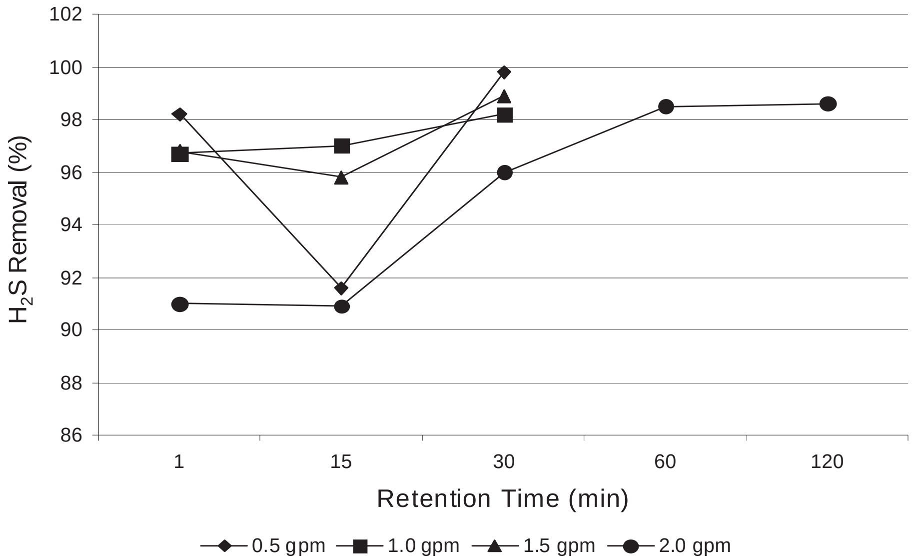

Figure 5.4 Effect of Hydrogen Peroxide Dose (0.14, 0.29, 0.43, and 0.56 g/L) and Retention Time on Sulfide Removal Efficiency [headspace measurements]

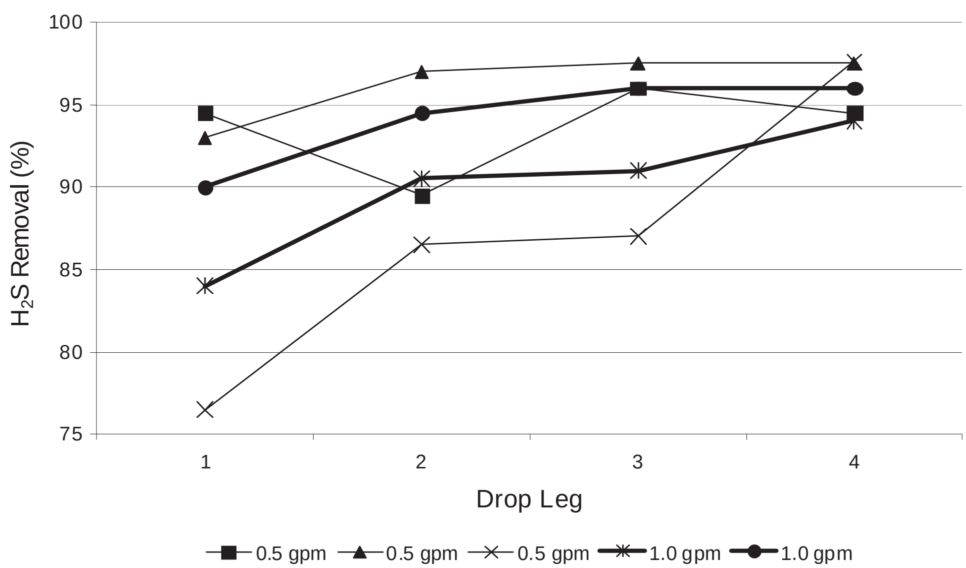

Figure 5.5 Effect of Hydrogen Peroxide Dose (0.14, 0.29, 0.43, and 0.56 g/L) and Sample Location on Sulfide Removal Efficiency [headspace measurements]

Another example of H_2O_2 use at a bleached kraft mill is illustrated in Figure 5.6. The mill conducted a bench study prior to an odor reduction trial to determine the dose-response curve for peroxide addition to foul condensates. Foul condensates were treated with the oxidant (50% H_2O_2; density 1.2 g/mL) volumes shown in the figure (equivalent to 0.14, 0.29, 0.43, and 0.56 g H_2O_2/L of foul condensate) at 50°C for 30 minutes in sealed vials. Samples were removed and analyzed by direct aqueous injection GC/sulfur chemiluminescence detectors (SCD) for sulfide, MeSH, DMS, and

DMDS. The data indicate that sulfide and MeSH were readily removed, but that DMS required significantly higher doses to achieve equivalent levels of removal. DMDS was not removed and in fact increased with peroxide dose, presumably due to oxidation of MeSH.

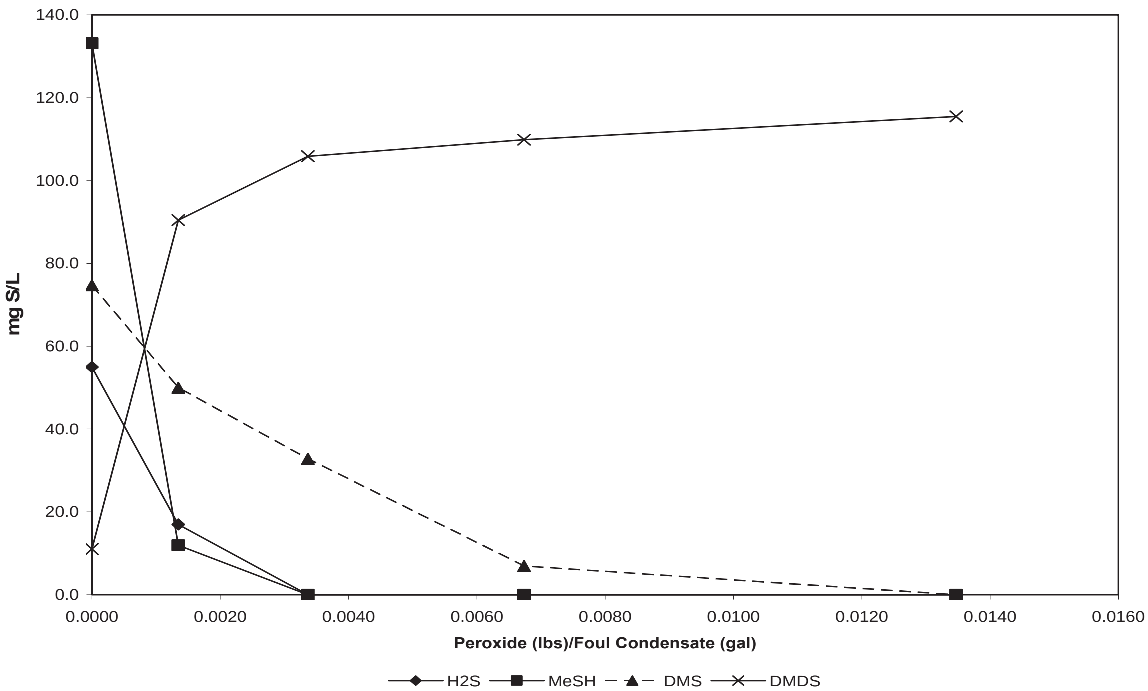

Figure 5.6 Hydrogen Peroxide Dose-Response Curve for Treatment of Foul Condensates

Following the bench studies, a mill trial was conducted over a five day period. H_2O_2 was added to the foul condensate tank (pH 9.0 to 9.3) at a rate of 1 gallon (100% H_2O_2) to every 500 gallons of condensate, which is equivalent to 2.8 g H_2O_2/L of foul condensate. This addition point provided a retention time of ~30 minutes prior to the WWTP. The trial resulted in overall average reductions in sulfide, MeSH, and DMS of 38.8, 64.6, and -3.9%, respectively (Table 5.1). The level of DMDS increased (probably due to oxidation of MeSH to DMDS) during the addition but reportedly did not affect overall odor from the WWTP (NCASI files). The mill continues to feed H_2O_2 to the foul condensate and has reported a reduction in odor at the WWTP.

Table 5.1 Percent Reduction in Hydrogen Sulfide, Methyl Mercaptan, and Dimethyl Sulfide during a Peroxide Addition Trial Conducted in a Foul Condensate

Day of Study	H_2S	MeSH	DMS
1	26.1	67.3	-20.8
2	68.3	74.7	16.5
3	38.1	57.0	1.9
4	36.4	60.0	2.6
5	25.3	63.8	-19.5
Average	38.8	64.6	-3.86

WASTEWATER TREATMENT PLANT – SUPPORTING INFORMATION BASELINE ACTUAL EMISSIONS

May/July 2022 Baseline Emissions Calculations

H_2S, TRS Compounds, and VOC

New-Indy Catawba - Catawba, SC

		Method: GC/SCD Reduced Sulfur Analysis (Average)			
Sample Date	**Sample Location**	**ALS H2S, ppb**	**ALS DMDS, ppb**	**ALS DMS, ppb**	**ALS MMC, ppb**
2021/2022	Avg. ASB Influent (2021 and 2022)	252	86.78	199	2.60
5/17/2022	Foul Condensate (prior to H_2O_2)	105,667	6,633	14,667	8,267
	Predicted % Reduction from H_2O_2	0.99	MMC converted into DMDS	0.90	0.99
	Foul Condensate (after H_2O_2)	1,057	14,647	1,467	82.67
7/19/2022	Foul Condensate (prior to H_2O_2)	58,333	5,633	5,400	3,900
	Predicted % Reduction from H_2O_2	0.99	MMC converted into DMDS	0.90	0.99
	Foul Condensate (after H_2O_2)	583	9,414	540	39.00
7/20/2022	Foul Condensate (prior to H_2O_2)	76,200	6,932	7,140	7,393
	Predicted % Reduction from H_2O_2	0.99	MMC converted into DMDS	0.90	0.99
	Foul Condensate (after H_2O_2)	762	14,099	714	73.93
7/21/2022	Foul Condensate (prior to H_2O_2)	62,500	8,967	9,200	6,533
	Predicted % Reduction from H_2O_2	0.99	MMC converted into DMDS	0.90	0.99
	Foul Condensate (after H_2O_2)	625	15,300	920	65.33
		ALS H2S, ppm	**ALS DMDS, ppm**	**ALS DMS, ppm**	**ALS MMC, ppm**
Flow Weight Average Loading Calculation	Avg. Foul Condensate Concentration (after peroxide)	0.76	13.36	0.91	0.07
	Avg. ASB Inlet Concentration	0.25	0.09	0.20	2.60E-03
	Avg. Hardpipe Flow, MGD	0.34			
	Avg. ASB Inlet Flow, MGD	23.96			
	Total Flow	24.30			
	Flow Weight. Avg. Loading (ppm)	**0.2593**	**0.2712**	**0.2088**	**0.0035**
Results and Emissions Factors Calculation	**H2SSIM/WATER9 Results**	**H2S, g/s**	**DMDS, g/s**	**DMS, g/s**	**MMC, g/s**
	ASB Zone 1	Multiple H2SSIM runs.	0.10	0.15	2.74E-03
	ASB Zone 2		1.43E-03	3.05E-05	4.63E-05
	ASB Zone 3		2.57E-05	1.01E-04	1.43E-06
	Total ASB		**0.10**	**0.16**	**2.78E-03**
	Baseline Emissions Factor 2200 ODTP/day	**H2S, lb/ODTP**	**DMDS, lb/ODTP**	**DMS, lb/ODTP**	**MMC, lb/ODTP**
	Baseline Emissions Factor	**1.51E-02**	**1.14E-02**	**1.85E-02**	**3.28E-04**

Type of unit is

1 Total water added at the unit (l/s)	50	0
2 Area of openings at unit (cm2)		50
3 Radius of drop pipe (cm)		5
4 Drop length to conduit (cm)		61
5 Humidity of inlet air (%)		40
6 Temperature of air (C)		25
7 Drain air velocity (ft/min)		84
8 manhole air velocity (ft/min)		128
9 Conduit air velocity (ft/min)		66
10 Wind speed (cm/s at 10 m)		447
11 distance to next unit (cm)		500
12 slope of underflow conduit		.015
13 friction factor liquid		.016
14 friction factor gas		.006
15 radius of underflow conduit (cm)		12
16 Underflow T (C)		25
17 oscillation cycle time (min)		5
18 design collection velocities (ft/s)		2
19 design branch line fraction full		.4

Type of unit is

8 HL partition flag=1, adjust for sorption	0
9 unit recycle convergence number	200
10 oil molecular weight	0
11 oil density (g/cc)	0
12 NaUT 1=municipal 2=industrial 3=turb.	0
13 NaUT 1=mass tr. 2=equil	0
14 parts biomass per 1000 parts COD	
15 oil water partition method 0=owpc	
16 use UNIFAC aqueous data base =1	
17 specify mass transfer for unit, =1	
18 Use biomass for unit option, =1	
19 biogrowth Monod half concentration ppm	

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment

WWTP\BAE\TRS\WATER9\ASB V5 3/14/2023 2:17:21 PM 19:17:08

COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment

1 Description of unit	11	ASB Zone 1
2 Wastewater temperature (C)		34.08
3 length of aeration unit (m)		295
4 width of aeration unit (m)		295
5 depth of aeration unit (m)		1.4
6 Area of agitation (each aerator,m2)		135
7 Total number of agitators in the unit		31
8 Power of agitation (each aerator,HP)		75
9 Impeller diameter (cm)		49.53
10 Impeller rotation (RPM)		1200
11 Agitator mechanical efficiency		0.83
12 aerator effectiveness, alpha		0.83
13 if there is plug flow, enter 1		0
14 Overall biorate (mg/g bio-hr)		19
15 Aeration air flow (m3/s)		0
16 active biomass, aeration (g/l)		0.3
17 If covered, then enter 1		0
18 special input		0
19 pH (enter 0 for no pH adjustment)		7.04

Properties of DIMETHYL DISULFIDE at 34.1 deg.C (93.3 deg.F)

```
   hl= 0.001714 atm-m3/mol      vp= 45.945 mmHg (0.88868 psia)
       95.2 y/x
       0.068011 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.041e-05 cm2/s  dv= 0.088022 cm2/s
Compound flow rate from inlet water is 0.26179 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 31.792 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 237.766.
kl is estimated as 5.971e-06 m/s.
kg is estimated as 0.005598 m/s.  Model: 2
kg is estimated as 0.005598 m/s.  Model: 2
The Schmidt number is 1.70412.
The friction velocity is 37.398 m/s
kg is estimated as 0.012927 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.11564 m/s.
kl (agitated)is estimated as 0.017486 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 2.753e-04 m/s.
 The effective stripping time (surface + diffused air) is 84.752 minutes. (1.41254 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1907.493 min. (31.792 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                          0.11781
   KL aerated (m/s)                          0.017486
   KL OVERALL AERATED (m/s)                  0.005609
   KG quiescent (m/s)                        0.005703
   KL quiescent (m/s)                        5.971e-06
   KL OVERALL QUIESCENT (m/s)                5.883e-06
   KL OVERALL (m/s)                          2.753e-04
   air stripping time constant (min)         84.752
   FRACTION SURFACE VOLATILIZED              0.36432
   FRACTION SUBMERGED VOLATILIZED            0.
   TOTAL FRACTION VOLATILIZED                0.36432
   FRACTION BIOLOGICALLY REMOVED             0.61949
   FRACTION ABSORBED                         0.
   TOTAL AIR EMISSIONS  (g/s)                0.095374
                     (Mg/year)               3.00772
   EMISSION FACTOR  (g/cm2-s)                1.096e-10
   UNIT EXIT CONCENTRATION (ppmw)            0.003981
DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream
```



```
COMPOUND: DIMETHYL DISULFIDE

Type of unit is system exit stream
1 Description of unit                    12    def.system exit st

   TOTAL AIR EMISSIONS  (g/s)                0.
```

```
                    (Mg/year)              0.
   EMISSION FACTOR  (g/cm2-s)              1.096e-10
   UNIT EXIT CONCENTRATION (ppmw)          6.079e-06
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain


                       WWTP\BAE\TRS\WATER9\ASB V5 3/14/2023 2:17:21 PM  19:17:08
COMPOUND: DIMETHYL DISULFIDE

Type of unit is open hub drain
1 Description of unit                      13    default open hub d
2 Underflow T (C)                                43.89
3 Total water added at the unit (l/s)            0
4 Area of openings at unit (cm2)                 50
5 Radius of drop pipe (cm)                       5
6 Drop length to conduit (cm)                    61
7 Open surface=1                                 1
8 Subsurface entrance=1                          0
9 subsurface exit =1                             0
10 radius of underflow conduit (cm)              12
11 distance to next unit (cm)                    500
12 slope of underflow conduit                    0.015
16 velocity air at drain opening (ft/min)        84
17 municipal waste in conduit =1                 0
18 Assume equilibrium in unit, =1                0
19 pH  (enter 0 for no pH adjustment)            8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1064.53 l/s.
   Weight fraction down is  2.712E-07
   Gas concentration in  0 mol fraction.
   Gas flow  1064.53 L/s
   Weight fraction out at base of drop is  2.45916666343852E-07
   fraction transferred in the drain drop from hub is .093228
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.093228
   fraction loss in unit                    0.
   fraction loss in line run                0.
   component upstream of unit, g/s          0.
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             3.134e-19
   mol fract. headspace vent base           6.978e-06
   headspace flow out vent (cc/s)           -1.065e+06
   headspace flow down line (cc/s)          1.065e+06
   KG surface (m/s)                         1860.422
   KL surface (m/s)                         6.37e-09
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.2887
   total component into unit, g/s           0.26179
   TOTAL AIR EMISSIONS  (g/s)               0.026915
                    (Mg/year)               0.84879
   EMISSION FACTOR  (g/cm2-s)               1.096e-10
   UNIT EXIT CONCENTRATION (ppmw)           0.24592
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment


                       WWTP\BAE\TRS\WATER9\ASB V5 3/14/2023 2:17:21 PM  19:17:08
COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment
1 Description of unit                      17    ASB Zone 3
```

```
2 Wastewater temperature   (C)                    30.01
3 length of aeration unit (m)                     376
4 width of aeration unit (m)                      188
5 depth of aeration unit (m)                      0.91
6 Area of agitation (each aerator,m2)             135
7 Total number of agitators in the unit           6
8 Power of agitation (each aerator,HP)            75
9 Impeller diameter (cm)                          49.53
10 Impeller rotation (RPM)                        1200
11 Agitator mechanical efficiency                 0.83
12 aerator effectiveness, alpha                   0.83
13 if there is plug flow, enter 1                 0
14 Overall biorate (mg/g bio-hr)                  19
15 Aeration air flow (m3/s)                       0
16 active biomass, aeration (g/l)                 0.3
17 If covered, then enter 1                       0
18 special input                                  0
19 pH  (enter 0 for no pH adjustment)             7.42

Properties of DIMETHYL DISULFIDE at 30. deg.C (86. deg.F)
   hl= 0.00141 atm-m3/mol      vp= 37.814 mmHg (0.7314 psia)
       78.352 y/x
       0.056726 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.027e-05 cm2/s  dv= 0.085991 cm2/s
Compound flow rate from inlet water is 1.411e-04 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 16.785 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 5.918e-06 m/s.
kg is estimated as 0.005575 m/s.  Model: 2
kg is estimated as 0.005575 m/s.  Model: 2
The Schmidt number is 1.74436.
The friction velocity is 37.398 m/s
kg is estimated as 0.012742 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.1143 m/s.
kl (agitated)is estimated as 0.015772 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 5.972e-05 m/s.
 The effective stripping time (surface + diffused air) is 253.944 minutes. (4.2324
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1007.112 min. (16.785 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                         0.11644
   KL aerated (m/s)                         0.015772
   KL OVERALL AERATED (m/s)                 0.004711
   KG quiescent (m/s)                       0.005679
   KL quiescent (m/s)                       5.918e-06
   KL OVERALL QUIESCENT (m/s)               5.813e-06
   KL OVERALL (m/s)                         5.972e-05
   air stripping time constant (min)        253.944
```

```
   FRACTION SURFACE VOLATILIZED             0.18189
   FRACTION SUBMERGED VOLATILIZED           0.
   TOTAL FRACTION VOLATILIZED               0.18189
   FRACTION BIOLOGICALLY REMOVED            0.77225
   FRACTION ABSORBED                        0.
   TOTAL AIR EMISSIONS  (g/s)               2.567e-05
                     (Mg/year)              8.094e-04
   EMISSION FACTOR  (g/cm2-s)               3.631e-14
   UNIT EXIT CONCENTRATION (ppmw)           6.079e-06
DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment
```



```
COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment
1 Description of unit                       18    ASB Zone 2
2 Wastewater temperature   (C)                    32.08
3 length of aeration unit (m)                     368
4 width of aeration unit (m)                      184
5 depth of aeration unit (m)                      0.97
6 Area of agitation (each aerator,m2)             135
7 Total number of agitators in the unit           15
8 Power of agitation (each aerator,HP)            75
9 Impeller diameter (cm)                          49.53
10 Impeller rotation (RPM)                        1200
11 Agitator mechanical efficiency                 0.83
12 aerator effectiveness, alpha                   0.83
13 if there is plug flow, enter 1                 0
14 Overall biorate (mg/g bio-hr)                  19
15 Aeration air flow (m3/s)                       0
16 active biomass, aeration (g/l)                 0.3
17 If covered, then enter 1                       0
18 special input                                  0
19 pH  (enter 0 for no pH adjustment)             7.24

Properties of DIMETHYL DISULFIDE at 32.1 deg.C (89.7 deg.F)
   hl= 0.001558 atm-m3/mol      vp= 41.785 mmHg (0.80821 psia)
       86.579 y/x
       0.062258 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.034e-05 cm2/s  dv= 0.087022 cm2/s
Compound flow rate from inlet water is 0.004238 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 17.139 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 5.945e-06 m/s.
kg is estimated as 0.005633 m/s.  Model: 2
kg is estimated as 0.005633 m/s.  Model: 2
The Schmidt number is 1.72371.
The friction velocity is 37.398 m/s
kg is estimated as 0.012836 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
```

```
kg (agitated)is estimated as 0.11498 m/s.
kl (agitated)is estimated as 0.016622 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 1.598e-04 m/s.
 The effective stripping time (surface + diffused air) is 101.198 minutes.
 (1.68663 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1028.32 min. (17.139 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                         0.11714
   KL aerated (m/s)                         0.016622
   KL OVERALL AERATED (m/s)                 0.005152
   KG quiescent (m/s)                       0.005738
   KL quiescent (m/s)                       5.945e-06
   KL OVERALL QUIESCENT (m/s)               5.85e-06
   KL OVERALL (m/s)                         1.598e-04
   air stripping time constant (min)        101.198
   FRACTION SURFACE VOLATILIZED             0.33837
   FRACTION SUBMERGED VOLATILIZED           0.
   TOTAL FRACTION VOLATILIZED               0.33837
   FRACTION BIOLOGICALLY REMOVED            0.62833
   FRACTION ABSORBED                        0.
   TOTAL AIR EMISSIONS  (g/s)               0.001434
                     (Mg/year)              0.045218
   EMISSION FACTOR  (g/cm2-s)               2.118e-12
   UNIT EXIT CONCENTRATION (ppmw)           1.326e-04
```

```
Type of unit is
1 Total water added at the unit (l/s)      50     0
2 Area of openings at unit (cm2)                  50
3 Radius of drop pipe (cm)                        5
4 Drop length to conduit (cm)                     61
5 Humidity of inlet air (%)                       40
6 Temperature of air (C)                          25
7 Drain air velocity (ft/min)                     84
8 manhole air velocity (ft/min)                   128
9 Conduit air velocity (ft/min)                   66
10 Wind speed (cm/s at 10 m)                      447
11 distance to next unit (cm)                     500
12 slope of underflow conduit                     .015
13 friction factor liquid                         .016
14 friction factor gas                            .006
15 radius of underflow conduit (cm)               12
16 Underflow T (C)                                25
17 oscillation cycle time (min)                   5
18 design collection velocities  (ft/s)           2
19 design branch line fraction full               .4

Type of unit is
8 HL partition flag=1, adjust for sorption        0
9 unit recycle convergence number                 200
10 oil molecular weight                           0
11 oil density  (g/cc)                           0
12 NaUT 1=municipal 2=industrial  3=turb.         0
13 NaUT 1=mass tr. 2=equil                        0
14 parts biomass per 1000 parts COD
15 oil water partition method 0=owpc
16 use UNIFAC aqueous data base =1
17 specify mass transfer for unit, =1
18 Use biomass for unit option, =1
19 biogrowth Monod half concentration ppm

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment
```



```
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is aerated biotreatment
1 Description of unit                      11    ASB Zone 1
2 Wastewater temperature   (C)                   34.08
3 length of aeration unit (m)                    295
4 width of aeration unit (m)                     295
5 depth of aeration unit (m)                     1.4
6 Area of agitation (each aerator,m2)            135
7 Total number of agitators in the unit          31
8 Power of agitation (each aerator,HP)           75
9 Impeller diameter (cm)                         49.53
10 Impeller rotation (RPM)                       1200
11 Agitator mechanical efficiency                0.83
12 aerator effectiveness, alpha                  0.83
13 if there is plug flow, enter 1                0
14 Overall biorate (mg/g bio-hr)                 19
15 Aeration air flow (m3/s)                      0
16 active biomass, aeration (g/l)                0.3
17 If covered, then enter 1                      0
18 special input                                 0
19 pH  (enter 0 for no pH adjustment)            7.04

Properties of DIMETHYL SULFIDE  (DMS) at 34.1 deg.C (93.3 deg.F)
```

```
   hl= 0.002924 atm-m3/mol      vp= 704.653 mmHg (13.629 psia)
       162.463 y/x
       0.11606 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.504e-05 cm2/s  dv= 0.14765 cm2/s
Compound flow rate from inlet water is 0.19189 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 31.792 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 237.766.
kl is estimated as 7.634e-06 m/s.
kg is estimated as 0.007917 m/s.  Model: 2
kg is estimated as 0.007917 m/s.  Model: 2
The Schmidt number is 1.01591.
The friction velocity is 37.398 m/s
kg is estimated as 0.017873 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.14978 m/s.
kl (agitated)is estimated as 0.021024 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 4.77e-04 m/s.
 The effective stripping time (surface + diffused air) is 48.915 minutes. (0.81526
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1907.493 min. (31.792 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                        0.15258
   KL aerated (m/s)                        0.021024
   KL OVERALL AERATED (m/s)                0.009769
   KG quiescent (m/s)                      0.008066
   KL quiescent (m/s)                      7.634e-06
   KL OVERALL QUIESCENT (m/s)              7.574e-06
   KL OVERALL (m/s)                        4.77e-04
   air stripping time constant (min)       48.915
   FRACTION SURFACE VOLATILIZED            0.80226
   FRACTION SUBMERGED VOLATILIZED          0.
   TOTAL FRACTION VOLATILIZED              0.80226
   FRACTION BIOLOGICALLY REMOVED           0.17717
   FRACTION ABSORBED                       0.
   TOTAL AIR EMISSIONS  (g/s)              0.15394
                    (Mg/year)              4.85471
   EMISSION FACTOR  (g/cm2-s)              1.769e-10
   UNIT EXIT CONCENTRATION (ppmw)          0.003708
DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream
```



```
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is system exit stream
1 Description of unit                     12    def.system exit st

   TOTAL AIR EMISSIONS  (g/s)              0.
```

```
                     (Mg/year)              0.
   EMISSION FACTOR  (g/cm2-s)              1.769e-10
   UNIT EXIT CONCENTRATION (ppmw)          1.362e-05
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain


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COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is open hub drain
1 Description of unit                      13    default open hub d
2 Underflow T (C)                                43.89
3 Total water added at the unit (l/s)            0
4 Area of openings at unit (cm2)                 50
5 Radius of drop pipe (cm)                       5
6 Drop length to conduit (cm)                    61
7 Open surface=1                                 1
8 Subsurface entrance=1                          0
9 subsurface exit =1                             0
10 radius of underflow conduit (cm)              12
11 distance to next unit (cm)                    500
12 slope of underflow conduit                    0.015
16 velocity air at drain opening (ft/min)        84
17 municipal waste in conduit =1                 0
18 Assume equilibrium in unit, =1                0
19 pH  (enter 0 for no pH adjustment)            8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1064.53 l/s.
   Weight fraction down is  2.088E-07
   Gas concentration in  0 mol fraction.
   Gas flow  1064.53 L/s
   Weight fraction out at base of drop is  1.80253671574623E-07
   fraction transferred in the drain drop from hub is .136716
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.13672
   fraction loss in unit                    0.
   fraction loss in line run                0.
   component upstream of unit, g/s          0.
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             4.509e-19
   mol fract. headspace vent base           1.195e-05
   headspace flow out vent (cc/s)           -1.065e+06
   headspace flow down line (cc/s)          1.065e+06
   KG surface (m/s)                         2626.947
   KL surface (m/s)                         8.245e-09
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.22227
   total component into unit, g/s           0.19189
   TOTAL AIR EMISSIONS  (g/s)               0.030388
                     (Mg/year)              0.95833
   EMISSION FACTOR  (g/cm2-s)               1.769e-10
   UNIT EXIT CONCENTRATION (ppmw)           0.18025
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment


                        WWTP\BAE\TRS\WATER9\ASB V5 3/14/2023 2:17:21 PM  19:18:13
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is aerated biotreatment
1 Description of unit                      17    ASB Zone 3
```

```
2 Wastewater temperature   (C)                     30.01
3 length of aeration unit (m)                      376
4 width of aeration unit (m)                       188
5 depth of aeration unit (m)                       0.91
6 Area of agitation (each aerator,m2)              135
7 Total number of agitators in the unit            6
8 Power of agitation (each aerator,HP)             75
9 Impeller diameter (cm)                           49.53
10 Impeller rotation (RPM)                         1200
11 Agitator mechanical efficiency                  0.83
12 aerator effectiveness, alpha                    0.83
13 if there is plug flow, enter 1                  0
14 Overall biorate (mg/g bio-hr)                   19
15 Aeration air flow (m3/s)                        0
16 active biomass, aeration (g/l)                  0.3
17 If covered, then enter 1                        0
18 special input                                   0
19 pH  (enter 0 for no pH adjustment)              7.42

Properties of DIMETHYL SULFIDE  (DMS) at 30. deg.C (86. deg.F)
   hl= 0.002519 atm-m3/mol      vp= 606.985 mmHg (11.74 psia)
       139.945 y/x
       0.10132 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.485e-05 cm2/s  dv= 0.14425 cm2/s
Compound flow rate from inlet water is 1.708e-04 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 16.785 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 7.566e-06 m/s.
kg is estimated as 0.007884 m/s.  Model: 2
kg is estimated as 0.007884 m/s.  Model: 2
The Schmidt number is 1.03989.
The friction velocity is 37.398 m/s
kg is estimated as 0.017611 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.14804 m/s.
kl (agitated)is estimated as 0.018962 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 1.053e-04 m/s.
 The effective stripping time (surface + diffused air) is 144.073 minutes.
 (2.40122 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1007.112 min. (16.785 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                         0.15081
   KL aerated (m/s)                         0.018962
   KL OVERALL AERATED (m/s)                 0.00854
   KG quiescent (m/s)                       0.008032
   KL quiescent (m/s)                       7.566e-06
   KL OVERALL QUIESCENT (m/s)               7.497e-06
   KL OVERALL (m/s)                         1.053e-04
   air stripping time constant (min)        144.073
```

```
   FRACTION SURFACE VOLATILIZED              0.59355
   FRACTION SUBMERGED VOLATILIZED            0.
   TOTAL FRACTION VOLATILIZED                0.59355
   FRACTION BIOLOGICALLY REMOVED             0.32154
   FRACTION ABSORBED                         0.
   TOTAL AIR EMISSIONS  (g/s)                1.014e-04
                    (Mg/year)                0.003197
   EMISSION FACTOR  (g/cm2-s)                1.434e-13
   UNIT EXIT CONCENTRATION (ppmw)            1.362e-05
DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment

                       WWTP\BAE\TRS\WATER9\ASB V5 3/14/2023 2:17:21 PM  19:18:13
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is aerated biotreatment
1 Description of unit                        18    ASB Zone 2
2 Wastewater temperature   (C)                     32.08
3 length of aeration unit (m)                      368
4 width of aeration unit (m)                       184
5 depth of aeration unit (m)                       0.97
6 Area of agitation (each aerator,m2)              135
7 Total number of agitators in the unit            15
8 Power of agitation (each aerator,HP)             75
9 Impeller diameter (cm)                           49.53
10 Impeller rotation (RPM)                         1200
11 Agitator mechanical efficiency                  0.83
12 aerator effectiveness, alpha                    0.83
13 if there is plug flow, enter 1                  0
14 Overall biorate (mg/g bio-hr)                   19
15 Aeration air flow (m3/s)                        0
16 active biomass, aeration (g/l)                  0.3
17 If covered, then enter 1                        0
18 special input                                   0
19 pH  (enter 0 for no pH adjustment)              7.24

Properties of DIMETHYL SULFIDE  (DMS) at 32.1 deg.C (89.7 deg.F)
   hl= 0.002719 atm-m3/mol      vp= 655.201 mmHg (12.673 psia)
       151.062 y/x
       0.10863 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.495e-05 cm2/s  dv= 0.14597 cm2/s
Compound flow rate from inlet water is 0.003948 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 17.139 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 7.6e-06 m/s.
kg is estimated as 0.007966 m/s.  Model: 2
kg is estimated as 0.007966 m/s.  Model: 2
The Schmidt number is 1.02758.
The friction velocity is 37.398 m/s
kg is estimated as 0.017744 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
```

```
kg (agitated)is estimated as 0.14892 m/s.
kl (agitated)is estimated as 0.019984 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 2.809e-04 m/s.
 The effective stripping time (surface + diffused air) is 57.552 minutes. (0.9592 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1028.32 min. (17.139 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                         0.15171
   KL aerated (m/s)                         0.019984
   KL OVERALL AERATED (m/s)                 0.009148
   KG quiescent (m/s)                       0.008115
   KL quiescent (m/s)                       7.6e-06
   KL OVERALL QUIESCENT (m/s)               7.537e-06
   KL OVERALL (m/s)                         2.809e-04
   air stripping time constant (min)        57.552
   FRACTION SURFACE VOLATILIZED             0.77311
   FRACTION SUBMERGED VOLATILIZED           0.
   TOTAL FRACTION VOLATILIZED               0.77311
   FRACTION BIOLOGICALLY REMOVED            0.18362
   FRACTION ABSORBED                        0.
   TOTAL AIR EMISSIONS  (g/s)               0.003052
                    (Mg/year)               0.096247
   EMISSION FACTOR  (g/cm2-s)               4.507e-12
   UNIT EXIT CONCENTRATION (ppmw)           1.605e-04
```

Type of unit is

1 Total water added at the unit (l/s)	50	0
2 Area of openings at unit (cm2)		50
3 Radius of drop pipe (cm)		5
4 Drop length to conduit (cm)		61
5 Humidity of inlet air (%)		40
6 Temperature of air (C)		25
7 Drain air velocity (ft/min)		84
8 manhole air velocity (ft/min)		128
9 Conduit air velocity (ft/min)		66
10 Wind speed (cm/s at 10 m)		447
11 distance to next unit (cm)		500
12 slope of underflow conduit		.015
13 friction factor liquid		.016
14 friction factor gas		.006
15 radius of underflow conduit (cm)		12
16 Underflow T (C)		25
17 oscillation cycle time (min)		5
18 design collection velocities (ft/s)		2
19 design branch line fraction full		.4

Type of unit is

8 HL partition flag=1, adjust for sorption	0
9 unit recycle convergence number	200
10 oil molecular weight	0
11 oil density (g/cc)	0
12 NaUT 1=municipal 2=industrial 3=turb.	0
13 NaUT 1=mass tr. 2=equil	0
14 parts biomass per 1000 parts COD	
15 oil water partition method 0=owpc	
16 use UNIFAC aqueous data base =1	
17 specify mass transfer for unit, =1	
18 Use biomass for unit option, =1	
19 biogrowth Monod half concentration ppm	

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment

COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment

1 Description of unit	11	ASB Zone 1
2 Wastewater temperature (C)		34.08
3 length of aeration unit (m)		295
4 width of aeration unit (m)		295
5 depth of aeration unit (m)		1.4
6 Area of agitation (each aerator,m2)		135
7 Total number of agitators in the unit		31
8 Power of agitation (each aerator,HP)		75
9 Impeller diameter (cm)		49.53
10 Impeller rotation (RPM)		1200
11 Agitator mechanical efficiency		0.83
12 aerator effectiveness, alpha		0.83
13 if there is plug flow, enter 1		0
14 Overall biorate (mg/g bio-hr)		19
15 Aeration air flow (m3/s)		0
16 active biomass, aeration (g/l)		0.3
17 If covered, then enter 1		0
18 special input		0
19 pH (enter 0 for no pH adjustment)		7.04

Properties of METHANETHIOL(methyl mercaptan) at 34.1 deg.C (93.3 deg.F)

```
    hl= 0.004158 atm-m3/mol      vp= 2272.142 mmHg (43.948 psia)
        230.99 y/x
        0.16502 g/L gas per g/L liquid
    Temperature adjustment factor = 1.046 ^(T-25), deg. C
    k1= 0. L/g-hr          dl= 1.525e-05 cm2/s  dv= 0.23702 cm2/s
 Compound flow rate from inlet water is 0.003078 g/s.
 Compound flow rate from inlet vent is 0. g/s.
 Compound flow rate from inlet duct is 0. g/s.
 Submerged aeration rate from inlet vent is 0. m3/s.
 Total submerged aeration is 0. m3/s.
 The residence time in the unit is 31.792 hr.
 ____Biomass production________________
     The biomass production rate is 0.mg/hr. (0. mg/L)
     The fraction dissolved solids converted is 0. .
     The estimated biomass exit concentration is 0. mg/L.
 ________Quiescent wind shear surface___Springer_
 The fetch to depth ratio is 237.766.
 kl is estimated as 7.703e-06 m/s.
 kg is estimated as 0.010871 m/s.  Model: 2
 kg is estimated as 0.010871 m/s.  Model: 2
 The Schmidt number is 0.63285.
 The friction velocity is 37.398 m/s
 kg is estimated as 0.024173 m/s.  Model: 3
 ________Agitated surface___________________
 The rotation speed is 125.654 radians per second.
 The rotation factor NRW is 2.052e+06.
 The power number NPR is 7.881e-04.
 The rotation factor NFR is 797.027.
 kg (agitated)is estimated as 0.18977 m/s.
 kl (agitated)is estimated as 0.021167 m/s.
     The specified and growth biomass is 0.3 g/L.
  The effective KL (surface + diffused air) is 6.265e-04 m/s.
  The effective stripping time (surface + diffused air) is 37.242 minutes. (0.62071
  hrs.)
  The pump mixing time is 5 x the pumping recirculaion time, 0. min.
  The ratio of the mixing to the striping (surface + diffused air) is 0.
  The mean residence time is 1907.493 min. (31.792 hr.)
  The ratio of the pump mixing to the residence time is 0.
    KG aerated (m/s)                          0.19332
    KL aerated (m/s)                          0.021167
    KL OVERALL AERATED (m/s)                  0.012876
    KG quiescent (m/s)                        0.011075
    KL quiescent (m/s)                        7.703e-06
    KL OVERALL QUIESCENT (m/s)                7.672e-06
    KL OVERALL (m/s)                          6.265e-04
    air stripping time constant (min)         37.242
    FRACTION SURFACE VOLATILIZED              0.88891
    FRACTION SUBMERGED VOLATILIZED            0.
    TOTAL FRACTION VOLATILIZED                0.88891
    FRACTION BIOLOGICALLY REMOVED             0.093739
    FRACTION ABSORBED                         0.
    TOTAL AIR EMISSIONS  (g/s)                0.002736
                     (Mg/year)                0.086272
    EMISSION FACTOR  (g/cm2-s)                3.144e-12
    UNIT EXIT CONCENTRATION (ppmw)            5.017e-05
 DETAILED CALCULATIONS at Unit 12 def.system exit st
 Type: system exit stream
```



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 COMPOUND: METHANETHIOL(methyl mercaptan)

 Type of unit is system exit stream
 1 Description of unit                       12    def.system exit st

    TOTAL AIR EMISSIONS  (g/s)                0.
```

```
                     (Mg/year)               0.
   EMISSION FACTOR  (g/cm2-s)                3.144e-12
   UNIT EXIT CONCENTRATION (ppmw)            1.458e-07
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain

                        WWTP\BAE\TRS\WATER9\ASB V5 3/14/2023 2:17:21 PM  19:18:53
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is open hub drain
1 Description of unit                      13    default open hub d
2 Underflow T (C)                                43.89
3 Total water added at the unit (l/s)            0
4 Area of openings at unit (cm2)                 50
5 Radius of drop pipe (cm)                       5
6 Drop length to conduit (cm)                    61
7 Open surface=1                                 1
8 Subsurface entrance=1                          0
9 subsurface exit =1                             0
10 radius of underflow conduit (cm)              12
11 distance to next unit (cm)                    500
12 slope of underflow conduit                    0.015
16 velocity air at drain opening (ft/min)        84
17 municipal waste in conduit =1                 0
18 Assume equilibrium in unit, =1                0
19 pH  (enter 0 for no pH adjustment)            8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1064.53 l/s.
   Weight fraction down is  3.5E-09
   Gas concentration in  0 mol fraction.
   Gas flow  1064.53 L/s
   Weight fraction out at base of drop is  2.89099406807993E-09
   fraction transferred in the drain drop from hub is .174002
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.174
   fraction loss in unit                    0.
   fraction loss in line run                0.
   component upstream of unit, g/s          0.
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             9.429e-21
   mol fract. headspace vent base           3.292e-07
   headspace flow out vent (cc/s)           -1.065e+06
   headspace flow down line (cc/s)          1.065e+06
   KG surface (m/s)                         3602.086
   KL surface (m/s)                         8.324e-09
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.003726
   total component into unit, g/s           0.003078
   TOTAL AIR EMISSIONS  (g/s)               6.483e-04
                     (Mg/year)              0.020445
   EMISSION FACTOR  (g/cm2-s)               3.144e-12
   UNIT EXIT CONCENTRATION (ppmw)           0.002891
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment

                        WWTP\BAE\TRS\WATER9\ASB V5 3/14/2023 2:17:21 PM  19:18:53
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment
1 Description of unit                      17    ASB Zone 3
```

```
2 Wastewater temperature   (C)                   30.01
3 length of aeration unit (m)                    376
4 width of aeration unit (m)                     188
5 depth of aeration unit (m)                     0.91
6 Area of agitation (each aerator,m2)            135
7 Total number of agitators in the unit          6
8 Power of agitation (each aerator,HP)           75
9 Impeller diameter (cm)                         49.53
10 Impeller rotation (RPM)                       1200
11 Agitator mechanical efficiency                0.83
12 aerator effectiveness, alpha                  0.83
13 if there is plug flow, enter 1                0
14 Overall biorate (mg/g bio-hr)                 19
15 Aeration air flow (m3/s)                      0
16 active biomass, aeration (g/l)                0.3
17 If covered, then enter 1                      0
18 special input                                 0
19 pH  (enter 0 for no pH adjustment)            7.42

Properties of METHANETHIOL(methyl mercaptan) at 30. deg.C (86. deg.F)
   hl= 0.003687 atm-m3/mol      vp= 2014.774 mmHg (38.97 psia)
       204.826 y/x
       0.14829 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr         dl= 1.505e-05 cm2/s  dv= 0.23155 cm2/s
Compound flow rate from inlet water is 1.957e-06 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 16.785 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 7.635e-06 m/s.
kg is estimated as 0.010826 m/s.  Model: 2
kg is estimated as 0.010826 m/s.  Model: 2
The Schmidt number is 0.64779.
The friction velocity is 37.398 m/s
kg is estimated as 0.023814 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.18756 m/s.
kl (agitated)is estimated as 0.019092 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 1.391e-04 m/s.
 The effective stripping time (surface + diffused air) is 109.038 minutes.
 (1.81731 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1007.112 min. (16.785 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                         0.19108
   KL aerated (m/s)                         0.019092
   KL OVERALL AERATED (m/s)                 0.011483
   KG quiescent (m/s)                       0.011029
   KL quiescent (m/s)                       7.635e-06
   KL OVERALL QUIESCENT (m/s)               7.6e-06
   KL OVERALL (m/s)                         1.391e-04
   air stripping time constant (min)        109.038
```

```
   FRACTION SURFACE VOLATILIZED             0.7324
   FRACTION SUBMERGED VOLATILIZED           0.
   TOTAL FRACTION VOLATILIZED               0.7324
   FRACTION BIOLOGICALLY REMOVED            0.1883
   FRACTION ABSORBED                        0.
   TOTAL AIR EMISSIONS  (g/s)               1.433e-06
                    (Mg/year)               4.52e-05
   EMISSION FACTOR  (g/cm2-s)               2.028e-15
   UNIT EXIT CONCENTRATION (ppmw)           1.458e-07
DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment

                       WWTP\BAE\TRS\WATER9\ASB V5 3/14/2023 2:17:21 PM  19:18:53
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment
1 Description of unit                       18    ASB Zone 2
2 Wastewater temperature   (C)                    32.08
3 length of aeration unit (m)                     368
4 width of aeration unit (m)                      184
5 depth of aeration unit (m)                      0.97
6 Area of agitation (each aerator,m2)             135
7 Total number of agitators in the unit           15
8 Power of agitation (each aerator,HP)            75
9 Impeller diameter (cm)                          49.53
10 Impeller rotation (RPM)                        1200
11 Agitator mechanical efficiency                 0.83
12 aerator effectiveness, alpha                   0.83
13 if there is plug flow, enter 1                 0
14 Overall biorate (mg/g bio-hr)                  19
15 Aeration air flow (m3/s)                       0
16 active biomass, aeration (g/l)                 0.3
17 If covered, then enter 1                       0
18 special input                                  0
19 pH  (enter 0 for no pH adjustment)             7.24

Properties of METHANETHIOL(methyl mercaptan) at 32.1 deg.C (89.7 deg.F)
   hl= 0.003921 atm-m3/mol      vp= 2142.771 mmHg (41.446 psia)
       217.838 y/x
       0.15664 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.515e-05 cm2/s  dv= 0.23433 cm2/s
Compound flow rate from inlet water is 5.341e-05 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 17.139 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 7.67e-06 m/s.
kg is estimated as 0.010938 m/s.  Model: 2
kg is estimated as 0.010938 m/s.  Model: 2
The Schmidt number is 0.64013.
The friction velocity is 37.398 m/s
kg is estimated as 0.023996 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
```

kg (agitated)is estimated as 0.18868 m/s.
kl (agitated)is estimated as 0.020121 m/s.
The specified and growth biomass is 0.3 g/L.
The effective KL (surface + diffused air) is 3.715e-04 m/s.
The effective stripping time (surface + diffused air) is 43.518 minutes. (0.72529 hrs.)
The pump mixing time is 5 x the pumping recirculaion time, 0. min.
The ratio of the mixing to the striping (surface + diffused air) is 0.
The mean residence time is 1028.32 min. (17.139 hr.)
The ratio of the pump mixing to the residence time is 0.

KG aerated (m/s)	0.19222
KL aerated (m/s)	0.020121
KL OVERALL AERATED (m/s)	0.012174
KG quiescent (m/s)	0.011143
KL quiescent (m/s)	7.67e-06
KL OVERALL QUIESCENT (m/s)	7.637e-06
KL OVERALL (m/s)	3.715e-04
air stripping time constant (min)	43.518
FRACTION SURFACE VOLATILIZED	0.86584
FRACTION SUBMERGED VOLATILIZED	0.
TOTAL FRACTION VOLATILIZED	0.86584
FRACTION BIOLOGICALLY REMOVED	0.097514
FRACTION ABSORBED	0.
TOTAL AIR EMISSIONS (g/s)	4.625e-05
(Mg/year)	0.001458
EMISSION FACTOR (g/cm2-s)	6.83e-14
UNIT EXIT CONCENTRATION (ppmw)	1.838e-06

BAE H2S Factor
Summary of H2SSIM Inputs and Outputs

H2SSIM Inputs Windspeed: 3.55 mph **H2SSIM Outputs**

5/17/2022

	Zone 1	Zone 2	Zone 3
DO	1.57	4.63	4.66
Temp	87.52	83.91	80.19
pH	6.77	7.19	7.44
Length	968	1208	1235
Width	968	604	617
Aerators	31	15	6
Total HP	2325	1125	450

	Main Inlet	Hardpipe	Units
Flow	25.11	0.35	MGD
Total Sulfide	0.060	1.06	mg/L
Sulfate	390	390	mg/L

	Zone 1	Zone 2	Zone 3	Total ASB	
H2S g/s	0.07	0.02	0.02	**0.111**	g/s
				1723	ODTP
				0.012	lb/ODTP

7/19/2022

	Zone 1	Zone 2	Zone 3
DO	1.57	4.63	4.66
Temp	96.27	93.37	89.26
pH	7.17	7.37	7.48
Length	968	1208	1235
Width	968	604	617
Aerators	31	15	6

	Main Inlet	Hardpipe	Units
Flow	25.32	0.42	MGD
Total Sulfide	0.921	0.583	mg/L
Sulfate	390	390	mg/L

	Zone 1	Zone 2	Zone 3	Total ASB	
H2S g/s	0.09	0.03	0.02	**0.144**	g/s
				1900	ODTP
				0.014	lb/ODTP

7/20/2022

	Zone 1	Zone 2	Zone 3
DO	1.57	4.63	4.66
Temp	94.80	91.27	87.57
pH	7.10	7.22	7.39
Length	968	1208	1235
Width	968	604	617
Aerators	31	15	6

	Main Inlet	Hardpipe	Units
Flow	25.48	0.39	MGD
Total Sulfide	0.053	0.762	mg/L
Sulfate	390	390	mg/L

	Zone 1	Zone 2	Zone 3	Total ASB	
H2S g/s	0.06	0.03	0.02	**0.111**	g/s
				1900	ODTP
				0.011	lb/ODTP
				0.01	

7/21/2022

	Zone 1	Zone 2	Zone 3
DO	1.57	4.63	4.66
Temp	94.76	90.42	87.08
pH	7.10	7.19	7.35
Length	968	1208	1235
Width	968	604	617
Aerators	31	15	6

	Main Inlet	Hardpipe	Units
Flow	19.93	0.19	MGD
Total Sulfide	0.094	0.625	mg/L
Sulfate	390	390	mg/L

	Zone 1	Zone 2	Zone 3	Total ASB	
H2S g/s	0.06	0.03	0.02	**0.111**	g/s
				940	ODTP
				0.022	lb/ODTP

*DO are based on average of all DO readings from 2021 and 2022 Subpart S performance testing.

AVG: **0.015** lb/ODTP

NCASI WASTEWATER HYDROGEN SULFIDE EMISSIONS SIMULATOR (H2SSIM)

Version 1.3

5/17/2022

Data Type 1. Site Identification

Company Name	New-Indy
Facility Name	Catawba SC
Basin Name	ASB

Data Type 2. Model Zone Information

Number of Zones	3
Zone Location of Hardpipe	1
Type of Basin	ASB

Data Type 3. Load Characteristics

Loading Characteristics	Main Influent	Hardpipe	Units
Flow	25.11	0.35	MGD
Total Sulfide	0.06	1.057	mg/L
Sulfate	390	390	mg/L

Data Type 4. Atmospheric Conditions

Windspeed	3.55	mph
Ambient Temperature	79	F

Data Type 5. Zone Physical and Chemical Conditions

Zone Condition	Zone 1	Zone 2	Zone 3	Zone 4	Units
Dissolved Oxygen	1.571780303	4.6275	4.659734848		mg/L
Temperature	87.52	83.91	80.19		F
pH	6.77	7.19	7.44		s.u.
Redox Condition	Aerobic	Aerobic	Aerobic	Aerobic	
Length	968	1208	1235		feet
Width	968	604	617		feet
Depth	4.5	3.2	3		feet
Mixing	Moderat	Moderat	Moderat		
Number of Aerators	31	15	6		
Total Horsepower	2325	1125	450		HP
Impellor Size	1.625	1.625	1.625		feet
Impellor RPM	1200	1200	1200		RPM
Diffused Air Flow	0	0	0		cms
Weir Height	0	0	0		feet

Model Controls

Run H2SSIM

View Parameters

Clear Input Sheet

H2SSIM Results

5/17/2022

Basin Emissions		Units
Total Emissions (H_2S)	0.111	gms/s
Total Emissions (H_2S)	7726.8	lbs/yr
Total Emissions (H_2S)	3.9	tons/yr
Total Emissions (H_2S)	3.5	tonnes/yr
Emission Flux (H_2S)	15.5	gms/m^2 yr

Zone Emissions	Zone 1	Zone 2	Zone 3	Zone 4	Units
Zone Emissions (H_2S)	0.07	0.02	0.02		gms/s
Zone Emissions (H_2S)	4978.9	1486.3	1261.7		lbs/yr
Emission Flux (H_2S)	25.9	9.9	8.1		gms/m^2 yr
Liquid Conc. (Total Sulfide)	0.003	0.001	0.000		mg/L
Liquid Sulfide Load (lbs/yr)	34.400	6.200	5.200		lbs/yr

Percent Inlet Sulfide Removed	-35.4%

Current Parameters	
kgen	0.25
ThetaGen	1.06
KDO	0.05
KSO4	10
kanox	0.006
ThetaOx	1.05
m	1
n	0.2
MLVSS	272.2
O_2 Transfer Coeff.	2
alpha 1	0.83
alpha 2	0.6

NCASI WASTEWATER HYDROGEN SULFIDE EMISSIONS SIMULATOR (H2SSIM)

Version 1.3

7/19/2022

Data Type 1. Site Identification

Company Name	New-Indy
Facility Name	Catawba SC
Basin Name	ASB

Data Type 2. Model Zone Information

Number of Zones	3
Zone Location of Hardpipe	1
Type of Basin	ASB

Data Type 3. Load Characteristics

Loading Characteristics	Main Influent	Hardpipe	Units
Flow	25.32	0.42	MGD
Total Sulfide	0.921	0.583	mg/L
Sulfate	390	390	mg/L

Data Type 4. Atmospheric Conditions

Windspeed	3.55	mph
Ambient Temperature	79	F

Data Type 5. Zone Physical and Chemical Conditions

Zone Condition	Zone 1	Zone 2	Zone 3	Zone 4	Units
Dissolved Oxygen	1.571780303	4.6275	4.659734848		mg/L
Temperature	96.27	93.37	89.26		F
pH	7.17	7.37	7.48		s.u.
Redox Condition	Aerobic	Aerobic	Aerobic	Aerobic	
Length	968	1208	1235		feet
Width	968	604	617		feet
Depth	4.5	3.2	3		feet
Mixing	Moderat	Moderat	Moderat		
Number of Aerators	31	15	6		
Total Horsepower	2325	1125	450		HP
Impellor Size	1.625	1.625	1.625		feet
Impellor RPM	1200	1200	1200		RPM
Diffused Air Flow	0	0	0		cms
Weir Height	0	0	0		feet

Model Controls

Run H2SSIM

View Parameters

Clear Input Sheet

H2SSIM Results

7/19/2022

Basin Emissions		Units
Total Emissions (H_2S)	0.145	gms/s
Total Emissions (H_2S)	10050.3	lbs/yr
Total Emissions (H_2S)	5.0	tons/yr
Total Emissions (H_2S)	4.6	tonnes/yr
Emission Flux (H_2S)	20.2	gms/m^2 yr

Zone Emissions	Zone 1	Zone 2	Zone 3	Zone 4	Units
Zone Emissions (H_2S)	0.09	0.03	0.02		gms/s
Zone Emissions (H_2S)	6430.8	1936.5	1683.0		lbs/yr
Emission Flux (H_2S)	33.5	13.0	10.8		gms/m^2 yr
Liquid Conc. (Total Sulfide)	0.005	0.000	0.000		mg/L
Liquid Sulfide Load (lbs/yr)	60.200	6.100	5.400		lbs/yr

Percent Inlet Sulfide Removed	86.0%

Current Parameters	
kgen	0.25
ThetaGen	1.06
KDO	0.05
KSO4	10
kanox	0.006
ThetaOx	1.05
m	1
n	0.2
MLVSS	272.2
O_2 Transfer Coeff.	2
alpha 1	0.83
alpha 2	0.6

NCASI WASTEWATER HYDROGEN SULFIDE EMISSIONS SIMULATOR (H2SSIM)
Version 1.3

7/20/2022

Data Type 1. Site Identification

Company Name	New-Indy
Facility Name	Catawba SC
Basin Name	ASB

Data Type 2. Model Zone Information

Number of Zones	3
Zone Location of Hardpipe	1
Type of Basin	ASB

Data Type 3. Load Characteristics

Loading Characteristics	Main Influent	Hardpipe	Units
Flow	25.48	0.39	MGD
Total Sulfide	0.053	0.762	mg/L
Sulfate	390	390	mg/L

Data Type 4. Atmospheric Conditions

Windspeed	3.55	mph
Ambient Temperature	79	F

Data Type 5. Zone Physical and Chemical Conditions

Zone Condition	Zone 1	Zone 2	Zone 3	Zone 4	Units
Dissolved Oxygen	1.571780303	4.6275	4.659734848		mg/L
Temperature	94.8	91.27	87.57		F
pH	7.1	7.22	7.39		s.u.
Redox Condition	Aerobic	Aerobic	Aerobic	Aerobic	
Length	968	1208	1235		feet
Width	968	604	617		feet
Depth	4.5	3.2	3		feet
Mixing	Moderat	Moderat	Moderat		
Number of Aerators	31	15	6		
Total Horsepower	2325	1125	450		HP
Impellor Size	1.625	1.625	1.625		feet
Impellor RPM	1200	1200	1200		RPM
Diffused Air Flow	0	0	0		cms
Weir Height	0	0	0		feet

Model Controls

Run H2SSIM

View Parameters

Clear Input Sheet

H2SSIM Results

7/20/2022

Basin Emissions		Units
Total Emissions (H_2S)	0.111	gms/s
Total Emissions (H_2S)	7721.2	lbs/yr
Total Emissions (H_2S)	3.9	tons/yr
Total Emissions (H_2S)	3.5	tonnes/yr
Emission Flux (H_2S)	15.5	gms/m^2 yr

Zone Emissions	Zone 1	Zone 2	Zone 3	Zone 4	Units
Zone Emissions (H_2S)	0.06	0.03	0.02		gms/s
Zone Emissions (H_2S)	4266.3	1852.9	1602.0		lbs/yr
Emission Flux (H_2S)	22.2	12.4	10.3		gms/m^2 yr
Liquid Conc. (Total Sulfide)	0.002	0.001	0.000		mg/L
Liquid Sulfide Load (lbs/yr)	26.800	6.300	5.600		lbs/yr

Percent Inlet Sulfide Removed	-54.1%

Current Parameters	
kgen	0.25
ThetaGen	1.06
KDO	0.05
KSO4	10
kanox	0.006
ThetaOx	1.05
m	1
n	0.2
MLVSS	272.2
O_2 Transfer Coeff.	2
alpha 1	0.83
alpha 2	0.6

NCASI WASTEWATER HYDROGEN SULFIDE EMISSIONS SIMULATOR (H2SSIM)

Version 1.3

7/21/2022

Data Type 1. Site Identification

Company Name	New-Indy
Facility Name	Catawba SC
Basin Name	ASB

Data Type 2. Model Zone Information

Number of Zones	3
Zone Location of Hardpipe	1
Type of Basin	ASB

Data Type 3. Load Characteristics

Loading Characteristics	Main Influent	Hardpipe	Units
Flow	19.93	0.19	MGD
Total Sulfide	0.094	0.625	mg/L
Sulfate	390	390	mg/L

Data Type 4. Atmospheric Conditions

Windspeed	3.55	mph
Ambient Temperature	79	F

Data Type 5. Zone Physical and Chemical Conditions

Zone Condition	Zone 1	Zone 2	Zone 3	Zone 4	Units
Dissolved Oxygen	1.571780303	4.6275	4.659734848		mg/L
Temperature	94.76	90.42	87.08		F
pH	7.1	7.19	7.35		s.u.
Redox Condition	Aerobic	Aerobic	Aerobic	Aerobic	
Length	968	1208	1235		feet
Width	968	604	617		feet
Depth	4.5	3.2	3		feet
Mixing	Moderat	Moderat	Moderat		
Number of Aerators	31	15	6		
Total Horsepower	2325	1125	450		HP
Impellor Size	1.625	1.625	1.625		feet
Impellor RPM	1200	1200	1200		RPM
Diffused Air Flow	0	0	0		cms
Weir Height	0	0	0		feet

Model Controls

Run H2SSIM

View Parameters

Clear Input Sheet

H2SSIM Results

7/21/2022

Basin Emissions		Units
Total Emissions (H_2S)	0.111	gms/s
Total Emissions (H_2S)	7700.8	lbs/yr
Total Emissions (H_2S)	3.9	tons/yr
Total Emissions (H_2S)	3.5	tonnes/yr
Emission Flux (H_2S)	15.5	gms/m^2 yr

Zone Emissions	Zone 1	Zone 2	Zone 3	Zone 4	Units
Zone Emissions (H_2S)	0.06	0.03	0.02		gms/s
Zone Emissions (H_2S)	4305.7	1814.2	1580.9		lbs/yr
Emission Flux (H_2S)	22.4	12.1	10.1		gms/m^2 yr
Liquid Conc. (Total Sulfide)	0.002	0.001	0.000		mg/L
Liquid Sulfide Load (lbs/yr)	21.300	5.000	4.400		lbs/yr

Percent Inlet Sulfide Removed	-27.1%

Current Parameters	
kgen	0.25
ThetaGen	1.06
KDO	0.05
KSO4	10
kanox	0.006
ThetaOx	1.05
m	1
n	0.2
MLVSS	272.2
O_2 Transfer Coeff.	2
alpha 1	0.83
alpha 2	0.6

WASTEWATER TREATMENT PLANT – SUPPORTING INFORMATION PROJECTED ACTUAL EMISSIONS

New Stripper Scenario - Projected Actual Emissions

H_2S, TRS Compounds, and VOC

New-Indy Catawba - Catawba, SC

Concentration Loadings	**H2S, ppm**	**DMDS, ppm**	**DMS, ppm**	**MMC, ppm**
No Hardpipe flow (foul or stripped)	N/A	N/A	N/A	N/A
ASB Influent (Wastewater)	0.25	0.09	0.20	0.0026
Flow Weighted Loading:	0.25	0.09	0.20	2.60E-03
WATER9 Results	**H2S, g/s**	**DMDS, g/s**	**DMS, g/s**	**MMC, g/s**
ASB Zone 1	0.07	0.03	0.15	2.13E-03
ASB Zone 2	0.03	5.03E-04	3.19E-03	3.77E-05
ASB Zone 3	0.02	9.42E-06	1.11E-04	1.22E-06
Total ASB	**0.12**	**0.03**	**0.16**	**2.17E-03**
PAE Emissions Factors	**H2S, lb/ODTP**	**DMDS, lb/ODTP**	**DMS, lb/ODTP**	**MMC, lb/ODTP**
Total ASB	**1.03E-02**	**2.81E-03**	**1.36E-02**	**1.88E-04**

Hardpipe Flow (Foul or Stripped Condensate)	0	MGD
Post-Project ASB Influent Flow:	25.48	MGD
Total ASB Flow:	25.48	MGD
Total ASB Flow:	1116.47	L/s
Pulp Production	2200	ODTP/day

	MW
H2S	34
DMDS	94
DMS	62
MMC	48

Type of unit is

1 Total water added at the unit (l/s)	50	0
2 Area of openings at unit (cm2)		50
3 Radius of drop pipe (cm)		5
4 Drop length to conduit (cm)		61
5 Humidity of inlet air (%)		40
6 Temperature of air (C)		25
7 Drain air velocity (ft/min)		84
8 manhole air velocity (ft/min)		128
9 Conduit air velocity (ft/min)		66
10 Wind speed (cm/s at 10 m)		447
11 distance to next unit (cm)		500
12 slope of underflow conduit		.015
13 friction factor liquid		.016
14 friction factor gas		.006
15 radius of underflow conduit (cm)		12
16 Underflow T (C)		25
17 oscillation cycle time (min)		5
18 design collection velocities (ft/s)		2
19 design branch line fraction full		.4

Type of unit is

8 HL partition flag=1, adjust for sorption	0
9 unit recycle convergence number	200
10 oil molecular weight	0
11 oil density (g/cc)	0
12 NaUT 1=municipal 2=industrial 3=turb.	0
13 NaUT 1=mass tr. 2=equil	0
14 parts biomass per 1000 parts COD	
15 oil water partition method 0=owpc	
16 use UNIFAC aqueous data base =1	
17 specify mass transfer for unit, =1	
18 Use biomass for unit option, =1	
19 biogrowth Monod half concentration ppm	

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment

WWTP\PAE\New Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM 19:27:50
COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment

1 Description of unit	11	ASB Zone 1
2 Wastewater temperature (C)		34.08
3 length of aeration unit (m)		295
4 width of aeration unit (m)		295
5 depth of aeration unit (m)		1.4
6 Area of agitation (each aerator,m2)		135
7 Total number of agitators in the unit		31
8 Power of agitation (each aerator,HP)		75
9 Impeller diameter (cm)		49.53
10 Impeller rotation (RPM)		1200
11 Agitator mechanical efficiency		0.83
12 aerator effectiveness, alpha		0.83
13 if there is plug flow, enter 1		0
14 Overall biorate (mg/g bio-hr)		19
15 Aeration air flow (m3/s)		0
16 active biomass, aeration (g/l)		0.3
17 If covered, then enter 1		0
18 special input		0
19 pH (enter 0 for no pH adjustment)		7.04

Properties of DIMETHYL DISULFIDE at 34.1 deg.C (93.3 deg.F)

```
    hl= 0.001714 atm-m3/mol      vp= 45.945 mmHg (0.88868 psia)
        95.2 y/x
        0.068011 g/L gas per g/L liquid
    Temperature adjustment factor = 1.046 ^(T-25), deg. C
    k1= 0. L/g-hr          dl= 1.041e-05 cm2/s  dv= 0.088022 cm2/s
Compound flow rate from inlet water is 0.087838 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 30.325 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 237.766.
kl is estimated as 5.971e-06 m/s.
kg is estimated as 0.005598 m/s.  Model: 2
kg is estimated as 0.005598 m/s.  Model: 2
The Schmidt number is 1.70412.
The friction velocity is 37.398 m/s
kg is estimated as 0.012927 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.11564 m/s.
kl (agitated)is estimated as 0.017486 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 2.753e-04 m/s.
 The effective stripping time (surface + diffused air) is 84.752 minutes. (1.41254
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1819.519 min. (30.325 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                         0.11781
   KL aerated (m/s)                         0.017486
   KL OVERALL AERATED (m/s)                 0.005609
   KG quiescent (m/s)                       0.005703
   KL quiescent (m/s)                       5.971e-06
   KL OVERALL QUIESCENT (m/s)               5.883e-06
   KL OVERALL (m/s)                         2.753e-04
   air stripping time constant (min)        84.752
   FRACTION SURFACE VOLATILIZED             0.36393
   FRACTION SUBMERGED VOLATILIZED           0.
   TOTAL FRACTION VOLATILIZED               0.36393
   FRACTION BIOLOGICALLY REMOVED            0.61912
   FRACTION ABSORBED                        0.
   TOTAL AIR EMISSIONS  (g/s)               0.031967
                    (Mg/year)               1.00811
   EMISSION FACTOR  (g/cm2-s)               3.673e-11
   UNIT EXIT CONCENTRATION (ppmw)           0.001334
DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream

                                                                    WWTP\PAE\New
  Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:27:50
COMPOUND: DIMETHYL DISULFIDE

Type of unit is system exit stream
1 Description of unit                     12    def.system exit st

   TOTAL AIR EMISSIONS  (g/s)               0.
```

```
                    (Mg/year)              0.
   EMISSION FACTOR  (g/cm2-s)              3.673e-11
   UNIT EXIT CONCENTRATION (ppmw)          2.231e-06
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain

                                                                   WWTP\PAE\New
  Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:27:50
COMPOUND: DIMETHYL DISULFIDE

Type of unit is open hub drain
1 Description of unit                      13    default open hub d
2 Underflow T (C)                                43.89
3 Total water added at the unit (l/s)            0
4 Area of openings at unit (cm2)                 50
5 Radius of drop pipe (cm)                       5
6 Drop length to conduit (cm)                    61
7 Open surface=1                                 1
8 Subsurface entrance=1                          0
9 subsurface exit =1                             0
10 radius of underflow conduit (cm)              12
11 distance to next unit (cm)                    500
12 slope of underflow conduit                    0.015
16 velocity air at drain opening (ft/min)        84
17 municipal waste in conduit =1                 0
18 Assume equilibrium in unit, =1                0
19 pH  (enter 0 for no pH adjustment)            8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1116 l/s.
   Weight fraction down is  8.680001E-08
   Gas concentration in  0 mol fraction.
   Gas flow  1116 L/s
   Weight fraction out at base of drop is  7.87078550837274E-08
   fraction transferred in the drain drop from hub is .093228
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.093228
   fraction loss in unit                    0.
   fraction loss in line run                0.
   component upstream of unit, g/s          0.
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             9.876e-20
   mol fract. headspace vent base           2.233e-06
   headspace flow out vent (cc/s)           -1.116e+06
   headspace flow down line (cc/s)          1.116e+06
   KG surface (m/s)                         1932.406
   KL surface (m/s)                         6.575e-09
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.096869
   total component into unit, g/s           0.087838
   TOTAL AIR EMISSIONS  (g/s)               0.009031
                    (Mg/year)               0.2848
   EMISSION FACTOR  (g/cm2-s)               3.673e-11
   UNIT EXIT CONCENTRATION (ppmw)           0.078708
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment

                                                                   WWTP\PAE\New
  Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:27:50
COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment
1 Description of unit                      17    ASB Zone 3
```

```
2 Wastewater temperature   (C)                  30.01
3 length of aeration unit (m)                   376
4 width of aeration unit (m)                    188
5 depth of aeration unit (m)                    0.91
6 Area of agitation (each aerator,m2)           135
7 Total number of agitators in the unit         6
8 Power of agitation (each aerator,HP)          75
9 Impeller diameter (cm)                        49.53
10 Impeller rotation (RPM)                      1200
11 Agitator mechanical efficiency               0.83
12 aerator effectiveness, alpha                 0.83
13 if there is plug flow, enter 1               0
14 Overall biorate (mg/g bio-hr)                19
15 Aeration air flow (m3/s)                     0
16 active biomass, aeration (g/l)               0.3
17 If covered, then enter 1                     0
18 special input                                0
19 pH  (enter 0 for no pH adjustment)           7.42

Properties of DIMETHYL DISULFIDE at 30. deg.C (86. deg.F)
   hl= 0.00141 atm-m3/mol      vp= 37.814 mmHg (0.7314 psia)
       78.352 y/x
       0.056726 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.027e-05 cm2/s  dv= 0.085991 cm2/s
Compound flow rate from inlet water is 5.19e-05 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 16.011 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 5.918e-06 m/s.
kg is estimated as 0.005575 m/s.  Model: 2
kg is estimated as 0.005575 m/s.  Model: 2
The Schmidt number is 1.74436.
The friction velocity is 37.398 m/s
kg is estimated as 0.012742 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.1143 m/s.
kl (agitated)is estimated as 0.015772 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 5.972e-05 m/s.
 The effective stripping time (surface + diffused air) is 253.944 minutes. (4.2324
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 960.664 min. (16.011 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                           0.11644
   KL aerated (m/s)                           0.015772
   KL OVERALL AERATED (m/s)                   0.004711
   KG quiescent (m/s)                         0.005679
   KL quiescent (m/s)                         5.918e-06
   KL OVERALL QUIESCENT (m/s)                 5.813e-06
   KL OVERALL (m/s)                           5.972e-05
   air stripping time constant (min)          253.944
```

FRACTION SURFACE VOLATILIZED 0.18149
FRACTION SUBMERGED VOLATILIZED 0.
TOTAL FRACTION VOLATILIZED 0.18149
FRACTION BIOLOGICALLY REMOVED 0.77054
FRACTION ABSORBED 0.
TOTAL AIR EMISSIONS (g/s) 9.419e-06
(Mg/year) 2.97e-04
EMISSION FACTOR (g/cm2-s) 1.332e-14
UNIT EXIT CONCENTRATION (ppmw) 2.231e-06

DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment

WWTP\PAE\New Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM 19:27:50

COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment

1 Description of unit	18	ASB Zone 2
2 Wastewater temperature (C)		32.08
3 length of aeration unit (m)		368
4 width of aeration unit (m)		184
5 depth of aeration unit (m)		0.97
6 Area of agitation (each aerator,m2)		135
7 Total number of agitators in the unit		15
8 Power of agitation (each aerator,HP)		75
9 Impeller diameter (cm)		49.53
10 Impeller rotation (RPM)		1200
11 Agitator mechanical efficiency		0.83
12 aerator effectiveness, alpha		0.83
13 if there is plug flow, enter 1		0
14 Overall biorate (mg/g bio-hr)		19
15 Aeration air flow (m3/s)		0
16 active biomass, aeration (g/l)		0.3
17 If covered, then enter 1		0
18 special input		0
19 pH (enter 0 for no pH adjustment)		7.24

Properties of DIMETHYL DISULFIDE at 32.1 deg.C (89.7 deg.F)
hl= 0.001558 atm-m3/mol vp= 41.785 mmHg (0.80821 psia)
86.579 y/x
0.062258 g/L gas per g/L liquid
Temperature adjustment factor = 1.046 ^(T-25), deg. C
k1= 0. L/g-hr dl= 1.034e-05 cm2/s dv= 0.087022 cm2/s
Compound flow rate from inlet water is 0.001489 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 16.348 hr.
____Biomass production________________
The biomass production rate is 0.mg/hr. (0. mg/L)
The fraction dissolved solids converted is 0. .
The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 5.945e-06 m/s.
kg is estimated as 0.005633 m/s. Model: 2
kg is estimated as 0.005633 m/s. Model: 2
The Schmidt number is 1.72371.
The friction velocity is 37.398 m/s
kg is estimated as 0.012836 m/s. Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.

```
kg (agitated)is estimated as 0.11498 m/s.
kl (agitated)is estimated as 0.016622 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 1.598e-04 m/s.
 The effective stripping time (surface + diffused air) is 101.198 minutes.
 (1.68663 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 980.894 min. (16.348 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                         0.11714
   KL aerated (m/s)                         0.016622
   KL OVERALL AERATED (m/s)                 0.005152
   KG quiescent (m/s)                       0.005738
   KL quiescent (m/s)                       5.945e-06
   KL OVERALL QUIESCENT (m/s)               5.85e-06
   KL OVERALL (m/s)                         1.598e-04
   air stripping time constant (min)        101.198
   FRACTION SURFACE VOLATILIZED             0.33782
   FRACTION SUBMERGED VOLATILIZED           0.
   TOTAL FRACTION VOLATILIZED               0.33782
   FRACTION BIOLOGICALLY REMOVED            0.62732
   FRACTION ABSORBED                        0.
   TOTAL AIR EMISSIONS  (g/s)               5.03e-04
                     (Mg/year)              0.015863
   EMISSION FACTOR  (g/cm2-s)               7.429e-13
   UNIT EXIT CONCENTRATION (ppmw)           4.65e-05
```

```
Type of unit is
1 Total water added at the unit (l/s)      50     0
2 Area of openings at unit (cm2)                  50
3 Radius of drop pipe (cm)                        5
4 Drop length to conduit (cm)                     61
5 Humidity of inlet air (%)                       40
6 Temperature of air (C)                          25
7 Drain air velocity (ft/min)                     84
8 manhole air velocity (ft/min)                   128
9 Conduit air velocity (ft/min)                   66
10 Wind speed (cm/s at 10 m)                      447
11 distance to next unit (cm)                     500
12 slope of underflow conduit                     .015
13 friction factor liquid                         .016
14 friction factor gas                            .006
15 radius of underflow conduit (cm)               12
16 Underflow T (C)                                25
17 oscillation cycle time (min)                   5
18 design collection velocities  (ft/s)           2
19 design branch line fraction full               .4

Type of unit is
8 HL partition flag=1, adjust for sorption        0
9 unit recycle convergence number                 200
10 oil molecular weight                           0
11 oil density  (g/cc)                            0
12 NaUT 1=municipal 2=industrial  3=turb.         0
13 NaUT 1=mass tr. 2=equil                        0
14 parts biomass per 1000 parts COD
15 oil water partition method 0=owpc
16 use UNIFAC aqueous data base =1
17 specify mass transfer for unit, =1
18 Use biomass for unit option, =1
19 biogrowth Monod half concentration ppm

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment

                                                                    WWTP\PAE\New
  Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:28:26
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is aerated biotreatment
1 Description of unit                      11    ASB Zone 1
2 Wastewater temperature   (C)                   34.08
3 length of aeration unit (m)                    295
4 width of aeration unit (m)                     295
5 depth of aeration unit (m)                     1.4
6 Area of agitation (each aerator,m2)            135
7 Total number of agitators in the unit          31
8 Power of agitation (each aerator,HP)           75
9 Impeller diameter (cm)                         49.53
10 Impeller rotation (RPM)                       1200
11 Agitator mechanical efficiency                0.83
12 aerator effectiveness, alpha                  0.83
13 if there is plug flow, enter 1                0
14 Overall biorate (mg/g bio-hr)                 19
15 Aeration air flow (m3/s)                      0
16 active biomass, aeration (g/l)                0.3
17 If covered, then enter 1                      0
18 special input                                 0
19 pH  (enter 0 for no pH adjustment)            7.04

Properties of DIMETHYL SULFIDE  (DMS) at 34.1 deg.C (93.3 deg.F)
```

```
      hl= 0.002924 atm-m3/mol      vp= 704.653 mmHg (13.629 psia)
          162.463 y/x
          0.11606 g/L gas per g/L liquid
      Temperature adjustment factor = 1.046 ^(T-25), deg. C
      k1= 0. L/g-hr          dl= 1.504e-05 cm2/s  dv= 0.14765 cm2/s
   Compound flow rate from inlet water is 0.19163 g/s.
   Compound flow rate from inlet vent is 0. g/s.
   Compound flow rate from inlet duct is 0. g/s.
   Submerged aeration rate from inlet vent is 0. m3/s.
   Total submerged aeration is 0. m3/s.
   The residence time in the unit is 30.325 hr.
   ____Biomass production________________
       The biomass production rate is 0.mg/hr. (0. mg/L)
       The fraction dissolved solids converted is 0. .
       The estimated biomass exit concentration is 0. mg/L.
   ________Quiescent wind shear surface___Springer_
   The fetch to depth ratio is 237.766.
   kl is estimated as 7.634e-06 m/s.
   kg is estimated as 0.007917 m/s.  Model: 2
   kg is estimated as 0.007917 m/s.  Model: 2
   The Schmidt number is 1.01591.
   The friction velocity is 37.398 m/s
   kg is estimated as 0.017873 m/s.  Model: 3
   ________Agitated surface___________________
   The rotation speed is 125.654 radians per second.
   The rotation factor NRW is 2.052e+06.
   The power number NPR is 7.881e-04.
   The rotation factor NFR is 797.027.
   kg (agitated)is estimated as 0.14978 m/s.
   kl (agitated)is estimated as 0.021024 m/s.
       The specified and growth biomass is 0.3 g/L.
    The effective KL (surface + diffused air) is 4.77e-04 m/s.
    The effective stripping time (surface + diffused air) is 48.915 minutes. (0.81526
    hrs.)
    The pump mixing time is 5 x the pumping recirculaion time, 0. min.
    The ratio of the mixing to the striping (surface + diffused air) is 0.
    The mean residence time is 1819.519 min. (30.325 hr.)
    The ratio of the pump mixing to the residence time is 0.
      KG aerated (m/s)                        0.15258
      KL aerated (m/s)                        0.021024
      KL OVERALL AERATED (m/s)                0.009769
      KG quiescent (m/s)                      0.008066
      KL quiescent (m/s)                      7.634e-06
      KL OVERALL QUIESCENT (m/s)              7.574e-06
      KL OVERALL (m/s)                        4.77e-04
      air stripping time constant (min)       48.915
      FRACTION SURFACE VOLATILIZED            0.80146
      FRACTION SUBMERGED VOLATILIZED          0.
      TOTAL FRACTION VOLATILIZED              0.80146
      FRACTION BIOLOGICALLY REMOVED           0.17699
      FRACTION ABSORBED                       0.
      TOTAL AIR EMISSIONS  (g/s)              0.15358
                        (Mg/year)             4.84331
      EMISSION FACTOR  (g/cm2-s)              1.765e-10
      UNIT EXIT CONCENTRATION (ppmw)          0.0037
   DETAILED CALCULATIONS at Unit 12 def.system exit st
   Type: system exit stream

                                                                    WWTP\PAE\New
     Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:28:26
   COMPOUND: DIMETHYL SULFIDE  (DMS)

   Type of unit is system exit stream
   1 Description of unit                     12    def.system exit st

      TOTAL AIR EMISSIONS  (g/s)              0.
```

```
                     (Mg/year)               0.
   EMISSION FACTOR  (g/cm2-s)               1.765e-10
   UNIT EXIT CONCENTRATION (ppmw)           1.485e-05
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain

                                                                   WWTP\PAE\New
  Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:28:26
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is open hub drain
1 Description of unit                      13    default open hub d
2 Underflow T (C)                                43.89
3 Total water added at the unit (l/s)            0
4 Area of openings at unit (cm2)                 50
5 Radius of drop pipe (cm)                       5
6 Drop length to conduit (cm)                    61
7 Open surface=1                                 1
8 Subsurface entrance=1                          0
9 subsurface exit =1                             0
10 radius of underflow conduit (cm)              12
11 distance to next unit (cm)                    500
12 slope of underflow conduit                    0.015
16 velocity air at drain opening (ft/min)        84
17 municipal waste in conduit =1                 0
18 Assume equilibrium in unit, =1                0
19 pH  (enter 0 for no pH adjustment)            8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1116 l/s.
   Weight fraction down is  1.989E-07
   Gas concentration in  0 mol fraction.
   Gas flow  1116 L/s
   Weight fraction out at base of drop is  1.71707119336225E-07
   fraction transferred in the drain drop from hub is .136716
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.13672
   fraction loss in unit                    0.
   fraction loss in line run                0.
   component upstream of unit, g/s          0.
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             4.229e-19
   mol fract. headspace vent base           1.138e-05
   headspace flow out vent (cc/s)           -1.116e+06
   headspace flow down line (cc/s)          1.116e+06
   KG surface (m/s)                         2728.591
   KL surface (m/s)                         8.51e-09
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.22197
   total component into unit, g/s           0.19163
   TOTAL AIR EMISSIONS  (g/s)               0.030347
                     (Mg/year)              0.95703
   EMISSION FACTOR  (g/cm2-s)               1.765e-10
   UNIT EXIT CONCENTRATION (ppmw)           0.17171
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment

                                                                   WWTP\PAE\New
  Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:28:26
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is aerated biotreatment
1 Description of unit                      17    ASB Zone 3
```

```
2 Wastewater temperature   (C)                    30.01
3 length of aeration unit (m)                     376
4 width of aeration unit (m)                      188
5 depth of aeration unit (m)                      0.91
6 Area of agitation (each aerator,m2)             135
7 Total number of agitators in the unit           6
8 Power of agitation (each aerator,HP)            75
9 Impeller diameter (cm)                          49.53
10 Impeller rotation (RPM)                        1200
11 Agitator mechanical efficiency                 0.83
12 aerator effectiveness, alpha                   0.83
13 if there is plug flow, enter 1                 0
14 Overall biorate (mg/g bio-hr)                  19
15 Aeration air flow (m3/s)                       0
16 active biomass, aeration (g/l)                 0.3
17 If covered, then enter 1                       0
18 special input                                  0
19 pH  (enter 0 for no pH adjustment)             7.42

Properties of DIMETHYL SULFIDE  (DMS) at 30. deg.C (86. deg.F)
   hl= 0.002519 atm-m3/mol      vp= 606.985 mmHg (11.74 psia)
       139.945 y/x
       0.10132 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.485e-05 cm2/s  dv= 0.14425 cm2/s
Compound flow rate from inlet water is 1.869e-04 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 16.011 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 7.566e-06 m/s.
kg is estimated as 0.007884 m/s.  Model: 2
kg is estimated as 0.007884 m/s.  Model: 2
The Schmidt number is 1.03989.
The friction velocity is 37.398 m/s
kg is estimated as 0.017611 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.14804 m/s.
kl (agitated)is estimated as 0.018962 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 1.053e-04 m/s.
 The effective stripping time (surface + diffused air) is 144.073 minutes.
 (2.40122 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 960.664 min. (16.011 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                         0.15081
   KL aerated (m/s)                         0.018962
   KL OVERALL AERATED (m/s)                 0.00854
   KG quiescent (m/s)                       0.008032
   KL quiescent (m/s)                       7.566e-06
   KL OVERALL QUIESCENT (m/s)               7.497e-06
   KL OVERALL (m/s)                         1.053e-04
   air stripping time constant (min)        144.073
```

```
      FRACTION SURFACE VOLATILIZED             0.59112
      FRACTION SUBMERGED VOLATILIZED           0.
      TOTAL FRACTION VOLATILIZED               0.59112
      FRACTION BIOLOGICALLY REMOVED            0.32022
      FRACTION ABSORBED                        0.
      TOTAL AIR EMISSIONS  (g/s)               1.105e-04
                       (Mg/year)               0.003484
      EMISSION FACTOR  (g/cm2-s)               1.563e-13
      UNIT EXIT CONCENTRATION (ppmw)           1.485e-05
   DETAILED CALCULATIONS at Unit 18 ASB Zone 2
   Type: aerated biotreatment

                                                                        WWTP\PAE\New
     Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:28:26
   COMPOUND: DIMETHYL SULFIDE  (DMS)

   Type of unit is aerated biotreatment
   1 Description of unit                        18    ASB Zone 2
   2 Wastewater temperature   (C)                     32.08
   3 length of aeration unit (m)                      368
   4 width of aeration unit (m)                       184
   5 depth of aeration unit (m)                       0.97
   6 Area of agitation (each aerator,m2)              135
   7 Total number of agitators in the unit            15
   8 Power of agitation (each aerator,HP)             75
   9 Impeller diameter (cm)                           49.53
   10 Impeller rotation (RPM)                         1200
   11 Agitator mechanical efficiency                  0.83
   12 aerator effectiveness, alpha                    0.83
   13 if there is plug flow, enter 1                  0
   14 Overall biorate (mg/g bio-hr)                   19
   15 Aeration air flow (m3/s)                        0
   16 active biomass, aeration (g/l)                  0.3
   17 If covered, then enter 1                        0
   18 special input                                   0
   19 pH  (enter 0 for no pH adjustment)              7.24

   Properties of DIMETHYL SULFIDE  (DMS) at 32.1 deg.C (89.7 deg.F)
      hl= 0.002719 atm-m3/mol      vp= 655.201 mmHg (12.673 psia)
          151.062 y/x
          0.10863 g/L gas per g/L liquid
      Temperature adjustment factor = 1.046 ^(T-25), deg. C
      k1= 0. L/g-hr          dl= 1.495e-05 cm2/s  dv= 0.14597 cm2/s
   Compound flow rate from inlet water is 0.004129 g/s.
   Compound flow rate from inlet vent is 0. g/s.
   Compound flow rate from inlet duct is 0. g/s.
   Submerged aeration rate from inlet vent is 0. m3/s.
   Total submerged aeration is 0. m3/s.
   The residence time in the unit is 16.348 hr.
   ____Biomass production________________
       The biomass production rate is 0.mg/hr. (0. mg/L)
       The fraction dissolved solids converted is 0. .
       The estimated biomass exit concentration is 0. mg/L.
   ________Quiescent wind shear surface___Springer_
   The fetch to depth ratio is 302.703.
   kl is estimated as 7.6e-06 m/s.
   kg is estimated as 0.007966 m/s.  Model: 2
   kg is estimated as 0.007966 m/s.  Model: 2
   The Schmidt number is 1.02758.
   The friction velocity is 37.398 m/s
   kg is estimated as 0.017744 m/s.  Model: 3
   ________Agitated surface___________________
   The rotation speed is 125.654 radians per second.
   The rotation factor NRW is 2.052e+06.
   The power number NPR is 7.881e-04.
   The rotation factor NFR is 797.027.
```

```
kg (agitated)is estimated as 0.14892 m/s.
kl (agitated)is estimated as 0.019984 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 2.809e-04 m/s.
 The effective stripping time (surface + diffused air) is 57.552 minutes. (0.9592
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 980.894 min. (16.348 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                          0.15171
   KL aerated (m/s)                          0.019984
   KL OVERALL AERATED (m/s)                  0.009148
   KG quiescent (m/s)                        0.008115
   KL quiescent (m/s)                        7.6e-06
   KL OVERALL QUIESCENT (m/s)                7.537e-06
   KL OVERALL (m/s)                          2.809e-04
   air stripping time constant (min)         57.552
   FRACTION SURFACE VOLATILIZED              0.7715
   FRACTION SUBMERGED VOLATILIZED            0.
   TOTAL FRACTION VOLATILIZED                0.7715
   FRACTION BIOLOGICALLY REMOVED             0.18324
   FRACTION ABSORBED                         0.
   TOTAL AIR EMISSIONS  (g/s)                0.003185
                     (Mg/year)               0.10045
   EMISSION FACTOR  (g/cm2-s)                4.704e-12
   UNIT EXIT CONCENTRATION (ppmw)            1.675e-04
```

```
Type of unit is
1 Total water added at the unit (l/s)      50     0
2 Area of openings at unit (cm2)                  50
3 Radius of drop pipe (cm)                        5
4 Drop length to conduit (cm)                     61
5 Humidity of inlet air (%)                       40
6 Temperature of air (C)                          25
7 Drain air velocity (ft/min)                     84
8 manhole air velocity (ft/min)                   128
9 Conduit air velocity (ft/min)                   66
10 Wind speed (cm/s at 10 m)                      447
11 distance to next unit (cm)                     500
12 slope of underflow conduit                     .015
13 friction factor liquid                         .016
14 friction factor gas                            .006
15 radius of underflow conduit (cm)               12
16 Underflow T (C)                                25
17 oscillation cycle time (min)                   5
18 design collection velocities  (ft/s)           2
19 design branch line fraction full               .4

Type of unit is
8 HL partition flag=1, adjust for sorption        0
9 unit recycle convergence number                 200
10 oil molecular weight                           0
11 oil density  (g/cc)                            0
12 NaUT 1=municipal 2=industrial  3=turb.         0
13 NaUT 1=mass tr. 2=equil                        0
14 parts biomass per 1000 parts COD
15 oil water partition method 0=owpc
16 use UNIFAC aqueous data base =1
17 specify mass transfer for unit, =1
18 Use biomass for unit option, =1
19 biogrowth Monod half concentration ppm

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment

                                                                       WWTP\PAE\New
  Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:28:58
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment
1 Description of unit                      11    ASB Zone 1
2 Wastewater temperature   (C)                   34.08
3 length of aeration unit (m)                    295
4 width of aeration unit (m)                     295
5 depth of aeration unit (m)                     1.4
6 Area of agitation (each aerator,m2)            135
7 Total number of agitators in the unit          31
8 Power of agitation (each aerator,HP)           75
9 Impeller diameter (cm)                         49.53
10 Impeller rotation (RPM)                       1200
11 Agitator mechanical efficiency                0.83
12 aerator effectiveness, alpha                  0.83
13 if there is plug flow, enter 1                0
14 Overall biorate (mg/g bio-hr)                 19
15 Aeration air flow (m3/s)                      0
16 active biomass, aeration (g/l)                0.3
17 If covered, then enter 1                      0
18 special input                                 0
19 pH  (enter 0 for no pH adjustment)            7.04

Properties of METHANETHIOL(methyl mercaptan) at 34.1 deg.C (93.3 deg.F)
```

```
     hl= 0.004158 atm-m3/mol      vp= 2272.142 mmHg (43.948 psia)
         230.99 y/x
         0.16502 g/L gas per g/L liquid
     Temperature adjustment factor = 1.046 ^(T-25), deg. C
     k1= 0. L/g-hr          dl= 1.525e-05 cm2/s  dv= 0.23702 cm2/s
  Compound flow rate from inlet water is 0.002397 g/s.
  Compound flow rate from inlet vent is 0. g/s.
  Compound flow rate from inlet duct is 0. g/s.
  Submerged aeration rate from inlet vent is 0. m3/s.
  Total submerged aeration is 0. m3/s.
  The residence time in the unit is 30.325 hr.
  ____Biomass production________________
      The biomass production rate is 0.mg/hr. (0. mg/L)
      The fraction dissolved solids converted is 0. .
      The estimated biomass exit concentration is 0. mg/L.
  ________Quiescent wind shear surface___Springer_
  The fetch to depth ratio is 237.766.
  kl is estimated as 7.703e-06 m/s.
  kg is estimated as 0.010871 m/s.  Model: 2
  kg is estimated as 0.010871 m/s.  Model: 2
  The Schmidt number is 0.63285.
  The friction velocity is 37.398 m/s
  kg is estimated as 0.024173 m/s.  Model: 3
  ________Agitated surface___________________
  The rotation speed is 125.654 radians per second.
  The rotation factor NRW is 2.052e+06.
  The power number NPR is 7.881e-04.
  The rotation factor NFR is 797.027.
  kg (agitated)is estimated as 0.18977 m/s.
  kl (agitated)is estimated as 0.021167 m/s.
      The specified and growth biomass is 0.3 g/L.
   The effective KL (surface + diffused air) is 6.265e-04 m/s.
   The effective stripping time (surface + diffused air) is 37.242 minutes. (0.62071
   hrs.)
   The pump mixing time is 5 x the pumping recirculaion time, 0. min.
   The ratio of the mixing to the striping (surface + diffused air) is 0.
   The mean residence time is 1819.519 min. (30.325 hr.)
   The ratio of the pump mixing to the residence time is 0.
     KG aerated (m/s)                       0.19332
     KL aerated (m/s)                       0.021167
     KL OVERALL AERATED (m/s)               0.012876
     KG quiescent (m/s)                     0.011075
     KL quiescent (m/s)                     7.703e-06
     KL OVERALL QUIESCENT (m/s)             7.672e-06
     KL OVERALL (m/s)                       6.265e-04
     air stripping time constant (min)      37.242
     FRACTION SURFACE VOLATILIZED           0.88816
     FRACTION SUBMERGED VOLATILIZED         0.
     TOTAL FRACTION VOLATILIZED             0.88816
     FRACTION BIOLOGICALLY REMOVED          0.09366
     FRACTION ABSORBED                      0.
     TOTAL AIR EMISSIONS  (g/s)             0.002129
                          (Mg/year)         0.06713
     EMISSION FACTOR  (g/cm2-s)             2.446e-12
     UNIT EXIT CONCENTRATION (ppmw)         3.904e-05
  DETAILED CALCULATIONS at Unit 12 def.system exit st
  Type: system exit stream

                                                                  WWTP\PAE\New
    Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:28:58
  COMPOUND: METHANETHIOL(methyl mercaptan)

  Type of unit is system exit stream
  1 Description of unit                     12    def.system exit st

     TOTAL AIR EMISSIONS  (g/s)             0.
```

```
                    (Mg/year)                0.
   EMISSION FACTOR  (g/cm2-s)                2.446e-12
   UNIT EXIT CONCENTRATION (ppmw)            1.24e-07
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\PAE\New
  Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:28:58
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is open hub drain
1 Description of unit                      13    default open hub d
2 Underflow T (C)                                43.89
3 Total water added at the unit (l/s)            0
4 Area of openings at unit (cm2)                 50
5 Radius of drop pipe (cm)                       5
6 Drop length to conduit (cm)                    61
7 Open surface=1                                 1
8 Subsurface entrance=1                          0
9 subsurface exit =1                             0
10 radius of underflow conduit (cm)              12
11 distance to next unit (cm)                    500
12 slope of underflow conduit                    0.015
16 velocity air at drain opening (ft/min)        84
17 municipal waste in conduit =1                 0
18 Assume equilibrium in unit, =1                0
19 pH  (enter 0 for no pH adjustment)            8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1116 l/s.
   Weight fraction down is  2.6E-09
   Gas concentration in  0 mol fraction.
   Gas flow  1116 L/s
   Weight fraction out at base of drop is  2.14759568570224E-09
   fraction transferred in the drain drop from hub is .174002
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.174
   fraction loss in unit                    0.
   fraction loss in line run                0.
   component upstream of unit, g/s          0.
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             6.896e-21
   mol fract. headspace vent base           2.445e-07
   headspace flow out vent (cc/s)           -1.116e+06
   headspace flow down line (cc/s)          1.116e+06
   KG surface (m/s)                         3741.46
   KL surface (m/s)                         8.591e-09
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.002902
   total component into unit, g/s           0.002397
   TOTAL AIR EMISSIONS  (g/s)               5.049e-04
                    (Mg/year)               0.015922
   EMISSION FACTOR  (g/cm2-s)               2.446e-12
   UNIT EXIT CONCENTRATION (ppmw)           0.002148
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment

                                                                  WWTP\PAE\New
  Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:28:58
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment
1 Description of unit                      17    ASB Zone 3
```

```
2 Wastewater temperature   (C)                   30.01
3 length of aeration unit (m)                    376
4 width of aeration unit (m)                     188
5 depth of aeration unit (m)                     0.91
6 Area of agitation (each aerator,m2)            135
7 Total number of agitators in the unit          6
8 Power of agitation (each aerator,HP)           75
9 Impeller diameter (cm)                         49.53
10 Impeller rotation (RPM)                       1200
11 Agitator mechanical efficiency                0.83
12 aerator effectiveness, alpha                  0.83
13 if there is plug flow, enter 1                0
14 Overall biorate (mg/g bio-hr)                 19
15 Aeration air flow (m3/s)                      0
16 active biomass, aeration (g/l)                0.3
17 If covered, then enter 1                      0
18 special input                                 0
19 pH  (enter 0 for no pH adjustment)            7.42

Properties of METHANETHIOL(methyl mercaptan) at 30. deg.C (86. deg.F)
   hl= 0.003687 atm-m3/mol      vp= 2014.774 mmHg (38.97 psia)
       204.826 y/x
       0.14829 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.505e-05 cm2/s  dv= 0.23155 cm2/s
Compound flow rate from inlet water is 1.671e-06 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 16.011 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 7.635e-06 m/s.
kg is estimated as 0.010826 m/s.  Model: 2
kg is estimated as 0.010826 m/s.  Model: 2
The Schmidt number is 0.64779.
The friction velocity is 37.398 m/s
kg is estimated as 0.023814 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.18756 m/s.
kl (agitated)is estimated as 0.019092 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 1.391e-04 m/s.
 The effective stripping time (surface + diffused air) is 109.038 minutes.
 (1.81731 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 960.664 min. (16.011 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                         0.19108
   KL aerated (m/s)                         0.019092
   KL OVERALL AERATED (m/s)                 0.011483
   KG quiescent (m/s)                       0.011029
   KL quiescent (m/s)                       7.635e-06
   KL OVERALL QUIESCENT (m/s)               7.6e-06
   KL OVERALL (m/s)                         1.391e-04
   air stripping time constant (min)        109.038
```

```
   FRACTION SURFACE VOLATILIZED             0.7296
   FRACTION SUBMERGED VOLATILIZED           0.
   TOTAL FRACTION VOLATILIZED               0.7296
   FRACTION BIOLOGICALLY REMOVED            0.18759
   FRACTION ABSORBED                        0.
   TOTAL AIR EMISSIONS  (g/s)               1.219e-06
                    (Mg/year)               3.844e-05
   EMISSION FACTOR  (g/cm2-s)               1.724e-15
   UNIT EXIT CONCENTRATION (ppmw)           1.24e-07
DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment
```



```
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment
1 Description of unit                        18    ASB Zone 2
2 Wastewater temperature   (C)                     32.08
3 length of aeration unit (m)                      368
4 width of aeration unit (m)                       184
5 depth of aeration unit (m)                       0.97
6 Area of agitation (each aerator,m2)              135
7 Total number of agitators in the unit            15
8 Power of agitation (each aerator,HP)             75
9 Impeller diameter (cm)                           49.53
10 Impeller rotation (RPM)                         1200
11 Agitator mechanical efficiency                  0.83
12 aerator effectiveness, alpha                    0.83
13 if there is plug flow, enter 1                  0
14 Overall biorate (mg/g bio-hr)                   19
15 Aeration air flow (m3/s)                        0
16 active biomass, aeration (g/l)                  0.3
17 If covered, then enter 1                        0
18 special input                                   0
19 pH  (enter 0 for no pH adjustment)              7.24

Properties of METHANETHIOL(methyl mercaptan) at 32.1 deg.C (89.7 deg.F)
   hl= 0.003921 atm-m3/mol      vp= 2142.771 mmHg (41.446 psia)
       217.838 y/x
       0.15664 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.515e-05 cm2/s  dv= 0.23433 cm2/s
Compound flow rate from inlet water is 4.357e-05 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 16.348 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 7.67e-06 m/s.
kg is estimated as 0.010938 m/s.  Model: 2
kg is estimated as 0.010938 m/s.  Model: 2
The Schmidt number is 0.64013.
The friction velocity is 37.398 m/s
kg is estimated as 0.023996 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
```

```
        kg (agitated)is estimated as 0.18868 m/s.
        kl (agitated)is estimated as 0.020121 m/s.
            The specified and growth biomass is 0.3 g/L.
         The effective KL (surface + diffused air) is 3.715e-04 m/s.
         The effective stripping time (surface + diffused air) is 43.518 minutes. (0.72529
         hrs.)
         The pump mixing time is 5 x the pumping recirculaion time, 0. min.
         The ratio of the mixing to the striping (surface + diffused air) is 0.
         The mean residence time is 980.894 min. (16.348 hr.)
         The ratio of the pump mixing to the residence time is 0.
           KG aerated (m/s)                         0.19222
           KL aerated (m/s)                         0.020121
           KL OVERALL AERATED (m/s)                 0.012174
           KG quiescent (m/s)                       0.011143
           KL quiescent (m/s)                       7.67e-06
           KL OVERALL QUIESCENT (m/s)               7.637e-06
           KL OVERALL (m/s)                         3.715e-04
           air stripping time constant (min)        43.518
           FRACTION SURFACE VOLATILIZED             0.86431
           FRACTION SUBMERGED VOLATILIZED           0.
           TOTAL FRACTION VOLATILIZED               0.86431
           FRACTION BIOLOGICALLY REMOVED            0.097342
           FRACTION ABSORBED                        0.
           TOTAL AIR EMISSIONS  (g/s)               3.766e-05
                            (Mg/year)               0.001188
           EMISSION FACTOR  (g/cm2-s)               5.562e-14
           UNIT EXIT CONCENTRATION (ppmw)           1.497e-06
```

Backup Stripper Scenario - Projected Actual Emissions

H_2S, TRS Compounds, and VOC

New-Indy Catawba - Catawba, SC

Concentration Loadings	**H2S, ppm**	**DMDS, ppm**	**DMS, ppm**	**MMC, ppm**
Design Foul Condensate Loadings to Backup Stripper	147	15.00	17.00	16.00
Backup Stripper TRS Removal Efficiency	0.98	0.98	0.98	0.98
Stripped Condensate to Hardpipe	2.93	0.30	0.34	0.32
Avg. ASB Inlet (2021 and 2022)	0.25	0.09	0.20	0.0026
Flow Weighted Loading:	0.38	0.10	0.21	0.02
WATER9 Results	**H2S, g/s**	**DMDS, g/s**	**DMS, g/s**	**MMC, g/s**
ASB Zone 1	0.08	0.04	0.17	0.01
ASB Zone 2	0.03	6.14E-04	3.60E-03	2.73E-04
ASB Zone 3	0.02	1.20E-05	1.31E-04	9.23E-06
Total ASB	**0.13**	**0.04**	**0.17**	**0.02**
PAE Emissions Factors	**H2S, lb/ODTP**	**DMDS, lb/ODTP**	**DMS, lb/ODTP**	**MMC, lb/ODTP**
Total ASB	**1.09E-02**	**3.28E-03**	**1.47E-02**	**1.30E-03**

Post-Project Stripped Condensate Flow:	850	gpm
Post-Project Stripped Condensate Flow:	1.22	MGD
Post-Project ASB Influent Flow:	25.48	MGD
Total ASB Flow:	26.71	MGD
Total ASB Flow:	1170	L/s
Pulp Production	2200	ODTP/day

	MW
H2S	34
DMDS	94
DMS	62
MMC	48

Type of unit is

1 Total water added at the unit (l/s)	50	0
2 Area of openings at unit (cm2)		50
3 Radius of drop pipe (cm)		5
4 Drop length to conduit (cm)		61
5 Humidity of inlet air (%)		40
6 Temperature of air (C)		25
7 Drain air velocity (ft/min)		84
8 manhole air velocity (ft/min)		128
9 Conduit air velocity (ft/min)		66
10 Wind speed (cm/s at 10 m)		447
11 distance to next unit (cm)		500
12 slope of underflow conduit		.015
13 friction factor liquid		.016
14 friction factor gas		.006
15 radius of underflow conduit (cm)		12
16 Underflow T (C)		25
17 oscillation cycle time (min)		5
18 design collection velocities (ft/s)		2
19 design branch line fraction full		.4

Type of unit is

8 HL partition flag=1, adjust for sorption	0
9 unit recycle convergence number	200
10 oil molecular weight	0
11 oil density (g/cc)	0
12 NaUT 1=municipal 2=industrial 3=turb.	0
13 NaUT 1=mass tr. 2=equil	0
14 parts biomass per 1000 parts COD	
15 oil water partition method 0=owpc	
16 use UNIFAC aqueous data base =1	
17 specify mass transfer for unit, =1	
18 Use biomass for unit option, =1	
19 biogrowth Monod half concentration ppm	

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment

WWTP\PAE\Old Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM 11:39:37

COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment

1 Description of unit	11	ASB Zone 1
2 Wastewater temperature (C)		34.08
3 length of aeration unit (m)		295
4 width of aeration unit (m)		295
5 depth of aeration unit (m)		1.4
6 Area of agitation (each aerator,m2)		135
7 Total number of agitators in the unit		31
8 Power of agitation (each aerator,HP)		75
9 Impeller diameter (cm)		49.53
10 Impeller rotation (RPM)		1200
11 Agitator mechanical efficiency		0.83
12 aerator effectiveness, alpha		0.83
13 if there is plug flow, enter 1		0
14 Overall biorate (mg/g bio-hr)		19
15 Aeration air flow (m3/s)		0
16 active biomass, aeration (g/l)		0.3
17 If covered, then enter 1		0
18 special input		0
19 pH (enter 0 for no pH adjustment)		7.04

Properties of DIMETHYL DISULFIDE at 34.1 deg.C (93.3 deg.F)

```
   hl= 0.001714 atm-m3/mol      vp= 45.945 mmHg (0.88868 psia)
       95.2 y/x
       0.068011 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.041e-05 cm2/s  dv= 0.088022 cm2/s
Compound flow rate from inlet water is 0.10249 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 28.926 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 237.766.
kl is estimated as 5.971e-06 m/s.
kg is estimated as 0.005598 m/s.  Model: 2
kg is estimated as 0.005598 m/s.  Model: 2
The Schmidt number is 1.70412.
The friction velocity is 37.398 m/s
kg is estimated as 0.012927 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.11564 m/s.
kl (agitated)is estimated as 0.017486 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 2.753e-04 m/s.
 The effective stripping time (surface + diffused air) is 84.752 minutes. (1.41254
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1735.541 min. (28.926 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                        0.11781
   KL aerated (m/s)                        0.017486
   KL OVERALL AERATED (m/s)                0.005609
   KG quiescent (m/s)                      0.005703
   KL quiescent (m/s)                      5.971e-06
   KL OVERALL QUIESCENT (m/s)              5.883e-06
   KL OVERALL (m/s)                        2.753e-04
   air stripping time constant (min)       84.752
   FRACTION SURFACE VOLATILIZED            0.36364
   FRACTION SUBMERGED VOLATILIZED          0.
   TOTAL FRACTION VOLATILIZED              0.36364
   FRACTION BIOLOGICALLY REMOVED           0.6186
   FRACTION ABSORBED                       0.
   TOTAL AIR EMISSIONS  (g/s)              0.037268
                    (Mg/year)              1.17529
   EMISSION FACTOR  (g/cm2-s)              4.282e-11
   UNIT EXIT CONCENTRATION (ppmw)          0.001555
DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream

                                                                      WWTP\PAE\Old
  Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM  11:39:37
COMPOUND: DIMETHYL DISULFIDE

Type of unit is system exit stream
1 Description of unit                    12    def.system exit st

   TOTAL AIR EMISSIONS  (g/s)              0.
```

```
                     (Mg/year)              0.
   EMISSION FACTOR  (g/cm2-s)               4.282e-11
   UNIT EXIT CONCENTRATION (ppmw)           2.847e-06
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain

                                                                    WWTP\PAE\Old
  Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM  11:39:37
COMPOUND: DIMETHYL DISULFIDE

Type of unit is open hub drain
1 Description of unit                      13    default open hub d
2 Underflow T (C)                                43.89
3 Total water added at the unit (l/s)            0
4 Area of openings at unit (cm2)                 50
5 Radius of drop pipe (cm)                       5
6 Drop length to conduit (cm)                    61
7 Open surface=1                                 1
8 Subsurface entrance=1                          0
9 subsurface exit =1                             0
10 radius of underflow conduit (cm)              12
11 distance to next unit (cm)                    500
12 slope of underflow conduit                    0.015
16 velocity air at drain opening (ft/min)        84
17 municipal waste in conduit =1                 0
18 Assume equilibrium in unit, =1                0
19 pH  (enter 0 for no pH adjustment)            8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1170 l/s.
   Weight fraction down is  9.66E-08
   Gas concentration in  0 mol fraction.
   Gas flow  1170 L/s
   Weight fraction out at base of drop is  8.7594214355091E-08
   fraction transferred in the drain drop from hub is .093228
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.093228
   fraction loss in unit                    0.
   fraction loss in line run                -7.27e-08
   component upstream of unit, g/s          0.
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             1.082e-19
   mol fract. headspace vent base           2.486e-06
   headspace flow out vent (cc/s)           -1.17e+06
   headspace flow down line (cc/s)          1.17e+06
   KG surface (m/s)                         2007.233
   KL surface (m/s)                         6.787e-09
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.11302
   total component into unit, g/s           0.10249
   TOTAL AIR EMISSIONS  (g/s)               0.010537
                     (Mg/year)              0.33229
   EMISSION FACTOR  (g/cm2-s)               4.282e-11
   UNIT EXIT CONCENTRATION (ppmw)           0.087594
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment

                                                                    WWTP\PAE\Old
  Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM  11:39:37
COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment
1 Description of unit                      17    ASB Zone 3
```

```
2 Wastewater temperature   (C)                    30.01
3 length of aeration unit (m)                     376
4 width of aeration unit (m)                      188
5 depth of aeration unit (m)                      0.91
6 Area of agitation (each aerator,m2)             135
7 Total number of agitators in the unit           6
8 Power of agitation (each aerator,HP)            75
9 Impeller diameter (cm)                          49.53
10 Impeller rotation (RPM)                        1200
11 Agitator mechanical efficiency                 0.83
12 aerator effectiveness, alpha                   0.83
13 if there is plug flow, enter 1                 0
14 Overall biorate (mg/g bio-hr)                  19
15 Aeration air flow (m3/s)                       0
16 active biomass, aeration (g/l)                 0.3
17 If covered, then enter 1                       0
18 special input                                  0
19 pH  (enter 0 for no pH adjustment)             7.42

Properties of DIMETHYL DISULFIDE at 30. deg.C (86. deg.F)
   hl= 0.00141 atm-m3/mol      vp= 37.814 mmHg (0.7314 psia)
       78.352 y/x
       0.056726 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.027e-05 cm2/s  dv= 0.085991 cm2/s
Compound flow rate from inlet water is 6.639e-05 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.272 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 5.918e-06 m/s.
kg is estimated as 0.005575 m/s.  Model: 2
kg is estimated as 0.005575 m/s.  Model: 2
The Schmidt number is 1.74436.
The friction velocity is 37.398 m/s
kg is estimated as 0.012742 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.1143 m/s.
kl (agitated)is estimated as 0.015772 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 5.972e-05 m/s.
 The effective stripping time (surface + diffused air) is 253.944 minutes. (4.2324
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 916.326 min. (15.272 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                          0.11644
   KL aerated (m/s)                          0.015772
   KL OVERALL AERATED (m/s)                  0.004711
   KG quiescent (m/s)                        0.005679
   KL quiescent (m/s)                        5.918e-06
   KL OVERALL QUIESCENT (m/s)                5.813e-06
   KL OVERALL (m/s)                          5.972e-05
   air stripping time constant (min)         253.944
```

```
   FRACTION SURFACE VOLATILIZED             0.18107
   FRACTION SUBMERGED VOLATILIZED           0.
   TOTAL FRACTION VOLATILIZED               0.18107
   FRACTION BIOLOGICALLY REMOVED            0.76875
   FRACTION ABSORBED                        0.
   TOTAL AIR EMISSIONS  (g/s)               1.202e-05
                    (Mg/year)               3.791e-04
   EMISSION FACTOR  (g/cm2-s)               1.7e-14
   UNIT EXIT CONCENTRATION (ppmw)           2.847e-06
DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment

```



```
COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment
1 Description of unit                      18    ASB Zone 2
2 Wastewater temperature   (C)                   32.08
3 length of aeration unit (m)                    368
4 width of aeration unit (m)                     184
5 depth of aeration unit (m)                     0.97
6 Area of agitation (each aerator,m2)            135
7 Total number of agitators in the unit          15
8 Power of agitation (each aerator,HP)           75
9 Impeller diameter (cm)                         49.53
10 Impeller rotation (RPM)                       1200
11 Agitator mechanical efficiency                0.83
12 aerator effectiveness, alpha                  0.83
13 if there is plug flow, enter 1                0
14 Overall biorate (mg/g bio-hr)                 19
15 Aeration air flow (m3/s)                      0
16 active biomass, aeration (g/l)                0.3
17 If covered, then enter 1                      0
18 special input                                 0
19 pH  (enter 0 for no pH adjustment)            7.24

Properties of DIMETHYL DISULFIDE at 32.1 deg.C (89.7 deg.F)
   hl= 0.001558 atm-m3/mol      vp= 41.785 mmHg (0.80821 psia)
       86.579 y/x
       0.062258 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.034e-05 cm2/s  dv= 0.087022 cm2/s
Compound flow rate from inlet water is 0.00182 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.594 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 5.945e-06 m/s.
kg is estimated as 0.005633 m/s.  Model: 2
kg is estimated as 0.005633 m/s.  Model: 2
The Schmidt number is 1.72371.
The friction velocity is 37.398 m/s
kg is estimated as 0.012836 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
```

```
       kg (agitated)is estimated as 0.11498 m/s.
       kl (agitated)is estimated as 0.016622 m/s.
           The specified and growth biomass is 0.3 g/L.
        The effective KL (surface + diffused air) is 1.598e-04 m/s.
        The effective stripping time (surface + diffused air) is 101.198 minutes.
        (1.68663 hrs.)
        The pump mixing time is 5 x the pumping recirculaion time, 0. min.
        The ratio of the mixing to the striping (surface + diffused air) is 0.
        The mean residence time is 935.622 min. (15.594 hr.)
        The ratio of the pump mixing to the residence time is 0.
          KG aerated (m/s)                          0.11714
          KL aerated (m/s)                          0.016622
          KL OVERALL AERATED (m/s)                  0.005152
          KG quiescent (m/s)                        0.005738
          KL quiescent (m/s)                        5.945e-06
          KL OVERALL QUIESCENT (m/s)                5.85e-06
          KL OVERALL (m/s)                          1.598e-04
          air stripping time constant (min)         101.198
          FRACTION SURFACE VOLATILIZED              0.33725
          FRACTION SUBMERGED VOLATILIZED            0.
          TOTAL FRACTION VOLATILIZED                0.33725
          FRACTION BIOLOGICALLY REMOVED             0.62627
          FRACTION ABSORBED                         0.
          TOTAL AIR EMISSIONS  (g/s)                6.138e-04
                            (Mg/year)               0.019356
          EMISSION FACTOR  (g/cm2-s)                9.065e-13
          UNIT EXIT CONCENTRATION (ppmw)            5.674e-05
```

```
Type of unit is
1 Total water added at the unit (l/s)      50     0
2 Area of openings at unit (cm2)                  50
3 Radius of drop pipe (cm)                        5
4 Drop length to conduit (cm)                     61
5 Humidity of inlet air (%)                       40
6 Temperature of air (C)                          25
7 Drain air velocity (ft/min)                     84
8 manhole air velocity (ft/min)                   128
9 Conduit air velocity (ft/min)                   66
10 Wind speed (cm/s at 10 m)                      447
11 distance to next unit (cm)                     500
12 slope of underflow conduit                     .015
13 friction factor liquid                         .016
14 friction factor gas                            .006
15 radius of underflow conduit (cm)               12
16 Underflow T (C)                                25
17 oscillation cycle time (min)                   5
18 design collection velocities  (ft/s)           2
19 design branch line fraction full               .4

Type of unit is
8 HL partition flag=1, adjust for sorption        0
9 unit recycle convergence number                 200
10 oil molecular weight                           0
11 oil density  (g/cc)                            0
12 NaUT 1=municipal 2=industrial  3=turb.         0
13 NaUT 1=mass tr. 2=equil                        0
14 parts biomass per 1000 parts COD
15 oil water partition method 0=owpc
16 use UNIFAC aqueous data base =1
17 specify mass transfer for unit, =1
18 Use biomass for unit option, =1
19 biogrowth Monod half concentration ppm

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment

                                                                    WWTP\PAE\Old
  Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM  19:24:18
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is aerated biotreatment
1 Description of unit                      11    ASB Zone 1
2 Wastewater temperature   (C)                   34.08
3 length of aeration unit (m)                    295
4 width of aeration unit (m)                     295
5 depth of aeration unit (m)                     1.4
6 Area of agitation (each aerator,m2)            135
7 Total number of agitators in the unit          31
8 Power of agitation (each aerator,HP)           75
9 Impeller diameter (cm)                         49.53
10 Impeller rotation (RPM)                       1200
11 Agitator mechanical efficiency                0.83
12 aerator effectiveness, alpha                  0.83
13 if there is plug flow, enter 1                0
14 Overall biorate (mg/g bio-hr)                 19
15 Aeration air flow (m3/s)                      0
16 active biomass, aeration (g/l)                0.3
17 If covered, then enter 1                      0
18 special input                                 0
19 pH  (enter 0 for no pH adjustment)            7.04

Properties of DIMETHYL SULFIDE  (DMS) at 34.1 deg.C (93.3 deg.F)
```

```
   hl= 0.002924 atm-m3/mol      vp= 704.653 mmHg (13.629 psia)
       162.463 y/x
       0.11606 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.504e-05 cm2/s  dv= 0.14765 cm2/s
Compound flow rate from inlet water is 0.20746 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 28.926 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 237.766.
kl is estimated as 7.634e-06 m/s.
kg is estimated as 0.007917 m/s.  Model: 2
kg is estimated as 0.007917 m/s.  Model: 2
The Schmidt number is 1.01591.
The friction velocity is 37.398 m/s
kg is estimated as 0.017873 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.14978 m/s.
kl (agitated)is estimated as 0.021024 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 4.77e-04 m/s.
 The effective stripping time (surface + diffused air) is 48.915 minutes. (0.81526
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1735.541 min. (28.926 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                        0.15258
   KL aerated (m/s)                        0.021024
   KL OVERALL AERATED (m/s)                0.009769
   KG quiescent (m/s)                      0.008066
   KL quiescent (m/s)                      7.634e-06
   KL OVERALL QUIESCENT (m/s)              7.574e-06
   KL OVERALL (m/s)                        4.77e-04
   air stripping time constant (min)       48.915
   FRACTION SURFACE VOLATILIZED            0.80063
   FRACTION SUBMERGED VOLATILIZED          0.
   TOTAL FRACTION VOLATILIZED              0.80063
   FRACTION BIOLOGICALLY REMOVED           0.17681
   FRACTION ABSORBED                       0.
   TOTAL AIR EMISSIONS  (g/s)              0.1661
                    (Mg/year)              5.23815
   EMISSION FACTOR  (g/cm2-s)              1.909e-10
   UNIT EXIT CONCENTRATION (ppmw)          0.004001
DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream
                                                                  WWTP\PAE\Old
  Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM  19:24:18
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is system exit stream
1 Description of unit                     12    def.system exit st

   TOTAL AIR EMISSIONS  (g/s)              0.
```

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                    (Mg/year)               0.
   EMISSION FACTOR  (g/cm2-s)               1.909e-10
   UNIT EXIT CONCENTRATION (ppmw)           1.753e-05
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain

                                                                       WWTP\PAE\Old
  Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM  19:24:18
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is open hub drain
1 Description of unit                      13    default open hub d
2 Underflow T (C)                                43.89
3 Total water added at the unit (l/s)            0
4 Area of openings at unit (cm2)                 50
5 Radius of drop pipe (cm)                       5
6 Drop length to conduit (cm)                    61
7 Open surface=1                                 1
8 Subsurface entrance=1                          0
9 subsurface exit =1                             0
10 radius of underflow conduit (cm)              12
11 distance to next unit (cm)                    500
12 slope of underflow conduit                    0.015
16 velocity air at drain opening (ft/min)        84
17 municipal waste in conduit =1                 0
18 Assume equilibrium in unit, =1                0
19 pH  (enter 0 for no pH adjustment)            8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1170 l/s.
   Weight fraction down is  2.054E-07
   Gas concentration in  0 mol fraction.
   Gas flow  1170 L/s
   Weight fraction out at base of drop is  1.77318497496617E-07
   fraction transferred in the drain drop from hub is .136716
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.13672
   fraction loss in unit                    0.
   fraction loss in line run                0.
   component upstream of unit, g/s          0.
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             4.299e-19
   mol fract. headspace vent base           1.175e-05
   headspace flow out vent (cc/s)           -1.17e+06
   headspace flow down line (cc/s)          1.17e+06
   KG surface (m/s)                         2834.248
   KL surface (m/s)                         8.784e-09
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.24032
   total component into unit, g/s          0.20746
   TOTAL AIR EMISSIONS  (g/s)               0.032855
                    (Mg/year)               1.03613
   EMISSION FACTOR  (g/cm2-s)               1.909e-10
   UNIT EXIT CONCENTRATION (ppmw)           0.17732
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment

                                                                       WWTP\PAE\Old
  Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM  19:24:18
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is aerated biotreatment
1 Description of unit                      17    ASB Zone 3
```

```
2 Wastewater temperature   (C)                    30.01
3 length of aeration unit (m)                     376
4 width of aeration unit (m)                      188
5 depth of aeration unit (m)                      0.91
6 Area of agitation (each aerator,m2)             135
7 Total number of agitators in the unit           6
8 Power of agitation (each aerator,HP)            75
9 Impeller diameter (cm)                          49.53
10 Impeller rotation (RPM)                        1200
11 Agitator mechanical efficiency                 0.83
12 aerator effectiveness, alpha                   0.83
13 if there is plug flow, enter 1                 0
14 Overall biorate (mg/g bio-hr)                  19
15 Aeration air flow (m3/s)                       0
16 active biomass, aeration (g/l)                 0.3
17 If covered, then enter 1                       0
18 special input                                  0
19 pH  (enter 0 for no pH adjustment)             7.42

Properties of DIMETHYL SULFIDE  (DMS) at 30. deg.C (86. deg.F)
   hl= 0.002519 atm-m3/mol      vp= 606.985 mmHg (11.74 psia)
       139.945 y/x
       0.10132 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.485e-05 cm2/s  dv= 0.14425 cm2/s
Compound flow rate from inlet water is 2.217e-04 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.272 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 7.566e-06 m/s.
kg is estimated as 0.007884 m/s.  Model: 2
kg is estimated as 0.007884 m/s.  Model: 2
The Schmidt number is 1.03989.
The friction velocity is 37.398 m/s
kg is estimated as 0.017611 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.14804 m/s.
kl (agitated)is estimated as 0.018962 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 1.053e-04 m/s.
 The effective stripping time (surface + diffused air) is 144.073 minutes.
 (2.40122 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 916.326 min. (15.272 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                          0.15081
   KL aerated (m/s)                          0.018962
   KL OVERALL AERATED (m/s)                  0.00854
   KG quiescent (m/s)                        0.008032
   KL quiescent (m/s)                        7.566e-06
   KL OVERALL QUIESCENT (m/s)                7.497e-06
   KL OVERALL (m/s)                          1.053e-04
   air stripping time constant (min)         144.073
```

```
   FRACTION SURFACE VOLATILIZED             0.5886
   FRACTION SUBMERGED VOLATILIZED           0.
   TOTAL FRACTION VOLATILIZED               0.5886
   FRACTION BIOLOGICALLY REMOVED            0.31886
   FRACTION ABSORBED                        0.
   TOTAL AIR EMISSIONS  (g/s)               1.305e-04
                    (Mg/year)               0.004115
   EMISSION FACTOR  (g/cm2-s)               1.846e-13
   UNIT EXIT CONCENTRATION (ppmw)           1.753e-05
DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment

                                                                      WWTP\PAE\Old
  Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM  19:24:18
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is aerated biotreatment
1 Description of unit                     18    ASB Zone 2
2 Wastewater temperature   (C)                  32.08
3 length of aeration unit (m)                   368
4 width of aeration unit (m)                    184
5 depth of aeration unit (m)                    0.97
6 Area of agitation (each aerator,m2)           135
7 Total number of agitators in the unit         15
8 Power of agitation (each aerator,HP)          75
9 Impeller diameter (cm)                        49.53
10 Impeller rotation (RPM)                      1200
11 Agitator mechanical efficiency               0.83
12 aerator effectiveness, alpha                 0.83
13 if there is plug flow, enter 1               0
14 Overall biorate (mg/g bio-hr)                19
15 Aeration air flow (m3/s)                     0
16 active biomass, aeration (g/l)               0.3
17 If covered, then enter 1                     0
18 special input                                0
19 pH  (enter 0 for no pH adjustment)           7.24

Properties of DIMETHYL SULFIDE  (DMS) at 32.1 deg.C (89.7 deg.F)
   hl= 0.002719 atm-m3/mol      vp= 655.201 mmHg (12.673 psia)
       151.062 y/x
       0.10863 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.495e-05 cm2/s  dv= 0.14597 cm2/s
Compound flow rate from inlet water is 0.004681 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.594 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 7.6e-06 m/s.
kg is estimated as 0.007966 m/s.  Model: 2
kg is estimated as 0.007966 m/s.  Model: 2
The Schmidt number is 1.02758.
The friction velocity is 37.398 m/s
kg is estimated as 0.017744 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
```

```
kg (agitated)is estimated as 0.14892 m/s.
kl (agitated)is estimated as 0.019984 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 2.809e-04 m/s.
 The effective stripping time (surface + diffused air) is 57.552 minutes. (0.9592
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 935.622 min. (15.594 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                         0.15171
   KL aerated (m/s)                         0.019984
   KL OVERALL AERATED (m/s)                 0.009148
   KG quiescent (m/s)                       0.008115
   KL quiescent (m/s)                       7.6e-06
   KL OVERALL QUIESCENT (m/s)               7.537e-06
   KL OVERALL (m/s)                         2.809e-04
   air stripping time constant (min)        57.552
   FRACTION SURFACE VOLATILIZED             0.76981
   FRACTION SUBMERGED VOLATILIZED           0.
   TOTAL FRACTION VOLATILIZED               0.76981
   FRACTION BIOLOGICALLY REMOVED            0.18284
   FRACTION ABSORBED                        0.
   TOTAL AIR EMISSIONS  (g/s)               0.003604
                     (Mg/year)              0.11365
   EMISSION FACTOR  (g/cm2-s)               5.322e-12
   UNIT EXIT CONCENTRATION (ppmw)           1.895e-04
```

```
Type of unit is
1 Total water added at the unit (l/s)      50     0
2 Area of openings at unit (cm2)                  50
3 Radius of drop pipe (cm)                        5
4 Drop length to conduit (cm)                     61
5 Humidity of inlet air (%)                       40
6 Temperature of air (C)                          25
7 Drain air velocity (ft/min)                     84
8 manhole air velocity (ft/min)                   128
9 Conduit air velocity (ft/min)                   66
10 Wind speed (cm/s at 10 m)                      447
11 distance to next unit (cm)                     500
12 slope of underflow conduit                     .015
13 friction factor liquid                         .016
14 friction factor gas                            .006
15 radius of underflow conduit (cm)               12
16 Underflow T (C)                                25
17 oscillation cycle time (min)                   5
18 design collection velocities  (ft/s)           2
19 design branch line fraction full               .4

Type of unit is
8 HL partition flag=1, adjust for sorption        0
9 unit recycle convergence number                 200
10 oil molecular weight                           0
11 oil density  (g/cc)                            0
12 NaUT 1=municipal 2=industrial  3=turb.         0
13 NaUT 1=mass tr. 2=equil                        0
14 parts biomass per 1000 parts COD
15 oil water partition method 0=owpc
16 use UNIFAC aqueous data base =1
17 specify mass transfer for unit, =1
18 Use biomass for unit option, =1
19 biogrowth Monod half concentration ppm

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment

                                                                        WWTP\PAE\Old
  Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM  19:25:00
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment
1 Description of unit                      11    ASB Zone 1
2 Wastewater temperature   (C)                   34.08
3 length of aeration unit (m)                    295
4 width of aeration unit (m)                     295
5 depth of aeration unit (m)                     1.4
6 Area of agitation (each aerator,m2)            135
7 Total number of agitators in the unit          31
8 Power of agitation (each aerator,HP)           75
9 Impeller diameter (cm)                         49.53
10 Impeller rotation (RPM)                       1200
11 Agitator mechanical efficiency                0.83
12 aerator effectiveness, alpha                  0.83
13 if there is plug flow, enter 1                0
14 Overall biorate (mg/g bio-hr)                 19
15 Aeration air flow (m3/s)                      0
16 active biomass, aeration (g/l)                0.3
17 If covered, then enter 1                      0
18 special input                                 0
19 pH  (enter 0 for no pH adjustment)            7.04

Properties of METHANETHIOL(methyl mercaptan) at 34.1 deg.C (93.3 deg.F)
```

```
      hl= 0.004158 atm-m3/mol      vp= 2272.142 mmHg (43.948 psia)
          230.99 y/x
          0.16502 g/L gas per g/L liquid
      Temperature adjustment factor = 1.046 ^(T-25), deg. C
      k1= 0. L/g-hr          dl= 1.525e-05 cm2/s  dv= 0.23702 cm2/s
   Compound flow rate from inlet water is 0.016622 g/s.
   Compound flow rate from inlet vent is 0. g/s.
   Compound flow rate from inlet duct is 0. g/s.
   Submerged aeration rate from inlet vent is 0. m3/s.
   Total submerged aeration is 0. m3/s.
   The residence time in the unit is 28.926 hr.
   ____Biomass production________________
       The biomass production rate is 0.mg/hr. (0. mg/L)
       The fraction dissolved solids converted is 0. .
       The estimated biomass exit concentration is 0. mg/L.
   ________Quiescent wind shear surface___Springer_
   The fetch to depth ratio is 237.766.
   kl is estimated as 7.703e-06 m/s.
   kg is estimated as 0.010871 m/s.  Model: 2
   kg is estimated as 0.010871 m/s.  Model: 2
   The Schmidt number is 0.63285.
   The friction velocity is 37.398 m/s
   kg is estimated as 0.024173 m/s.  Model: 3
   ________Agitated surface___________________
   The rotation speed is 125.654 radians per second.
   The rotation factor NRW is 2.052e+06.
   The power number NPR is 7.881e-04.
   The rotation factor NFR is 797.027.
   kg (agitated)is estimated as 0.18977 m/s.
   kl (agitated)is estimated as 0.021167 m/s.
       The specified and growth biomass is 0.3 g/L.
    The effective KL (surface + diffused air) is 6.265e-04 m/s.
    The effective stripping time (surface + diffused air) is 37.242 minutes. (0.62071
    hrs.)
    The pump mixing time is 5 x the pumping recirculaion time, 0. min.
    The ratio of the mixing to the striping (surface + diffused air) is 0.
    The mean residence time is 1735.541 min. (28.926 hr.)
    The ratio of the pump mixing to the residence time is 0.
      KG aerated (m/s)                          0.19332
      KL aerated (m/s)                          0.021167
      KL OVERALL AERATED (m/s)                  0.012876
      KG quiescent (m/s)                        0.011075
      KL quiescent (m/s)                        7.703e-06
      KL OVERALL QUIESCENT (m/s)                7.672e-06
      KL OVERALL (m/s)                          6.265e-04
      air stripping time constant (min)         37.242
      FRACTION SURFACE VOLATILIZED              0.88738
      FRACTION SUBMERGED VOLATILIZED            0.
      TOTAL FRACTION VOLATILIZED                0.88738
      FRACTION BIOLOGICALLY REMOVED             0.093577
      FRACTION ABSORBED                         0.
      TOTAL AIR EMISSIONS  (g/s)                0.01475
                        (Mg/year)               0.46517
      EMISSION FACTOR  (g/cm2-s)                1.695e-11
      UNIT EXIT CONCENTRATION (ppmw)            2.705e-04
   DETAILED CALCULATIONS at Unit 12 def.system exit st
   Type: system exit stream

                                                                    WWTP\PAE\Old
     Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM  19:25:00
   COMPOUND: METHANETHIOL(methyl mercaptan)

   Type of unit is system exit stream
   1 Description of unit                     12    def.system exit st

      TOTAL AIR EMISSIONS  (g/s)                0.
```

```
                     (Mg/year)               0.
   EMISSION FACTOR  (g/cm2-s)                1.695e-11
   UNIT EXIT CONCENTRATION (ppmw)            9.387e-07
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain

                                                                           WWTP\PAE\Old
  Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM  19:25:00
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is open hub drain
1 Description of unit                      13    default open hub d
2 Underflow T (C)                                43.89
3 Total water added at the unit (l/s)            0
4 Area of openings at unit (cm2)                 50
5 Radius of drop pipe (cm)                       5
6 Drop length to conduit (cm)                    61
7 Open surface=1                                 1
8 Subsurface entrance=1                          0
9 subsurface exit =1                             0
10 radius of underflow conduit (cm)              12
11 distance to next unit (cm)                    500
12 slope of underflow conduit                    0.015
16 velocity air at drain opening (ft/min)        84
17 municipal waste in conduit =1                 0
18 Assume equilibrium in unit, =1                0
19 pH  (enter 0 for no pH adjustment)            8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1170 l/s.
   Weight fraction down is  1.72E-08
   Gas concentration in  0 mol fraction.
   Gas flow  1170 L/s
   Weight fraction out at base of drop is  1.42071711698917E-08
   fraction transferred in the drain drop from hub is .174002
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.174
   fraction loss in unit                    0.
   fraction loss in line run                0.
   component upstream of unit, g/s          0.
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             4.491e-20
   mol fract. headspace vent base           1.618e-06
   headspace flow out vent (cc/s)           -1.17e+06
   headspace flow down line (cc/s)          1.17e+06
   KG surface (m/s)                         3886.338
   KL surface (m/s)                         8.868e-09
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.020124
   total component into unit, g/s           0.016622
   TOTAL AIR EMISSIONS  (g/s)               0.003502
                     (Mg/year)              0.11043
   EMISSION FACTOR  (g/cm2-s)               1.695e-11
   UNIT EXIT CONCENTRATION (ppmw)           0.014207
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment

                                                                           WWTP\PAE\Old
  Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM  19:25:00
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment
1 Description of unit                      17    ASB Zone 3
```

```
2 Wastewater temperature   (C)                       30.01
3 length of aeration unit (m)                        376
4 width of aeration unit (m)                         188
5 depth of aeration unit (m)                         0.91
6 Area of agitation (each aerator,m2)                135
7 Total number of agitators in the unit              6
8 Power of agitation (each aerator,HP)               75
9 Impeller diameter (cm)                             49.53
10 Impeller rotation (RPM)                           1200
11 Agitator mechanical efficiency                    0.83
12 aerator effectiveness, alpha                      0.83
13 if there is plug flow, enter 1                    0
14 Overall biorate (mg/g bio-hr)                     19
15 Aeration air flow (m3/s)                          0
16 active biomass, aeration (g/l)                    0.3
17 If covered, then enter 1                          0
18 special input                                     0
19 pH  (enter 0 for no pH adjustment)                7.42

Properties of METHANETHIOL(methyl mercaptan) at 30. deg.C (86. deg.F)
   hl= 0.003687 atm-m3/mol      vp= 2014.774 mmHg (38.97 psia)
       204.826 y/x
       0.14829 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.505e-05 cm2/s  dv= 0.23155 cm2/s
Compound flow rate from inlet water is 1.27e-05 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.272 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 7.635e-06 m/s.
kg is estimated as 0.010826 m/s.  Model: 2
kg is estimated as 0.010826 m/s.  Model: 2
The Schmidt number is 0.64779.
The friction velocity is 37.398 m/s
kg is estimated as 0.023814 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.18756 m/s.
kl (agitated)is estimated as 0.019092 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 1.391e-04 m/s.
 The effective stripping time (surface + diffused air) is 109.038 minutes.
 (1.81731 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 916.326 min. (15.272 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                            0.19108
   KL aerated (m/s)                            0.019092
   KL OVERALL AERATED (m/s)                    0.011483
   KG quiescent (m/s)                          0.011029
   KL quiescent (m/s)                          7.635e-06
   KL OVERALL QUIESCENT (m/s)                  7.6e-06
   KL OVERALL (m/s)                            1.391e-04
   air stripping time constant (min)           109.038
```

```
   FRACTION SURFACE VOLATILIZED              0.72669
   FRACTION SUBMERGED VOLATILIZED            0.
   TOTAL FRACTION VOLATILIZED                0.72669
   FRACTION BIOLOGICALLY REMOVED             0.18684
   FRACTION ABSORBED                         0.
   TOTAL AIR EMISSIONS  (g/s)                9.23e-06
                    (Mg/year)                2.911e-04
   EMISSION FACTOR  (g/cm2-s)                1.306e-14
   UNIT EXIT CONCENTRATION (ppmw)            9.387e-07
DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment

                                                                    WWTP\PAE\Old
  Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM  19:25:00
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment
1 Description of unit                       18    ASB Zone 2
2 Wastewater temperature   (C)                    32.08
3 length of aeration unit (m)                     368
4 width of aeration unit (m)                      184
5 depth of aeration unit (m)                      0.97
6 Area of agitation (each aerator,m2)             135
7 Total number of agitators in the unit           15
8 Power of agitation (each aerator,HP)            75
9 Impeller diameter (cm)                          49.53
10 Impeller rotation (RPM)                        1200
11 Agitator mechanical efficiency                 0.83
12 aerator effectiveness, alpha                   0.83
13 if there is plug flow, enter 1                 0
14 Overall biorate (mg/g bio-hr)                  19
15 Aeration air flow (m3/s)                       0
16 active biomass, aeration (g/l)                 0.3
17 If covered, then enter 1                       0
18 special input                                  0
19 pH  (enter 0 for no pH adjustment)             7.24

Properties of METHANETHIOL(methyl mercaptan) at 32.1 deg.C (89.7 deg.F)
   hl= 0.003921 atm-m3/mol      vp= 2142.771 mmHg (41.446 psia)
       217.838 y/x
       0.15664 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.515e-05 cm2/s  dv= 0.23433 cm2/s
Compound flow rate from inlet water is 3.165e-04 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.594 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 7.67e-06 m/s.
kg is estimated as 0.010938 m/s.  Model: 2
kg is estimated as 0.010938 m/s.  Model: 2
The Schmidt number is 0.64013.
The friction velocity is 37.398 m/s
kg is estimated as 0.023996 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
```

```
        kg (agitated)is estimated as 0.18868 m/s.
        kl (agitated)is estimated as 0.020121 m/s.
            The specified and growth biomass is 0.3 g/L.
         The effective KL (surface + diffused air) is 3.715e-04 m/s.
         The effective stripping time (surface + diffused air) is 43.518 minutes. (0.72529
         hrs.)
         The pump mixing time is 5 x the pumping recirculaion time, 0. min.
         The ratio of the mixing to the striping (surface + diffused air) is 0.
         The mean residence time is 935.622 min. (15.594 hr.)
         The ratio of the pump mixing to the residence time is 0.
           KG aerated (m/s)                         0.19222
           KL aerated (m/s)                         0.020121
           KL OVERALL AERATED (m/s)                 0.012174
           KG quiescent (m/s)                       0.011143
           KL quiescent (m/s)                       7.67e-06
           KL OVERALL QUIESCENT (m/s)               7.637e-06
           KL OVERALL (m/s)                         3.715e-04
           air stripping time constant (min)        43.518
           FRACTION SURFACE VOLATILIZED             0.86271
           FRACTION SUBMERGED VOLATILIZED           0.
           TOTAL FRACTION VOLATILIZED               0.86271
           FRACTION BIOLOGICALLY REMOVED            0.097161
           FRACTION ABSORBED                        0.
           TOTAL AIR EMISSIONS  (g/s)               2.731e-04
                            (Mg/year)               0.008611
           EMISSION FACTOR  (g/cm2-s)               4.033e-13
           UNIT EXIT CONCENTRATION (ppmw)           1.086e-05
```

No Stripper Scenario - Projected Actual Emissions

H_2S, TRS Compounds, and VOC

New-Indy Catawba - Catawba, SC

Concentration Loadings	**H2S, ppm**	**DMDS, ppm**	**DMS, ppm**	**MMC, ppm**
Design Foul Condensate Loadings (prior to H2O2)	147	15.00	17.00	16.00
Predicted % Reduction from H_2O_2	0.99	MMC converted into DMDS	0.90	0.99
Foul Condensate (after H_2O_2)	1.47	30.51	1.70	0.16
Avg. ASB Inlet (2021 and 2022)	0.25	0.09	0.20	0.0026
Flow Weighted Loading:	0.31	1.48	0.27	9.82E-03
H2SSIM/WATER9 Results	**H2S, g/s**	**DMDS, g/s**	**DMS, g/s**	**MMC, g/s**
ASB Zone 1	0.08	0.57	0.22	8.40E-03
ASB Zone 2	0.03	9.43E-03	4.70E-03	1.56E-04
ASB Zone 3	0.02	1.85E-04	1.70E-04	5.26E-06
Total ASB	**0.12**	**0.58**	**0.22**	**8.56E-03**
PAE Emissions Factors	**H2S, lb/ODTP**	**DMDS, lb/ODTP**	**DMS, lb/ODTP**	**MMC, lb/ODTP**
Total ASB	**1.06E-02**	**5.04E-02**	**1.92E-02**	**7.42E-04**

Post-Project Foul Condensate Flow:	850	gpm
Post-Project Foul Condensate Flow:	1.22	MGD
Post-Project ASB Influent Flow:	25.48	MGD
Total ASB Flow:	26.71	MGD
Total ASB Flow:	1170	L/s
Pulp Production	2200	ODTP/day

	MW
H2S	34
DMDS	94
DMS	62
MMC	48

Type of unit is

1 Total water added at the unit (l/s)	50	0
2 Area of openings at unit (cm2)		50
3 Radius of drop pipe (cm)		5
4 Drop length to conduit (cm)		61
5 Humidity of inlet air (%)		40
6 Temperature of air (C)		25
7 Drain air velocity (ft/min)		84
8 manhole air velocity (ft/min)		128
9 Conduit air velocity (ft/min)		66
10 Wind speed (cm/s at 10 m)		447
11 distance to next unit (cm)		500
12 slope of underflow conduit		.015
13 friction factor liquid		.016
14 friction factor gas		.006
15 radius of underflow conduit (cm)		12
16 Underflow T (C)		25
17 oscillation cycle time (min)		5
18 design collection velocities (ft/s)		2
19 design branch line fraction full		.4

Type of unit is

8 HL partition flag=1, adjust for sorption	0
9 unit recycle convergence number	200
10 oil molecular weight	0
11 oil density (g/cc)	0
12 NaUT 1=municipal 2=industrial 3=turb.	0
13 NaUT 1=mass tr. 2=equil	0
14 parts biomass per 1000 parts COD	
15 oil water partition method 0=owpc	
16 use UNIFAC aqueous data base =1	
17 specify mass transfer for unit, =1	
18 Use biomass for unit option, =1	
19 biogrowth Monod half concentration ppm	

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment

COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment

1 Description of unit	11	ASB Zone 1
2 Wastewater temperature (C)		34.08
3 length of aeration unit (m)		295
4 width of aeration unit (m)		295
5 depth of aeration unit (m)		1.4
6 Area of agitation (each aerator,m2)		135
7 Total number of agitators in the unit		31
8 Power of agitation (each aerator,HP)		75
9 Impeller diameter (cm)		49.53
10 Impeller rotation (RPM)		1200
11 Agitator mechanical efficiency		0.83
12 aerator effectiveness, alpha		0.83
13 if there is plug flow, enter 1		0
14 Overall biorate (mg/g bio-hr)		19
15 Aeration air flow (m3/s)		0
16 active biomass, aeration (g/l)		0.3
17 If covered, then enter 1		0
18 special input		0
19 pH (enter 0 for no pH adjustment)		7.04

```
Properties of DIMETHYL DISULFIDE at 34.1 deg.C (93.3 deg.F)
   hl= 0.001714 atm-m3/mol      vp= 45.945 mmHg (0.88868 psia)
       95.2 y/x
       0.068011 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.041e-05 cm2/s  dv= 0.088022 cm2/s
Compound flow rate from inlet water is 1.57133 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 28.926 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 237.766.
kl is estimated as 5.971e-06 m/s.
kg is estimated as 0.005598 m/s.  Model: 2
kg is estimated as 0.005598 m/s.  Model: 2
The Schmidt number is 1.70412.
The friction velocity is 37.398 m/s
kg is estimated as 0.012927 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.11564 m/s.
kl (agitated)is estimated as 0.017486 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 2.753e-04 m/s.
 The effective stripping time (surface + diffused air) is 84.752 minutes. (1.41254
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1735.541 min. (28.926 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                         0.11781
   KL aerated (m/s)                         0.017486
   KL OVERALL AERATED (m/s)                 0.005609
   KG quiescent (m/s)                       0.005703
   KL quiescent (m/s)                       5.971e-06
   KL OVERALL QUIESCENT (m/s)               5.883e-06
   KL OVERALL (m/s)                         2.753e-04
   air stripping time constant (min)        84.752
   FRACTION SURFACE VOLATILIZED             0.36452
   FRACTION SUBMERGED VOLATILIZED           0.
   TOTAL FRACTION VOLATILIZED               0.36452
   FRACTION BIOLOGICALLY REMOVED            0.61768
   FRACTION ABSORBED                        0.
   TOTAL AIR EMISSIONS  (g/s)               0.57278
                    (Mg/year)               18.063
   EMISSION FACTOR  (g/cm2-s)               6.582e-10
   UNIT EXIT CONCENTRATION (ppmw)           0.023907
DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream
```



```
COMPOUND: DIMETHYL DISULFIDE

Type of unit is system exit stream
1 Description of unit                      12    def.system exit st
```

```
   TOTAL AIR EMISSIONS  (g/s)               0.
                     (Mg/year)              0.
   EMISSION FACTOR  (g/cm2-s)               6.582e-10
   UNIT EXIT CONCENTRATION (ppmw)           4.376e-05
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain
```



```
COMPOUND: DIMETHYL DISULFIDE

Type of unit is open hub drain
1 Description of unit                      13    default open hub d
2 Underflow T (C)                                43.89
3 Total water added at the unit (l/s)            0
4 Area of openings at unit (cm2)                 50
5 Radius of drop pipe (cm)                       5
6 Drop length to conduit (cm)                    61
7 Open surface=1                                 1
8 Subsurface entrance=1                          0
9 subsurface exit =1                             0
10 radius of underflow conduit (cm)              12
11 distance to next unit (cm)                    500
12 slope of underflow conduit                    0.015
16 velocity air at drain opening (ft/min)        84
17 municipal waste in conduit =1                 0
18 Assume equilibrium in unit, =1                0
19 pH  (enter 0 for no pH adjustment)            8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1170 l/s.
   Weight fraction down is  1.4811E-06
   Gas concentration in  0 mol fraction.
   Gas flow  1170 L/s
   Weight fraction out at base of drop is  1.3430203399053E-06
   fraction transferred in the drain drop from hub is .093228
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.093228
   fraction loss in unit                    0.
   fraction loss in line run                0.
   component upstream of unit, g/s          0.
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             1.659e-18
   mol fract. headspace vent base           3.811e-05
   headspace flow out vent (cc/s)           -1.17e+06
   headspace flow down line (cc/s)          1.17e+06
   KG surface (m/s)                         2007.233
   KL surface (m/s)                         6.787e-09
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  1.73289
   total component into unit, g/s           1.57133
   TOTAL AIR EMISSIONS  (g/s)               0.16155
                     (Mg/year)              5.09474
   EMISSION FACTOR  (g/cm2-s)               6.582e-10
   UNIT EXIT CONCENTRATION (ppmw)           1.34302
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment
```

```
COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment
1 Description of unit                      17    ASB Zone 3
2 Wastewater temperature   (C)                   30.01
3 length of aeration unit (m)                    376
4 width of aeration unit (m)                     188
5 depth of aeration unit (m)                     0.91
6 Area of agitation (each aerator,m2)            135
7 Total number of agitators in the unit          6
8 Power of agitation (each aerator,HP)           75
9 Impeller diameter (cm)                         49.53
10 Impeller rotation (RPM)                       1200
11 Agitator mechanical efficiency                0.83
12 aerator effectiveness, alpha                  0.83
13 if there is plug flow, enter 1                0
14 Overall biorate (mg/g bio-hr)                 19
15 Aeration air flow (m3/s)                      0
16 active biomass, aeration (g/l)                0.3
17 If covered, then enter 1                      0
18 special input                                 0
19 pH  (enter 0 for no pH adjustment)            7.42

Properties of DIMETHYL DISULFIDE at 30. deg.C (86. deg.F)
   hl= 0.00141 atm-m3/mol      vp= 37.814 mmHg (0.7314 psia)
       78.352 y/x
       0.056726 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.027e-05 cm2/s  dv= 0.085991 cm2/s
Compound flow rate from inlet water is 0.00102 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.272 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 5.918e-06 m/s.
kg is estimated as 0.005575 m/s.  Model: 2
kg is estimated as 0.005575 m/s.  Model: 2
The Schmidt number is 1.74436.
The friction velocity is 37.398 m/s
kg is estimated as 0.012742 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.1143 m/s.
kl (agitated)is estimated as 0.015772 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 5.972e-05 m/s.
 The effective stripping time (surface + diffused air) is 253.944 minutes. (4.2324
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 916.326 min. (15.272 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                        0.11644
   KL aerated (m/s)                        0.015772
   KL OVERALL AERATED (m/s)                0.004711
   KG quiescent (m/s)                      0.005679
```

```
   KL quiescent (m/s)                        5.918e-06
   KL OVERALL QUIESCENT (m/s)                5.813e-06
   KL OVERALL (m/s)                          5.972e-05
   air stripping time constant (min)         253.944
   FRACTION SURFACE VOLATILIZED              0.18107
   FRACTION SUBMERGED VOLATILIZED            0.
   TOTAL FRACTION VOLATILIZED                0.18107
   FRACTION BIOLOGICALLY REMOVED             0.76875
   FRACTION ABSORBED                         0.
   TOTAL AIR EMISSIONS  (g/s)                1.848e-04
                    (Mg/year)                0.005827
   EMISSION FACTOR  (g/cm2-s)                2.614e-13
   UNIT EXIT CONCENTRATION (ppmw)            4.376e-05
DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment
```



```
COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment
1 Description of unit                      18    ASB Zone 2
2 Wastewater temperature   (C)                   32.08
3 length of aeration unit (m)                    368
4 width of aeration unit (m)                     184
5 depth of aeration unit (m)                     0.97
6 Area of agitation (each aerator,m2)            135
7 Total number of agitators in the unit          15
8 Power of agitation (each aerator,HP)           75
9 Impeller diameter (cm)                         49.53
10 Impeller rotation (RPM)                       1200
11 Agitator mechanical efficiency                0.83
12 aerator effectiveness, alpha                  0.83
13 if there is plug flow, enter 1                0
14 Overall biorate (mg/g bio-hr)                 19
15 Aeration air flow (m3/s)                      0
16 active biomass, aeration (g/l)                0.3
17 If covered, then enter 1                      0
18 special input                                 0
19 pH  (enter 0 for no pH adjustment)            7.24

Properties of DIMETHYL DISULFIDE at 32.1 deg.C (89.7 deg.F)
   hl= 0.001558 atm-m3/mol      vp= 41.785 mmHg (0.80821 psia)
       86.579 y/x
       0.062258 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.034e-05 cm2/s  dv= 0.087022 cm2/s
Compound flow rate from inlet water is 0.027971 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.594 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 5.945e-06 m/s.
kg is estimated as 0.005633 m/s.  Model: 2
kg is estimated as 0.005633 m/s.  Model: 2
The Schmidt number is 1.72371.
The friction velocity is 37.398 m/s
kg is estimated as 0.012836 m/s.  Model: 3
```

```
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.11498 m/s.
kl (agitated)is estimated as 0.016622 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 1.598e-04 m/s.
 The effective stripping time (surface + diffused air) is 101.198 minutes. (1.68663 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 935.622 min. (15.594 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                        0.11714
   KL aerated (m/s)                        0.016622
   KL OVERALL AERATED (m/s)                0.005152
   KG quiescent (m/s)                      0.005738
   KL quiescent (m/s)                      5.945e-06
   KL OVERALL QUIESCENT (m/s)              5.85e-06
   KL OVERALL (m/s)                        1.598e-04
   air stripping time constant (min)       101.198
   FRACTION SURFACE VOLATILIZED            0.33728
   FRACTION SUBMERGED VOLATILIZED          0.
   TOTAL FRACTION VOLATILIZED              0.33728
   FRACTION BIOLOGICALLY REMOVED           0.62623
   FRACTION ABSORBED                       0.
   TOTAL AIR EMISSIONS  (g/s)              0.009434
                     (Mg/year)             0.29751
   EMISSION FACTOR  (g/cm2-s)              1.393e-11
   UNIT EXIT CONCENTRATION (ppmw)          8.721e-04
```

Type of unit is

1 Total water added at the unit (l/s)	50	0
2 Area of openings at unit (cm2)		50
3 Radius of drop pipe (cm)		5
4 Drop length to conduit (cm)		61
5 Humidity of inlet air (%)		40
6 Temperature of air (C)		25
7 Drain air velocity (ft/min)		84
8 manhole air velocity (ft/min)		128
9 Conduit air velocity (ft/min)		66
10 Wind speed (cm/s at 10 m)		447
11 distance to next unit (cm)		500
12 slope of underflow conduit		.015
13 friction factor liquid		.016
14 friction factor gas		.006
15 radius of underflow conduit (cm)		12
16 Underflow T (C)		25
17 oscillation cycle time (min)		5
18 design collection velocities (ft/s)		2
19 design branch line fraction full		.4

Type of unit is

8 HL partition flag=1, adjust for sorption	0
9 unit recycle convergence number	200
10 oil molecular weight	0
11 oil density (g/cc)	0
12 NaUT 1=municipal 2=industrial 3=turb.	0
13 NaUT 1=mass tr. 2=equil	0
14 parts biomass per 1000 parts COD	
15 oil water partition method 0=owpc	
16 use UNIFAC aqueous data base =1	
17 specify mass transfer for unit, =1	
18 Use biomass for unit option, =1	
19 biogrowth Monod half concentration ppm	

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment

COMPOUND: DIMETHYL SULFIDE (DMS)

Type of unit is aerated biotreatment

1 Description of unit	11	ASB Zone 1
2 Wastewater temperature (C)		34.08
3 length of aeration unit (m)		295
4 width of aeration unit (m)		295
5 depth of aeration unit (m)		1.4
6 Area of agitation (each aerator,m2)		135
7 Total number of agitators in the unit		31
8 Power of agitation (each aerator,HP)		75
9 Impeller diameter (cm)		49.53
10 Impeller rotation (RPM)		1200
11 Agitator mechanical efficiency		0.83
12 aerator effectiveness, alpha		0.83
13 if there is plug flow, enter 1		0
14 Overall biorate (mg/g bio-hr)		19
15 Aeration air flow (m3/s)		0
16 active biomass, aeration (g/l)		0.3
17 If covered, then enter 1		0
18 special input		0
19 pH (enter 0 for no pH adjustment)		7.04

```
Properties of DIMETHYL SULFIDE  (DMS) at 34.1 deg.C (93.3 deg.F)
   hl= 0.002924 atm-m3/mol      vp= 704.653 mmHg (13.629 psia)
       162.463 y/x
       0.11606 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.504e-05 cm2/s  dv= 0.14765 cm2/s
Compound flow rate from inlet water is 0.27039 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 28.926 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 237.766.
kl is estimated as 7.634e-06 m/s.
kg is estimated as 0.007917 m/s.  Model: 2
kg is estimated as 0.007917 m/s.  Model: 2
The Schmidt number is 1.01591.
The friction velocity is 37.398 m/s
kg is estimated as 0.017873 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.14978 m/s.
kl (agitated)is estimated as 0.021024 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 4.77e-04 m/s.
 The effective stripping time (surface + diffused air) is 48.915 minutes. (0.81526
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1735.541 min. (28.926 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                          0.15258
   KL aerated (m/s)                          0.021024
   KL OVERALL AERATED (m/s)                  0.009769
   KG quiescent (m/s)                        0.008066
   KL quiescent (m/s)                        7.634e-06
   KL OVERALL QUIESCENT (m/s)                7.574e-06
   KL OVERALL (m/s)                          4.77e-04
   air stripping time constant (min)         48.915
   FRACTION SURFACE VOLATILIZED              0.80064
   FRACTION SUBMERGED VOLATILIZED            0.
   TOTAL FRACTION VOLATILIZED                0.80064
   FRACTION BIOLOGICALLY REMOVED             0.1768
   FRACTION ABSORBED                         0.
   TOTAL AIR EMISSIONS  (g/s)                0.21648
                    (Mg/year)                6.82699
   EMISSION FACTOR  (g/cm2-s)                2.488e-10
   UNIT EXIT CONCENTRATION (ppmw)            0.005215
DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream

                        WWTP\PAE\Hardpipe Scenario\ASB Hardpipe Scenario V7
  3/16/2023 1:47:24 PM  19:21:06
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is system exit stream
1 Description of unit                      12    def.system exit st
```

```
   TOTAL AIR EMISSIONS  (g/s)              0.
                     (Mg/year)             0.
   EMISSION FACTOR  (g/cm2-s)              2.488e-10
   UNIT EXIT CONCENTRATION (ppmw)          2.285e-05
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain
```



```
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is open hub drain
1 Description of unit                      13    default open hub d
2 Underflow T (C)                                43.89
3 Total water added at the unit (l/s)            0
4 Area of openings at unit (cm2)                 50
5 Radius of drop pipe (cm)                       5
6 Drop length to conduit (cm)                    61
7 Open surface=1                                 1
8 Subsurface entrance=1                          0
9 subsurface exit =1                             0
10 radius of underflow conduit (cm)              12
11 distance to next unit (cm)                    500
12 slope of underflow conduit                    0.015
16 velocity air at drain opening (ft/min)        84
17 municipal waste in conduit =1                 0
18 Assume equilibrium in unit, =1                0
19 pH  (enter 0 for no pH adjustment)            8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1170 l/s.
   Weight fraction down is  2.677E-07
   Gas concentration in  0 mol fraction.
   Gas flow  1170 L/s
   Weight fraction out at base of drop is  2.31101058606837E-07
   fraction transferred in the drain drop from hub is .136716
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.13672
   fraction loss in unit                    0.
   fraction loss in line run                0.
   component upstream of unit, g/s          0.
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             5.603e-19
   mol fract. headspace vent base           1.532e-05
   headspace flow out vent (cc/s)           -1.17e+06
   headspace flow down line (cc/s)          1.17e+06
   KG surface (m/s)                         2834.248
   KL surface (m/s)                         8.784e-09
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.31321
   total component into unit, g/s           0.27039
   TOTAL AIR EMISSIONS  (g/s)               0.042821
                     (Mg/year)              1.3504
   EMISSION FACTOR  (g/cm2-s)               2.488e-10
   UNIT EXIT CONCENTRATION (ppmw)           0.2311
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment
```

```
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is aerated biotreatment
1 Description of unit                       17    ASB Zone 3
2 Wastewater temperature   (C)                    30.01
3 length of aeration unit (m)                     376
4 width of aeration unit (m)                      188
5 depth of aeration unit (m)                      0.91
6 Area of agitation (each aerator,m2)             135
7 Total number of agitators in the unit           6
8 Power of agitation (each aerator,HP)            75
9 Impeller diameter (cm)                          49.53
10 Impeller rotation (RPM)                        1200
11 Agitator mechanical efficiency                 0.83
12 aerator effectiveness, alpha                   0.83
13 if there is plug flow, enter 1                 0
14 Overall biorate (mg/g bio-hr)                  19
15 Aeration air flow (m3/s)                       0
16 active biomass, aeration (g/l)                 0.3
17 If covered, then enter 1                       0
18 special input                                  0
19 pH  (enter 0 for no pH adjustment)             7.42

Properties of DIMETHYL SULFIDE  (DMS) at 30. deg.C (86. deg.F)
   hl= 0.002519 atm-m3/mol      vp= 606.985 mmHg (11.74 psia)
       139.945 y/x
       0.10132 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.485e-05 cm2/s  dv= 0.14425 cm2/s
Compound flow rate from inlet water is 2.889e-04 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.272 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 7.566e-06 m/s.
kg is estimated as 0.007884 m/s.  Model: 2
kg is estimated as 0.007884 m/s.  Model: 2
The Schmidt number is 1.03989.
The friction velocity is 37.398 m/s
kg is estimated as 0.017611 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.14804 m/s.
kl (agitated)is estimated as 0.018962 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 1.053e-04 m/s.
 The effective stripping time (surface + diffused air) is 144.073 minutes.
 (2.40122 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 916.326 min. (15.272 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                         0.15081
   KL aerated (m/s)                         0.018962
   KL OVERALL AERATED (m/s)                 0.00854
   KG quiescent (m/s)                       0.008032
```

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   KL quiescent (m/s)                        7.566e-06
   KL OVERALL QUIESCENT (m/s)                7.497e-06
   KL OVERALL (m/s)                          1.053e-04
   air stripping time constant (min)         144.073
   FRACTION SURFACE VOLATILIZED              0.5886
   FRACTION SUBMERGED VOLATILIZED            0.
   TOTAL FRACTION VOLATILIZED                0.5886
   FRACTION BIOLOGICALLY REMOVED             0.31886
   FRACTION ABSORBED                         0.
   TOTAL AIR EMISSIONS  (g/s)                1.701e-04
                    (Mg/year)                0.005363
   EMISSION FACTOR  (g/cm2-s)                2.406e-13
   UNIT EXIT CONCENTRATION (ppmw)            2.285e-05
DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment
```



```
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is aerated biotreatment
1 Description of unit                          18    ASB Zone 2
2 Wastewater temperature   (C)                       32.08
3 length of aeration unit (m)                        368
4 width of aeration unit (m)                         184
5 depth of aeration unit (m)                         0.97
6 Area of agitation (each aerator,m2)                135
7 Total number of agitators in the unit              15
8 Power of agitation (each aerator,HP)               75
9 Impeller diameter (cm)                             49.53
10 Impeller rotation (RPM)                           1200
11 Agitator mechanical efficiency                    0.83
12 aerator effectiveness, alpha                      0.83
13 if there is plug flow, enter 1                    0
14 Overall biorate (mg/g bio-hr)                     19
15 Aeration air flow (m3/s)                          0
16 active biomass, aeration (g/l)                    0.3
17 If covered, then enter 1                          0
18 special input                                     0
19 pH  (enter 0 for no pH adjustment)                7.24

Properties of DIMETHYL SULFIDE  (DMS) at 32.1 deg.C (89.7 deg.F)
   hl= 0.002719 atm-m3/mol      vp= 655.201 mmHg (12.673 psia)
       151.062 y/x
       0.10863 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.495e-05 cm2/s  dv= 0.14597 cm2/s
Compound flow rate from inlet water is 0.006101 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.594 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 7.6e-06 m/s.
kg is estimated as 0.007966 m/s.  Model: 2
kg is estimated as 0.007966 m/s.  Model: 2
The Schmidt number is 1.02758.
The friction velocity is 37.398 m/s
kg is estimated as 0.017744 m/s.  Model: 3
```

```
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.14892 m/s.
kl (agitated)is estimated as 0.019984 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 2.809e-04 m/s.
 The effective stripping time (surface + diffused air) is 57.552 minutes. (0.9592
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 935.622 min. (15.594 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                         0.15171
   KL aerated (m/s)                         0.019984
   KL OVERALL AERATED (m/s)                 0.009148
   KG quiescent (m/s)                       0.008115
   KL quiescent (m/s)                       7.6e-06
   KL OVERALL QUIESCENT (m/s)               7.537e-06
   KL OVERALL (m/s)                         2.809e-04
   air stripping time constant (min)        57.552
   FRACTION SURFACE VOLATILIZED             0.76981
   FRACTION SUBMERGED VOLATILIZED           0.
   TOTAL FRACTION VOLATILIZED               0.76981
   FRACTION BIOLOGICALLY REMOVED            0.18284
   FRACTION ABSORBED                        0.
   TOTAL AIR EMISSIONS  (g/s)               0.004697
                     (Mg/year)              0.14812
   EMISSION FACTOR  (g/cm2-s)               6.937e-12
   UNIT EXIT CONCENTRATION (ppmw)           2.469e-04
```

Type of unit is

1 Total water added at the unit (l/s)	50	0
2 Area of openings at unit (cm2)		50
3 Radius of drop pipe (cm)		5
4 Drop length to conduit (cm)		61
5 Humidity of inlet air (%)		40
6 Temperature of air (C)		25
7 Drain air velocity (ft/min)		84
8 manhole air velocity (ft/min)		128
9 Conduit air velocity (ft/min)		66
10 Wind speed (cm/s at 10 m)		447
11 distance to next unit (cm)		500
12 slope of underflow conduit		.015
13 friction factor liquid		.016
14 friction factor gas		.006
15 radius of underflow conduit (cm)		12
16 Underflow T (C)		25
17 oscillation cycle time (min)		5
18 design collection velocities (ft/s)		2
19 design branch line fraction full		.4

Type of unit is

8 HL partition flag=1, adjust for sorption	0
9 unit recycle convergence number	200
10 oil molecular weight	0
11 oil density (g/cc)	0
12 NaUT 1=municipal 2=industrial 3=turb.	0
13 NaUT 1=mass tr. 2=equil	0
14 parts biomass per 1000 parts COD	
15 oil water partition method 0=owpc	
16 use UNIFAC aqueous data base =1	
17 specify mass transfer for unit, =1	
18 Use biomass for unit option, =1	
19 biogrowth Monod half concentration ppm	

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment

WWTP\PAE\Hardpipe Scenario\ASB Hardpipe Scenario V7
3/16/2023 1:47:24 PM 19:21:41

COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment

1 Description of unit	11	ASB Zone 1
2 Wastewater temperature (C)		34.08
3 length of aeration unit (m)		295
4 width of aeration unit (m)		295
5 depth of aeration unit (m)		1.4
6 Area of agitation (each aerator,m2)		135
7 Total number of agitators in the unit		31
8 Power of agitation (each aerator,HP)		75
9 Impeller diameter (cm)		49.53
10 Impeller rotation (RPM)		1200
11 Agitator mechanical efficiency		0.83
12 aerator effectiveness, alpha		0.83
13 if there is plug flow, enter 1		0
14 Overall biorate (mg/g bio-hr)		19
15 Aeration air flow (m3/s)		0
16 active biomass, aeration (g/l)		0.3
17 If covered, then enter 1		0
18 special input		0
19 pH (enter 0 for no pH adjustment)		7.04

```
Properties of METHANETHIOL(methyl mercaptan) at 34.1 deg.C (93.3 deg.F)
   hl= 0.004158 atm-m3/mol      vp= 2272.142 mmHg (43.948 psia)
       230.99 y/x
       0.16502 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.525e-05 cm2/s  dv= 0.23702 cm2/s
Compound flow rate from inlet water is 0.009471 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 28.926 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 237.766.
kl is estimated as 7.703e-06 m/s.
kg is estimated as 0.010871 m/s.  Model: 2
kg is estimated as 0.010871 m/s.  Model: 2
The Schmidt number is 0.63285.
The friction velocity is 37.398 m/s
kg is estimated as 0.024173 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.18977 m/s.
kl (agitated)is estimated as 0.021167 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 6.265e-04 m/s.
 The effective stripping time (surface + diffused air) is 37.242 minutes. (0.62071
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1735.541 min. (28.926 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                          0.19332
   KL aerated (m/s)                          0.021167
   KL OVERALL AERATED (m/s)                  0.012876
   KG quiescent (m/s)                        0.011075
   KL quiescent (m/s)                        7.703e-06
   KL OVERALL QUIESCENT (m/s)                7.672e-06
   KL OVERALL (m/s)                          6.265e-04
   air stripping time constant (min)         37.242
   FRACTION SURFACE VOLATILIZED              0.88738
   FRACTION SUBMERGED VOLATILIZED            0.
   TOTAL FRACTION VOLATILIZED                0.88738
   FRACTION BIOLOGICALLY REMOVED             0.093578
   FRACTION ABSORBED                         0.
   TOTAL AIR EMISSIONS  (g/s)                0.008404
                    (Mg/year)                0.26504
   EMISSION FACTOR  (g/cm2-s)                9.657e-12
   UNIT EXIT CONCENTRATION (ppmw)            1.541e-04
DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream

                        WWTP\PAE\Hardpipe Scenario\ASB Hardpipe Scenario V7
  3/16/2023 1:47:24 PM  19:21:41
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is system exit stream
1 Description of unit                      12    def.system exit st
```

```
   TOTAL AIR EMISSIONS  (g/s)               0.
                     (Mg/year)              0.
   EMISSION FACTOR  (g/cm2-s)               9.657e-12
   UNIT EXIT CONCENTRATION (ppmw)           5.348e-07
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain
```



```
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is open hub drain
1 Description of unit                      13    default open hub d
2 Underflow T (C)                                43.89
3 Total water added at the unit (l/s)            0
4 Area of openings at unit (cm2)                 50
5 Radius of drop pipe (cm)                       5
6 Drop length to conduit (cm)                    61
7 Open surface=1                                 1
8 Subsurface entrance=1                          0
9 subsurface exit =1                             0
10 radius of underflow conduit (cm)              12
11 distance to next unit (cm)                    500
12 slope of underflow conduit                    0.015
16 velocity air at drain opening (ft/min)        84
17 municipal waste in conduit =1                 0
18 Assume equilibrium in unit, =1                0
19 pH  (enter 0 for no pH adjustment)            8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1170 l/s.
   Weight fraction down is  9.8E-09
   Gas concentration in  0 mol fraction.
   Gas flow  1170 L/s
   Weight fraction out at base of drop is  8.09478308097639E-09
   fraction transferred in the drain drop from hub is .174002
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.174
   fraction loss in unit                    0.
   fraction loss in line run                0.
   component upstream of unit, g/s          0.
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             2.559e-20
   mol fract. headspace vent base           9.217e-07
   headspace flow out vent (cc/s)           -1.17e+06
   headspace flow down line (cc/s)          1.17e+06
   KG surface (m/s)                         3886.338
   KL surface (m/s)                         8.868e-09
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.011466
   total component into unit, g/s           0.009471
   TOTAL AIR EMISSIONS  (g/s)               0.001995
                     (Mg/year)              0.062918
   EMISSION FACTOR  (g/cm2-s)               9.657e-12
   UNIT EXIT CONCENTRATION (ppmw)           0.008095
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment
```

```
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment
1 Description of unit                      17    ASB Zone 3
2 Wastewater temperature   (C)                   30.01
3 length of aeration unit (m)                    376
4 width of aeration unit (m)                     188
5 depth of aeration unit (m)                     0.91
6 Area of agitation (each aerator,m2)            135
7 Total number of agitators in the unit          6
8 Power of agitation (each aerator,HP)           75
9 Impeller diameter (cm)                         49.53
10 Impeller rotation (RPM)                       1200
11 Agitator mechanical efficiency                0.83
12 aerator effectiveness, alpha                  0.83
13 if there is plug flow, enter 1                0
14 Overall biorate (mg/g bio-hr)                 19
15 Aeration air flow (m3/s)                      0
16 active biomass, aeration (g/l)                0.3
17 If covered, then enter 1                      0
18 special input                                 0
19 pH  (enter 0 for no pH adjustment)            7.42

Properties of METHANETHIOL(methyl mercaptan) at 30. deg.C (86. deg.F)
   hl= 0.003687 atm-m3/mol      vp= 2014.774 mmHg (38.97 psia)
       204.826 y/x
       0.14829 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.505e-05 cm2/s  dv= 0.23155 cm2/s
Compound flow rate from inlet water is 7.237e-06 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.272 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 7.635e-06 m/s.
kg is estimated as 0.010826 m/s.  Model: 2
kg is estimated as 0.010826 m/s.  Model: 2
The Schmidt number is 0.64779.
The friction velocity is 37.398 m/s
kg is estimated as 0.023814 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.18756 m/s.
kl (agitated)is estimated as 0.019092 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 1.391e-04 m/s.
 The effective stripping time (surface + diffused air) is 109.038 minutes.
 (1.81731 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 916.326 min. (15.272 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                        0.19108
   KL aerated (m/s)                        0.019092
   KL OVERALL AERATED (m/s)                0.011483
   KG quiescent (m/s)                      0.011029
```

```
   KL quiescent (m/s)                        7.635e-06
   KL OVERALL QUIESCENT (m/s)                7.6e-06
   KL OVERALL (m/s)                          1.391e-04
   air stripping time constant (min)         109.038
   FRACTION SURFACE VOLATILIZED              0.72669
   FRACTION SUBMERGED VOLATILIZED            0.
   TOTAL FRACTION VOLATILIZED                0.72669
   FRACTION BIOLOGICALLY REMOVED             0.18684
   FRACTION ABSORBED                         0.
   TOTAL AIR EMISSIONS  (g/s)                5.259e-06
                    (Mg/year)                1.658e-04
   EMISSION FACTOR  (g/cm2-s)                7.439e-15
   UNIT EXIT CONCENTRATION (ppmw)            5.348e-07
DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment
```



```
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment
1 Description of unit                      18    ASB Zone 2
2 Wastewater temperature   (C)                   32.08
3 length of aeration unit (m)                    368
4 width of aeration unit (m)                     184
5 depth of aeration unit (m)                     0.97
6 Area of agitation (each aerator,m2)            135
7 Total number of agitators in the unit          15
8 Power of agitation (each aerator,HP)           75
9 Impeller diameter (cm)                         49.53
10 Impeller rotation (RPM)                       1200
11 Agitator mechanical efficiency                0.83
12 aerator effectiveness, alpha                  0.83
13 if there is plug flow, enter 1                0
14 Overall biorate (mg/g bio-hr)                 19
15 Aeration air flow (m3/s)                      0
16 active biomass, aeration (g/l)                0.3
17 If covered, then enter 1                      0
18 special input                                 0
19 pH  (enter 0 for no pH adjustment)            7.24

Properties of METHANETHIOL(methyl mercaptan) at 32.1 deg.C (89.7 deg.F)
   hl= 0.003921 atm-m3/mol      vp= 2142.771 mmHg (41.446 psia)
       217.838 y/x
       0.15664 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.515e-05 cm2/s  dv= 0.23433 cm2/s
Compound flow rate from inlet water is 1.803e-04 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.594 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 7.67e-06 m/s.
kg is estimated as 0.010938 m/s.  Model: 2
kg is estimated as 0.010938 m/s.  Model: 2
The Schmidt number is 0.64013.
The friction velocity is 37.398 m/s
kg is estimated as 0.023996 m/s.  Model: 3
```

```
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.18868 m/s.
kl (agitated)is estimated as 0.020121 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 3.715e-04 m/s.
 The effective stripping time (surface + diffused air) is 43.518 minutes. (0.72529 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 935.622 min. (15.594 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                         0.19222
   KL aerated (m/s)                         0.020121
   KL OVERALL AERATED (m/s)                 0.012174
   KG quiescent (m/s)                       0.011143
   KL quiescent (m/s)                       7.67e-06
   KL OVERALL QUIESCENT (m/s)               7.637e-06
   KL OVERALL (m/s)                         3.715e-04
   air stripping time constant (min)        43.518
   FRACTION SURFACE VOLATILIZED             0.86271
   FRACTION SUBMERGED VOLATILIZED           0.
   TOTAL FRACTION VOLATILIZED               0.86271
   FRACTION BIOLOGICALLY REMOVED            0.097161
   FRACTION ABSORBED                        0.
   TOTAL AIR EMISSIONS  (g/s)               1.556e-04
                     (Mg/year)              0.004907
   EMISSION FACTOR  (g/cm2-s)               2.298e-13
   UNIT EXIT CONCENTRATION (ppmw)           6.185e-06
```

PAE H2S Factor
Summary of H2SSIM Inputs and Outputs

PAE - No Stripper Scenario	Zone 1	Zone 2	Zone 3		Main Inlet	Hardpipe	Units		Zone 1	Zone 2	Zone 3	Total ASB	
								H2S g/s	0.08	0.03	0.02	**0.122**	g/s
DO	1.57	4.63	4.66	Flow	25.48	1.22	MGD					2200	ODTP/day
Temp	93.34	89.74	86.02	Total Sulfide	0.252	1.47	mg/L					1.06E-02	lb/ODTP
pH	7.04	7.24	7.42	Sulfate	390	390	mg/L						
Length	968	1208	1235										
Width	968	604	617										
Aerators	31	15	6										

PAE - Backup Stripper	Zone 1	Zone 2	Zone 3		Main Inlet	Hardpipe	Units		Zone 1	Zone 2	Zone 3	Total ASB	
								H2S g/s	0.08	0.03	0.02	**0.126**	g/s
DO	1.57	4.63	4.66	Flow	25.48	1.22	MGD					2200	ODTP/day
Temp	93.34	89.74	86.02	Total Sulfide	0.252	2.93	mg/L					1.09E-02	lb/ODTP
pH	7.04	7.24	7.42	Sulfate	390	390	mg/L						
Length	968	1208	1235										
Width	968	604	617										
Aerators	31	15	6										

PAE - New Stripper	Zone 1	Zone 2	Zone 3		Main Inlet	Hardpipe	Units		Zone 1	Zone 2	Zone 3	Total ASB	
								H2S g/s	0.07	0.03	0.02	**0.119**	
DO	1.57	4.63	4.66	Flow	25.48	0.00	MGD					2200	ODTP/day
Temp	93.34	89.74	86.02	Total Sulfide	0.252	0.00	mg/L					1.03E-02	lb/ODTP
pH	7.04	7.24	7.42	Sulfate	390	390	mg/L						
Length	968	1208	1235										
Width	968	604	617										
Aerators	31	15	6										

*DO are based on average of all DO readings from 2021 and 2022 Subpart S performance testing.

NCASI WASTEWATER HYDROGEN SULFIDE EMISSIONS SIMULATOR (H2SSIM)

Version 1.3

New Stripper Scenario

Data Type 1. Site Identification

Company Name	New-Indy
Facility Name	Catawba SC
Basin Name	ASB

Data Type 2. Model Zone Information

Number of Zones	3
Zone Location of Hardpipe	1
Type of Basin	ASB

Data Type 3. Load Characteristics

Loading Characteristics	Main Influent	Hardpipe	Units
Flow	25.48		MGD
Total Sulfide	0.252		mg/L
Sulfate	390	390	mg/L

Data Type 4. Atmospheric Conditions

Windspeed	3.55	mph
Ambient Temperature	79	F

Data Type 5. Zone Physical and Chemical Conditions

Zone Condition	Zone 1	Zone 2	Zone 3	Zone 4	Units
Dissolved Oxygen	1.57	4.63	4.66		mg/L
Temperature	93.34	89.74	86.02		F
pH	7.04	7.24	7.42		s.u.
Redox Condition	Aerobic	Aerobic	Aerobic	Aerobic	
Length	968	1208	1235		feet
Width	968	604	617		feet
Depth	4.5	3.2	3		feet
Mixing	Moderat	Moderat	Moderat		
Number of Aerators	31	15	6		
Total Horsepower	2325	1125	450		HP
Impellor Size	1.625	1.625	1.625		feet
Impellor RPM	1200	1200	1200		RPM
Diffused Air Flow	0	0	0		cms
Weir Height	0	0	0		feet

Model Controls

Run H2SSIM

View Parameters

Clear Input Sheet

H2SSIM Results

New Stripper Scenario

Basin Emissions		Units
Total Emissions (H_2S)	0.119	gms/s
Total Emissions (H_2S)	8271.8	lbs/yr
Total Emissions (H_2S)	4.1	tons/yr
Total Emissions (H_2S)	3.8	tonnes/yr
Emission Flux (H_2S)	16.6	gms/m^2 yr

Zone Emissions	Zone 1	Zone 2	Zone 3	Zone 4	Units
Zone Emissions (H_2S)	0.07	0.03	0.02		gms/s
Zone Emissions (H_2S)	4987.3	1762.5	1522.0		lbs/yr
Emission Flux (H_2S)	26.0	11.8	9.8		gms/m^2 yr
Liquid Conc. (Total Sulfide)	0.003	0.001	0.000		mg/L
Liquid Sulfide Load (lbs/yr)	36.300	6.200	5.400		lbs/yr

Percent Inlet Sulfide Removed	57.7%

Current Parameters	
kgen	0.25
ThetaGen	1.06
KDO	0.05
KSO4	10
kanox	0.006
ThetaOx	1.05
m	1
n	0.2
MLVSS	272.2
O_2 Transfer Coeff.	2
alpha 1	0.83
alpha 2	0.6

NCASI WASTEWATER HYDROGEN SULFIDE EMISSIONS SIMULATOR (H2SSIM)
Version 1.3

Backup Stripper Scenario

Data Type 1. Site Identification

Company Name	New-Indy
Facility Name	Catawba SC
Basin Name	ASB

Data Type 2. Model Zone Information

Number of Zones	3
Zone Location of Hardpipe	1
Type of Basin	ASB

Data Type 3. Load Characteristics

Loading Characteristics	Main Influent	Hardpipe	Units
Flow	25.48	1.22	MGD
Total Sulfide	0.252	2.93	mg/L
Sulfate	390	390	mg/L

Data Type 4. Atmospheric Conditions

Windspeed	3.55	mph
Ambient Temperature	79	F

Data Type 5. Zone Physical and Chemical Conditions

Zone Condition	Zone 1	Zone 2	Zone 3	Zone 4	Units
Dissolved Oxygen	1.57	4.63	4.66		mg/L
Temperature	93.34	89.74	86.02		F
pH	7.04	7.24	7.42		s.u.
Redox Condition	Aerobic	Aerobic	Aerobic	Aerobic	
Length	968	1208	1235		feet
Width	968	604	617		feet
Depth	4.5	3.2	3		feet
Mixing	Moderat	Moderat	Moderat		
Number of Aerators	31	15	6		
Total Horsepower	2325	1125	450		HP
Impellor Size	1.625	1.625	1.625		feet
Impellor RPM	1200	1200	1200		RPM
Diffused Air Flow	0	0	0		cms
Weir Height	0	0	0		feet

Model Controls

Run H2SSIM

View Parameters

Clear Input Sheet

H2SSIM Results

Backup Stripper
Scenario

Basin Emissions		Units
Total Emissions (H_2S)	0.126	gms/s
Total Emissions (H_2S)	8765.3	lbs/yr
Total Emissions (H_2S)	4.4	tons/yr
Total Emissions (H_2S)	4.0	tonnes/yr
Emission Flux (H_2S)	17.6	gms/m^2 yr

Zone Emissions	Zone 1	Zone 2	Zone 3	Zone 4	Units
Zone Emissions (H_2S)	0.08	0.03	0.02		gms/s
Zone Emissions (H_2S)	5479.5	1763.8	1521.9		lbs/yr
Emission Flux (H_2S)	28.6	11.8	9.8		gms/m^2 yr
Liquid Conc. (Total Sulfide)	0.004	0.001	0.000		mg/L
Liquid Sulfide Load (lbs/yr)	45.000	6.500	5.700		lbs/yr

Percent Inlet Sulfide Removed	71.2%

Current Parameters	
kgen	0.25
ThetaGen	1.06
KDO	0.05
KSO4	10
kanox	0.006
ThetaOx	1.05
m	1
n	0.2
MLVSS	272.2
O_2 Transfer Coeff.	2
alpha 1	0.83
alpha 2	0.6

NCASI WASTEWATER HYDROGEN SULFIDE EMISSIONS SIMULATOR (H2SSIM)
Version 1.3

No Stripper Scenario

Data Type 1. Site Identification

Company Name	New-Indy
Facility Name	Catawba SC
Basin Name	ASB

Data Type 2. Model Zone Information

Number of Zones	3
Zone Location of Hardpipe	1
Type of Basin	ASB

Data Type 3. Load Characteristics

Loading Characteristics	Main Influent	Hardpipe	Units
Flow	25.48	1.22	MGD
Total Sulfide	0.252	1.47	mg/L
Sulfate	390	390	mg/L

Data Type 4. Atmospheric Conditions

Windspeed	3.55	mph
Ambient Temperature	79	F

Data Type 5. Zone Physical and Chemical Conditions

Zone Condition	Zone 1	Zone 2	Zone 3	Zone 4	Units
Dissolved Oxygen	1.57	4.63	4.66		mg/L
Temperature	93.34	89.74	86.02		F
pH	7.04	7.24	7.42		s.u.
Redox Condition	Aerobic	Aerobic	Aerobic	Aerobic	
Length	968	1208	1235		feet
Width	968	604	617		feet
Depth	4.5	3.2	3		feet
Mixing	Moderat	Moderat	Moderat		
Number of Aerators	31	15	6		
Total Horsepower	2325	1125	450		HP
Impellor Size	1.625	1.625	1.625		feet
Impellor RPM	1200	1200	1200		RPM
Diffused Air Flow	0	0	0		cms
Weir Height	0	0	0		feet

Model Controls

Run H2SSIM

View Parameters

Clear Input Sheet

H2SSIM Results

No Stripper Scenario

Basin Emissions		Units
Total Emissions (H_2S)	0.123	gms/s
Total Emissions (H_2S)	8518.1	lbs/yr
Total Emissions (H_2S)	4.3	tons/yr
Total Emissions (H_2S)	3.9	tonnes/yr
Emission Flux (H_2S)	17.1	gms/m^2 yr

Zone Emissions	Zone 1	Zone 2	Zone 3	Zone 4	Units
Zone Emissions (H_2S)	0.08	0.03	0.02		gms/s
Zone Emissions (H_2S)	5232.9	1763.2	1521.9		lbs/yr
Emission Flux (H_2S)	27.3	11.8	9.8		gms/m^2 yr
Liquid Conc. (Total Sulfide)	0.003	0.001	0.000		mg/L
Liquid Sulfide Load (lbs/yr)	41.500	6.500	5.700		lbs/yr

Percent Inlet Sulfide Removed	65.9%

Current Parameters	
kgen	0.25
ThetaGen	1.06
KDO	0.05
KSO4	10
kanox	0.006
ThetaOx	1.05
m	1
n	0.2
MLVSS	272.2
O_2 Transfer Coeff.	2
alpha 1	0.83
alpha 2	0.6

Methanol PAE Emissions Factors

Methanol PAE Scenarios	Hardpipe ppm	Hardpipe Flow, MGD	Air Stripping g/s	Pulp Production	Methanol Emissions Factor lb/ODTP
New Stripper	N/A	N/A	3.47	2200	0.30
Backup Stripper	2095	1.22	17.63	2200	1.53
No Stripper	3809	1.22	26.69	2200	2.31

Design MeOH:	1620	lb/hr
	16	lb/ODT

APPENDIX C FORMS - CALCULATING FRACTION BIODEGRADED

Data Date: PAE - New Stripper Scenario

Instructions: Enter data in green shaded sections of this page of this spreadsheet only.

I. BIOTREATMENT UNIT DESCRIPTION

	Units	Zone 1	Zone 2	Zone 3
Number of 75 HP Aerators	#	31	15	6
Number of 100 HP Aerators	#	0	0	0
Total Horsepower	HP	2325	1125	450
Temperature	C	35.4	33.5	31.3
Length	ft	968	1,208	1,235
Width	ft	968	604	617
Average Depth	ft	4.5	3.2	3
Aerator Rotation	rpm	1200	1200	1200
Agitation Area per 75 HP aerator	ft2	1452	1452	1452
Agitation Area per 100 HP aerator	ft2	2206	2206	2206
Impellor Diameter	in	19.5	19.5	19.5

II. OVERALL PARAMS - individual flows

	Flow MGD	MeOH mg/L	
Inlet Stream **	25.48	60.0	AVG ASB Inlet, 2021 and 2022
Condensate Stream	0.0	0	
Outlet	25.5	5.1	AVG ASB Effluent, 2021 and 2022

** *except condensate flow*

NA - individual flow/conc data not available

II. OVERALL PARAMS - total flows

	Flow m3/sec	Flow MGD	MeOH mg/L
Influent Concentration		25.5	60.0
Effluent Concentration			5.10
Wind Speed	mph		3.8

III. HAP DATA

Methanol — Average Zone Concentration

	Units	Inlet	Zone 1	Zone 2	Zone 3	Detect Limit
Conc.	mg/L	60.0	7.4	5.4	3.2	0.5
Temp.	F		95.7	92.3	88.3	
			12%	**9%**	**5%**	

Expected zone concentration reductions similar to 2022 data.
No Hardpipe Stream

IV. RESULTS

fbio - Methanol	%
Fraction biodegraded	86.3
Fraction air emissions	5.2
Fraction remaining in unit effluent	8.5

APPENDIX C FORMS - CALCULATING FRACTION BIODEGRADED
PARAMETERS FOR CALCULATING MASS TRANSFER COEFIICIENTS

Data Date: PAE - New Stripper Scenario

	Diff in Water cm2/s	Diff in Air cm2/s	Henry's Law atm-m3/mol	Equil. Ratio (Hc) or (Keq) m3 liq to m3 gas	MW g/mol	ScG	Antoine Eqtn b	Antoine Eqtn c
Methanol	1.64E-05	0.150	5.19E-06	2.12E-04	32.0	1.006	1474	229.13
Acetaldehyde	1.41E-05	0.124	8.77E-05	3.58E-03	45.1	1.216	1600	291.8
MEK	9.80E-06	0.081	1.30E-04	5.31E-03	72.1	1.867	1305	229.27

General

	Units	Value	Name
viscosity of air	g/cm-s	0.000181	va
viscosity of water	g/cm-s	0.002	vw
density of air	g/cm3	0.0012	da
density of water	g/cm3	1	dw
MW of air	g/mol	29	Mwa
MW of water	g/mol	18	MWw
Diff of O2 in H2O	cm2/s	2.40E-05	DO2w
grav const.	lb-ft/s2/lb	32.17	g
R	atm-m3/mol K	8.21E-05	R_
Aerator Motor Eff	fraction	0.85	AerEff
O2 Trans Correct		0.83	Beta
Wind Speed	m/s	1.69	U
Diff of Ether	m/s	8.50E-06	Dether
O2 Trans	lb O2/HP-h	3	J

TURBULENT
KL Params

	Zone 1	Zone 2	Zone 3
w	126.3	126.3	126.3
Re	2.07E+06	2.07E+06	2.07E+06
PI	35063	35063	35063
Power Number, p	7.92E-04	7.92E-04	7.92E-04
Fr	8.06E+02	8.06E+02	8.06E+02
Total TurbArea (ft2)	45012	21780	8712
Total TurbArea (m2)	4181.6	2023.4	809.3
Frac. Agitated	0.048	0.030	0.011
(by surface aerators)			
QUIESCENT			
Depth	1.37	0.98	0.92
SurfArea (ft2)	937472	729750	762343
SurfArea (m2)	87208.33	67885.00	70916.98
F/D Ratio	243	301	328

These Parameters are used when F/D < 14 **AND** U > 3.25 m/s

	Zone 1	Zone 2	Zone 3
ScL - Methanol	NA	NA	NA
ScL - Acetaldehyde	NA	NA	NA
ScL - MEK	NA	NA	NA
U* (Friction Velocity)	NA	NA	NA

DIFFUSED

	Zone 1	Zone 2	Zone 3
Air flow, cfm	0	0	0
Air flow, m3/s	0.000	0.000	0.000

APPENDIX C FORMS - CALCULATING FRACTION BIODEGRADED

Calculating Mass Transfer Coefficient KL for Various Zones

Data Date: **PAE - New Stripper Scenario**

Surface Aeration													
		Turbulent Area			Quiescent Area								
						kL, m/s							
							U10 > 3.25						
	Temp Adj H	**kG** m/s	**kL** m/s	**KL turb** m/s	**kG** m/s	**U10 < 3.25**	F/D<14	14<F/D<51.2	F/D>51.2	**kL** m/s	**KL quisc** m/s	**KL overall** m/s
Zone1												
Methanol	8.77E-06	1.55E-01	2.27E-02	5.37E-05	3.82E-03	4.31E-06	NA	3.38E-06	1.16E-06	4.31E-06	1.01E-06	3.54E-06
Zone 2												
Methanol	7.99E-06	1.55E-01	2.17E-02	4.92E-05	3.88E-03	4.31E-06	NA	4.06E-06	1.16E-06	4.31E-06	9.57E-07	2.40E-06
Zone 3												
Methanol	7.16E-06	1.55E-01	2.06E-02	4.44E-05	3.87E-03	4.31E-06	NA	4.37E-06	1.16E-06	4.31E-06	8.82E-07	1.38E-06

FORM XIII. DATA FORM FOR THE ESTIMATION OF MULTIPLE ZONE BIODEGRADATION FROM UNIT CONCENTRATIONS

Data Date: PAE - New Stripper Scenario

NAME OF THE FACILITY		
COMPOUND for site specific biorate determination		**Methanol**
Number of zones in the biological treatment unit	1	
VOLUME of full-scale system (cubic meters)	2	250372.98
Average DEPTH of the full-scale system (meters)	3	1.0878333
FLOW RATE of wastewater to the unit (m3/s)	4	1.116
FLOW RATE of condensate to the unit (m3/s)	5	0.000
Total wastewater flowrate - (including condensates) (m3/s)	5-A	1.116
ESTIMATE OF KL (m/s)	6	*see table*
Concentration in the wastewater treated in the unit (mg/L)	7	60
Concentration in the condensates (mg/L)	8	0
Concentration in wastewater (total - inc. cond) in (mg/L)	8-A	60
Concentration in the effluent (mg/L)	9	5.0982378

TOTAL INLET FLOW (m3/s) line 4 plus the number on line 5 (or 5-A)	10	1.116	
TOTAL RESIDENCE TIME (s) line 2 divided by line 10.	11	224279	2.60 days
TOTAL AREA OF IMPOUNDMENT (m2) line 2 divided by line 3	12	230157	

Lines 13 through 15 Not Used

Zone Number	Concentration for zone, Ci (mg/L)	Area of the zone, A (m2)	Estimate of KL in the zone (m/s)	AIR STRIPPING KL A Ci (g/s)	
1	7.38608521	87091.1501	3.54365E-06	2.2795	0.308621
2	5.393164807	67793.7816	2.39719E-06	0.8765	0.162515
3	3.166816433	70821.6825	1.37942E-06	0.309	0.097693
4					
5					
6					
TOTALS - sum for each zone.	15	225706.614	16	3.47	

Removal by air stripping (g/s). Line 16.	17	3.47
Loading in effluent (g/s). Line 9 times line 10.	18	5.69
Total loading (g/s). {(line 5*line 8)+(line 4*line 7)} or {line 5-A*line 8-A}.	19	67.0
Removal by biodegradation (g/s) Line 19 minus (line 17 + line 18).	20	57.8
Fraction biodegraded: Divide line 20 by line 19.	21	0.863
Fraction air emissions: Divide line 17 by line 19.	22	0.052
Fraction remaining in unit effluent. Divide line 18 by 19.	23	0.085

APPENDIX C FORMS - CALCULATING FRACTION BIODEGRADED

Data Date: PAE - Old Stripper Scenario

Instructions: Enter data in green shaded sections of this page of this spreadsheet only.

I. BIOTREATMENT UNIT DESCRIPTION

	Units	Zone 1	Zone 2	Zone 3
Number of 75 HP Aerators	#	31	15	6
Number of 100 HP Aerators	#	0	0	0
Total Horsepower	HP	2325	1125	450
Temperature	C	35.4	33.5	31.3
Length	ft	968	1,208	1,235
Width	ft	968	604	617
Average Depth	ft	4.5	3.2	3
Aerator Rotation	rpm	1200	1200	1200
Agitation Area per 75 HP aerator	ft2	1452	1452	1452
Agitation Area per 100 HP aerator	ft2	2206	2206	2206
Impellor Diameter	in	19.5	19.5	19.5

II. OVERALL PARAMS - individual flows

	Flow MGD	MeOH mg/L
Inlet Stream **	25.48	59.5
Condensate Stream	1.2	2,095
Outlet	26.7	5.1

** *except condensate flow*

NA - individual flow/conc data not available

II. OVERALL PARAMS - total flows

		Flow m3/sec	Flow MGD	MeOH mg/L
Influent Concentration			26.7	152.8
Effluent Concentration				5.10
Wind Speed	mph			3.8

III. HAP DATA

Methanol

	Units	Inlet	Average Zone Concentration Zone 1	Zone 2	Zone 3	Detect Limit
Conc.	mg/L	152.8	41.9	24.2	7.6	0.5
Temp.	F		95.7	92.3	88.3	

	Zone 1	Zone 2	Zone 3
Avg. 2021/2022 Zone Reductions	**27%**	**16%**	**5%**

IV. RESULTS

fbio - Methanol	%
Fraction biodegraded	86.8
Fraction air emissions	9.9
Fraction remaining in unit effluent	3.3

APPENDIX C FORMS - CALCULATING FRACTION BIODEGRADED
PARAMETERS FOR CALCULATING MASS TRANSFER COEFIICIENTS

Data Date: PAE - Old Stripper Scenario

	Diff in Water cm2/s	Diff in Air cm2/s	Henry's Law atm-m3/mol	Equil. Ratio (Hc) or (Keq) m3 liq to m3 gas	MW g/mol	ScG	Antoine Eqtn b	Antoine Eqtn c
Methanol	1.64E-05	0.150	5.19E-06	2.12E-04	32.0	1.006	1474	229.13
Acetaldehyde	1.41E-05	0.124	8.77E-05	3.58E-03	45.1	1.216	1600	291.8
MEK	9.80E-06	0.081	1.30E-04	5.31E-03	72.1	1.867	1305	229.27

General

	Units	Value	Name
viscosity of air	g/cm-s	0.000181	va
viscosity of water	g/cm-s	0.002	vw
density of air	g/cm3	0.0012	da
density of water	g/cm3	1	dw
MW of air	g/mol	29	Mwa
MW of water	g/mol	18	MWw
Diff of O2 in H2O	cm2/s	2.40E-05	DO2w
grav const.	lb-ft/s2/lb	32.17	g
R	atm-m3/mol K	8.21E-05	R_
Aerator Motor Eff	fraction	0.85	AerEff
O2 Trans Correct		0.83	Beta
Wind Speed	m/s	1.69	U
Diff of Ether	m/s	8.50E-06	Dether
O2 Trans	lb O2/HP-h	3	J

TURBULENT
KL Params

	Zone 1	Zone 2	Zone 3
w	126.3	126.3	126.3
Re	2.07E+06	2.07E+06	2.07E+06
PI	35063	35063	35063
Power Number, p	7.92E-04	7.92E-04	7.92E-04
Fr	8.06E+02	8.06E+02	8.06E+02
Total TurbArea (ft2)	45012	21780	8712
Total TurbArea (m2)	4181.6	2023.4	809.3
Frac. Agitated	0.048	0.030	0.011
(by surface aerators)			
QUIESCENT			
Depth	1.37	0.98	0.92
SurfArea (ft2)	937472	729750	762343
SurfArea (m2)	87208.33	67885.00	70916.98
F/D Ratio	243	301	328
ScL - Methanol	NA	NA	NA
ScL - Acetaldehyde	NA	NA	NA
ScL - MEK	NA	NA	NA
U* (Friction Velocity)	NA	NA	NA

These Parameters are used when F/D < 14 **AND** U > 3.25 m/s

DIFFUSED

	Zone 1	Zone 2	Zone 3
Air flow, cfm	0	0	0
Air flow, m3/s	0.000	0.000	0.000

APPENDIX C FORMS - CALCULATING FRACTION BIODEGRADED

Calculating Mass Transfer Coefficient KL for Various Zones

Data Date: **PAE - Old Stripper Scenario**

Surface Aeration												
		Turbulent Area			Quiescient Area							
						kL, m/s						
							U10 > 3.25					
	Temp Adj H	kG m/s	kL m/s	KL turb m/s	kG m/s	U10 < 3.25	F/D<14	14<F/D<51.2	F/D>51.2	kL m/s	KL quisc m/s	KL overall m/s
Zone1												
Methanol	8.77E-06	1.55E-01	2.27E-02	5.37E-05	3.82E-03	4.31E-06	NA	3.38E-06	1.16E-06	4.31E-06	1.01E-06	3.54E-06
Zone 2												
Methanol	7.99E-06	1.55E-01	2.17E-02	4.92E-05	3.88E-03	4.31E-06	NA	4.06E-06	1.16E-06	4.31E-06	9.57E-07	2.40E-06
Zone 3												
Methanol	7.16E-06	1.55E-01	2.06E-02	4.44E-05	3.87E-03	4.31E-06	NA	4.37E-06	1.16E-06	4.31E-06	8.82E-07	1.38E-06

FORM XIII. DATA FORM FOR THE ESTIMATION OF MULTIPLE ZONE BIODEGRADATION FROM UNIT CONCENTRATIONS

Data Date: PAE - Old Stripper Scenario

NAME OF THE FACILITY		
COMPOUND for site specific biorate determination		**Methanol**
Number of zones in the biological treatment unit	1	
VOLUME of full-scale system (cubic meters)	2	250372.98
Average DEPTH of the full-scale system (meters)	3	1.0878333
FLOW RATE of wastewater to the unit (m3/s)	4	1.116
FLOW RATE of condensate to the unit (m3/s)	5	0.054
Total wastewater flowrate - (including condensates) (m3/s)	5-A	1.170
ESTIMATE OF KL (m/s)	6	*see table*
Concentration in the wastewater treated in the unit (mg/L)	7	59.511413
Concentration in the condensates (mg/L)	8	2094.7948
Concentration in wastewater (total - inc. cond) in (mg/L)	8-A	152.79058
Concentration in the effluent (mg/L)	9	5.0982378

TOTAL INLET FLOW (m3/s) line 4 plus the number on line 5 (or 5-A)	10	1.170		
TOTAL RESIDENCE TIME (s) line 2 divided by line 10.	11	214000	2.48	days
TOTAL AREA OF IMPOUNDMENT (m2) line 2 divided by line 3	12	230157		

Lines 13 through 15 Not Used

Zone Number	Concentration for zone, Ci (mg/L)	Area of the zone, A (m2)	Estimate of KL in the zone (m/s)	AIR STRIPPING KL A Ci (g/s)	
1	41.94854003	87091.1501	3.54365E-06	12.9462	0.308621
2	24.242506	67793.7816	2.39719E-06	3.9398	0.162515
3	7.579459633	70821.6825	1.37942E-06	0.740	0.097693
4					
5					
6					
TOTALS - sum for each zone. 15		225706.614	16	17.63	

Removal by air stripping (g/s). Line 16.	17	17.63
Loading in effluent (g/s). Line 9 times line 10.	18	5.96
Total loading (g/s). {(line 5*line 8)+(line 4*line 7)} or {line 5-A*line 8-A}.	19	178.8
Removal by biodegradation (g/s) Line 19 minus (line 17 + line 18).	20	155.2
Fraction biodegraded: Divide line 20 by line 19.	21	0.868
Fraction air emissions: Divide line 17 by line 19.	22	0.099
Fraction remaining in unit effluent. Divide line 18 by 19.	23	0.033

APPENDIX C FORMS - CALCULATING FRACTION BIODEGRADED

Data Date: PAE - No Stripper

Instructions: Enter data in green shaded sections of this page of this spreadsheet only.

I. BIOTREATMENT UNIT DESCRIPTION

	Units	Zone 1	Zone 2	Zone 3
Number of 75 HP Aerators	#	31	15	6
Number of 100 HP Aerators	#	0	0	0
Total Horsepower	HP	2325	1125	450
Temperature	C	35.4	33.5	31.3
Length	ft	968	1,208	1,235
Width	ft	968	604	617
Average Depth	ft	4.5	3.2	3
Aerator Rotation	rpm	1200	1200	1200
Agitation Area per 75 HP aerator	ft2	1452	1452	1452
Agitation Area per 100 HP aerator	ft2	2206	2206	2206
Impellor Diameter	in	19.5	19.5	19.5

II. OVERALL PARAMS - individual flows

	Flow MGD	MeOH mg/L
Inlet Stream **	25.48	59.5
Condensate Stream	1.2	3,809
Outlet	26.7	5.1

*** except condensate flow*

NA - individual flow/conc data not available

II. OVERALL PARAMS - total flows

	Flow m3/sec	Flow MGD	MeOH mg/L
Influent Concentration		26.7	231.3
Effluent Concentration			5.09824
Wind Speed	mph		3.8

III. HAP DATA

Methanol	Units	Inlet	Average Zone Concentration Zone 1	Zone 2	Zone 3	Detect Limit
Conc.	mg/L	231.3	63.5	36.7	11.5	0.5
Temp.	F		95.7	92.3	88.3	

	Zone 1	Zone 2	Zone 3
Avg. 2021/2022 Zone Reductions	**27%**	**16%**	**5%**

IV. RESULTS

fbio - Methanol	%
Fraction biodegraded	87.9
Fraction air emissions	9.9
Fraction remaining in unit effluent	2.2

APPENDIX C FORMS - CALCULATING FRACTION BIODEGRADED
PARAMETERS FOR CALCULATING MASS TRANSFER COEFIICIENTS

Data Date: PAE - No Stripper

	Diff in Water cm2/s	Diff in Air cm2/s	Henry's Law atm-m3/mol	Equil. Ratio (Hc) or (Keq) m3 liq to m3 gas	MW g/mol	ScG	Antoine Eqtn b	Antoine Eqtn c
Methanol	1.64E-05	0.150	5.19E-06	2.12E-04	32.0	1.006	1474	229.13
Acetaldehyde	1.41E-05	0.124	8.77E-05	3.58E-03	45.1	1.216	1600	291.8
MEK	9.80E-06	0.081	1.30E-04	5.31E-03	72.1	1.867	1305	229.27

General

	Units	Value	Name
viscosity of air	g/cm-s	0.000181	va
viscosity of water	g/cm-s	0.002	vw
density of air	g/cm3	0.0012	da
density of water	g/cm3	1	dw
MW of air	g/mol	29	Mwa
MW of water	g/mol	18	MWw
Diff of O2 in H2O	cm2/s	2.40E-05	DO2w
grav const.	lb-ft/s2/lb	32.17	g
R	atm-m3/mol K	8.21E-05	R_
Aerator Motor Eff	fraction	0.85	AerEff
O2 Trans Correct		0.83	Beta
Wind Speed	m/s	1.69	U
Diff of Ether	m/s	8.50E-06	Dether
O2 Trans	lb O2/HP-h	3	J

TURBULENT
KL Params

	Zone 1	Zone 2	Zone 3
w	126.3	126.3	126.3
Re	2.07E+06	2.07E+06	2.07E+06
PI	35063	35063	35063
Power Number, p	7.92E-04	7.92E-04	7.92E-04
Fr	8.06E+02	8.06E+02	8.06E+02
Total TurbArea (ft2)	45012	21780	8712
Total TurbArea (m2)	4181.6	2023.4	809.3
Frac. Agitated	0.048	0.030	0.011
(by surface aerators)			
QUIESCENT			
Depth	1.37	0.98	0.92
SurfArea (ft2)	937472	729750	762343
SurfArea (m2)	87208.33	67885.00	70916.98
F/D Ratio	243	301	328
ScL - Methanol	NA	NA	NA
ScL - Acetaldehyde	NA	NA	NA
ScL - MEK	NA	NA	NA
U* (Friction Velocity)	NA	NA	NA

These Parameters are used when F/D < 14 **AND** U > 3.25 m/s

DIFFUSED

	Zone 1	Zone 2	Zone 3
Air flow, cfm	0	0	0
Air flow, m3/s	0.000	0.000	0.000

APPENDIX C FORMS - CALCULATING FRACTION BIODEGRADED
Calculating Mass Transfer Coefficient KL for Various Zones

Data Date: **PAE - No Stripper**

Surface Aeration												
		Turbulent Area			Quiescent Area							
						kL, m/s						
							U10 > 3.25					
	Temp Adj H	kG m/s	kL m/s	KL turb m/s	kG m/s	U10 < 3.25	F/D<14	14<F/D<51.2	F/D>51.2	kL m/s	KL quisc m/s	KL overall m/s
Zone1												
Methanol	8.77E-06	1.55E-01	2.27E-02	5.37E-05	3.82E-03	4.31E-06	NA	3.38E-06	1.16E-06	4.31E-06	1.01E-06	3.54E-06
Zone 2												
Methanol	7.99E-06	1.55E-01	2.17E-02	4.92E-05	3.88E-03	4.31E-06	NA	4.06E-06	1.16E-06	4.31E-06	9.57E-07	2.40E-06
Zone 3												
Methanol	7.16E-06	1.55E-01	2.06E-02	4.44E-05	3.87E-03	4.31E-06	NA	4.37E-06	1.16E-06	4.31E-06	8.82E-07	1.38E-06

FORM XIII. DATA FORM FOR THE ESTIMATION OF MULTIPLE ZONE BIODEGRADATION FROM UNIT CONCENTRATIONS

Data Date: PAE - No Stripper

NAME OF THE FACILITY		
COMPOUND for site specific biorate determination		**Methanol**
Number of zones in the biological treatment unit	1	
VOLUME of full-scale system (cubic meters)	2	250372.98
Average DEPTH of the full-scale system (meters)	3	1.0878333
FLOW RATE of wastewater to the unit (m3/s)	4	1.116
FLOW RATE of condensate to the unit (m3/s)	5	0.054
Total wastewater flowrate - (including condensates) (m3/s)	5-A	1.170
ESTIMATE OF KL (m/s)	6	*see table*
Concentration in the wastewater treated in the unit (mg/L)	7	59.511413
Concentration in the condensates (mg/L)	8	3808.7177
Concentration in wastewater (total - inc. cond) in (mg/L)	8-A	231.34146
Concentration in the effluent (mg/L)	9	5.0982378

TOTAL INLET FLOW (m3/s) line 4 plus the number on line 5 (or 5-A)	10	1.170	
TOTAL RESIDENCE TIME (s) line 2 divided by line 10.	11	214000	2.48 days
TOTAL AREA OF IMPOUNDMENT (m2) line 2 divided by line 3	12	230157	

Lines 13 through 15 Not Used

Zone Number	Concentration for zone, Ci (mg/L)	Area of the zone, A (m2)	Estimate of KL in the zone (m/s)	AIR STRIPPING KL A Ci (g/s)	
1	63.5146271	87091.1501	3.54365E-06	19.6019	0.308621
2	36.70577636	67793.7816	2.39719E-06	5.9652	0.162515
3	11.47612174	70821.6825	1.37942E-06	1.121	0.097693
4					
5					
6					
TOTALS - sum for each zone.	15	225706.614	16	26.69	

Removal by air stripping (g/s). Line 16.	17	26.69
Loading in effluent (g/s). Line 9 times line 10.	18	5.96
Total loading (g/s). {(line 5*line 8)+(line 4*line 7)} or {line 5-A*line 8-A}.	19	270.7
Removal by biodegradation (g/s) Line 19 minus (line 17 + line 18).	20	238.0
Fraction biodegraded: Divide line 20 by line 19.	21	0.879
Fraction air emissions: Divide line 17 by line 19.	22	0.099
Fraction remaining in unit effluent. Divide line 18 by 19.	23	0.022

APPENDIX C -
AIR DISPERSION MODELING DOCUMENTATION

Background:

New-Indy Catawba initially submitted an updated ambient air dispersion modeling analysis in support of the New Condensate Stripper Construction Permit Application (application) in March 2023. Facility-wide modeling of hydrogen sulfide (H_2S), methyl mercaptan (MMC), and total reduced sulfur (TRS) compounds was conducted using the source parameters, meteorology, and receptor network provided by SCDHEC, with the exception of the additional secondary containment tank (Source ID NEWSPLTK) and associated structure (Structure ID NEWSPLTK) that were included in the March 8, 2023 modeling submitted to SCDHEC.

For WWTP sources, New-Indy Catawba used the maximum actual emissions rates as submitted in the October 2021 analysis (for H_2S, and TRS) and corresponding MMC emissions rates, with the exception of the ASB. Based on U.S. EPA's direction, the October 2021 modeling analysis was performed using WWTP emissions rates derived from the RSK-175 method results, rather than the ALS GC method results.

Refined emissions rates reflecting the new steam stripper operation and foul condensate flow for the ASB were developed in support of the application based on ALS GC method results. Due to the ASB being the only WWTP source impacted by the new condensate steam stripper, New-Indy Catawba initially submitted the ambient air dispersion modeling analysis with the updated ASB emissions rates (ALS GC method), but did not change the emissions rates of the other WWTP sources from the October 2021 modeling analysis (RSK-175 method).

The emissions rates used in the original application's modeling analysis were most recently provided to SCDHEC in New-Indy Catawba's July 6, 2023 response.

In discussions and communications after submittal of the original application, SCDHEC has directed New-Indy Catawba to update the air dispersion modeling analysis with emissions rates for all of the WWTP sources based on the ALS GC method results, specifically in the August 25, 2023 email from Katharine Buckner (SCDHEC). This updated air dispersion modeling analysis was submitted in October 2023.

Discussion of Updated WWTP Emissions Rates:

The average ALS GC results from the July 2021 sampling were used to estimate actual emissions rates, which was then scaled up to a maximum emissions rate using the ratio of the July 2021 actual pulp production to a max of 2700 ADTP/day. The modeling analysis is based on these maximum emissions rates. There are no changes to the Post Aeration Basin, Holding Pond (H_2S only), and Sludge Pond emissions rates, as they were not dependent upon July 2021 liquid sulfur sampling results.

Air Dispersion Modeling Results:

The air dispersion modeling analysis was conducted using the updated ALS emissions rates for WWTP sources as discussed above, with the same source parameters and emissions rates for non-WWTP sources and the Post-Aeration Basin as the original modeling analysis for the application. Results of the air dispersion modeling analysis demonstrate that ambient concentrations are below the relevant standards for H_2S, MM, and TRS for each averaging period.

Pollutant	Standard[a]	Averaging Period[b]	Modeled Concentration (µg/m^3)	UTM Easting (m)	UTM Northing (m)	Rank[a]	Standard[a][c][d] (µg/m^3)
H_2S	MAAC	24-hour	20.20	511,397.27	3,856,649.76	1st High	140
	EPA Action Level	30-minute	100.80	511,249.70	3,856,644.83	1-hour 1st High	837
MMC	MAAC	24-hour	9.46	510,115.55	3,856,041.31	1st High	10
	EPA Action Level	30-minute	48.00	510,209.41	3,856,039.95	1-hour 1st High	57,000
TRS	MAAC	24-hour	77.25	511,249.70	3,856,644.83	1st High	140
	EPA Action Level	30-minute	385.32	510,143.86	3,855,999.18	1-hour 1st High	837

(a) https://scdhec.gov/sites/default/files/media/document/BAQ_SC%20Modeling%20Guidelines_10.15.18_revised%204.15.19.pdf.

(b) 30-minute averaging period to be compared against maximum 1-hour modeled concentration, per DHEC October 6, 2021 request.

(c) TRS does not have a SC Standard - compare to H_2S.

(d) Methyl Mercaptan does not have an established AEGL-1 value due to insufficient data. Comparison of modeled concentrations are to the 30-minute AEGL-2 value for MMC only.

APPENDIX D - BACKUP STRIPPER METHANOL MODE ADDENDUM

Background

The construction permit application for the New Condensate Steam Stripper project (Project) was originally submitted in March 2023. The application was updated in April 2024 to reflect the final project description and project emissions calculations at the request of SCDHEC.

The Mill currently utilizes a dual-treatment approach for compliance with the pulping condensate standards of 40 CFR Part 63, Subpart S. The Mill currently operates the existing steam stripper in "methanol mode", which prioritizes operation of the existing condensate steam stripper to remove or "strip" both total reduced sulfur (TRS) compounds and methanol while being fed ~350 gallons per minute (gpm) of foul condensates. Any excess foul condensate flow is treated with hydrogen peroxide to chemically oxidize the hydrogen sulfide into either elemental sulfur or sulfate, then sent via hardpipe to the aerated stabilization basin (ASB) for biological treatment of methanol. When operating in methanol mode, stripped condensates are recycled to the Brownstock Washers, as needed, or discharged to the ASB via the sewer.

Upon installation of the new steam stripper, the existing steam stripper will operate as a backup steam stripper during periods of downtime on the new steam stripper. As part of the Project, the Mill is proposing to operate the backup steam stripper in "TRS mode," which entails feeding all of the foul condensates collected at the mill to the backup steam stripper (nominally 850 gpm). No foul condensates would be sent directly down the hardpipe when the backup steam stripper is in TRS mode.

In TRS mode, the backup steam stripper is expected to still be capable of stripping all of the TRS compounds from the foul condensates (nominal >98% removal). However, due to the higher feed rate of foul condensates to the backup stripper, it is not expected to still be capable of stripping all of the methanol (nominal 45% removal expected). Consequently, the stripped condensate would need to be sent via existing hardpipe to the ASB for further biological treatment of methanol, consistent with the PAE calculations. Emissions calculations for the backup stripper in TRS mode were presented in the original construction permit application submitted in March 2023.

The Mill has been required to operate the existing steam stripper in methanol mode. As such, the Mill is unable to gather meaningful trial data for confirmation of the expected performance of the existing steam stripper operating in TRS mode. After further discussions with SCDHEC concerning the potential technical limitations of gathering data on TRS mode, the Mill provided SCDHEC an update to the PSD applicability calculations to include the alternate operating scenario of the backup stripper operating in methanol mode (i.e., the backup stripper operating as it currently does as the primary, existing stripper). This information, also provided in this updated application, demonstrates that operating the backup stripper in either TRS or methanol mode results in no change to the PSD applicability conclusions of the project.

Methanol Mode Emissions

This section addresses the differences in the project emissions calculations between the backup stripper operating in either TRS or methanol mode. For each pollutant, New-Indy presented emissions factors for both operating modes in the Appendix B calculations, but the worst-case operating mode was used for PSD applicability calculations to demonstrate the flexibility between the two modes.

One key difference between the two operating modes is that methanol mode requires more steam fed to the stripper. Generally, the Mill has updated the post-project emissions calculations for products of combustion resulting from generation of steam for the backup stripper to account for the higher steam requirements of methanol mode, which results in a small increase in post-project emissions from the original application submittal. Since the existing stripper has operated in methanol mode during the entirety of the baseline, steam heat input for the projected backup stripper methanol mode scenario was assumed to equal the baseline value.

Emissions resulting from the incineration of the backup stripper off gases (SOG) in the combination boilers vary, particularly for VOC and TRS compounds (and consequently SO_2), based on how much of these compounds are present in the SOG prior to combustion, which depends on several variables, including stripper feed flow rate and stripper removal efficiency. The operating mode of the backup stripper affects both of these variables. Although methanol mode results in a higher stripper removal efficiency, it is at a reduced feed rate, which would both impact the mass of VOC and TRS compounds present in the SOG.

For simplicity, New-Indy based emissions from the backup stripper SOG incineration on the assumption that 100% of the VOC and TRS compounds present in the full volume of foul condensates would be stripped into the SOG and then result in incineration emissions. This is the most conservative SOG emissions calculation as it assumes a 100% stripper removal efficiency for both VOC and TRS compounds at the full foul condensate flow rate (nominal 850 gpm).

The key difference between the backup stripper operating modes is the post-project emissions from the ASB. When the backup stripper is in TRS mode, the ASB would receive up to 850 gpm of condensate that has been stripped of TRS compounds but still containing ~55% of its original methanol. When the backup stripper is in methanol mode, the ASB would receive ~500 gpm of foul condensate. TRS compounds would be treated with hydrogen peroxide addition and the methanol would be treated biologically in the ASB.

Appendix B includes the H2SSIM, WATER9, and Form XIII calculations for determining the ASB emissions factors for VOC, TRS, and H_2S when the backup stripper is operating in TRS mode. This appendix includes H2SSIM, WATER9, and Form XIII calculations for the ASB VOC, TRS, and H_2S emissions factors when the backup stripper is operating in methanol mode.

New-Indy used the worst-case emissions factor between the two scenarios for each pollutant's PSD applicability calculations to demonstrate that PSD is not triggered during post-project periods that the backup stripper must be operated, whether it operates in TRS or methanol mode.

Backup Stripper (Methanol Mode) Scenario - Projected Actual Emissions
H_2S, TRS Compounds, and VOC
New-Indy Catawba - Catawba, SC

Concentration Loadings	**H2S, ppm**	**DMDS, ppm**	**DMS, ppm**	**MMC, ppm**
Design Foul Condensate Loadings (prior to H2O2)	147	15.00	17.00	16.00
Predicted % Reduction from H_2O_2	0.99	MMC converted into DMDS	0.90	0.99
Foul Condensate (after H_2O_2)	1.47	30.51	1.70	0.16
Avg. ASB Inlet (2021 and 2022)	0.25	0.09	0.20	0.0026
Flow Weighted Loading:	0.29	0.92	0.24	6.93E-03
H2SSIM/WATER9 Results	**H2S, g/s**	**DMDS, g/s**	**DMS, g/s**	**MMC, g/s**
ASB Zone 1	0.07	0.35	0.19	5.81E-03
ASB Zone 2	0.03	5.66E-03	4.06E-03	1.06E-04
ASB Zone 3	0.02	1.09E-04	1.45E-04	3.51E-06
Total ASB	**0.12**	**0.36**	**0.19**	**5.92E-03**
PAE Emissions Factors	**H2S, lb/ODTP**	**DMDS, lb/ODTP**	**DMS, lb/ODTP**	**MMC, lb/ODTP**
Total ASB	**1.05E-02**	**3.08E-02**	**1.69E-02**	**5.12E-04**

Post-Project Foul Condensate Flow:	500	gpm
Post-Project Foul Condensate Flow:	0.72	MGD
Post-Project ASB Influent Flow:	25.48	MGD
Total ASB Flow:	26.20	MGD
Total ASB Flow:	1148	L/s
Pulp Production	2200	ODTP/day

	MW
H2S	34
DMDS	94
DMS	62
MMC	48

NCASI WASTEWATER HYDROGEN SULFIDE EMISSIONS SIMULATOR (H2SSIM)
Version 1.3

Data Type 1. Site Identification

Company Name	New-Indy
Facility Name	Catawba SC
Basin Name	ASB

Data Type 2. Model Zone Information

Number of Zones	3
Zone Location of Hardpipe	1
Type of Basin	ASB

Data Type 3. Load Characteristics

Loading Characteristics	Main Influent	Hardpipe	Units
Flow	25.48	0.72	MGD
Total Sulfide	0.252	1.47	mg/L
Sulfate	390	390	mg/L

Data Type 4. Atmospheric Conditions

Windspeed	3.55	mph
Ambient Temperature	79	F

Data Type 5. Zone Physical and Chemical Conditions

Zone Condition	Zone 1	Zone 2	Zone 3	Zone 4	Units
Dissolved Oxygen	1.57	4.63	4.66		mg/L
Temperature	93.34	89.74	86.02		F
pH	7.04	7.24	7.42		s.u.
Redox Condition	Aerobic	Aerobic	Aerobic	Aerobic	
Length	968	1208	1235		feet
Width	968	604	617		feet
Depth	4.5	3.2	3		feet
Mixing	Moderat	Moderat	Moderat		
Number of Aerators	31	15	6		
Total Horsepower	2325	1125	450		HP
Impellor Size	1.625	1.625	1.625		feet
Impellor RPM	1200	1200	1200		RPM
Diffused Air Flow	0	0	0		cms
Weir Height	0	0	0		feet

Model Controls

Run H2SSIM

View Parameters

Clear Input Sheet

H2SSIM Results

Backup Stripper Methanol Mode Scenario

Basin Emissions		Units
Total Emissions (H_2S)	0.121	gms/s
Total Emissions (H_2S)	8417.2	lbs/yr
Total Emissions (H_2S)	4.2	tons/yr
Total Emissions (H_2S)	3.8	tonnes/yr
Emission Flux (H_2S)	16.9	gms/m^2 yr

Zone Emissions	Zone 1	Zone 2	Zone 3	Zone 4	Units
Zone Emissions (H_2S)	0.07	0.03	0.02		gms/s
Zone Emissions (H_2S)	5132.3	1762.9	1521.9		lbs/yr
Emission Flux (H_2S)	26.7	11.8	9.8		gms/m^2 yr
Liquid Conc. (Total Sulfide)	0.003	0.001	0.000		mg/L
Liquid Sulfide Load (lbs/yr)	39.300	6.400	5.600		lbs/yr

Percent Inlet Sulfide Removed	63.0%

Current Parameters	
kgen	0.25
ThetaGen	1.06
KDO	0.05
KSO4	10
kanox	0.006
ThetaOx	1.05
m	1
n	0.2
MLVSS	272.2
O_2 Transfer Coeff.	2
alpha 1	0.83
alpha 2	0.6

SUMMARY FOR EMISSIONS AT UNIT 11 ASB Zone 1 aerated biotreatment
03-14-2024 09:38:13

COMPOUND NAME	conc in (ppmw)	fe air	fe bio	conc out (ppmw)	emissions (g/s)
DIMETHYL DISULFIDE	8.367e-1	0.36428	0.61827	1.46e-2	3.499e-1
DIMETHYL SULFIDE (DMS)	2.074e-1	0.80097	0.17688	4.593e-3	1.907e-1
HYDROGEN SULFIDE	2.835e-1	0.98155	0.	5.231e-3	3.195e-1
METHANETHIOL(methyl mercaptan)	5.699e-3	0.8877	0.09361	1.065e-4	5.808e-3
Total rate for all compounds					8.658e-1

SUMMARY FOR EMISSIONS AT UNIT 17 ASB Zone 3 aerated biotreatment
03-14-2024 09:38:13

COMPOUND NAME	conc in (ppmw)	fe air	fe bio	conc out (ppmw)	emissions (g/s)
DIMETHYL DISULFIDE	5.231e-4	0.18124	0.76948	2.578e-5	1.088e-4
DIMETHYL SULFIDE (DMS)	2.136e-4	0.58962	0.31941	1.943e-5	1.446e-4
HYDROGEN SULFIDE	2.231e-4	0.88747	0.	2.511e-5	2.273e-4
METHANETHIOL(methyl mercaptan)	4.197e-6	0.72787	0.18714	3.567e-7	3.507e-6
Total rate for all compounds					4.842e-4

SUMMARY FOR EMISSIONS AT UNIT 18 ASB Zone 2 aerated biotreatment
03-14-2024 09:38:13

COMPOUND NAME	conc in (ppmw)	fe air	fe bio	conc out (ppmw)	emissions (g/s)
DIMETHYL DISULFIDE	1.46e-2	0.3375	0.62668	5.231e-4	5.658e-3
DIMETHYL SULFIDE (DMS)	4.593e-3	0.7705	0.183	2.136e-4	4.063e-3
HYDROGEN SULFIDE	5.231e-3	0.95735	0.	2.231e-4	5.749e-3
METHANETHIOL(methyl mercaptan)	1.065e-4	0.86336	0.09723	4.197e-6	1.056e-4
Total rate for all compounds					1.558e-2

APPENDIX C FORMS - CALCULATING FRACTION BIODEGRADED

Data Date: PAE - Backup Stripper (Methanol Mode)

Instructions: Enter data in green shaded sections of this page of this spreadsheet only.

I. BIOTREATMENT UNIT DESCRIPTION

	Units	Zone 1	Zone 2	Zone 3
Number of 75 HP Aerators	#	31	15	6
Number of 100 HP Aerators	#	0	0	0
Total Horsepower	HP	2325	1125	450
Temperature	C	35.4	33.5	31.3
Length	ft	968	1,208	1,235
Width	ft	968	604	617
Average Depth	ft	4.5	3.2	3
Aerator Rotation	rpm	1200	1200	1200
Agitation Area per 75 HP aerator	ft2	1452	1452	1452
Agitation Area per 100 HP aerator	ft2	2206	2206	2206
Impellor Diameter	in	19.5	19.5	19.5

II. OVERALL PARAMS - individual flows

	Flow MGD	MeOH mg/L
Inlet Stream **	25.48	59.5
Condensate Stream	0.7	3,809
Outlet	26.2	5.1

** *except condensate flow*

NA - individual flow/conc data not available

II. OVERALL PARAMS - total flows

		Flow m3/sec	Flow MGD	MeOH mg/L
Influent Concentration			26.2	162.5
Effluent Concentration				5.09824
Wind Speed	mph			3.8

III. HAP DATA

Methanol

	Units	Inlet	Average Zone Concentration Zone 1	Zone 2	Zone 3	Detect Limit
Conc.	mg/L	162.5	44.6	25.8	8.1	0.5
Temp.	F		95.7	92.3	88.3	

	Zone 1	Zone 2	Zone 3
Avg. 2021/2022 Zone Reductions	**27%**	**16%**	**5%**

IV. RESULTS

fbio - Methanol	%
Fraction biodegraded	86.8
Fraction air emissions	10.1
Fraction remaining in unit effluent	3.1

APPENDIX C FORMS - CALCULATING FRACTION BIODEGRADED
PARAMETERS FOR CALCULATING MASS TRANSFER COEFIICIENTS

Data Date: PAE - Backup Stripper (Methanol Mode)

	Diff in Water cm2/s	Diff in Air cm2/s	Henry's Law atm-m3/mol	Equil. Ratio (Hc) or (Keq) m3 liq to m3 gas	MW g/mol	ScG	Antoine Eqtn b	Antoine Eqtn c
Methanol	1.64E-05	0.150	5.19E-06	2.12E-04	32.0	1.006	1474	229.13
Acetaldehyde	1.41E-05	0.124	8.77E-05	3.58E-03	45.1	1.216	1600	291.8
MEK	9.80E-06	0.081	1.30E-04	5.31E-03	72.1	1.867	1305	229.27

General

	Units	Value	Name
viscosity of air	g/cm-s	0.000181	va
viscosity of water	g/cm-s	0.002	vw
density of air	g/cm3	0.0012	da
density of water	g/cm3	1	dw
MW of air	g/mol	29	Mwa
MW of water	g/mol	18	MWw
Diff of O2 in H2O	cm2/s	2.40E-05	DO2w
grav const.	lb-ft/s2/lb	32.17	g
R	atm-m3/mol K	8.21E-05	R_
Aerator Motor Eff	fraction	0.85	AerEff
O2 Trans Correct		0.83	Beta
Wind Speed	m/s	1.69	U
Diff of Ether	m/s	8.50E-06	Dether
O2 Trans	lb O2/HP-h	3	J

TURBULENT KL Params

	Zone 1	Zone 2	Zone 3
w	126.3	126.3	126.3
Re	2.07E+06	2.07E+06	2.07E+06
PI	35063	35063	35063
Power Number, p	7.92E-04	7.92E-04	7.92E-04
Fr	8.06E+02	8.06E+02	8.06E+02
Total TurbArea (ft2)	45012	21780	8712
Total TurbArea (m2)	4181.6	2023.4	809.3
Frac. Agitated	0.048	0.030	0.011
(by surface aerators)			
QUIESCENT			
Depth	1.37	0.98	0.92
SurfArea (ft2)	937472	729750	762343
SurfArea (m2)	87208.33	67885.00	70916.98
F/D Ratio	243	301	328
ScL - Methanol	NA	NA	NA
ScL - Acetaldehyde	NA	NA	NA
ScL - MEK	NA	NA	NA
U* (Friction Velocity)	NA	NA	NA

These Parameters are used when F/D < 14 **AND** U > 3.25 m/s

DIFFUSED

	Zone 1	Zone 2	Zone 3
Air flow, cfm	0	0	0
Air flow, m3/s	0.000	0.000	0.000

APPENDIX C FORMS - CALCULATING FRACTION BIODEGRADED
Calculating Mass Transfer Coefficient KL for Various Zones

Data Date: **PAE - Backup Stripper (Methanol Mode)**

Surface Aeration													
		Turbulent Area			Quiescent Area								
						kL, m/s							
							U10 > 3.25						
	Temp Adj H	kG m/s	kL m/s	KL turb m/s	kG m/s	U10 < 3.25	F/D<14	14<F/D<51.2	F/D>51.2	kL m/s	KL quisc m/s	KL overall m/s
Zone1												
Methanol	8.77E-06	1.55E-01	2.27E-02	5.37E-05	3.82E-03	4.31E-06	NA	3.38E-06	1.16E-06	4.31E-06	1.01E-06	3.54E-06
Zone 2												
Methanol	7.99E-06	1.55E-01	2.17E-02	4.92E-05	3.88E-03	4.31E-06	NA	4.06E-06	1.16E-06	4.31E-06	9.57E-07	2.40E-06
Zone 3												
Methanol	7.16E-06	1.55E-01	2.06E-02	4.44E-05	3.87E-03	4.31E-06	NA	4.37E-06	1.16E-06	4.31E-06	8.82E-07	1.38E-06

FORM XIII. DATA FORM FOR THE ESTIMATION OF MULTIPLE ZONE BIODEGRADATION FROM UNIT CONCENTRATIONS

Data Date: PAE - Backup Stripper (Methanol Mode)

NAME OF THE FACILITY				
COMPOUND for site specific biorate determination		**Methanol**		
Number of zones in the biological treatment unit	1			
VOLUME of full-scale system (cubic meters)	2	250372.98		
Average DEPTH of the full-scale system (meters)	3	1.0878333		
FLOW RATE of wastewater to the unit (m3/s)	4	1.116		
FLOW RATE of condensate to the unit (m3/s)	5	0.032		
Total wastewater flowrate - (including condensates) (m3/s)	5-A	1.148		
ESTIMATE OF KL (m/s)	6	*see table*		
Concentration in the wastewater treated in the unit (mg/L)	7	59.511413		
Concentration in the condensates (mg/L)	8	3809		
Concentration in wastewater (total - inc. cond) in (mg/L)	8-A	162.53984		
Concentration in the effluent (mg/L)	9	5.0982378		
TOTAL INLET FLOW (m3/s) line 4 plus the number on line 5 (or 5-A)	10	1.148		
TOTAL RESIDENCE TIME (s) line 2 divided by line 10.	11	218116	2.52	days
TOTAL AREA OF IMPOUNDMENT (m2) line 2 divided by line 3	12	230157		

Lines 13 through 15 Not Used

Zone Number	Concentration for zone, Ci (mg/L)	Area of the zone, A (m2)	Estimate of KL in the zone (m/s)	AIR STRIPPING KL A Ci (g/s)	
1	44.62519102	87091.1501	3.54365E-06	13.7723	0.308621
2	25.78937099	67793.7816	2.39719E-06	4.1912	0.162515
3	8.06308953	70821.6825	1.37942E-06	0.788	0.097693
4					
5					
6					
TOTALS - sum for each zone.	15	225706.614	16	18.75	

Removal by air stripping (g/s). Line 16.	17	18.75
Loading in effluent (g/s). Line 9 times line 10.	18	5.85
Total loading (g/s). {(line 5*line 8)+(line 4*line 7)} or {line 5-A*line 8-A}.	19	186.6
Removal by biodegradation (g/s) Line 19 minus (line 17 + line 18).	20	162.0
Fraction biodegraded: Divide line 20 by line 19.	21	0.868
Fraction air emissions: Divide line 17 by line 19.	22	0.101
Fraction remaining in unit effluent. Divide line 18 by 19.	23	0.031

NEW CONDENSATE STRIPPER

CONSTRUCTION PERMIT APPLICATION

NEW-INDY CATAWBA LLC – CATAWBA, SC MILL

MARCH 2023

UPDATED APRIL 2024

RECEIVED
APR 30 2024
BAQ PERMITTING

Submitted by:

Submitted to:

New-Indy Catawba LLC – Catawba, SC Mill
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SC Department of Health and Environmental Control
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1. INTRODUCTION AND APPLICATION OVERVIEW

New-Indy Catawba LLC (New-Indy Catawba) operates a pulp and paper mill located in Catawba, South Carolina (Mill or the Mill) and currently operates under Title V Operating Permit No. TV-2440-005 (TVOP or TV-2440-0005), effective on July 1, 2019.

New-Indy Catawba has prepared this construction permit application as required by the Consent Order to Correct Undesirable Levels of Air Contaminants ("Consent Order"), issued on November 23, 2022, by the South Carolina Department of Health and Environmental Control (SCDHEC)[1]. For compliance with the provisions of the Consent Order, New-Indy Catawba is proposing a modification to their current foul condensate treatment system (condensate treatment system) to install a new foul condensate stripper (new steam stripper) and demote the existing steam stripper [existing steam stripper (ID 9801)] strictly to backup operation during periods of downtime experienced by the new steam stripper (Project). The Project also includes the installation of a stripper feed tank, methanol storage tank, and hot water tank to serve the new steam stripper. The stripper feed tank and methanol storage tank will be controlled in the LVHC system. The hot water tank is not expected to be a source of emissions. The Project will also satisfy the requirements of Item I.a. of Appendix A of Consent Decree Civil No. 0:21-cv-02053-SAL, United States of America v. New-Indy Catawba, LLC, dated November 16, 2022 (EPA Consent Decree).

This document represents the construction permit application for this Project (Application). This application was originally submitted in March 2023. This application has been updated in April 2024 to reflect the final project description and project emissions calculations at the request of SCDHEC.

[1] The November 23, 2022, Consent Order amends and replaces the Order to Correct Undesirable Level of Air Contaminants issued by SCDHEC on May 7, 2021.

2. PROCESS AND PROJECT DESCRIPTION

New-Indy Catawba is comprised of seven distinct process areas that include the following: the woodyard area, the kraft pulp mill area, the paper mill area, the chemical recovery area, the utilities area, the waste treatment area, and a miscellaneous area. A simplified process flow diagram for these process areas is included as Figure 2-1. A description of the process areas is presented below, with more detail provided in the areas that are impacted by the Project.

Southern pine logs and chips are received at the woodyard. Logs are debarked, chipped, and the chips are screened prior to storage for use within the pulping process. Likewise, purchased wood chips received are screened, and processed as needed, prior to use within the pulping processes.

The kraft (sulfate) process area is used to produce pulp. Pulp from the kraft process is produced from "cooking" wood chips in the continuous digester in a caustic solution at an elevated temperature and pressure. The pulp slurry from the continuous digester is sent to the blow tank, then to one of two parallel pulping lines, each consisting of an enclosed deshive refiner and a three-stage drum displacement washer system and associated filtrate tanks. Weak black liquor from the washer filtrate tanks is stored before being recycled to chemical recovery. Rejects from the refiners are sent to the screw presses, with the filtrate being screened and stored before being recycled to chemical recovery. Washed pulp is stored and then sent to the paper mill area. With the exception of the pulp storage tanks after pulp washing, the kraft pulp mill sources are currently collected and routed to the high volume low concentration (HVLC) or low volume, high concentration (LVHC) systems, and emissions are controlled through combustion in the Nos. 1 or 2 Combination Boilers.

Linerboard (the outside layer of a corrugated container) is produced in the paper mill area on one state-of-the-art paper machine. Unbleached market pulp is produced on one pulp dryer. A second paper machine at the Mill is currently idled.

Weak black liquor is concentrated in the Nos. 1-3 Evaporator Sets and is then fired in the recovery furnaces (chemical recovery area) that burn the organics extracted from the chips and recover cooking chemicals. The causticizing area utilizes the chemicals recovered by the recovery furnaces, and after adding lime, provides the cooking chemicals for the kraft process.

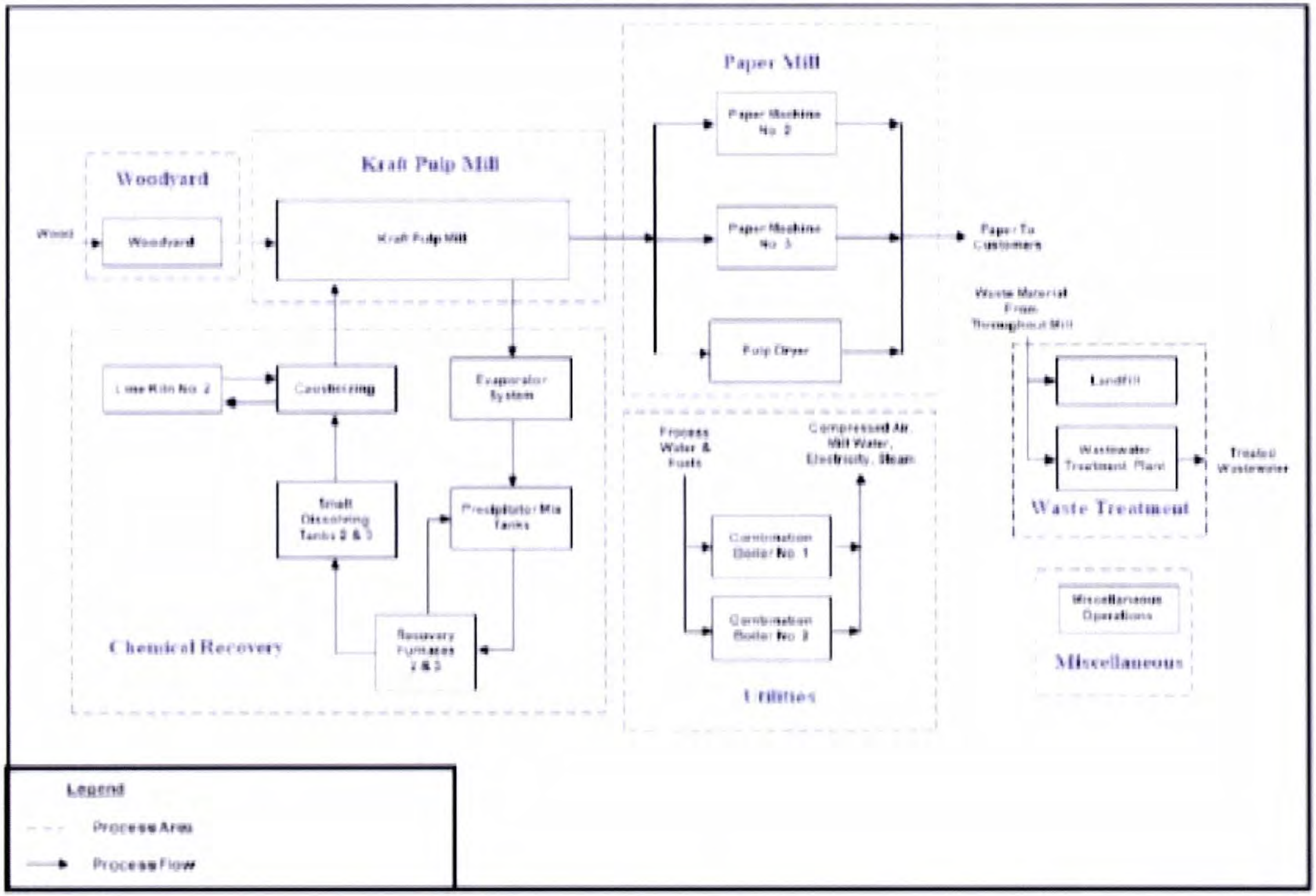
Emissions from the Evaporator Sets and Turpentine Recovery System are collected in the LVHC gas collection system and combusted in the Nos. 1 or 2 Combination Boilers. Several weak black liquor tanks are collected in the HVLC system and combusted in the Nos. 1 or 2 Combination Boilers. Evaporator condensates are segregated, with the combined condensates being recycled to the Brownstock washer system or sewered. The foul condensates are treated in a dual control device configuration: foul condensates are preferentially treated in the existing condensate steam stripper system, with the remaining flow being directed to the aerated stabilization basin (ASB) via the Hardpipe (ID 9802).

Steam and electricity are produced for facility-wide use by two combination boilers. The recovery furnaces also generate steam.

A waste treatment area receives wastewater and mill waste (solid waste) from the various previously mentioned areas of the facility. Wastewater undergoes biological treatment to remove the dissolved organic wastes prior to discharge into the receiving stream. Mill solid waste is deposited in an on-site landfill.

The miscellaneous areas include everything that is not captured in one of the aforementioned process operating areas, such as facility roads and the pulp storage tanks.

Figure 2-1 Simplified Mill Flow Diagram



Actual Representation of
Original Document
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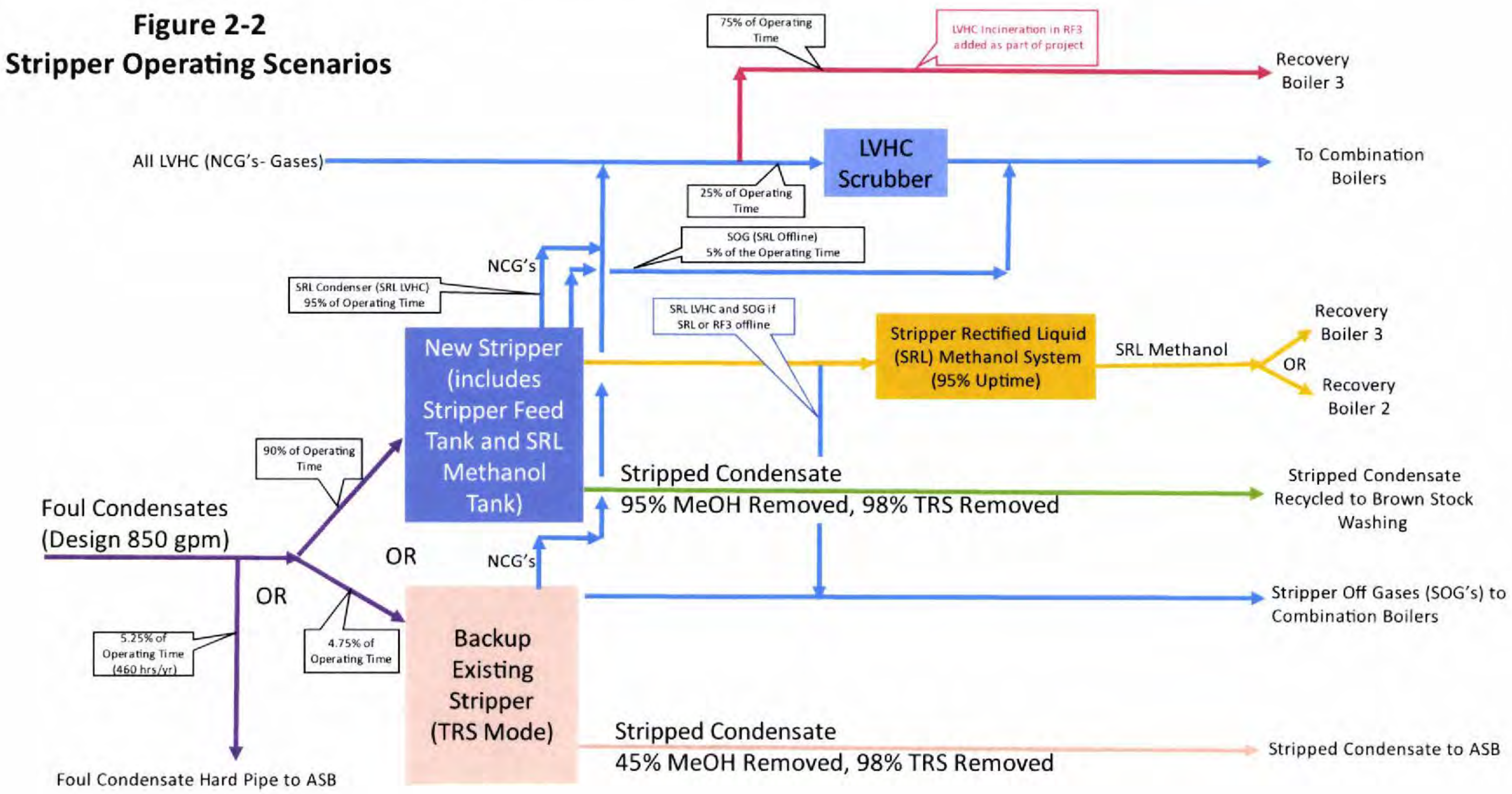
This document represents the construction permit application for this Project in accordance with the SCDHEC Consent Order. The Project consists of the following new equipment and proposed changes to the existing treatment scenarios:

1. Construct and operate a new low-pressure steam foul condensate stripper system that will process the pulping process condensates (foul condensate) for compliance with 40 CFR Part 63, Subpart S. The resultant stripped methanol will be condensed into a liquid [called stripper rectified liquid (SRL)] and combusted along with the black liquor in the Nos. 2 and 3 Recovery Furnaces (ID Nos. 2505 and 5105). The SRL will be added to the black liquor at a maximum amount of 2% by volume. There are no anticipated changes in black liquor firing as a result of the project. The LVHC gases from the SRL condenser system, stripper feed tank, and SRL tank will be combusted in the No. 3 Recovery Furnace. The LVHC system will include a 1.0 mmBtu/hr natural gas ignitor for combustion of the LVHC gases when black liquor firing is less than 50% of capacity. The existing Nos. 1 and 2 Combination Boilers (ID Nos. 2605 and 3705) will serve as back-up control for the new Stripper's LVHC gases when the SRL condenser system is not in operation. Stripped condensates will be recycled to the Brownstock washers (ID 5230), as needed;
2. Operate the existing steam stripper (ID 9801) as a backup to the new low-pressure steam stripper. The existing steam stripper will be operated to process the foul condensate and remove 98% of the total reduced sulfur (TRS) compounds; although with reduced methanol removal efficiency (referred to as "TRS Mode"). Further methanol treatment through biological destruction will be accomplished by routing the stripped condensates to the existing Hardpipe system that discharges the foul condensates below the liquid surface of the existing ASB; and
3. Modify the No. 3 Recovery Furnace to combust gases collected in the LVHC system. The Nos. 1 and 2 Combination Boilers will serve as backup control for the LVHC gases following the Project. When these LVHC gases are combusted in the combination boilers, a caustic scrubber will be operated to provide 50% removal of the sulfur prior to combustion.

Figure 2-2 presents a simplified process flow with the possible operating scenarios for treatment of the foul condensates and the associated control scenarios for the new and existing steam stripper vent gases. Section 3.2.2.3 presents the prevention of significant deterioration (PSD) analysis that details the basis for the projected actual emissions (PAE) calculations for the proposed future operating scenarios.

Figure 2-2 Stripper Operating Scenarios



3. REGULATORY REVIEW

This section summarizes Federal and State air quality regulations that potentially apply to the Project. Discussions pertaining to applicable regulatory requirements are separated into three categories:

- Federal Air Quality Regulations
- South Carolina Air Quality Regulations
- Provisions of the SCDHEC Consent Order and EPA Consent Decree

3.1 FEDERAL AIR QUALITY REGULATIONS

For the purpose of this Application, potentially applicable Federal regulations consist of:

- Standards of Performance for New Stationary Sources (NSPS)
- National Emission Standards for Hazardous Air Pollutants (NESHAP)
- New Source Review (NSR) and PSD
- Compliance Assurance Monitoring (CAM)
- Requirements for Preparation, Adoption, and Submittal of Implementation Plans
- Title V Operating Permits

A discussion of each specific Federal air quality regulation is provided in the following subsections.

3.1.1 Standards of Performance for New Stationary Sources

U.S. EPA has promulgated NSPS at 40 CFR Part 60. NSPS requirements are promulgated under 40 CFR 60 pursuant to Section 111 of the Clean Air Act.

3.1.1.1 40 CFR Part 60, Subparts BB and BBa – Standards of Performance for Kraft Pulp Mills

40 CFR Part 60, Subpart BB – Standards of Performance for Kraft Pulp Mills applies to TRS emissions from digesters, brownstock washers, multiple-effect evaporators, recovery furnaces, smelt dissolving tanks, lime kilns, and condensate strippers that commenced construction, reconstruction, or modification after September 24, 1976, and on or before May 23, 2013.

Subpart BBa applies to the same sources that commence construction, reconstruction, or modification after May 23, 2013.

The No. 3 Multi-effect Evaporator Set with Concentrator is currently subject to 40 CFR 60, Subpart BB for TRS (Standards of Performance for Kraft Pulp Mills). The existing condensate stripper system and No. 1 Multi-effect Evaporator Set with Concentrator are currently subject to 40 CFR 60, Subpart BBa for TRS. Compliance with the TRS standards at §60.283(a)(1) and §60.283a(a)(1) is currently demonstrated by combusting the stripper off-gases and evaporator vent gases in the Nos. 1 and 2 Combination Boilers per §60.283(a)(1)(iii) [combust the gases at a minimum temperature of 650 °C (1200 °F) for at least 0.5 seconds] and §60.283a(a)(1)(iii) [collect the gases in the existing low volume high concentration (LVHC) closed-vent collection system meeting the requirements of §63.450 and combust the gases at a minimum temperature of 650 °C (1200 °F) for at least 0.5 seconds]. As there are no physical modifications to the existing condensate stripper and Nos. 1-3 Multi-effect Evaporator Sets with Concentrators, the Mill will continue to combust the existing stripper off-gases in the Nos. 1 and 2 Combination Boilers; however, following the Project, the vent gases from the Nos. 1-3 Multi-effect Evaporator Sets with Concentrators will be combusted in the No. 3 Recovery Furnace per §60.283a(a)(1)(ii) [gases are collected in the existing LVHC closed-vent collection system meeting the requirements of §63.450 and combusted in a recovery furnace subject to §60.283(a)(2)] or in the Nos. 1 and 2 Combination Boilers per §60.283a(a)(1)(iii). The No. 2 Multi-effect Evaporator Set with Concentrator is not subject to either Subpart BB or Subpart BBa but gases are collected and controlled in the same manner as the other evaporator sets.

Upon completion of the Project, the new condensate stripper system will be subject to 40 CFR Part 60, Subpart BBa for TRS (Standards of Performance for Kraft Pulp Mill Affected Sources for Which Construction, Reconstruction, or Modification Commenced After May 23, 2013). Compliance with the TRS standard at 60.283a(a)(1) will be demonstrated through collection of the stripper off-gases (SOG) in the existing SOG collection system and SRL gases in the existing LVHC closed-vent collection system meeting the requirements of §63.450. The SOG will continue to be combusted in the Nos. 1 and 2 Combination Boilers per §60.283a(a)(1)(iii). The LVHC collection system gases will be combusted in the No. 3 Recovery Furnace per §60.283a(a)(1)(ii) or in the Nos. 1 and 2 Combination Boilers per §60.283a(a)(1)(iii). Emissions from the stripper feed tank will also be collected in the LVHC collection system. The Mill will continuously monitor the incineration of SOG and LVHC gases in the No. 3 recovery furnace, each combination boiler, and venting of the SOG and LVHC closed-vent systems as required by §60.284a(d)(3)(iii) and currently utilized for monitoring compliance with Subpart BB.

New-Indy Catawba will maintain records of excess emissions and malfunctions for the new stripper as required by §60.287a(b)(7) and (c), respectively. The Mill will report periods of excess emissions and malfunctions as required by §60.288a(a) and (d), respectively. As defined in §60.284a(e)(1)(vi), periods of excess emissions from the LVHC closed-vent system (condensate stripper system) that are less than one percent (1%) of operating time during a semi-annual period are not a violation of §60.283a(a)(1)(iii).

The stripper feed tank, methanol tank, hot water tank, Hardpipe, and ASB are not included in the definition of condensate stripper system under §60.281 or §60.281a and are not affected sources under Subparts BB or BBa.

3.1.1.2 40 CFR Part 60, Subpart Kb - Standards of Performance for Volatile Organic Liquid Storage Vessels (Including Petroleum Liquid Storage Vessels) for Which Construction, Reconstruction, or Modification Commenced After July 23, 1984

The Project includes a new stripper feed tank, new methanol tank, and a new hot water tank. 40 CFR Part 60, Subpart Kb includes standards of performance for new storage tanks. However, per 60.111b, the definition of storage tank does not include process tanks (tanks that collect material from one part of a process before sending it to another part of the process). Therefore, the new tanks are not subject to Subpart Kb.

3.1.2 National Emission Standards for Hazardous Air Pollutants

NESHAP found in 40 CFR Part 61 apply to specific compounds emitted from certain listed processes. 40 CFR Part 61 subparts do not apply to the Mill, and there are no Part 61 subparts that apply to the proposed Project. Applicability of Part 63 NESHAP is discussed below.

3.1.2.1 40 CFR Part 63, Subpart S – National Emission Standards for Hazardous Air Pollutants from the Pulp and Paper Industry

New-Indy Catawba is subject to 40 CFR Part 63, Subpart S, also referred to as Maximum Achievable Control Technology (MACT) I for the pulp and paper industry. This standard regulates hazardous air pollutant (HAP) emissions from pulping and bleaching systems. The affected source under this standard is the total of all HAP emission points in the pulping and bleaching systems. The Mill does not produce bleached pulp and is therefore not subject to the requirements of §63.445.

The Nos. 1-3 Multi-effect Evaporator Sets with Concentrators and Turpentine Recovery System were constructed prior to 1993 and are existing affected sources, while the existing condensate stripper was constructed after 1993, making it a new source under 40 CFR Part 63, Subpart S. Compliance is currently demonstrated by collecting the gases in the existing LVHC closed-vent system meeting the requirements of §63.450 and combustion of the SOG and LVHC system gases in the Nos. 1 and 2 Combination Boilers per §63.443(d)(4)(i) (introduce the HAP emission stream with the primary fuel or into the flame zone). The Mill currently complies with the pulping condensates collection requirements in §63.446(c)(3) [collect the pulping process condensates from equipment systems listed in §63.446(b)(1) through (b)(5) that in total contain a minimum of 7.2 lb HAP per ton oven dried ton of pulp (lb HAP/ODTP)] and the treatment requirements in §63.446(e)(4) [treat a minimum of 6.6 lb HAP/ODTP]. The Mill has utilized concurrent use of the existing steam stripper and Hardpipe for compliance with §63.446(e)(4).

Subpart S requires collection of LVHC gases from steam stripper systems, defined to include the stripper column, associated feed tanks, condensers, and any methanol rectification process. The new condensate stripper, stripper feed tank, methanol condenser, and methanol tank will be subject to this rule upon startup.

Following the completion of the proposed Project, SOG from the existing condensate stripper and vent gases from the existing Nos. 1-3 Multi-effect Evaporator Sets with Concentrators and Turpentine system will continue to be collected in the existing LVHC closed-vent system meeting the requirements of §63.450 and §63.453(k)(1-6). The existing SOG will continue to be combusted in the Nos. 1 and 2 Combination Boilers per §63.443(d)(4)(i). However, the vent gases from the LVHC collection system will be combusted in the No. 3 Recovery Furnace or in the Nos. 1 and 2 Combination Boilers (as backup) per §63.443(d)(4)(i). The Mill will update the leak detection and repair (LDAR) site inspection plan as appropriate per §63.454(b).

The Mill plans to demonstrate compliance with the pulping condensates collection requirements in §63.446(c)(3) [collect the pulping process condensates from equipment systems listed in §63.446(b)(1) through (b)(5) that in total contain 7.2 lb HAP/ODTP] and the treatment requirements in §63.446(e)(4) [treat a minimum of 6.6 lb HAP/ODTP]. The Mill will utilize the new condensate stripper for compliance with §63.446(e)(4) and will operate a continuous monitoring system for the parameters in §63.453(g)(1-3). Vents from the new condensate stripper (including the stripper feed tank, SRL condenser, and SRL tank) will be collected in the existing LVHC closed-vent system meeting the requirements of §63.450 and combusted in the No. 3 Recovery Furnace or Nos. 1 and 2 Combination Boilers per §63.443(d)(4)(i). The Mill will update the LDAR site inspection plan as appropriate per §63.454(b) and will perform the required inspection and monitoring requirements per §63.453(k)(1-6). The new stripper will be included in semi-annual excess emission reports under §63.455. Per §63.446(g), periods of excess emissions reported under §63.455 are not considered a violation of §63.446(e)(4) provided that the time of excess emissions divided by the total process operating time in a semi-annual reporting period does not exceed 10 percent.

At the request of SCDHEC, the Mill is providing additional information regarding plans to demonstrate continuous compliance with the pulping condensate collection and treatment in the new steam stripper. These are as follows:

- Pulping condensate collection emissions limit of 7.2 lb HAP/ODTP:
    - HAP will be measured "as methanol" per §63.457(f)(2);
    - Daily sampling of foul condensates for methanol concentration representative of the inlet to the new stripper;
    - Continuous measurement of new steam stripper inlet foul condensate feed flow (gpm);
    - Daily measurement of pulp production (ODTP); and
    - Daily calculation of a 15-day rolling average collection (lbs methanol/ODTP) [Note: The Mill may use historical and/or collect future foul condensate sampling data to support a longer averaging period].
- Pulping condensate treatment in the new steam stripper to remove 6.6 lb HAP/ODTP:
    - HAP will be measured "as methanol" per §63.457(f)(2); and
    - Daily sampling of stripped condensates for methanol concentration representative of the outlet of the new stripper.
    - Continuous measurement of:
        - New steam stripper inlet foul condensate feed flow (gpm);
        - New steam stripper steam feed flow (lbs/hr);
        - Foul condensate to new steam stripper feed temperature (°F); and
        - New steam stripper stripped condensate flow (gpm).
    - Daily measurement of pulp production (ODTP).
    - Daily calculation of the percent methanol removed in the steam stripper .
    - Daily calculation of the treatment in the new steam stripper [15-day (or other averaging period, as justified) rolling average methanol collected (lbs methanol/ODTP) multiplied by the calculated daily methanol percent removal in the new stripper].

Please note that the Mill may choose to establish a methanol concentration factor in lieu of daily methanol sampling at the inlet to the new steam stripper once sufficient data has been collected demonstrating consistency in the foul condensate methanol concentration. In addition, the Mill may choose to establish an effective steam to feed ratio (ESFR) curve for the new stripper system to be used to establish the methanol removal efficiency across the stripper in lieu of the method described above. The compliance approach will be delineated in the Notification of Compliance Status (NOCS) that will be submitted with the results of the initial compliance demonstration to be conducted within 180 days of startup of the new stripper system.

3.1.2.2 40 CFR Part 63, Subpart MM National Emission Standards for Hazardous Air Pollutants (NESHAP) for Chemical Recovery Combustion Sources at Kraft, Soda, Sulfite, and Stand-Alone Semichemical Pulp Mills

New-Indy Catawba is subject to 40 CFR Part 63, Subpart MM, also referred to as MACT II for the pulp and paper industry. This standard regulates particulate matter (PM) emissions from existing recovery boilers, smelt tanks, and lime kilns when processing black liquor or calcium oxide. The Nos. 2 and 3 Recovery Furnaces are currently subject to the existing source requirements of this regulation. The proposed Project will modify the LVHC collection system that delivers the LVHC gases to the No. 3 Recovery Furnace for combustion, but no changes in black liquor firing are expected for the recovery furnaces and PM emissions from black liquor combustion are not expected to increase. The Mill will continue to meet the existing PM emission limits under Subpart MM after completion of the Project.

3.1.2.3 40 CFR Part 63, Subpart EEEE – National Emission Standards for Hazardous Air Pollutants: Organic Liquids Distribution (non-Gasoline)

Subpart EEEE applies to organic liquids distribution (OLD) operations at major sources of HAP. The Project includes installation of a new methanol tank and a new hot water tank. However, these new tanks are not subject to this rule because they are part of the Mill's pulping system as defined under Subpart S. EPA confirmed that tanks in pulp and paper mills that are part of the pulping or bleaching systems are not subject to Subpart EEEE in a December 2004 determination (ADI Control Number M050008).

3.1.2.4 40 CFR Part 63, Subpart DDDDD – National Emission Standards for Hazardous Air Pollutants for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters.

New-Indy Catawba is subject to 40 CFR Part 63, Subpart DDDDD, also referred to as Boiler MACT. Boiler MACT sets forth emissions limits and work practice standards; testing and fuel analyses requirements; and monitoring, recordkeeping, notification, and reporting requirements that apply to boilers and process heaters located at major sources of HAP. The Nos. 1 and 2 Combination Boilers are subject to the requirements of 40 CFR Part 63, Subpart DDDDD. The

Nos. 2 and 3 Recovery Furnaces are not subject to the rule per §63.7491(b). The Project will not affect the regulatory applicability of 40 CFR Part 63, Subpart DDDDD, for either combination boiler and will not affect compliance with the applicable emissions limits. The Mill will continue to comply with the currently applicable provisions of 40 CFR Part 63, Subpart DDDDD, in the same manner after completion of the Project.

3.1.3 New Source Review

The Mill is located in York County which is classified as in attainment of or unclassifiable for the National Ambient Air Quality Standards (NAAQS) for regulated NSR pollutants. Therefore, Nonattainment New Source Review (NNSR) regulations do not apply to this Project and the Project is analyzed for applicability as it relates to the PSD requirements. Implementation of the PSD regulations (i.e., 40 CFR §51.166) has been delegated in full to the State of South Carolina. Refer to Section 3.2.2.3 for a discussion of PSD applicability.

3.1.4 Compliance Assurance Monitoring

U.S. EPA developed the CAM rule at 40 CFR Part 64 as a means for providing reasonable assurance that continuous compliance with applicable requirements is achieved for certain emissions units located at major stationary sources subject to Title V permitting. CAM applies to pollutant-specific emissions units (PSEUs) that (1) are subject to an emissions limit or standard (2) use a control device to achieve compliance with that emissions limit or standard, and (3) have potential pre-control device emissions in the amount required to classify the unit as a major source under Part 70 of the Clean Air Act (CAA). Part 64 does not apply to emissions limitations or standards proposed after November 15, 1990 pursuant to Section 111 or 112 of the Clean Air Act (e.g., post-1990 NSPS or NESHAP). The proposed Project is not subject to CAM requirements because the new steam stripper is subject to 40 CFR Part 60, Subpart BBa and 40 CFR Part 63, Subpart S, which are standards proposed after November 15, 1990.

3.1.5 Requirements for Preparation, Adoption, and Submittal of Implementation Plans

U.S. EPA requires air agencies to develop and submit air quality data characterizing maximum 1-hour ambient concentrations of sulfur dioxide (SO_2) through ambient air quality monitoring or air quality modeling analysis at the air agency's election. These requirements are promulgated under 40 CFR Part 51.

3.1.5.1 40 CFR Part 51, Subpart BB—Data Requirements for Characterizing Air

Quality for the Primary SO_2 NAAQS (SO_2 Data Requirements Rule or SO_2 DRR)

The Mill submitted facility-wide air dispersion modeling in November 2016 to comply with 40 CFR 51.1203(d). The Mill updated the facility-wide air dispersion modeling in October 2021. The actual SO_2 emissions following the Project are expected to remain below the SO_2 emission rates included in the modeling analysis submitted in 2016 and 2021. The Mill will continue to perform an annual review of the actual SO_2 emission rates against the 2016 and 2021 model emission rates to determine if an updated modeling demonstration is necessary.

3.1.6 Title V Operating Permits

New-Indy Catawba operates under TVOP TV-2440-0005 issued on May 7, 2019, with an effective date of July 1, 2019, and an expiration date of December 31, 2023. New-Indy Catawba submitted a Title V operating permit renewal application on December 1, 2023. SCDHEC determined the Title V operating permit renewal application was complete on December 18, 2023. Through this Application, New-Indy Catawba is requesting a construction permit to perform the Project. Construction permit application forms required by SCDHEC are included in Appendix A. New-Indy Catawba will request a modification to the TVOP within 15 days of startup of the Project, which is required by the Consent Order to be no later than June 30, 2025.

3.2 SOUTH CAROLINA AIR QUALITY REGULATIONS

This section addresses the applicability of state air regulatory requirements to the Project.

3.2.1 Regulation 61-62.1: Section II, Permit Requirements

This regulation specifies the construction and operating permit requirements for new or modified sources. This permit application is intended to satisfy the construction permitting requirements of Regulation 62.1 Section II. Completed SCDHEC construction permit application forms are included in Appendix A. The original application was submitted in March 2023, prior to implementation of the current SCDHEC ePermitting system. This updated application has been re-submitted in the original hardcopy form and is not in the ePermitting system.

3.2.2 Regulation 61-62.5: Air Pollution Control Standards

The list below identifies potentially applicable SC air pollution control regulations and standards associated with the Project.

- Standard No. 2 – Ambient Air Quality Standards

- Standard No. 3 – Waste Combustion and Reduction
- Standard No. 4 – Emissions from Process Industries
- Standard No. 7 – Prevention of Significant Deterioration
- Standard No. 8 – Toxic Air Pollutants

3.2.2.1 Standard No. 2 – Ambient Air Quality Standards

SCDHEC Standard No. 2 addresses the National Ambient Air Quality Standards (NAAQS). Except for an ambient air quality standard for gaseous fluorides, the SCHDEC ambient air quality standards are equivalent to the Federal NAAQS. New-Indy Catawba has previously submitted facility-wide air dispersion modeling evaluations to demonstrate compliance with Standard No. 2.

The Project may slightly increase the actual emissions of SO_2, nitrogen oxides (NO_X), and carbon monoxide (CO) from the No. 3 Recovery Furnace when burning LVHC gases. However, the maximum SO_2 and NO_X emissions from the No.3 Recovery Furnace when burning LVHC gases will be less than 10 percent of the emissions from burning the LVHC gases in the Nos. 1 and 2 Combination Boilers. The maximum SO_2 and NO_X emissions from LVHC combustion in the combination boilers are not expected to change as a result of the project. The CO emissions from burning LVHC gases will be unchanged when combusted in the recovery furnace or the combination boilers.

The emissions of SO_2, NO_X, CO, particulate matter (PM), PM less than 10 microns (PM_{10}), and PM less than 2.5 microns ($PM_{2.5}$) from the LVHC System natural gas ignitor in the No. 3 Recovery Furnace are well below the 1.14 pounds per hour modeling exemption threshold in the South Carolina Modeling Guidelines[2], Section 2.2.3. Therefore, the very small emissions increases from the LVHC natural gas ignitor have not been modeled for this permit application.

The additional steam potentially required from the combination boilers to operate the new condensate stripper will not exceed the current steaming capacity of each combination boiler, as reflected in the SO_2, NO_X, CO, PM, PM_{10}, $PM_{2.5}$ and CO emissions rates modeled previously.

[2] South Carolina Modeling Guidelines for Air Quality Permits (Revised April 15, 2019).

Therefore, no updates to the modeled emissions rates from the combination boilers are required for this permit application.

The SO_2 emissions from the Project will decrease by approximately 90 tons per year. The reduction in SO_2 emissions meets the single factor emissions netting option 2 in the South Carolina Other Information Guidance[3]. The modeled SO_2 Emissions Rate from black liquor combustion in the 2016 and 2021 SO_2 DRR modeling is 18.70 lb/hr from the No. 3 Recovery Furnace. The maximum SO_2 emissions rate from burning black liquor in the 2023 Title V renewal application is 5.95 pounds per hour. The additional SO_2 emissions from LVHC gases and methanol combustion is 7.4 pounds per hour, making the new total SO_2 emissions 13.35 pounds per hour, more than 5 pounds per hour lower than the modeled SO_2 emissions rate from black liquor combustion. Therefore, no updates to the SO_2 modeling submitted previously in 2016 and 2021 have been prepared for this permit application.

The NO_X emissions will increase from the Project approximately 24 tpy, which is slightly over one-half the Prevention of Significant Deterioration (PSD) significance threshold, due primarily to increased steam usage by the new condensate stripper. The NO_X emissions due to the Project meet weight of evidence approach 1 in the South Carolina Other Information. The modeled NO_X Emissions Rate for Ambient Air Standards in the current Title V permit is 146.03 lb/hr from the No. 3 Recovery Furnace. The maximum NO_X emissions rate from burning black liquor in the 2023 Title V renewal application is 122.4 pounds per hour. The additional NO_X emissions from LVHC gases and methanol combustion is 4.3 pounds per hour, making the new total NO_X emissions 126.7 pounds per hour, more than 19 pounds per hour lower than the modeled NO_X emissions rate . Therefore, no updates to the NO_X modeling submitted previously have been prepared for this permit application.

The CO emissions will increase from the Project less than one-half the Prevention of Significant Deterioration (PSD) significance threshold, due primarily to increased steam usage by the new condensate stripper. The CO emissions due to the Project meet weight of evidence approach 1 in the South Carolina Other Information. The CO emissions from burning LVHC gases will be unchanged when combusted in the recovery furnace or the combination boilers. The modeled CO Emissions Rate for Ambient Air Standards in the current Title V permit is 330.96 lb/hr from

[3] Guidance Concerning Other Information Used for Permitting Requirements in Demonstrating Emissions Do Not Interfere With Attainment or Maintenance of any State of Federal Standard (Updated December 12, 2018).

the No. 3 Recovery Furnace. The maximum CO emissions rate from burning black liquor in the 2023 Title V renewal application is 102.9 pounds per hour. The additional CO emissions from LVHC gases and methanol combustion is 8.3 pounds per hour, making the new total CO emissions 111.1 pounds per hour, more than 200 pounds per hour lower than the modeled CO emissions rate. Therefore, no updates to the CO modeling submitted previously have been prepared for this permit application.

Therefore, no updates to the previous Standard No. 2 modeling demonstration are required.

3.2.2.1 Standard No. 3 – Waste Combustion and Reduction

Standard No. 3 applies to any source that burns any waste other than virgin fuels for any purpose. The standard contains various exemptions for the pulp and paper source category. Section I.J.1 specifies that recovery furnaces burning black liquor and TRS compounds are not subject to the standard. Section I.J.1 also specifies that gaseous process streams containing TRS compounds that are regulated in accordance with Section XI of Regulation 61-62.5, Standard No. 4, or NSPS are not subject to Standard No. 3. Because the SOG and LVHC collection system gases containing TRS that are regulated in accordance with Standard No. 4 or NSPS Subpart BB/BBa, combustion of those gases in combination boilers or recovery furnaces is not subject to Standard No. 3.

Standard No. 3 specifically states that any "facility with an emission unit and/or control device that complies with all the requirements of an applicable Maximum Achievable Control Technology (MACT) Standard under 40 CFR 63, including the testing and reporting requirements, may request an exemption from this standard." (61 -62.5, Section I.J.3.)

During development of the Pulp and Paper MACT regulations at 40 CFR 63, Subpart S, U.S. EPA reviewed the practice of combusting methanol condensed from stripper-off-gases. The U.S. EPA determined that the methanol condensate "does not appear to contain metal or chlorinated organic HAP's ..." (61 Fed. Reg. 9397) (emphasis added). The U.S. EPA also found that burning methanol condensate "will not increase the potential environmental risk over the burning of the steam stripper vent gases prior to condensation." U.S. EPA reaffirmed this conclusion in 2011 during its Residual Risk and Technology Review (RTR) of the Pulp and Paper (Subpart S) MACT. In the final RTR rule, U.S. EPA stated: "We conclude based on the Residual Risk Assessment cited here that the risks from the subpart S pulp and papermaking source category are acceptable and that the current standard protects the public health with an ample margin of safety. Consequently, we are re-adopting the MACT standards for subpart S pursuant to our 112(f)(2) review." (77 Fed. Reg. 55705)

Therefore, the combustion of black liquor and condensed methanol from stripper-off-gases in the recovery furnaces mill qualifies for the exemption from Standard No. 3 provided in Section I.J.3.

3.2.2.2 Standard No. 4 – Emissions from Process Industries

SCDHEC Regulation 61-62.5, Standard No. 4 establishes standards for opacity and certain other pollutants for specific sources in specific industries and establishes PM and opacity standards for industrial processes not otherwise regulated. The new steam stripper and the new tanks do not cause visible emissions into the atmosphere; therefore, this standard does not apply.

Section XI regulates emissions of TRS from Kraft Pulp Mills where construction or modification commenced prior to September 24, 1976 from recovery furnaces, digester systems, multiple-effect evaporator systems, lime kilns, and condensate stripper systems. The No. 2 Recovery Furnace is currently subject to Standard 4 and will continue to comply with the TRS limits after completion of the Project. The TRS emissions from the No. 3 Recovery Furnace and No. 3 Evaporator Set with Concentrator are subject to 40 CFR Part 60, Subpart BB. The TRS emissions from the No. 1 Evaporator Set with Concentrator, the existing steam stripper, and the new condensate steam stripper are/will be subject to 40 CFR Part 60, Subpart BBa.

3.2.2.3 Standard No. 7 – Prevention of Significant Deterioration – Permit Requirements

PSD requirements apply to major stationary sources of regulated NSR pollutants that are located in areas that are in attainment with the NAAQS or unclassifiable. Implementation of the PSD regulations has been delegated in full to the State of South Carolina. These air quality regulations are contained in SCDHEC Regulation 61-62.5, Standard No. 7. The PSD regulations apply to major modifications at major stationary sources, which are considered those sources belonging to any one of the 28 source categories listed in the regulations that have the potential to emit (PTE) 100 tons per year (tpy) or more of an NSR-regulated pollutant, or any other source that has the PTE 250 tpy or more of an NSR-regulated pollutant. The Mill is considered a major stationary source because it emits or has the PTE 100 tpy or more of a regulated NSR pollutant. Because it includes physical changes to the Mill, the installation of the new steam stripper is a "project" as defined in Standard No. 7(b)(40).

New-Indy Catawba has assessed the applicability of PSD to this Project by performing the hybrid test as prescribed under U.S. EPA's PSD rules (as adopted by South Carolina) at 40 CFR 52.21(a)(2)(iv)(f), described as the hybrid test for projects that involve multiple types of emissions units. The future emissions from the backup steam stripper system, existing foul condensate Hardpipe, existing ASB, existing evaporator and turpentine recovery system LVHC gases, and steam required for the existing steam stripper system are calculated as PAE per SCDHEC Regulation 61-62.5, Standard No. 7, paragraph (B)(41). The future emissions from the new steam stripper and the generation of steam to operate the new steam stripper are PTE per SCDHEC Regulation 61-62.5, Standard No. 7, paragraph (B)(37).

The PSD applicability analysis has been completed for the applicable NSR regulated air pollutants, including SO_2, NO_x, CO, volatile organic compounds (VOC), TRS, H_2S, PM, PM_{10}, $PM_{2.5}$, lead (Pb), sulfuric acid mist, and carbon dioxide (CO_2). There are no increases in emissions of fluorides from the Project. Emissions calculations used for determining PSD applicability are included in Appendix B.

At this time, New-Indy Catawba has not excluded emissions the mill was capable of accommodating during the baseline period or excluded demand growth from the projected actual emissions as allowed under SCDHEC Regulation 61-62.5, Standard No. 7, paragraph (B)(41)(b)(iii). New-Indy Catawba may decide to utilize these two exclusions from PAE during this or future permitting if desirable.

3.2.2.3.1 Baseline Actual Emissions

Baseline actual emissions (BAE) from an existing source are defined by Standard No. 7, paragraph (B)(4)(b) as:

> *"the average rate, in tpy, at which the emissions unit actually emitted the pollutant during any consecutive 24-month period selected by the owner or operator within the 10-year period immediately preceding either the date the owner or operator begins actual construction of the project, or the date a complete permit application is received by the Department for a permit required under this section or under a plan approved by the Administrator, whichever is earlier, except that the 10-year period shall not include any period earlier than November 15, 1990."*

BAE for all existing sources and pollutants are based on the 24-month period following conversion of the mill to manufacturing unbleached paper grades starting in March 2021 and extending through February 2023. For simplicity, baseline annual production rates are assumed to occur over 8,760 operating hours. The BAE for the existing steam stripper (aka future backup stripper) off gases (and the required steam) are adjusted using the actual operating days to reflect that the stripper did not return to service until May 3, 2021.

Sulfur Dioxide

The baseline actual SO_2 emissions from burning the SOG from the existing steam stripper and LVHC collection system gases are based on the average emissions factors developed from the most recent (October 2021) source testing for SO_2. The emissions are further sub-divided between LVHC and HVLC streams using the post-Project Columbia SO_2 emissions factors presented in Appendix C – Tab A of the July 2019 and April 2020 permit applications approved by SCDHEC in Construction Permit DF.

Nitrogen Oxides and Carbon Monoxide

The baseline actual NO_X and CO emissions from burning the SOG from the existing steam stripper are based on the post-Project Columbia NO_X emissions factors presented in Appendix C – Tab A of the July 2019 and April 2020 permit applications approved by SCDHEC in Construction Permit DF.

Volatile Organic Compounds

The baseline actual VOC emissions from the existing condensate stripper system are based on the actual amount of methanol stripped from the foul condensate during the baseline period for which records are available. The non-methanol VOC emissions (including the TRS compounds that are also VOC as further described in the next section) from the ASB from treatment of Mill process wastewater and the foul condensate not treated in the existing steam stripper are calculated using the U.S. EPA WATER9 Model. To calculate methanol emissions from the ASB, New-Indy Catawba used a spreadsheet version of the WATER9 calculations from the National Council for Air and Stream Improvement (NCASI) to calculate the fractions biodegraded and emitted developed from Procedure 5 (Multiple Zone Concentration Measurements) in 40 CFR Part 63, Appendix C, Form XIII ("NCASI Form XIII calculation spreadsheet"). The WATER9 Model and Form XIII calculation utilize site-specific liquid concentration data, the site-specific configuration of the treatment unit [including the area or length of unit, liquid depth, wind speed, aeration type (i.e., mechanical aeration)], and the total amount of aeration to calculate the emissions rate in grams per second (g/s).

Baseline actual methanol emissions from the ASB are based on the NCASI Form XIII calculations for NESHAP Subpart S performance testing conducted during the baseline period. The baseline actual VOC emissions from the LVHC collection system are based on the post-Project Columbia VOC emissions factors presented in Appendix C – Tab A of the July 2019 and April 2020 permit applications approved by SCDHEC in Construction Permit DF.

Hydrogen Sulfide and Total Reduced Sulfur Compounds

The baseline hydrogen sulfide (H_2S) and total reduced sulfur (TRS) emissions from burning the SOG from the existing steam stripper and the LVHC collection system gases are based on the average emissions factors developed from the June 2021 source testing for H_2S and TRS. The emissions are further sub-divided between LVHC and HVLC streams using the post-Project Columbia H_2S and TRS emissions factors presented in Appendix C – Tab A of the July 2019 and April 2020 permit applications approved by SCDHEC in Construction Permit DF.

The baseline actual H_2S emissions from the ASB from treatment of Mill process wastewater and the foul condensate not treated in the existing steam stripper are calculated using the NCASI Hydrogen Sulfide Emissions Simulator, or "H2SSIM" Model, which utilizes site-specific wastewater configuration, site-specific liquid test results for H_2S, and site-specific data inputs [e.g., temperature, dissolved oxygen (DO), pH]. H2SSIM inputs are based on May and July 2022 sampling data for H_2S in the foul condensate, as well as dissolved oxygen (DO) data for the ASB taken during NESHAP Subpart S performance testing during the baseline period. The baseline emissions for methyl mercaptan (MMC), dimethyl disulfide (DMDS), and dimethyl sulfide (DMS) are calculated using WATER9 based on May and July 2022 sampling of the foul condensate. During the May and July 2022 testing, foul condensate sample results were representative of the concentrations before chemical oxidant was added. The Mill has been chemically oxidizing the contents of the Hardpipe prior to entry into the ASB since June 2021. For calculating BAE of H_2S and TRS emissions from the ASB, the May and July 2022 foul condensate samples were adjusted as follows to account for the effects of the chemical oxidant:

- H_2S concentrations in the Hardpipe effluent were reduced by 99%.
- DMS concentrations in the Hardpipe effluent were reduced by 90%.
- MMC concentrations in the Hardpipe effluent were reduced by 99% and assumed to be converted to DMDS.
- DMDS concentrations are assumed to not be reduced by chemical oxidant. DMDS concentrations in the Hardpipe effluent were increased to account for the oxidation of MMC to DMDS.

These adjustments are based on NCASI Technical Bulletin No. 949, Section 5.3.1 for Hydrogen Peroxide and additional bench scale study results and curves provided by NCASI. Pertinent pages from NCASI Technical Bulletin No. 949 and the bench scale study are attached as supporting information in Appendix B.

Steam Baseline

The BAE of products of combustion (NO_X, CO, VOC, PM, PM_{10}, $PM_{2.5}$, Lead, and CO_2e) for the steam required by the existing steam stripper are based on the actual heat input from fossil fuels to both combination boilers during the baseline period. New-Indy Catawba operates the two recovery furnaces as base-loaded steam generators with the combination boilers handling most swings in steam load. New-Indy Catawba burns all the biomass available in the combination boilers because biomass is the most cost-effective fuel on an MMBtu basis. Additional steam is generated from burning natural gas and No. 6 fuel oil as needed. During the baseline period, natural gas accounted for 97.9% of the fossil fuel heat input to both combination boilers, with No. 6 fuel oil constituting the remaining 2.1% of the fossil fuel heat input.

3.2.2.3.2 Projected Actual Emissions and Potential to Emit

PAE is defined by the SCDHEC Regulation 61-62.5, Standard No. 7, paragraph (B)(41) as:

> *"the maximum annual rate, in tpy, at which an existing emissions unit is projected to emit a regulated NSR pollutant in any one of the five (5) years (12-month period) following the date the unit resumes regular operation after the project, or in any one of the ten (10) years following that date, if the project involves increasing the emissions unit's design capacity or its potential to emit that regulated NSR pollutant and full utilization of the unit would result in a significant emissions increase or a significant net emissions increase at the major stationary source."*

As described previously, PAE are calculated from the existing steam stripper, existing foul condensate Hardpipe, existing ASB, existing LVHC collection system gases, and steam required for the existing steam stripper.

PTE is defined by the SCDHEC Regulation 61-62.5, Standard No Standard No. 7, paragraph (B)(37) as:

> *"the maximum capacity of a stationary source to emit a pollutant under its physical and operational design. Any physical or operational limitation on the capacity of the source to emit a pollutant, including air pollution control equipment and restrictions on hours of operation or on the type or amount of material combusted, stored, or processed, shall be treated as part of its design if the limitation or the effect it would have on emissions is federally enforceable."*

The future emissions from the new steam stripper system and the generation of steam to operate the new steam stripper system are PTE.

PAE and PTE were calculated for three different stripper operating scenarios as shown below in Table 3-1. The new stripper is expected to be online at least 90% of the annual operating time. The backup steam stripper is expected to be online 4.75% of the annual operating time. There will also be periods when the new stripper may need to go offline and the backup stripper brought into service. During these transition periods until a stripper is returned to service, untreated foul condensate will be discharged through the Hardpipe to the ASB. While in the Hardpipe prior to entering the ASB, the TRS compounds in the condensates will be chemically oxidized to reduce the potential for odors from the ASB when operating during these brief transition periods, which are required by Part I of Appendix A of the November 16, 2022 EPA Consent Decree to be equal to or less than 460 hours (5.25%) of annual operating time.

The PAE and PTE for all scenarios are based on the design foul condensate sulfur loading [168 parts per million by weight (ppmw)] and maximum design foul condensate flow [850 gallons per minute (gpm)]. Emissions factors [on a pound per air-dried ton of pulp (lb/ADTP) basis] are calculated based on 2,444 ADTP/day, which is at the lower range of production for which the maximum design foul condensate flow is expected. The design foul condensate sulfur loading is based on liquid samples taken during the June 2021 site-specific testing. The sulfur concentration of 168 ppmw at the design foul condensate flow is equivalent to 0.70 pound of TRS as sulfur per ADTP. PAE are calculated for each of the three stripper operating scenarios based on 8,760 hours per year and a maximum pulp production of 2,700 ADTP/day.

The following sections provide further detail and different operating configurations within particular scenarios.

New Steam Stripper Online Scenario

While the new steam stripper is operating, the stripped condensate from the new steam stripper will be recycled to the brownstock washers, as needed.

The new stripper has two operating configurations, with and without the rectified methanol system operating. The rectified methanol system will separate methanol from the new stripper's offgases. The rectified methanol is referred to as SRL. As stated previously, the new steam stripper is expected to be online at least 90% of the annual operating time. The rectified methanol system is expected to be online 95% of the time that the new stripper is operating. A summary of the different operating control configurations for when the new stripper is operating is summarized in Table 3-2 below.

Table 3-1 Stripper Operating Scenarios

Stripper Operating Scenario	Operating Time	
	%	hrs
New Stripper Online	90%	7,884.0
Backup Stripper Online	4.75%	416.0
No Stripper Online	5.25%	460.0

Table 3-2 New Stripper System Operating Scenarios

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time	
	%	hrs		%	hrs		%	hrs
New Stripper Online	90%	7,884.0	SRL Online	95%	7,489.8	SRL Methanol to RF2/3	100.0%	7,489.8
			SRL Online	95%	7,489.8	SRL LVHC to RF3	75.0%	5,617.4
			SRL Online	95%	7,489.8	SRL LVHC to CB1/CB2	25.0%	1,872.5
			SRL Offline	5%	394.2	SOG to CB1/CB2	100.0%	394.2

The SRL is expected to contain approximately 40% of the TRS, with the remaining 60% in the LVHC off-gases from the rectified methanol system. The SRL will be blended with black liquor and burned in both recovery furnaces at a maximum concentration of 2%. The sodium fume inside the recovery furnace absorbs the sulfur from combustion of the black liquor and will also absorb the sulfur from combustion of the SRL. We conservatively assumed 99% absorption within the salt fume based on information provided in NCASI Technical Bulletin No. 604. This is expected to occur 100% of the time the rectified methanol system is operating (SRL mode).

When operating in SRL mode, the LVHC off-gases from the rectified methanol system will be vented into the LVHC System. In addition, the LVHC gases from the evaporators and turpentine recovery system will be vented to the No. 3 Recovery Furnace as part of this project. The No. 3 Recovery Furnace is expected to be available for LVHC combustion at least 75% of the operating time. When the No. 3 Recovery Furnace cannot receive these gases, the LVHC will be combusted in the combination boilers the remaining 25% of the time. The LVHC gases will pass through the LVHC caustic scrubber prior to being combusted in the combination boilers. The LVHC scrubber removes approximately 50% of the sulfur from the gas stream. The LVHC gas scrubber is not necessary and will not be used when the LVHC gases are being combusted in the No. 3 Recovery Furnace because the salt fume in the recovery furnace provides the expected sulfur control.

Sulfur Dioxide, Hydrogen Sulfide, and Total Reduced Sulfur Compounds

As previously stated, the SRL is expected to contain approximately 40% of the TRS as sulfur foul condensate loading of 0.70 lb S/ADTP. The sodium fume inside the recovery furnace absorbs the sulfur produced from combusting black liquor and will also absorb the sulfur produced by combusting the foul condensate present in the methanol. It is conservatively assumed that 99% of the sulfur from combusting the SRL is absorbed by the sodium fume (NCASI Technical Bulletin 604), and the remaining 1% is oxidized to SO_2. This is expected to occur 100% of the time in SRL mode.

To calculate TRS and H_2S emissions from burning the SRL in the recovery furnaces, a sulfur capture of 99% is applied with a 99% conversion factor to SO_2, for a combined capture and conversion factor of 99.9%.

Similarly, the LVHC gases from the rectified methanol system are expected to contain approximately 60% of the TRS as sulfur foul condensate loading of 0.70 lb S/ADTP and will be vented into the LVHC System. When the LVHC is combusted in the No. 3 Recovery Furnace, the sodium fume inside the recovery furnace is also expected to absorb 99% of the sulfur from the

LVHC gases before it can be converted to SO_2. When the LVHC is combusted in the combination boilers, the LVHC scrubber will capture 50% of the sulfur before conversion to SO_2. H_2S and TRS emissions from the rectified methanol system LVHC are calculated based on conservatively assuming 99.9% capture or conversion to SO_2 in the recovery furnace and 99% conversion to SO_2 in the combination boilers.

When the rectified methanol system is not operating, SOG from the new stripper will be vented to the combination boilers, and the TRS as sulfur foul condensate loading of 0.70 lb S/ADTP is assumed to be 100% converted to SO_2 to calculate SO_2 emissions. H_2S and TRS emissions from combusting SOGs in the combination boilers are based on conservatively assuming a 99% conversion to SO_2.

When the new stripper is operating, regardless of SRL status, there will be no foul or stripped condensate flow to the Hardpipe. Projected emissions of TRS compounds (excluding H_2S) from the ASB are calculated based on the WATER9 Model. Projected emissions of H_2S from the ASB are calculated based on the H2SSIM Model. Both WATER9 and H2SSIM emissions calculations are based on the average ASB influent concentrations from data collected during the 2021 and 2022 TRS testing efforts.

Nitrogen Oxides

When the rectified methanol system is operating, the methanol condenser is expected to condense more than 90% of the methanol in the SOG. The SOG also contains ammonia, which is also expected to be condensed with the methanol. The remaining ammonia will be vented with the SRL off-gases into the LVHC system. As a result, there will be an increase in ammonia when (1) SRL is mixed with liquor and burned in the recovery furnaces and (2) the SRL LVHC off-gases are combusted in the No. 3 Recovery Furnace.

The ammonia in the methanol is expected to contribute less than 2% of the total nitrogen in the black liquor. The NO_X emissions from the recovery furnaces have been conservatively assumed to increase 2% when burning SRL and the SRL LVHC.

The NO_X emissions from combustion of the SRL LVHC and SOG in the combination boilers are based on the post-Project Columbia NO_X emissions factors presented in Appendix C – Tab A of the July 2019 and April 2020 permit applications approved by SCDHEC in Construction Permit DF.

Carbon Monoxide

In SRL mode, the SRL will be blended with the black liquor and burned in both recovery furnaces at a maximum concentration of 2%. There is no information to suggest the CO emissions will change when the SRL is burned in the recovery furnaces.

The CO emissions from combustion of the SRL LVHC and SOG are based on the post-Project Columbia CO emissions factors presented in Appendix C – Tab A of the July 2019 and April 2020 permit applications approved by SCDHEC in Construction Permit DF.

Volatile Organic Compounds

The projected actual VOC emissions for the new steam stripper system are based on the theoretical maximum methanol collection (16 lb/ODTP) at the maximum pulp production (2,700 ADTP/day).

In SRL mode, the SRL will be blended with the black liquor and burned in both recovery furnaces at a maximum concentration of 2%. The SRL will be combusted in the recovery furnace to an expected 99.9% VOC destruction in the liquid phase.

When the new stripper is operating, there will be no foul or stripped condensate flow to the Hardpipe. Non-methanol VOC emissions (acetaldehyde, methyl ethyl ketone, propionaldehyde, and TRS VOCs) from the ASB are calculated based on WATER9, using the average ASB influent concentrations from data collected during 2021 and 2022 TRS and NESHAP Subpart S testing efforts. Methanol emissions from the ASB are based on the NCASI Form XIII calculation spreadsheet using the average ASB influent and effluent methanol concentrations from all data collected during 2021 and 2022 and the average zone treatment profiles from 2021 and 2022 NESHAP Subpart S performance tests.

Backup Stripper Online Scenario

As stated previously, once the new stripper is installed, the existing stripper will be demoted to the backup steam stripper role. For the purposes of calculating projected actual emissions (PAE), the backup steam stripper is projected to be online a minimum of 4.75% of the annual operating time. The backup steam stripper will be operated in "TRS mode" to remove TRS from the foul condensate. In TRS mode, the backup stripper will also remove approximately 45% of the methanol from the foul condensate. The SOG from the backup steam stripper will be vented to the combination boilers. The stripped condensate from the backup steam stripper will be discharged to the Hardpipe where the remaining unstripped methanol will be biologically treated in the ASB.

After the original submittal of this application and further discussions with SCDHEC, an alternate operating scenario for the backup stripper operating in "methanol mode" was established in addition to the "TRS mode" operation described above. Upon completion of the Project, the Mill can operate the existing stripper in either "TRS mode" or "methanol mode" during the periods the backup stripper is projected to operate. The calculations provided in Appendix B of this application include the emissions rates of each pollutant for both the TRS mode and methanol mode backup stripper operating scenarios. For each pollutant, the worst-case backup stripper operating mode was used to determine PSD applicability. For simplicity, this section will only discuss the TRS mode emissions calculations, consistent with the original submittal. Appendix D to this application provides a detailed description of the backup stripper operating in "methanol mode" as well as the supporting calculation documentation provided to SCDHEC after submittal of the original application.

Sulfur Dioxide

The backup steam stripper will be operated in "TRS mode" to remove TRS from the foul condensate. SO_2 emissions from combustion of the backup stripper SOG in the combination boilers are conservatively calculated assuming all of the 0.70 lb S/ADTP of sulfur present in the foul condensate will be captured in the SOG and converted to SO_2 during combustion.

Nitrogen Oxides and Carbon Monoxide

The NO_X and CO emissions from combustion of SOG are based on the post-Project Columbia NO_X emissions factors presented in Appendix C – Tab A of the July 2019 and April 2020 permit applications approved by SCDHEC in Construction Permit DF.

Volatile Organic Compounds

The projected actual VOC emissions for the backup stripper are based on the maximum expected methanol collection (16 lb/ODTP) at the maximum pulp production (2,700 ADTP/day). To calculate VOC emissions from backup stripper SOG combustion, it is conservatively assumed that the methanol present in the foul condensate will be captured with the SOG and combusted with 98% control at the combination boilers.

Methanol emissions from the ASB are based on the NCASI Form XIII calculation spreadsheet using the average ASB influent and effluent methanol concentrations from all data collected during 2021 and 2022 and the average zone treatment profiles from 2021 and 2022 NESHAP Subpart S performance tests. The methanol concentration in the stripped condensate from the backup stripper is based on the theoretical maximum methanol collection (16 lb/ODTP) in the foul condensate and an expected 45% removal efficiency from the backup stripper operating in "TRS mode."

Acetaldehyde, methyl ethyl ketone, and propionaldehyde are assumed to be emitted at the same ratio to methanol as compared to the baseline. Emissions of TRS compounds that are also VOC are calculated using WATER9 with the design foul condensate loadings of TRS compounds being reduced by 98% in the backup stripper operating in "TRS mode" before entering the ASB.

Hydrogen Sulfide and Total Reduced Sulfur Compounds

To calculate TRS and H_2S emissions from backup stripper SOG combustion, it is conservatively assumed that the design foul condensate sulfur loading will be captured with the SOG and only 99% will be converted to SO_2 at the combination boilers.

Projected emissions of TRS compounds (excluding H_2S) from the ASB are based on WATER9. Projected emissions of H_2S from the ASB are calculated based on H2SSIM. Both WATER9 and H2SSIM emissions are based on the average ASB influent concentrations from data collected during 2021 and 2022 TRS testing and the design foul condensate sulfur loadings of TRS compounds being reduced by 98% in the backup stripper operating in "TRS mode."

No Stripper Online Scenario

The post-Project emissions also account for brief periods when the new stripper may need to go offline and the backup stripper brought into service. During these transition periods, untreated foul condensate will be discharged through the Hardpipe to the ASB. While in the Hardpipe prior to entering the ASB, the TRS compounds will be chemically oxidized to reduce the potential for odors from the ASB when operating during these transition periods, which are required by Item I.a of Appendix A of the November 16, 2022 EPA Consent Decree to be less than 460 hours (5.25%) of annual operating time.

When there is no SOG being created by either stripper, there are no emissions of SO_2, NOx, or CO corresponding to the periods when all foul condensate is treated in the ASB.

Volatile Organic Compounds, Hydrogen Sulfide, and Total Reduced Sulfur Compounds

Methanol emissions from the ASB are based on NCASI Form XIII calculation spreadsheet using the average ASB influent and effluent methanol concentrations from all data collected during 2021 and 2022 and the average zone treatment profiles from 2021 and 2022 NESHAP Subpart S performance tests. The methanol concentration in the foul condensate is based on the maximum methanol collection (16 lb/ODTP).

Acetaldehyde, methyl ethyl ketone, and propionaldehyde are assumed to be emitted at the same ratio to methanol as compared to the baseline.

Emissions of TRS compounds are calculated using WATER9 and H2SSIM (H_2S) with the design foul condensate sulfur loadings of TRS compounds being adjusted based on NCASI Technical Bulletin No. 949 to account for the effects of the chemical oxidant, consistent with how baseline actual emissions are calculated.

- H_2S concentrations in the Hardpipe were reduced by 99%.
- DMS concentrations in the Hardpipe were reduced by 90%.
- MMC concentrations in the Hardpipe were reduced by 99% and assumed to be converted to DMDS.
- DMDS concentrations are assumed not reduced by chemical oxidant. DMDS concentrations of the Hardpipe were increased to account for the MMC oxidized into DMDS.

PAE and PTE Independent from Stripper Operating Scenario

LVHC Collection System

As stated previously, the No. 3 Recovery Furnace is expected to provide LVHC combustion at least 75% of the operating time. When the No. 3 Recovery Furnace cannot receive the LVHC gases, the LVHC gases will then be combusted in the combination boilers the remaining 25% of the time. The emissions from combusting LVHC gases are unaffected by the stripper operating scenario. PAE of SO_2, H_2S, and TRS are based on 2021 stack testing and SCDHEC approved emissions factors from Construction Permit DF. The VOC PAE from the LVHC collection system are based on the post-project Columbia VOC emissions factors presented Appendix C – Tab A of the July 2019 and April 2020 permit applications approved by SCDHEC in Construction Permit DF. The New Stripper Project does not impact the generation of HVLC gases and associated emissions (i.e., HVLC sources are not affected or modified as a result of the project); therefore, emissions associated with the combustion of HVLC gases are not included in the PAE (or BAE) emissions.

No. 3 Recovery Furnace LVHC Ignitor

The No. 3 Recovery Furnace will also have a 1 MMBtu/hr natural gas-fired LVHC ignitor to be used when the black liquor load is less than 50%. The natural gas ignitor is expected to be required no more than 15% of the time the No. 3 Recovery Furnace is in operation. PAE of products of combustion from the ignitor are based on AP-42 emissions factors.

Steam for New Stripper and Backup Stripper

The steam requirements for the new stripper and the backup stripper were provided by the vendor and adjusted for the thermal efficiency of the combination boilers firing natural gas and No. 6 fuel oil. The projected fossil fuel usage reflects the highest No. 6 fuel oil usage occurring during the previous 10 years. The highest fuel oil usage was during calendar year 2014 and accounted for 18.4% of the fossil fuel heat input. The PAE and PTE of products of combustion are based on AP-42 emissions factors.

3.2.2.3.3 PSD Non-Applicability

The changes in emissions from the Mill as a result of the Project were compared to the significant emission rates in Standard No. 7, paragraph (B)(49). Based on the emissions calculations described above, presented in Appendix B, and summarized in Table 3-3, the Project is not subject to the PSD permitting requirements in paragraphs (J) through (R) of Standard No. 7.

Table 3-3 Summary of PSD Applicability for the Project (tpy)

Pollutant[A]	PM	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	H2SO4	TRS	VOC	Pb	H_2S	CO_2
Baseline Actual Emissions	1.11	1.02	0.559	124	737	25.2	1.23	12.8	233	1.10E-04	3.61	12,275
Projected Actual Emissions	13.3	10.3	8.37	148	646	62.8	2.43	16.8	260	2.06E-03	5.59	48,200
Net Emissions Changes (PAE - BAE)	12.2	9.32	7.41	23.8	-91.2	37.6	1.20	3.95	26.8	1.95E-03	1.98	35,925
PSD Significant Emissions Rates	**25**	**15**	**10**	**40**	**40**	**100**	**7**	**10**	**40**	**0.6**	**10**	**75,000**
PSD Significant?	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**

A - HF is not emitted from new, modified, or affected emissions units.

3.2.2.4 Standard No. 7 – Prevention of Significant Deterioration – Air Dispersion Modeling Requirements

Standard No. 7 also includes PSD air quality increments that apply to all increases and decreases in PSD pollutant emissions following the PSD minor source baseline date. In York County the minor source baseline dates are December 1, 1981, for PM10 and March 3, 2017 for PM2.5. This Application does not trigger PSD review as discussed above; therefore, the project is unlikely to interfere with attainment or maintenance of State or Federal ambient air quality standards.

3.2.2.5 Standard No. 8 – Toxic Air Pollutants

SCDHEC Standard No. 8 regulates emissions of air toxics from new and existing sources. The Standard does not apply to fuel burning sources that burn only virgin fuel or specification used oil. Section I.D(1) of Standard No. 8 exempts sources subject to a Federal NESHAP. The Mill is subject to the Federal NESHAP for the pulp and paper source category (Subparts S and MM), industrial boilers (Subpart DDDDD), and reciprocating internal combustion engines (Subpart ZZZZ). Section I.D(2) of Standard No. 8 exempts non-NESHAP sources after a facility-wide residual risk analysis is completed. U.S. EPA published the results of facility-wide residual risk analyses for Subpart S sources on December 27, 2011, and for Subpart MM sources on December 30, 2017. The residual risk analyses completed by U.S. EPA concluded that there was no unacceptable risk from pulp and paper mills. Therefore, all emissions sources of HAP at New-Indy Catawba are exempt from Standard No. 8 under sections I.D(1) and/or I.D(2).

New-Indy Catawba emits two South Carolina toxic air pollutants (TAP) that are not listed HAP, H_2S and methyl mercaptan. Both compounds are generated by the Kraft pulping process and are components of TRS gases that are contained in LVHC and HVLC gases and in the pulping process condensates. Section I.D(3) allows sources to request an exemption for non-HAPs controlled by MACT controls to reduce HAP. This Project will improve emissions of H_2S and MMC from the Mill. However, because SCDHEC recently modeled emissions of H_2S and MMC and to demonstrate that emissions from these two TAPs following the Project remain below the maximum allowable ambient concentrations (MAAC) in Standard No. 8, the Mill has included an updated modeling demonstration in Appendix C.

The updated modeling analysis for TRS (as H_2S), H_2S and MMC in Appendix C focused on the changes to the emissions from the aerated stabilization basin. The TRS, H_2S and MMC emissions from the No. 3 Recovery furnace were not updated due to the insignificant maximum modeled concentrations from the No. 3 Recovery Furnace when compared to the overall maximum modeled concentrations for the Mill. The TRS (as H_2S) maximum modeled concentrations from the No. 3 Recovery Furnace were approximately 0.12% of the maximum modeled concentrations from the Mill. Similarly, the MMC concentrations were approximately 0.08% of the maximum concentrations from the Mill, and the TRS (as H_2S) maximum concentrations from the No. 3 Recovery Furnace were approximately 0.04% of the maximum mill concentrations.

3.2.3 Regulation 61-62.60: South Carolina Designated Facility Plan and New Source Performance Standard

Regulation 61-62.60 incorporates the 40 CFR Part 60 Subparts by reference. Refer to Section 3.1.1 for a discussion of 40 CFR Part 60.

3.2.4 Regulation 61-62.61 and 61-62.62: National Emission Standards for Hazardous Air Pollutants

Regulation 61-62.61 incorporates the 40 CFR Part 61 Subparts by reference. Refer to Section 3.1.2 for a discussion of the non-applicability of 40 CFR Part 61. Regulation 61-62.63 incorporates the 40 CFR Part 63 Subparts by reference. Refer to Section 3.1.2 for a discussion of applicability of 40 CFR Part 63.

3.2.5 Regulation 61-62.70 – Title V Operating Permit Program

Refer to Section 3.1.6 for discussion of the TVOP Program.

3.3 PROVISIONS OF THE SCDHEC CONSENT ORDER AND EPA CONSENT DECREE

This section addresses the provisions of the November 23, 2022 SCDHEC Consent Order and Part I of Appendix A of the November 16, 2022 EPA Consent Decree.

3.3.1 November 23, 2022 SCDHEC Consent Order

Items 4 through 6 of the Consent Order require that New-Indy Catawba:

- Install, operate, and maintain a primary stripper that is adequately sized to collect and treat all foul condensate streams in accordance with applicable state and federal air quality regulations. *The proposed new stripper will be sized at 850 gpm, which is designed to process foul condensates generated from producing the maximum pulp production of 2,700 ADTP/d, and New-Indy Catawba will operate the unit in accordance with applicable state and federal air quality regulations.*
- The primary stripper shall use low-pressure steam and must be designed for both methanol and sulfur compound removal with the off gases being treated in the recovery boilers to

absorb the sulfur compounds in the stripper off gas. The proposed new stripper will utilize 60 pounds per square inch gauge (psig) steam. *The new stripper off-gases and SRL will be incinerated in the No. 2 or 3 Recovery Furnace, with the exception of when the SRL system is unavailable (5% of the operating time of the new stripper).*

- Complete preliminary engineering and submit a construction permit application for the primary stripper within one hundred and twenty (120) days of the execution of this order. *Preliminary engineering is complete and this application is being submitted by March 23, 2023.*
- New-Indy must optimize, operate, and maintain the existing stripper at its current design capacity to allow it to be operated independently of the primary stripper. To optimize the existing stripper at its current design, it will be operated in "TRS mode" to remove 98% of the TRS and approximately 45% of the methanol from the foul condensate or in "methanol mode" (see Appendix D).
- The following required events have or will be completed in the future:
  - Order the primary stripper within 30 days of submitting the application for the air construction permit.
  - Within 30 days of receiving the air construction permit, New-Indy Catawba must start civil engineering preparation.
  - Within 30 days of receiving the primary stripper, New-Indy Catawba must start installation and testing.
  - New-Indy Catawba must complete startup operations and place the primary stripper into operation no later than June 30, 2025.
  - New-Indy shall operate its steam stripper system, comprised of the primary stripper and the existing stripper, in accordance with all applicable state and federal air quality regulations.
  - In the event the stripping system is out of service and foul condensate must be discharged to the ASB, New-Indy Catawba must use automated control of addition of a chemical oxidant, hydrogen peroxide, to treat the unstripped foul condensate prior to discharging into the ASB to maintain a rolling 90-minute average oxidation reduction potential (ORP) of the foul condensate above 0 millivolts.
  - New-Indy Catawba must notify SCDHEC at least 48 hours prior to any planned downtime and within 24 hours of unplanned downtime for which the primary stripper will not be operational (and for the existing stripper when it should be operating but will not be).

- New-Indy Catawba must submit reports to the Department regarding the implementation of the Consent Order to NewIndyOrderReports@dhec.sc.gov. For twelve consecutive months after execution of this order, the reports shall be submitted monthly on the 1st business day of the month. Thereafter, reports shall only be submitted every three months on the 1st business day of the month until the order terminates.

3.3.2 November 16, 2022 EPA Consent Decree

Item I(a) of Appendix A

Item I(a) of Appendix A of the Consent Decree contains requirements related to the uptime and monitoring of the foul condensate steam stripper at the Mill.

- New-Indy Catawba will operate their foul condensate treatment system (inclusive of the new and existing steam strippers) during all times that unbleached kraft pulp is being produced and foul condensate is being generated at the Mill.
- During periods the new steam stripper is experiencing downtime the existing steam stripper will be used.
- Periods of downtime in which both strippers are down will not exceed 576 hours for the first year and 460 hours annually thereafter.
- Peroxide will be added to the non-stripped condensate during the transition to the existing steam stripper and will continue to be added throughout the period in which the existing steam stripper is in operation as necessary to maintain a rolling 90-minute average ORP of the foul condensate above 0 millivolts.
- The Mill will notify the necessary authorities forty-eight (48) hours prior to any scheduled downtime and within twenty-four (24) hours of any unscheduled downtime and will operate both steam strippers, as applicable, for compliance with 40 CFR Part 63, Subpart S.

Item I(b) of Appendix A of the Consent Decree

Item I(b) of Appendix A of the Consent Decree covers the maintenance, operation, and calibration of the system used to treat the unstripped foul condensate by the Mill. The Mill's foul condensate treatment system (inclusive of the new equipment to be installed with this application) will be capable of continuously measuring the ORP of the foul condensate, automatically controlling the dosage of hydrogen peroxide to maintain a rolling ninety-minute average of the ORP of the foul condensate above 0 millivolts (mV) before it is discharged to the ASB, and treating the maximum amount of foul condensate produced when both steam strippers are down and when untreated foul condensate is discharged to the Hardpipe.

Item I(c) of Appendix A of the Consent Decree

Item I(c) of Appendix A of the Consent Decree contains recordkeeping requirements for data obtained by the ORP monitoring system used by the Mill. The Mill will maintain continuous records of the ORP monitoring system used by the Mill and will provide data to U.S. EPA upon request.

Item I(d) of Appendix A of the Consent Decree

Item I(d) of Appendix A of the Consent Decree includes reporting requirements for the ORP monitoring system used by the Mill. When untreated foul condensate is discharged to the Hardpipe, New-Indy Catawba will include the date, time, and value of any instance of a rolling ninety-minute average of the ORP falling below 0 mV in the Mill's semi-annual report for the previous six months.

APPENDIX A - PERMIT APPLICATION FORMS

RECEIVED
APR 30 2024
BAQ PERMITTING

SECTION 1 - FACILITY IDENTIFICATION

SC Air Permit Number (8-digits only) *(Leave blank if one has never been assigned)* 2440 - 0005	Application Date March 2023, updated April 2024
Facility Name/Legal Identity *(This should be the official legal name under which the facility is owned/operated and should be consistent with the name registered with the S.C. Secretary of State's office, as applicable.)* New-Indy Catawba LLC	
Facility Site Name (Optional) *(Please provide any alternative or additional identifier of the facility, such as a specific plant identifier (e.g., Columbia plant) or any applicable "doing business as" (DBA) identity. This name will be listed on the permit and used to identify the facility at the physical address listed below.)*	
Facility Federal Tax Identification Number *(Established by the U.S. Internal Revenue Service to identify a business entity)* 83-1904423	

REQUEST TYPE (Check all that apply)

Exemption Request: ☐
Complete Section 1 and attach documentation to support exemption request.

Construction Application:
☒ Minor New Source Review Project
☐ Synthetic Minor Project
☐ Prevention of Significant Deterioration Project
☐ 112(g) Project

Expedited Review Request: ☐
If checked, include Expedited Form D-2212 in the construction application package.

Construction Permit Modification: ☐
Provide the construction permit ID (e.g. CA, CB, etc.) for which modification is requested:

Application Revision: ☐

CONSTRUCTION PERMIT APPLICATION FORMS BEING REVISED
(Amended construction permit forms must be filled out completely and attached to this modification request.)

Form #	Date of Original Submittal	Brief Description of Revision
D-2566	March 2023	Updated Faciltiy Air Contact, Owner or Operator, Application Narrative and Appendix B
D-2573	March 2023	Updated Faciltiy Air Contact

FACILITY PHYSICAL ADDRESS

Physical Address: 5300 Cureton Ferry Road		County: York
City: Catawba	State: SC	Zip Code: 29704
Facility Coordinates *(Facility coordinates should be based at the front door or main entrance of the facility)* Latitude: 34°50'37"N	Longitude: 80°53'25"W	

FACILITY'S PRODUCTS / SERVICES	
Primary Products / Services *(List the primary product and/or service)* Linerboard / Pulp Manufacturing	
Primary SIC Code *(Standard Industrial Classification Codes)* 2631	Primary NAICS Code *(North American Industry Classification System)* 322130
Other Products / Services *(List other products and/or services)*	
Other SIC Code(s):	Other NAICS Code(s):

PROJECT DESCRIPTION
Project Description (What, why, how, etc.): Installation of a new steam stripper system to treat foul condensate prior to being hard piped to the aeration stabilization basin. The new steam stripper will include a new stripper feed tank, new methanol tank, new hot water tank, and a new methanol rectification condenser. The rectified methanol will be burned in the recovery furnaces with the black liquor. The LVHC gases from the methanol condenser system, stripper feed tank, and methanol tank will be combusted in the No. 3 Recovery Furnace. The hot water tank is not expected to be a source of air emissions. The existing steam stripper will serve as a backup to the new steam stripper.

AIR PERMIT FACILITY CONTACT *(Person listed will be in our files as the point of contact for all air permitting related questions and will receive all air permitting notifications.)*			
Title/Position: Environmental Manager	Salutation: Ms.	First Name: Rachel	Last Name: Davis
Mailing Address: P.O. Box 7			
City: Catawba		State: SC	Zip Code: 29704
E-mail Address: rachel.davis@new-indycb.com		Primary Phone No.: (803) 981-8206	Alternate Phone No.:

The signed permit will be e-mailed to the designated Air Permit Contact. If additional individuals need copies of the permit, please provide their names and e-mail addresses.	
Name	**E-mail Address**
Steven Moore	smoore@all4inc.com

CONFIDENTIAL INFORMATION / DATA
Is confidential information or data being submitted under separate cover? ☒ No ☐ Yes*

If yes, submit **ONLY ONE COMPLETE CONFIDENTIAL APPLICATION, with original signature, along with the public version of the application.*

CO-LOCATION DETERMINATION
Are there other facilities in close proximity that could be considered collocated? ☒ No ☐ Yes*
If yes, list potential collocated facilities, including air permit numbers if applicable:

**If yes, please submit collocation applicability determination details in an attachment to this application.*

OWNER OR OPERATOR			
Title/Position: Mill Manager	Salutation: Mr.	First Name: Chris	Last Name: Loach
Mailing Address: P.O. Box 7			
City: Catawba		State: SC	Zip Code: 29704
E-mail Address: chris.loach@new-indycb.com		Primary Phone No.: 803-981-8000	Alternate Phone No.:
OWNER OR OPERATOR SIGNATURE			
I certify, to the best of my knowledge and belief, that no applicable standards and/or regulations will be contravened or violated. I certify that any application form, supporting documentation, report, or compliance certification submitted in this permit application is true, accurate, and complete based on information and belief formed after reasonable inquiry. I understand that any statements and/or descriptions, which are found to be incorrect, may result in the immediate revocation of any permit issued for this application.			

Chris Loach

Signature of Owner or Operator

4-29-24

Date

APPLICATION PREPARER (if other than Professional Engineer below)			
Title/Position: Senior Managing Consultant	Salutation: Mr.	First Name: Steven	Last Name: Moore
Mailing Address: 630 Davis Drive, Suite 203			
City: Durham		State: NC	Zip Code: 27560
E-mail Address: smoore@all4inc.com		Phone No.: (919) 234-5981	Cell No.: (864) 616-4711

PROFESSIONAL ENGINEER INFORMATION			
Consulting Firm Name: ALL4 LLC		SC Certificate of Authority License No.: 6409	
Title/Position: PE	Salutation: Ms.	First Name: Sheryl	Last Name: Watkins
Mailing Address: 300 Chastain Center Blvd, Suite 395			
City: Kennesaw		State: Georgia	Zip Code: 30144
E-mail Address: swatkins@all4inc.com		Phone No.: (678) 293-9428	Cell No.: (386) 503-0266
SC License/Registration No.: 34347			
PROFESSIONAL ENGINEER SIGNATURE			
I have placed my signature and seal on the engineering documents submitted, signifying that I have reviewed this construction permit application as it pertains to the requirements of *South Carolina Regulation 61-62, Air Pollution Control Regulations and Standards*.			

Sheryl Watkins

SOUTH CAROLINA PROFESSIONAL ENGINEER LICENSED No. 34347 SHERYL WATKINS

Signature of Professional Engineer

4-26-24

Date

EQUIPMENT / PROCESS INFORMATION					
Equipment ID/ Process ID	**Action**	**Equipment / Process Description**	**Maximum Design Capacity (Units)**	**Control Device ID(s)**	**Emission Point ID(s)**
9801	☐ Add ☐ Remove ☒ Modify ☐ Existing	Existing Steam Stripper	850 gallons/minute	9820, 2605, 3705, 2901	2610S2, 2610S1, Fugitive
9802	☐ Add ☐ Remove ☒ Modify ☐ Existing	Hardpipe	850 gallons/minute	2901	Fugitive
9803	☒ Add ☐ Remove ☐ Modify ☐ Existing	New Steam Stripper (Methanol Condenser)	6.5 gallons/minute	5260, 5260C, 2605, 3705, 5105	5105S, 2610S2, 2610S1
9803	☒ Add ☐ Remove ☐ Modify ☐ Existing	New Steam Stripper (Condensed Methanol)	6.5 gallons/minute	2505, 5105	2505S, 5105S
9803	☒ Add ☐ Remove ☐ Modify ☐ Existing	New Steam Stripper (Stripper Off Gases)	850 gallons/minute	9820, 2605, 3705	2610S2, 2610S1
9804	☒ Add ☐ Remove ☐ Modify ☐ Existing	New Steam Stripper Feed Tank	80,400 gallons	5260, 5260C, 5105, 2605, 3705	2610S2, 2610S1, 5105S
9805	☒ Add ☐ Remove ☐ Modify ☐ Existing	New Steam Stripper Rectified Liquid Methanol Tank	1,300 gallons	5260, 5260C, 5105, 2605, 3705	2610S2, 2610S1, 5105S

CONTROL DEVICE INFORMATION								
Control Device ID	**Action**	**Control Device Description**	**Maximum Design Capacity (Units)**	**Inherent/ Required/ Voluntary**	**Pollutants Controlled** (Include CAS #)	**Capture Efficiency**	**Destruction/ Removal Efficiency**	**Emission Point ID(s)**
2505	☐ Add ☐ Remove ☐ Modify ☒ Existing	No. 2 Recovery Furnace	412,140 tons BLS/year	Required	See Appendix B/Narrative			2505S
2605	☐ Add ☐ Remove ☐ Modify ☒ Existing	No. 1 Combination Boiler	405 MMBtu/hr	Required	See Appendix B/Narrative			2610S2
2901	☐ Add ☐ Remove ☐ Modify ☒ Existing	Aerated Biotreatment (Aerated Stabilization Basin)	N/A	Required	See Appendix B/Narrative			Fugitive
3705	☐ Add ☐ Remove ☐ Modify ☒ Existing	No. 2 Combination Boiler	720 MMBtu/hr	Required	See Appendix B/Narrative			2610S1
5105	☐ Add ☐ Remove ☐ Modify ☒ Existing	No. 3 Recovery Furnace	744,600 tons BLS/year	Required	See Appendix B/Narrative			5105S
9820	☐ Add ☐ Remove ☒ Modify ☐ Existing	Stripper Off Gases Collection System	2,700 ADTP/day	Required	See Appendix B/Narrative			2610S1, 2610S2
5260	☐ Add ☐ Remove ☒ Modify ☐ Existing	LVHC Collection System	2,700 ADTP/day	Required	See Appendix B/Narrative			2610S1, 2610S2, 5105S
5260C	☐ Add ☐ Remove ☐ Modify ☒ Existing	LVHC Collection System Caustic Scrubber	2,700 ADTP/day	Required	See Appendix B/Narrative			2610S1, 2610S2, 5105S

This form is subject to Retention Schedule 16303.

Check Box for information addressed	Required Information
Source identification and emissions:	
☒	• Name of each source, process, and control device.
☒	• Assign each source an Equipment ID. The IDs must match the IDs listed in Section 2 of this application.
☒	• Assign an Emission Point ID for each source.
☒	• Assign a Control Device ID for each control device.
☒	• List each pollutant the source will emit.
☒	• List the Uncontrolled, Controlled, and PTE emissions for each source or equipment in lb/hr and tons/year.
☒	• Emission rates for each pollutant should be totaled and listed in lb/hr and tons/year.
☒	• Provide the CAS# for each Hazardous Air Pollutant (HAP) and/or Toxic Air Pollutant (TAP).
Information to support emission rates:	
☒	• Sample calculations.
☒	• Emission factors. Include the source, revision date, specific table and/or chapters. Include source test data if factors were derived from source testing.
☒	• Explanation of assumptions, bottlenecks, etc.
☐	• Source test information: A copy of the source test results may be requested. If the test results are not included in the application, the application should cite whether this was a DHEC approved test, and if not, explain where the test was conducted and other identifying information.
☐	• Manufacturer's data.
☐	• Vendor guarantees that support control device efficiencies.
☒	• New Source Review (NSR) analysis.
☒	• Other (e.g. example particle size analysis)

Existing (Permitted) Facilities		
Check Box	**Required Information**	**Location in Application**
☒	Facility-wide emissions prior to construction/modification: • Include an explanation if these emissions do not match the facility-wide emissions submitted in the last application.	Appendix B
☒	Facility-wide emissions after construction/modification: • Include net change, if applicable.	Appendix B
As applicable for the construction/ modification:		
☒	• Name of each source.	See Equipment/Process Information Above

This form is subject to Retention Schedule 16303.

Existing (Permitted) Facilities		
Check Box	**Required Information**	**Location in Application**
☒	• Assign each source an Equipment ID. The IDs must match the IDs listed in Section 2 of this application or on your current construction / operating permit.	See Equipment/Process Information Above
☒	• Assign a Control Device ID for each control device.	See Equipment/Process Information Above
☒	• Assign an Emission Point ID for each source.	See Equipment/Process Information Above
☒	• List each pollutant the source will emit.	Appendix B
☒	• List the Uncontrolled, Controlled, and PTE (if applicable) emissions for each source or equipment.	Appendix B
☒	• Emission rates for each pollutant should be totaled and listed in lb/hr and tons/year.	Appendix B
☒	• Provide the CAS# for each HAP and/or TAP.	Appendix B
Information to support facility-wide emission rates:		
☒	• Sample calculations.	Appendix B
☒	• Emission factors. Include the source, revision date, specific table and/or chapters. Include source test data if factors were derived from source testing.	Narrative, Appendix B
☒	• Explanation of assumptions, bottlenecks, etc.	Narrative
☒	• Source test information: A copy of source the test results may be requested. If the results are not included in the application, the application should cite whether this was a DHEC approved test and if not, explain where the test was conducted and other identifying information.	Appendix B
☐	• Manufacturer's data.	
☐	• Vendor guarantees that support control device efficiencies.	
☒	• NSR analysis.	Narrative
☒	• Other (please explain)	Appendix B

Check Box	State and Federal Air Pollution Control Regulations and Standards
☒	S.C. Regulation 61-62.1 Section II.E Synthetic Minor Construction Permits
☒	S.C. Regulation 61-62.5 Air Pollution Control Standards
☐	• Standard No. 1 Emissions from Fuel Combustion
☒	• Standard No. 2 Ambient Air Quality
☒	• Standard No. 3 Waste Combustion and Reduction (state only)
☒	• Standard No. 4 Emissions from Process Industries *(Note: If Section VIII of this Standard applies, include the process weight rate (PWR) in ton per hour for each applicable source or process.)*
☐	• Standard No. 5 Volatile Organic Compounds
☐	• Standard No. 5.2 Nitrogen Oxides Lowest Achievable Emission Rate
☒	• Standard No. 7 Prevention of Significant Deterioration (PSD)
☐	• Standard No. 7.1 Nonattainment New Source Review (NSR)
☒	• Standard No. 8 Toxic Air Pollutants (TAPs) (state only)
☐	S.C. Regulation 61-62.6 Control of Fugitive Particulate Matter
☒	S.C. Regulation 61-62.60 and 40 CFR Part 60 New Source Performance Standards (NSPS)
☒	S.C. Regulation 61-62.61 and 40 CFR Part 61 National Emission Standards for Hazardous Air Pollutants (NESHAP)
☒	S.C. Regulation 61-62.63 and 40 CFR Part 63 National Emission Standards for Hazardous Air Pollutants (NESHAP) for Source Categories
☒	40 CFR Part 64 Compliance Assurance Monitoring (CAM)
☐	S.C. Regulation 61-62.68 and 40 CFR Part 68 Chemical Accident Prevention Provisions
☒	S.C. Regulation 61-62.70 and 40 CFR Part 70 Title V Operating Program
☐	Other S.C. Air Pollution Control Regulations, as applicable.
☐	Other Federal Air Pollution Control Regulations, as applicable.
☐	40 CFR 98 Green House Gas (GHG) emissions *(Note: Quantify GHG emissions, if S.C. Regulation 61-62.5, Standard No. 7 or S.C. Regulation 61-62.5, Standard No. 7.1 is triggered.)*

This form is subject to Retention Schedule 16303.

Check Box	Completeness Checklist:
Applicability Determination:	
☒	• Is this regulation *applicable, reasonably applicable, potentially applicable,* or *not applicable?*
☒	• Is the basis for the applicability determination explained?
Affected Sources:	
☒	• Is the name and identification of each emission source or process included?
Compliance Demonstration:	
☒	• How will compliance be demonstrated?
☒	• Are specific methods or activities to be utilized by the facility to demonstrate compliance with each specific limitation and/or requirement provided?
☒	• Are control devices and control device requirements included?
☒	• Are monitoring, recordkeeping, and reporting requirements necessary to demonstrate compliance included?
Regulatory Citations:	
☒	• Are the regulatory citations identified?

This form is subject to Retention Schedule 16303.

A. APPLICATION IDENTIFICATION	
1. Facility Name: New-Indy Catawba LLC	
2. SC Air Permit Number (if known; 8-digits only): 2440 - 0005	3. Application Date: March 2023, updated April 2024
4. Project Description: New Condensate Stripper Permit Application	
5. Are other facilities collocated for air compliance? ☐ Yes ☒ No	6. If Yes, provide permit numbers of collocated facilities:

B. AIR CONTACT			
Consulting Firm Name (if applicable):			
Title/Position: Environmental Manager	Salutation: Ms.	First Name: Rachel	Last Name: Davis
Mailing Address: P.O. Box 7			
City: Catawba		State: SC	Zip Code: 29704
E-mail Address: rachel.davis@new-indycb.com		Phone No.: (803) 981-8206	Cell No.:

C. EMISSION POINT DISPERSION PARAMETERS

- Source data requirements are based on the appropriate source classification.
- Each emission point is classified as a point, flare, area, area circular, area polygon, volume, open pit, line, or buoyant line source.
- Contact the Bureau of Air Quality for clarification of data requirements.
- Include sources on a scaled site map. Also, a picture of area or volume sources would be helpful but is not required.
- A user generated document or spreadsheet may be substituted in lieu of this form provided all of the required emission point parameters are submitted in the same order, units, etc. as presented in these tables.

Abbreviations / Units of Measure:

- AGL = Above Ground Level
- BTU/hr = British Thermal Unit per hour
- ° = Degrees
- °F = Degrees Fahrenheit
- ft = feet
- ft/s = feet per second
- K = Kelvin
- m = meters
- UTM = Universal Transverse Mercator

dhec

Reminder: For all Emission Points, list the unique Emission Point ID for that source. Use the same emission point ID as shown in the current permit and provided in the last modeling submittal (as applicable). If the emission point ID has been changed from what was previously submitted, please list the current emission point ID with the old emission point ID in parenthesis

D. POINT SOURCE

Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height AGL (ft)	Exit Temp. (°F)	Exit Velocity (ft/s)	Inside Diameter (ft)	Discharge Orienta-tion	Rain Cap? (Y/N)	Distance To Nearest Property Boundary (ft)	Building		
		Easting (m)	Northing (m)								Height (ft)	Length (ft)	Width (ft)
2610S1	No. 2 Combination Boiler Stack	510039.32	3855689.18	228	364	47.2	10.0	Vert.	N	3,937	N/A	N/A	N/A
2610S2	No. 1 Combination Boiler Stack	510020.32	3855678.18	228	405	62.3	10.0	Vert.	N	3,937	N/A	N/A	N/A
2505S	No. 2 Recovery Furnace	510095.85	3855743.58	195	365	99.1	7.0	Vert.	N	3,953	N/A	N/A	N/A
5105S	No. 3 Recovery Furnace	510032.37	3855802.28	225	342	61.7	10.5	Vert.	N	4,134	N/A	N/A	N/A

E. FLARE SOURCE

Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height AGL (ft)	Heat Release Rate (BTU/hr)	Exit Velocity (ft/s)	Exit Temp. (°F)	Heat Loss Fraction	Distance To Nearest Property Boundary (ft)	Building		
		Easting (m)	Northing (m)							Height (ft)	Length (ft)	Width (ft)

F. AREA SOURCE

Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height AGL (ft)	Easterly Length (ft)	Northerly Length (ft)	Angle From North (°)	Initial Vertical Dimension σ_z (ft)	Distance To Nearest Property Boundary (ft)
		Easting (m)	Northing (m)						

dhec

Bureau of Air Quality
Emission Point Information

G. AREA CIRCULAR SOURCE

Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height AGL (ft)	Radius of Area (ft)	Number of Vertices	Initial Vertical Dimension σ_z (ft)	Distance To Nearest Property Boundary (ft)
		Easting (m)	Northing (m)					

H. AREA POLYGON SOURCE

Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height AGL (ft)	Initial Vertical Dimension (ft)	Number of Vertices	Area (ft^2)	Distance To Nearest Property Boundary (ft)
		Easting-1 (m)	Northing-1 (m)					
Fugitive	Aerated Stabilization Basin (Zone 1)	510803.40	3856319.69	20	0	15	547,769	1,969
Fugitive	Aerated Stabilization Basin (Zone 2)	510964.42	3856054.20	20	0	18	733,653	1,510
Fugitive	Aerated Stabilization Basin (Zone 3)	511052.13	3855887.21	20	0	10	783,500	1,180

I. VOLUME SOURCE

Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height AGL (ft)	Physical Horizontal Dimension (ft)	Initial Horizontal Dimension σ_y (ft)	Physical Vertical Dimension (ft)	Initial Vertical Dimension σ_z (ft)	Distance To Nearest Property Boundary (ft)
		Easting (m)	Northing (m)						

J. OPEN PIT SOURCE

Emission Point ID	Description/Name	UTM Coordinates (NAD83)		Release Height AGL (ft)	Easterly Length (ft)	Northerly Length (ft)	Pit Volume (ft^3)	Angle From North (°)
		Easting (m)	Northing (m)					

K. LINE SOURCE									
Emission Point ID	Description/Name	UTM Coordinates (NAD83)				Release Height AGL (ft)	Line Length (ft)	Line Width (ft)	Initial Vertical Dimension σ_z (ft)
		Start Easting (m)	Start Northing (m)	End Easting (m)	End Northing (m)				

L. BUOYANT LINE SOURCE (must complete Line Source and Buoyant Line Source tables)							
Emission Point ID	Description/Name	Average Building Length (ft)	Average Building Height (ft)	Average Building Width (ft)	Average Line Source Width (ft)	Average Building Separation (ft)	Average Buoyancy Parameter (m^4/s^3)

M. EMISSION RATES						
Emission Point ID	Pollutant Name	CAS #	Emission Rate (lb/hr)	Same as Permitted? (1)	Controlled or Uncontrolled	Averaging Period
2610S2, 2610S1	Refer to Appendix B					
2505S						
5105S						
Fugitive						

(1) Any difference between the rates used for permitting and the air compliance demonstration must be explained in the application report.

APPENDIX B - EMISSIONS CALCULATIONS

NEW-INDY CATAWBA MILL STRIPPER PROJECT

Stripper Operating Scenario	Operating Time	
	%	hrs
New Stripper Online	90%	7,884.0
Backup Stripper Online	4.75%	416.0
No Stripper Online	5.25%	460.0

LVHC Control Operating Scenario	Operating Time	
	%	hrs
RF3 Available for LVHC	75%	6,570.0
LVHC to CB1/CB2	25%	2,190.0

Summary of PSD Applicability
(tons/year)

Pollutant[(A)]	PM	PM_{10}	$PM_{2.5}$	NO_X	SO_2	CO	H2SO4	TRS	VOC	Pb	H_2S	CO_2
Baseline Actual Emissions	1.11	1.02	0.959	124	737	25.2	1.23	12.8	233	1.10E-04	3.61	12,275
Projected Actual Emissions	13.3	10.3	8.37	148	646	62.8	2.43	16.8	260	2.06E-03	5.59	48,200
Net Emissions Changes (PAE - BAE)	12.2	9.32	7.41	23.8	-91.2	37.6	1.20	3.95	26.8	1.95E-03	1.98	35,925
PSD Significant Emissions Rates	**25**	**15**	**10**	**40**	**40**	**100**	**7**	**10**	**40**	**0.6**	**10**	**75,000**
PSD Significant?	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**

A - HF is not emitted from new, modified, or affected emissions units.

SO2 EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		SO2 Emissions Factor		Sulfur Capture[C]	SO2 Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100%	8,004.0	SOG to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	1.06	October 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	60.4	241.8
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	1.97	October 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	112.0	490.6
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B,E]	97.9%	7,835.7	NA	100.0%	7,835.7	26.0	mmBtu/hr	6.00E-04	AP-42 Table 1.4-2.	NA	0.02	0.1
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B,E]	2.1%	168.3	NA	100.0%	168.3	24.8	mmBtu/hr	2.20E+00	AP-42 Table 1.3-1. 2.1% Sulfur Content.	NA	54.6	4.6
SO2 BASELINE ACTUAL EMISSIONS (BAE)															**737.0**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90.0%	7,884.0	SRL Online	95%	7,489.8	SRL Methanol to RF2/3[G]	100.0%	7,489.8	2,700	ADTP/day	0.56	Vendor / Preliminary Design Information	99%	0.6	2.4
New Stripper Online	90.0%	7,884.0	SRL Online	95%	7,489.8	SRL LVHC to RF3[G]	75.0%	5,617.4	2,700	ADTP/day	0.84	Vendor / Preliminary Design Information	99%	0.9	2.7
New Stripper Online	90.0%	7,884.0	SRL Online	95%	7,489.8	SRL LVHC to CB1/CB2[G]	25.0%	1,872.5	2,700	ADTP/day	0.84	Vendor / Preliminary Design Information	50%	47.2	44.2
New Stripper Online	90.0%	7,884.0	SRL Offline	5%	394.2	SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	1.40	Vendor / Preliminary Design Information	0%	157.4	31.0
Backup Stripper Online[H]	4.75%	416.0	NA	100%	416.0	SOG to CB1/CB2	100.0%	416.0	2,700	ADTP/day	1.40	Vendor / Preliminary Design Information	0%	157.4	32.7
No Stripper Online	5.25%	460.0	Foul Condensate to Hard Pipe	100%	460.0	Hydrogen Peroxide Addition	100.0%	460.0	NA	NA	NA	NA	NA	NA	NA
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	5.87	Project Columbia Projected Emissions Factor[H], Combination Boilers No. 1 and No. 2 maximum. Pre-control emissions based on LVHC scrubber efficiency (50%) and estimated bark ash sulfur capture (20%) from 2012 stack test.	99%	6.6	21.7
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	5.87	Project Columbia Projected Emissions Factor[H], Combination Boilers No. 1 and No. 2 maximum. Pre-control emissions based on LVHC scrubber efficiency (50%) and estimated bark ash sulfur capture (20%) from 2012 stack test.	50%	330.3	361.7
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5	NA	100.0%	985.5	1.0	mmBtu/hr	6.00E-04	AP-42 Table 1.4-2.	NA	0.00	0.0
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D,F]	81.6%	6,433.3	NA	100.0%	6,433.3	96.8	mmBtu/hr	6.00E-04	AP-42 Table 1.4-2.	NA	0.06	0.2
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D,F]	18.4%	1,450.7	NA	100.0%	1,450.7	92.2	mmBtu/hr	2.20E+00	AP-42 Table 1.3-1. 2.1% Sulfur Content.	NA	202.9	147.2
Backup Stripper Steam - Natural Gas[J]	4.75%	416.0	Natural Gas[D,F]	81.6%	339.5	NA	100.0%	339.5	26.0	mmBtu/hr	6.00E-04	AP-42 Table 1.4-2.	NA	0.02	0.003
Backup Stripper Steam - No. 6 Oil[J]	4.75%	416.0	No. 6 Oil[D,F]	18.4%	76.5	NA	100.0%	76.5	24.8	mmBtu/hr	2.20E+00	AP-42 Table 1.3-1. 2.1% Sulfur Content.	NA	54.6	2.1
SO2 PROJECTED ACTUAL EMISSIONS (PAE)															**645.80**
NET EMISSIONS CHANGE (PAE - BAE)															
NET EMISSIONS CHANGE (PAE - BAE)															**-91.21**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Sulfur capture in recovery furnace >99, sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - The Backup Stripper operating in Methanol Mode would potentially strip less sulfur, but SOG emissions are conservatively based upon all of the sulfur being captured in the SOG.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

J - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

H - Project Columbia SO2 emissions factor from NCG Combustion applied to October 2021 stack test SO2 emissions distribution between LVHC, HVLC, and SOG.

H2SO4 EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		H2SO4 Emissions Factor		Sulfur Capture	H2SO4 Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/ADTP	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	4.93E-03	NCASI Technical Bulletin 858, Table 10	NA	0.3	1.2
H2SO4 BASELINE ACTUAL EMISSIONS (BAE)															1.2
PROJECTED ACTUAL EMISSIONS															
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	4.93E-03	NCASI Technical Bulletin 858, Table 10	NA	0.55	1.82
LVHC Collection System	100%	8,760.0	NA	100%	8,760.0	LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	4.93E-03	NCASI Technical Bulletin 858, Table 10	NA	0.55	0.61
H2SO4 PROJECTED ACTUAL EMISSIONS (PAE)															2.43
NET EMISSIONS CHANGE (PAE - BAE)															
NET EMISSIONS CHANGE (PAE - BAE)															1.20

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Sulfur capture in recovery furnace >99, sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%

D - Historically high fuel oil percentage of fossil fuel heat input (2014)

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

NOX EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		NOX Emissions Factor		Ammonia Increase[C]	NOX Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	SOG to CB1/CB2	100%	8,004.0	1,365	ADTP/day	0.415	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	23.6	94.5
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B,E]	97.9%	7,835.7	NA	100%	7,835.7	26.0	mmBtu/hr	2.80E-01	AP-42 Table 1.4-2.	NA	7.3	28.6
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B,E]	2.1%	168.3	NA	100%	168.3	24.8	mmBtu/hr	3.13E-01	AP-42 Table 1.3-1.	NA	7.8	0.7
NOX BASELINE ACTUAL EMISSIONS															123.72
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3[G]	100%	7,489.8	2,852	TBLS/day	1.500	NCASI Technical Bulletin 884, Table 4.12.	2.0%	3.6	13.4
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3[G]	75%	5,617.4	316.9	TBLS/day	1.500	NCASI Technical Bulletin 884, Table 4.12.	2.0%	0.4	1.1
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2[G]	25%	1,872.5	270.0	ADTP/day	0.415	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	4.7	4.4
New Stripper Online	90%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100%	394.2	2,700	ADTP/day	0.415	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	46.7	9.2
Backup Stripper Online[H]	4.75%	416.0	NA	100.0%	416.0	SOG to CB1/CB2	100%	416.0	2,700	ADTP/day	0.415	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	46.7	9.7
No Stripper Online	5.25%	460.0	Foul Condensate to Hard Pipe	100.0%	460.0	Hydrogen Peroxide Addition	100%	460.0	NA	NA	NA	NA	NA	NA	NA
Recovery Furnace #3 LVHC Ignitor	75%	6,570.0	Natural Gas[I]	15.0%	985.5	NA	100%	985.5	1.0	mmBtu/hr	2.80E-01	AP-42 Table 1.4-2.	NA	0.3	0.1
New Stripper Steam - Natural Gas	90%	7,884.0	Natural Gas[D,F]	81.6%	6,433.3	NA	100%	6,433.3	96.8	mmBtu/hr	2.80E-01	AP-42 Table 1.4-2.	NA	27.1	87.2
New Stripper Steam - No. 6 Oil	90%	7,884.0	No. 6 Oil[D,F]	18.4%	1,450.7	NA	100%	1,450.7	92.2	mmBtu/hr	3.13E-01	AP-42 Table 1.3-1.	NA	28.9	20.9
Backup Stripper Steam - Natural Gas[J]	4.75%	416.0	Natural Gas[D]	81.6%	339.5	NA	100%	339.5	26.0	mmBtu/hr	2.80E-01	AP-42 Table 1.4-2.	NA	7.3	1.2
Backup Stripper Steam - No. 6 Oil[J]	4.75%	416.0	No. 6 Oil[D]	18.4%	76.5	NA	100%	76.5	24.8	mmBtu/hr	3.13E-01	AP-42 Table 1.3-1.	NA	7.8	0.3
NOX PROJECTED ACTUAL EMISSIONS															147.54
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															23.82

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Ammonia input to recovery furnace increases >2% with maximum addition of SRL of 2% by volume (representative of ~1% by volume pure methanol.)

D - Historically high fuel oil percentage of fossil fuel heat input (2014)

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - >90% of methanol condensed and burned in recovery furnace, < 10% of methanol vented into LVHC System.

H - No change in NO_x emissions factor between Backup Stripper TRS mode and Methanol mode.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

J - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

CO EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		CO Emissions Factor		CO Control	CO Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
						BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)									
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	SOG to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	0.0728	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	4.1	16.6
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7	NA	100.0%	7,835.7	26.0	mmBtu/hr	8.40E-02	AP-42 Table 1.4-2	NA	2.2	8.6
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3	NA	100.0%	168.3	24.8	mmBtu/hr	3.33E-02	AP-42 Table 1.3-1	NA	0.8	0.1
CO BASELINE ACTUAL EMISSIONS															**25.22**
						PROJECTED ACTUAL EMISSIONS									
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3	100.0%	7,489.8	NA	NA	NA	NA	NA	NA	NA
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3	75%	5,617.4	2,700	ADTP/day	0.0728	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	8.2	23.0
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2	25%	1,872.5	2,700	ADTP/day	0.0728	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	8.2	7.7
New Stripper Online	90%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	0.0728	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	8.2	1.6
Backup Stripper Online[C]	4.75%	416.0	NA	100.0%	416.0	SOG to CB1/CB2	100.0%	416.0	2,700	ADTP/day	0.0728	July 2019 Project Columbia Application. Page B-2 for Kraft Mill NCG System	NA	8.2	1.7
No Stripper Online	5.25%	460.0	Foul Condensate to Hard Pipe	100.0%	460.0	Hydrogen Peroxide Addition	100.0%	460.0	NA	NA	NA	NA	NA	NA	NA
Recovery Furnace #3 LVHC Ignitor	75%	6,570.0	Natural Gas[I]	15.0%	985.5	NA	100.0%	985.5	1.0	mmBtu/hr	8.40E-02	AP-42 Table 1.4-2	NA	0.1	0.0
New Stripper Steam - Natural Gas	90%	7,884.0	Natural Gas[D]	81.6%	6,433.3	NA	100.0%	6,433.3	96.8	mmBtu/hr	8.40E-02	AP-42 Table 1.4-2	NA	8.1	26.2
New Stripper Steam - No. 6 Oil	90%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7	NA	100.0%	1,450.7	92.2	mmBtu/hr	3.33E-02	AP-42 Table 1.3-1	NA	3.1	2.2
Backup Stripper Steam - Natural Gas[G]	4.75%	416.0	Natural Gas[D]	81.6%	339.5	NA	100.0%	339.5	26.0	mmBtu/hr	8.40E-02	AP-42 Table 1.4-2	NA	2.2	0.4
Backup Stripper Steam - No. 6 Oil[G]	4.75%	416.0	No. 6 Oil[D]	18.4%	76.5	NA	100.0%	76.5	24.8	mmBtu/hr	3.33E-02	AP-42 Table 1.3-1	NA	0.8	0.0
CO PROJECTED ACTUAL EMISSIONS															**62.81**
						NET EMISSIONS CHANGE (PAE - BAE)									
PAE - BAE															**37.60**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - No change in CO emissions factor between Backup Stripper TRS mode and Methanol mode.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

VOC EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		VOC Emissions Factor		Removal[C]	VOC Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	LVHC to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	4.35	Average daily methanol stripped based on daily Subpart S compliance through 2/28/2023.	98.0%	4.95	19.81
Aerated Stabilization Basin (ASB)	100.0%	8,760.0	Foul Condensate to Hard Pipe	100.0%	8,760.0	NA	100.0%	8,760.0	1,365	ADTP/day	8.51E-01	WATER9 Inputs and Outputs Provided.	NA	48.39	211.96
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	3.10E-03	July 2019 Project Columbia Application. Page C-3 for Total LVHC Emissions.	NA	0.18	0.77
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7	NA	100.0%	7,835.7	26.0	mmBtu/hr	5.50E-03	AP-42 Table 1.4-2.	NA	0.1	0.6
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3	NA	100.0%	168.3	24.8	mmBtu/hr	1.87E-03	AP-42 Table 1.3-3. NMTOC for no. 6 oil.	NA	0.0	0.0
VOC BASELINE ACTUAL EMISSIONS															**233.11**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3[G]	100%	7,489.8	2,700	ADTP/day	14.40	Vendor / Preliminary Design information	99.9%	1.62	6.07
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3[G]	75%	5,617.4	2,700	ADTP/day	1.60	Vendor / Preliminary Design information	98%	3.60	10.11
New Stripper Online	90%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2[G]	25%	1,872.5	2,700	ADTP/day	1.60	Vendor / Preliminary Design information	98%	3.60	3.37
New Stripper Online	90%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100%	394.2	2,700	ADTP/day	16.00	Vendor / Preliminary Design information	98%	36.00	7.10
Backup Stripper Online (TRS Mode)[H]	4.75%	416.0	NA	100.0%	416.0	SOG to CB1/CB2	100%	416.0	2,700	ADTP/day	7.20	Vendor / Preliminary Design information	98%		
Backup Stripper Online (Methanol Mode)[H]	4.75%	416.0	NA	100.0%	416.0	SOG to CB1/CB2	100%	416.0	2,700	ADTP/day	16.00	Assume methanol mode captures all VOC in SOG	98%	36.00	7.49
ASB - New Stripper Online	90%	7,884.0	No Foul Condensate to Hard Pipe	100.0%	7,884.0	NA	100%	7,884.0	2,700	ADTP/day	0.29	WATER9 Inputs and Outputs Provided.	NA	32.85	129.50
ASB - Backup Stripper Online (TRS Mode)[J]	4.75%	416.0	TRS Stripped From Foul Condensate	100.0%	416.0	NA	100%	416.0	2,700	ADTP/day	1.43	WATER9 Inputs and Outputs Provided.	NA		
ASB - Backup Stripper Online (Methanol Mode)[J]	4.75%	416.0	500 gpm Foul Condensate to Hard Pipe	100.0%	416.0	Hydrogen Peroxide Addition	100.0%	416.0	2,700	ADTP/day	1.54	WATER9 Inputs and Outputs Provided.	NA	173.20	36.03
ASB - No Stripper Online	5.25%	460.0	Foul Condensate to Hard Pipe	100.0%	460.0	NA	100%	460.0	2,700	ADTP/day	2.20	WATER9 Inputs and Outputs Provided.	NA	247.14	56.84
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to RF3	75%	6,570.0	2,700	ADTP/day	3.10E-03	July 2019 Project Columbia Application. Page C-3 for Total LVHC Emissions.	NA	0.35	1.15
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	25%	2,190.0	2,700	ADTP/day	3.10E-03	July 2019 Project Columbia Application. Page C-3 for Total LVHC Emissions.	NA	0.35	0.38
Recovery Furnace #3 LVHC Ignitor	75%	6,570.0	Natural Gas[I]	15.0%	985.5	NA	100%	985.5	1.0	mmBtu/hr	5.50E-03	AP-42 Table 1.4-2.	NA	5.50E-03	2.71E-03
New Stripper Steam - Natural Gas	90%	7,884.0	Natural Gas[D]	81.6%	6,433.3	NA	100%	6,433.3	96.8	mmBtu/hr	5.50E-03	AP-42 Table 1.4-2.	NA	0.5	1.7
New Stripper Steam - No. 6 Oil	90%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7	NA	100%	1,450.7	92.2	mmBtu/hr	1.87E-03	AP-42 Table 1.3-3. NMTOC for no. 6 oil.	NA	0.2	0.1
Backup Stripper Steam - Natural Gas[K]	4.75%	416.0	Natural Gas[D]	81.6%	339.5	NA	100%	339.5	26.0	mmBtu/hr	5.50E-03	AP-42 Table 1.4-2.	NA	0.1	0.0
Backup Stripper Steam - No. 6 Oil[K]	4.75%	416.0	No. 6 Oil[D]	18.4%	76.5	NA	100%	76.5	24.8	mmBtu/hr	1.87E-03	AP-42 Table 1.3-3. NMTOC for no. 6 oil.	NA	0.0	0.0
VOC PROJECTED ACTUAL EMISSIONS															**259.89**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**26.79**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - VOC destruction >98% in vapor phase, 99.9% in liquid phase.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023.

F - Projected steam usage at 850 gpm from vendor design.

G - >90% of methanol condensed and burned in recovery furnace, < 10% of methanol vented into LVHC System.

H - The Backup Stripper operating in Methanol Mode result in higher SOG emissions, since more VOC are stripped.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

J - When the Backup Stripper is operating, ASB emissions are higher if the stripper is operating in methanol mode. Both emissions factors are shown in the table, but ASB emissions are based on methanol mode operation.

K - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

TRS EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		TRS Emissions Factor		Sulfur Capture[C]	TRS Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	LVHC to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	2.88E-03	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	0.16	0.65
Aerated Stabilization Basin (ASB)	100.0%	8,760.0	NA	100.0%	8,760.0	NA	100.0%	8,760.0	1,365	ADTP/day	4.08E-02	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	2.32	10.16
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	8.01E-03	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	0.46	2.00
TRS BASELINE ACTUAL EMISSIONS															12.81
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3[G,H]	100.0%	7,489.8	2,700	ADTP/day	0.33	Vendor / Preliminary Design Information	99.9%	0.04	0.14
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3[G,H]	75.0%	5,617.4	2,700	ADTP/day	0.49	Vendor / Preliminary Design Information	99.9%	0.05	0.15
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2[G]	25.0%	1,872.5	2,700	ADTP/day	0.49	Vendor / Preliminary Design Information	99%	0.55	0.51
New Stripper Online	90.0%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	0.81	Vendor / Preliminary Design Information	99%	0.91	0.18
Backup Stripper Online[I]	4.75%	416.0	NA	100.0%	416.0	SOG to CB1/CB2	100.0%	416.0	2,700	ADTP/day	0.81	Vendor / Preliminary Design Information	99%	0.91	0.19
ASB - New Stripper Online	90.0%	7,884.0	No Foul Condensate to Hard Pipe	100.0%	7,884.0	NA	100.0%	7,884.0	2,700	ADTP/day	2.42E-02	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	2.72	10.74
ASB - Backup Stripper Online (TRS Mode)[J]	4.75%	416.0	TRS Stripped From Foul Condensate	100.0%	416.0	NA	100.0%	416.0	2,700	ADTP/day	2.72E-02	H2SSIM/WATER9 Inputs and Outputs Provided	NA		
ASB - Backup Stripper Online (Methanol Mode)[J]	4.75%	416.0	500 gpm Foul Condensate to Hard Pipe	100.0%	416.0	Hydrogen Peroxide Addition	100.0%	416.0	2,700	ADTP/day	5.28E-02	H2SSIM/WATER9 Inputs and Outputs Provided	NA	5.94	1.24
ASB - No Stripper Online	5.25%	460.0	Foul Condensate to Hard Pipe	100.0%	460.0	Hydrogen Peroxide Addition	100.0%	460.0	2,700	ADTP/day	7.28E-02	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	8.19	1.88
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	1.75E+00	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. Pre-control emissions based on LVHC scrubber efficiency (50%) and estimated 99% combustion efficiency in combination boilers.	99.9%	0.20	0.65
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	8.76E-03	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. DHEC Approved Test.	NA	0.99	1.08
TRS PROJECTED ACTUAL EMISSIONS															16.76
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															3.95

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Sulfur capture in recovery furnace >99.9% (see note H), sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023.

F - Projected steam usage at 850 gpm from vendor design.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - Recovery Furnace captures 99% of sulfur and converts 99% of remaining uncaptured sulfur.

I - Backup Stripper SOG emissions are conservatively based upon all of the sulfur being captured in the SOG for both TRS mode and Methanol mode.

J - When the Backup Stripper is operating, ASB emissions are higher if the stripper is operating in methanol mode. Both emissions factors are shown in the table, but ASB emissions are based on methanol mode operation.

H2S EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		H2S Emissions Factor		Sulfur Capture[C]	H2S Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper SOG[A]	91.4%	8,004.0	NA	100.0%	8,004.0	LVHC to CB1/CB2	100.0%	8,004.0	1,365	ADTP/day	4.13E-04	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	0.02	0.09
Aerated Stabilization Basin (ASB)	100.0%	8,760.0	Foul Condensate to Hard Pipe	100.0%	8,760.0	Hydrogen Peroxide Addition	100.0%	8,760.0	1,365	ADTP/day	1.36E-02	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	0.77	3.39
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	100.0%	8,760.0	1,365	ADTP/day	5.03E-04	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 average. DHEC Approved Test.	NA	0.03	0.13
H2S BASELINE ACTUAL EMISSIONS															**3.61**
PROJECTED ACTUAL EMISSIONS															
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL Methanol to RF2/3[G,H]	100.0%	7,489.8	2,700	ADTP/day	0.24	Vendor / Preliminary Design Information	99.9%	0.03	0.10
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to RF3[B,H]	75.0%	5,617.4	2,700	ADTP/day	0.37	Vendor / Preliminary Design Information	99.9%	0.04	0.12
New Stripper Online	90.0%	7,884.0	SRL Online	95.0%	7,489.8	SRL LVHC to CB1/CB2[G]	25.0%	1,872.5	2,700	ADTP/day	0.37	Vendor / Preliminary Design Information	99%	0.41	0.39
New Stripper Online	90.0%	7,884.0	SRL Offline	5.0%	394.2	SOG to CB1/CB2	100.0%	394.2	2,700	ADTP/day	0.61	Vendor / Preliminary Design Information	99%	0.69	0.14
Backup Stripper Online[I]	4.75%	416.0	NA	100.0%	416.0	SOG to CB1/CB2	100.0%	416.0	2,700	ADTP/day	0.61	Vendor / Preliminary Design Information	99%	0.69	0.14
ASB - New Stripper Online	90.0%	7,884.0	No Foul Condensate to Hard Pipe	100.0%	7,884.0	NA	100.0%	7,884.0	2,700	ADTP/day	9.27E-03	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	1.04	4.11
ASB - Backup Stripper Online (TRS Mode)[J]	4.75%	416.0	H2S Stripped From Foul Condensate	100.0%	416.0	NA	100.0%	416.0	2,700	ADTP/day	9.81E-03	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	1.10	0.23
ASB - Backup Stripper Online (Methanol Mode)[J]	4.75%	416.0	500 gpm Foul Condensate to Hard Pipe	100.0%	416.0	Hydrogen Peroxide Addition	100.0%	416.0	2,700	ADTP/day	9.45E-03	H2SSIM/WATER9 Inputs and Outputs Provided.	NA		
ASB - No Stripper Online	5.25%	460.0	Foul Condensate to Hard Pipe	100.0%	460.0	Hydrogen Peroxide Addition	100.0%	460.0	2,700	ADTP/day	9.54E-03	H2SSIM/WATER9 Inputs and Outputs Provided.	NA	1.07	0.25
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to RF3	75.0%	6,570.0	2,700	ADTP/day	1.17E-01	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. Pre control emissions based on LVHC scrubber efficiency (50%) and estimated 99% combustion efficiency in combination boilers	99.9%	0.01	0.04
LVHC Collection System	100.0%	8,760.0	NA	100.0%	8,760.0	LVHC to CB1/CB2	25.0%	2,190.0	2,700	ADTP/day	5.87E-04	June 2021 Stack Test, Combination Boilers No. 1 and No. 2 maximum. DHEC Approved Test	NA	0.07	0.07
H2S PROJECTED ACTUAL EMISSIONS															**5.59**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**1.98**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Sulfur capture in recovery furnace >99.9% (see note H), sulfur capture in LVHC scrubber 50%, sulfur conversion in combination boilers 99%.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - 40% of TRS/H2S condensed into methanol and 60% of TRS/H2S vented into LVHC System.

H - Recovery Furnace captures 99% of sulfur and converts 99% of remaining uncaptured sulfur.

I - Backup Stripper SOG emissions are conservatively based upon all of the sulfur being captured in the SOG for both TRS mode and Methanol mode.

J - When the Backup Stripper is operating, H2S ASB emissions are higher if the stripper is operating in TRS mode. Both emissions factors are shown in the table, but ASB emissions are based on TRS mode operation.

PM EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		PM Emissions Factor		PM Control	PM Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	26.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable	NA	0.2	0.8
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	24.8	mmBtu/hr	1.61E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	4.0	0.3
PM BASELINE ACTUAL EMISSIONS															**1.1**
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	7.60E-03	3.74E-03
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.7	2.4
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	1.61E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	14.8	10.8
Backup Stripper Steam - Natural Gas[C]	4.75%	416.0	Natural Gas[D]	81.6%	339.5		100.0%	339.5	26.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.0
Backup Stripper Steam - No. 6 Oil[C]	4.75%	416.0	No. 6 Oil[D]	18.4%	76.5		100.0%	76.5	24.8	mmBtu/hr	1.61E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	4.0	0.2
PM PROJECTED ACTUAL EMISSIONS															**13.33**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**12.22**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor

PM10 EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		PM10 Emissions Factor		PM10 Control	PM10 Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	26.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.8
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	24.8	mmBtu/hr	1.17E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	2.9	0.2
PM10 BASELINE ACTUAL EMISSIONS															1.02
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[J]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	7.60E-03	3.74E-03
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.7	2.4
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[E]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	1.17E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	10.8	7.8
Backup Stripper Steam - Natural Gas[C]	4.75%	416.0	Natural Gas[D]	81.6%	339.5		100.0%	339.5	26.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.0
Backup Stripper Steam - No. 6 Oil[C]	4.75%	416.0	No. 6 Oil[E]	18.4%	76.5		100.0%	76.5	24.8	mmBtu/hr	1.17E-01	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	2.9	0.1
PM10 PROJECTED ACTUAL EMISSIONS															10.34
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															9.32

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

J - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor

PM2.5 EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		PM2.5 Emissions Factor		PM2.5 Control	PM2.5 Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	26.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.8
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	24.8	mmBtu/hr	8.80E-02	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	2.2	0.2
PM2.5 BASELINE ACTUAL EMISSIONS															0.96
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	7.60E-03	3.74E-03
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.7	2.4
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	8.80E-02	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	8.1	5.9
Backup Stripper Steam - Natural Gas[C]	4.75%	416.0	Natural Gas[D]	81.6%	339.5		100.0%	339.5	26.0	mmBtu/hr	7.60E-03	AP-42 Table 1.4-2. Filterable and Condensable.	NA	0.2	0.0
Backup Stripper Steam - No. 6 Oil[C]	4.75%	416.0	No. 6 Oil[D]	18.4%	76.5		100.0%	76.5	24.8	mmBtu/hr	8.80E-02	AP-42 Tables 1.3-1 (filterable) and 1.3-2 (condensable).	NA	2.2	0.1
PM2.5 PROJECTED ACTUAL EMISSIONS															8.37
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															7.41

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

LEAD EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		Lead Emissions Factor		Lead Control	Lead Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	26.0	mmBtu/hr	5.00E-07	AP-42 Table 1.4-2.	NA	1.30E-05	5.10E-05
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	24.8	mmBtu/hr	2.80E-05	U.S. EPA document "Estimating Air Toxic Emissions from Coal and Oil Combustion Sources" [EPA-450/2 89-001] for Uncontrolled Residual Oil-fired Utility Boilers (Table 4-1)	NA	6.95E-04	5.85E-05
LEAD BASELINE ACTUAL EMISSIONS															**1.10E-04**
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	5.00E-07	AP-42 Table 1.4-2.	NA	5.00E-07	2.46E-07
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	5.00E-07	AP-42 Table 1.4-2.	NA	4.84E-05	1.56E-04
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	2.80E-05	U.S. EPA document "Estimating Air Toxic Emissions from Coal and Oil Combustion Sources" [EPA-450/2-89-001] for Uncontrolled Residual Oil-fired Utility Boilers (Table 4-1)	NA	2.58E-03	1.87E-03
Backup Stripper Steam - Natural Gas[C]	4.75%	416.0	Natural Gas[D]	81.6%	339.5		100.0%	339.5	26.0	mmBtu/hr	5.00E-07	AP-42 Table 1.4-2.	NA	1.30E-05	2.21E-06
Backup Stripper Steam - No. 6 Oil[C]	4.75%	416.0	No. 6 Oil[D]	18.4%	76.5		100.0%	76.5	24.8	mmBtu/hr	2.80E-05	U.S. EPA document "Estimating Air Toxic Emissions from Coal and Oil Combustion Sources" [EPA-450/2-89-001] for Uncontrolled Residual Oil-fired Utility Boilers (Table 4-1)	NA	6.95E-04	2.66E-05
LEAD PROJECTED ACTUAL EMISSIONS															**2.06E-03**
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															**1.95E-03**

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

CO2 EMISSIONS REFERENCES

Stripper Operating Scenario	Stripper Scenario Operating Time		Operating Configuration	Operating Configuration Time		Controls	Controls Operating Time		Production Rate		CO2 Emissions Factor		CO2 Control	CO2 Emissions	
	%	hrs		%	hrs		%	hrs	Value	UOM	lb/UOM	Reference	%	lb/hr	tpy
BASELINE ACTUAL EMISSIONS (March 2021 - February 2023)															
Backup Stripper Steam[A]	91.4%	8,004.0	Natural Gas[B]	97.9%	7,835.7		100.0%	7,835.7	26.0	mmBtu/hr	1.17E+02	40 CFR Part 98, Table C-1	NA	3,044.8	11,929
Backup Stripper Steam[A]	91.4%	8,004.0	No. 6 Oil[B]	2.1%	168.3		100.0%	168.3	24.8	mmBtu/hr	1.66E+02	40 CFR Part 98, Table C-1	NA	4,109.9	346
CO2 BASELINE ACTUAL EMISSIONS															12,275
PROJECTED ACTUAL EMISSIONS															
Recovery Furnace #3 LVHC Ignitor	75.0%	6,570.0	Natural Gas[I]	15.0%	985.5		100.0%	985.5	1.0	mmBtu/hr	1.17E+02	40 CFR Part 98, Table C-1	NA	116.9	58
New Stripper Steam - Natural Gas	90.0%	7,884.0	Natural Gas[D]	81.6%	6,433.3		100.0%	6,433.3	96.8	mmBtu/hr	1.17E+02	40 CFR Part 98, Table C-1	NA	11,313.5	36,392
New Stripper Steam - No. 6 Oil	90.0%	7,884.0	No. 6 Oil[D]	18.4%	1,450.7		100.0%	1,450.7	92.2	mmBtu/hr	1.66E+02	40 CFR Part 98, Table C-1	NA	15,270.9	11,076
Backup Stripper Steam - Natural Gas[C]	4.75%	416.0	Natural Gas[D]	81.6%	339.5		100.0%	339.5	26.0	mmBtu/hr	1.17E+02	40 CFR Part 98, Table C-1	NA	3,044.8	517
Backup Stripper Steam - No. 6 Oil[C]	4.75%	416.0	No. 6 Oil[D]	18.4%	76.5		100.0%	76.5	24.8	mmBtu/hr	1.66E+02	40 CFR Part 98, Table C-1	NA	4,109.9	157
CO2 PROJECTED ACTUAL EMISSIONS															48,200
NET EMISSIONS CHANGE (PAE - BAE)															
PAE - BAE															35,925

A - Current (future backup) condensate steam stripper resumed operation on May 3, 2021.

B - Additional process steam to operate condensate stream stripper from fossil fuel combustion. Average fossil fuel distribution in Combination Boilers No. 1 and No. 2 during baseline.

C - Backup Stripper Steam requirement is higher when operating in methanol mode. Steam MMBtu rates assumed equal to BAE.

D - Historically high fuel oil percentage of fossil fuel heat input (2014).

E - Baseline actual steam usage based on average net steam used by existing stripper 5/3/2021 through 2/28/2023

F - Projected steam usage at 850 gpm from vendor design.

G - reserved.

H - reserved.

I - Natural gas ignitor required when recovery furnace is less than 50% load on black liquor.

SUMMARY OF ASB EMISSIONS FACTORS

Scenario	ASB Emissions Factors (lb/ODTP)							
	H_2S	DMDS	DMS	MMC	TRS as H_2S	Methanol	VOC[A]	TRS[B]
Baseline Actual Emissions	0.0151	0.0114	0.0185	3.28E-04	3.37E-02	0.89	0.95	0.0453
New Stripper Scenario	0.0103	0.0028	0.0136	1.88E-04	1.99E-02	0.30	0.32	0.0269
Backup Stripper Scenario - TRS Mode	0.0109	0.0033	0.0147	1.30E-03	2.23E-02	1.53	1.59	0.0302
Backup Stripper Scenario - Methanol Mode	0.0105	0.0308	0.0169	5.12E-04	4.24E-02	1.62	1.71	0.0587
No Stripper Scenario	0.0106	0.0504	0.0192	7.42E-04	5.81E-02	2.31	2.44	0.0809

A - Includes VOC TRS compounds, methanol, acetaldehyde, methyl ethyl ketone, and propionaldehyde.

B - TRS as compounds

BAE Other VOC Emissions Factors

Date of Subpart S Performance Testing	Acetadehyde, ppm	MEK, ppm	Prop., ppm
7/9/2021	24.3	7.7	1.1
7/10/2021	25.3	5.7	4.0
7/11/2021	25.0	6.5	7.0
10/26/2021	25.0	12.3	0.8
10/27/2021	27.5	13.3	1.0
10/28/2021	10.6	6.6	1.2
10/29/2021	15.0	8.6	0.9
2/14/2022	16.7	7.5	0.7
2/15/2022	17.0	9.5	0.6
2/16/2022	15.7	8.6	1.0
5/4/2022	20.7	7.1	1.0
5/5/2022	16.3	7.3	1.0
5/6/2022	15.0	6.8	1.0
8/9/2022	15.3	5.9	0.7
8/10/2022	25.0	7.2	1.1
8/11/2022	20.3	6.0	1.0
9/27/2022	14.3	5.3	0.7
9/28/2022	15.0	5.2	0.7
9/29/2022	18.0	5.6	0.9
10/18/2022	25.0	5.6	1.0
10/19/2022	23.7	5.5	1.1
10/20/2022	23.0	6.6	0.9
AVG ppm:	**19.72**	**7.28**	**1.34**
Lbs into ASB	55.48	20.49	3.78
Fair estimated from WATER9 properties	0.55	0.38	0.43
Lbs emitted	30.73	7.73	1.61
Average Pulp Production during Subpart S testing	1716		
lb/ODTP	**0.018**	**0.005**	**0.001**

PAE Other VOC Emissions Factors

	BAE lb/ODTP	PAE lb/ODTP			
		New Stripper	Backup Stripper TRS Mode	No Stripper	Backup Stripper Methanol Mode
Methanol	0.89	0.30	1.53	2.31	1.62
Acetadehyde	0.018	0.006	0.031	0.046	0.033
MEK	0.005	0.002	0.008	0.012	0.008
Propionaldehyde	0.001	0.000	0.002	0.002	0.002
DMDS	0.0114	0.0028	0.0033	0.0504	0.0308
DMS	0.0185	0.0136	0.0147	0.0192	0.0169
MMC	3.28E-04	1.88E-04	1.30E-03	7.42E-04	5.12E-04
VOC:	**0.95**	**0.32**	**1.59**	**2.44**	**1.71**

New Indy Catawba ASB BAE Methanol Emissions Factor

Month	Pulp Production ADTP	Pulp Production ODTP	Methanol Emissions Factor lb/ODTP	Emissions Factor Reference
Mar-21	42,474	38,226	1.50	Average of 2021 Subpart S Performance Tests. Representative of ASB operation from March 2021 to February 2022.
Apr-21	43,075	38,767	1.50	
May-21	46,962	42,266	1.50	
Jun-21	42,867	38,581	1.50	
Jul-21	49,371	44,434	1.50	
Aug-21	44,614	40,152	1.50	
Sep-21	40,177	36,159	1.50	
Oct-21	47,234	42,510	1.50	
Nov-21	39,185	35,266	1.50	
Dec-21	38,734	34,860	1.50	
Jan-22	43,690	39,321	1.50	
Feb-22	37,736	33,962	0.33	Average of 2022 Subpart S Performance Tests. Representative of ASB operation from February 2022 to February 2023.
Mar-22	43,944	39,549	0.33	
Apr-22	40,046	36,041	0.33	
May-22	38,896	35,006	0.33	
Jun-22	23,184	20,866	0.33	
Jul-22	39,890	35,901	0.33	
Aug-22	53,396	48,057	0.33	
Sep-22	45,044	40,539	0.33	
Oct-22	47,517	42,765	0.33	
Nov-22	40,133	36,120	0.33	
Dec-22	33,859	30,474	0.33	
Jan-23	35,464	31,918	0.33	
Feb-23	39,276	35,348	0.33	
Baseline Methanol Emissions Factor (Pulp Weighted Average)			**0.89**	**lb/ODTP**

Stripper Inlet Foul Condensate - Table 2-17 (Weston report dated October 2, 2021, Work Order No. 15730.001.008)

		Concentration (ppm)				
Date	**Sample Time**	**Hydrogen Sulfide**	**Methyl Mercaptan**	**Dimethyl Sulfide**	**Dimethyl Disulfide**	**Total TRS**
6/24/2021	15:10	130	14	16	13	173
6/24/2021	15:10	140	14	16	17	187
6/24/2021	17:00	140	17	18	14	189
6/24/2021	18:45	150	19	18	16	203
6/25/2021	10:35	130	12	12	11	165
6/25/2021	12:05	120	10	12	9.6	151.6
6/25/2021	13:45	190	22	22	23	257
Average of all data		142.9	15.4	16.3	14.8	189.4
Max of 6/24 or 6/25		146.7	16.0	17.0	15.0	194.7

		MW	
H2S	Hydrogen Sulfide	34.08	g/mol
Ch4S	Methyl Mercaptan	48.11	g/mol
C2H6S	Dimethyl Sulfide	62.13	g/mol
C2H6S2	Dimethyl Disulfide	94.20	g/mol
S	Sulfur	32.07	g/mol

Convert compound to equivalent S (ppm)

Hydrogen Sulfide	Methyl Mercaptan	Dimethyl Sulfide	Dimethyl Disulfide
138.0	10.7	8.8	10.2
82.3%	6.4%	5.2%	6.1%

S (ppm)	168	Maximum feed to stripper (AHL)
Lb S/gallon FC	1.40E-03	
Lb S/hr @850 gpm	71.3	
Lb S/ADTP (@2200 ODTP)[a]	0.7001	

[a] Conservative Lb S/ADTP emissions factor using 2200 ODTP (2200 ODTP * ADTP/0.9 ODTP = 2444.4 ADTP) Emissions factor is representative of the lower end of the range of pulp production at the maximum steam stripper design of 850 gpm. Calculations are scaled to 2700 ADTP to represent worst case emissions.

Assumption
1. Assume no losses in feed tank
2. Assume 98% efficiency of S across stripper therefore 0.69 # S/ADTP in SOG

New-Indy Catawba Monthly Production

Month	Kraft Mill ADTP	Combination Boiler No. 1 Natural Gas mmBtu	Combination Boiler No. 2 Natural Gas mmBtu	Total Natural Gas mmBtu	Combination Boiler No. 1 No. 6 Fuel Oil gallons	Combination Boiler No. 2 No. 6 Fuel Oil gallons	Total No. 6 Fuel Oil gallons	Total No. 6 Fuel Oil mmBtu
Mar-21	42,474	61,175	99,507	160,683	0	2,057	2,057	309
Apr-21	43,075	41,363	75,012	116,376	0	0	0	0
May-21	46,962	38,834	63,467	102,301	0	0	0	0
Jun-21	42,867	1,909	59,909	61,818	0	1,199	1,199	180
Jul-21	49,371	67,565	55,824	123,389	3	97	100	15
Aug-21	44,614	33,863	32,461	66,325	0	0	0	0
Sep-21	40,177	40,779	41,811	82,590	86	0	86	13
Oct-21	47,234	69,732	75,498	145,230	0	0	0	0
Nov-21	39,185	60,664	80,397	141,061	0	0	0	0
Dec-21	38,734	62,931	60,176	123,107	0	0	0	0
Jan-22	43,690	84,088	82,251	166,339	69,200	66,720	135,920	20,388
Feb-22	37,736	57,764	75,924	133,688	27,042	370	27,412	4,112
Mar-22	43,944	62,423	82,083	144,506	335	0	335	50
Apr-22	40,046	44,634	62,835	107,469	0	0	0	0
May-22	38,896	39,982	73,918	113,900	0	0	0	0
Jun-22	23,184	43,071	89,239	132,310	2,238	0	2,238	336
Jul-22	39,890	64,532	86,134	150,666	0	0	0	0
Aug-22	53,396	48,067	73,591	121,658	0	0	0	0
Sep-22	45,044	60,782	65,899	126,681	24	0	24	4
Oct-22	47,517	70,539	89,760	160,299	0	0	0	0
Nov-22	40,133	82,534	114,164	196,698	0	0	0	0
Dec-22	33,859	101,466	95,023	196,490	170,076	0	170,076	25,511
Jan-23	35,464	95,982	92,733	188,715	102,558	0	102,558	15,384
Feb-23	39,276	78,431	96,813	175,244	21,626	53	21,679	3,252
Total	996,766			3,237,544				69,553
Annual Average	498,383							
				97.9%				2.1%

WASTEWATER TREATMENT PLANT – SUPPORTING INFORMATION
PEROXIDE ADDITION

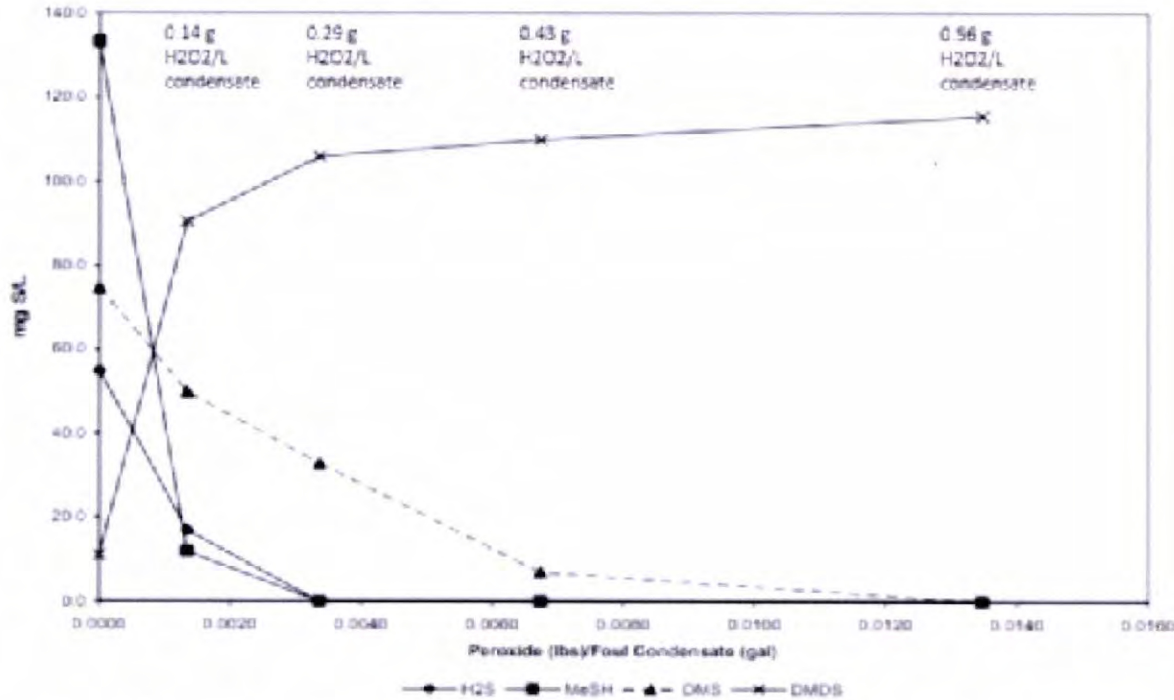


Figure 5.6 Hydrogen Peroxide Dose-Response Curve for Treatment of Foul Condensates

Source: TB949 H2O2 Mill Bench Scale Study

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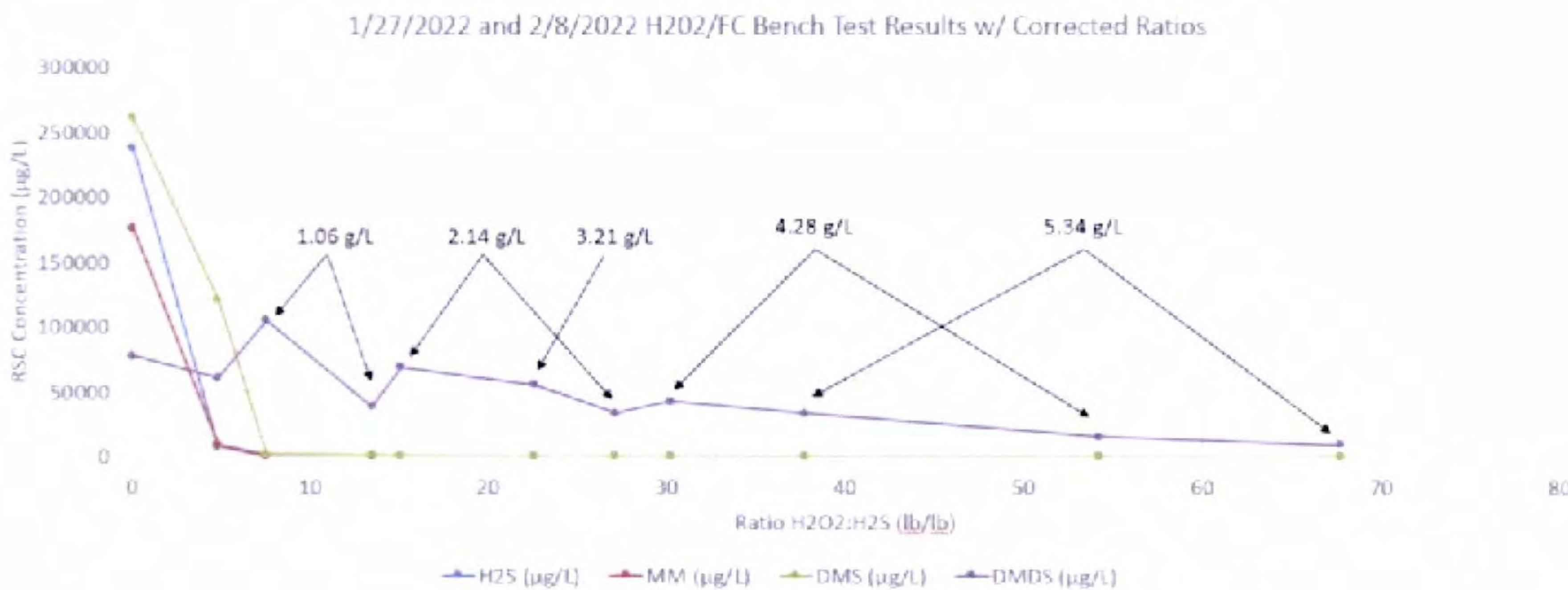
1/27/2022 and 2/8/2022 H202/FC Bench Test Results w/ Corrected Ratios
RSC Concentration (µg/L)
300000
250000
200000
150000
100000
50000
0
1.06 g/L
2.14 g/L
3.21 g/L
4.28 g/L
5.34 g/L
0
10
20
30
40
50
60
70
80
Ratio H2O2:H2S (lb/lb)
H2S (µg/L)
MM (µg/L)
DMS (µg/L)
DMDS (µg/L)

ncasi

NATIONAL COUNCIL FOR AIR AND STREAM IMPROVEMENT

SUMMARY OF INDUSTRY EXPERIENCE WITH ODOR MINIMIZATION AT WASTEWATER TREATMENT PLANTS

TECHNICAL BULLETIN NO. 949

MAY 2008

by
Diana Cook
NCASI West Coast Regional Center
Corvallis, Oregon

5.3 Oxidation

Several oxidizing agents have been used for destruction of odors resulting from H_2S. The approach is to oxidize the sulfide into nonvolatile forms such as elemental sulfur, thiosulfate, sulfite, and sulfate. Chemical oxidation reactions are generally slower than biochemical oxidation reactions (ASCE 1989). In the presence of large organic loads, as with industrial wastewaters, the economics of oxidizing agent use can be prohibitive due to competitive reactions with organic materials. Some of the commonly used oxidizing agents are chlorine, chlorine dioxide, hypochlorite, oxygen, and hydrogen peroxide. Industry experience with use of oxidizing agents is summarized herein.

5.3.1 *Hydrogen Peroxide*

Hydrogen peroxide (H_2O_2) can be used to chemically oxidize H_2S into either elemental sulfur or sulfate (the former at pH <8 to 9; the latter at pH >8 to 9), as shown in Equations 5.6 and 5.7. In the range of pH 7 to 9, both reactions may occur. Excess H_2O_2 can oxidize other wastewater components or decompose to release oxygen and water.

$$H_2O_2 + H_2S \rightarrow S + 2H_2O \quad \text{(Eq. 5.6)}$$

$$4H_2O_2 + S^{2-} \rightarrow SO_4^{2-} + 4H_2O \quad \text{(Eq. 5.7)}$$

H_2O_2 is a clear, colorless, nonflammable compound that is miscible with water in all proportions and is normally sold as a solution expressed as a percentage of the solution's weight (e.g., a 35% solution contains 35% H_2O_2 and 65% water by weight). Solutions of >8% are classified as oxidizers by the U.S. Department of Transportation. H_2O_2 can be obtained in small drums or tanks equipped with metering pumps and plumbed to the addition point. Storage containers must be properly vented because contamination or excess heat can accelerate decomposition to oxygen and water. Special safety handling is required, including eye protection and protective clothing.

Davies, Christy, and O'Connor (2000) reported on the effectiveness of using H_2O_2 to control odors resulting from release of H_2S at four locations around the WWTP at a pulp and paper mill in Canada. The specific objectives were to reduce H_2S concentration in an anaerobic spill basin effluent returned to the effluent clarification and treatment system; treat anaerobic sludge from the spill basin; minimize odors arising from sewering condensates; and treat all foul condensates from the mill during a scheduled shutdown of the steam stripper.

H_2O_2 was found to be effective for odor reduction at all the locations. It was added to the anaerobic spill basin effluent at a location that promoted good mixing prior to introduction into the clarifier. The residence time associated with transfer of effluent from the spill basin to the clarifier was sufficient to oxidize H_2S and minimize odor. Sludge dewatering equipment consisted of a screen, an agitation tank, a centrifuge, and a belt press. H_2O_2 was added to the agitation tank. In addition, an odor-controlling spray (Ecosorb) was applied to the air around the screens to capture any residual odors. H_2O_2 was also used to reduce odors during occasional sewering of condensates. Dosage levels were selected based on laboratory studies that indicated that ~200 mg H_2O_2/L of treated condensate was sufficient to remove odors. A solution containing 50% H_2O_2 was also used to reduce odors during steam stripper downtime events when foul condensates were piped directly into the aeration pond.

H_2O_2 and calcium peroxide (CaO_2) have been used in the presence of peroxidase, an enzyme found in horseradish, to remove odors in swine manure. Swine manure is known to contain large amounts of VFAs, phenolic compounds, and indolic compounds that have been implicated in odor. Peroxidase, in the presence of peroxides, has been found to polymerize phenolic odorants, thereby reducing associated odors (Govere et al. 2007).

H_2O_2 has also been used successfully as one element of a multi-pronged approach to control odor attributed to VFA generation in anaerobic environments (Davis and Smith 2001). H_2O_2 would be particularly beneficial for use in mills with high levels of water reuse (e.g., some recycle mills). Oxygen-limited environments in the process water transport system at those facilities can be ideal for anaerobic bacterial growth. Traditional oxidizers such as sodium hypochlorite, chlorine, and chlorine dioxide increase total chloride and conductivity in the reused effluent, which can disrupt process performance and cause corrosion. The multi-pronged approach used at a 100% recycled corrugating medium mill focused on good operating practices aimed at oxygenation, biocide application to control the amount of aerobic bacteria, and H_2O_2 use to prevent anaerobic environments in the secondary treatment system (Davis and Smith 2001).

NCASI assisted a bleached kraft mill that conducted a trial to investigate the effects of adding H_2O_2 to foul condensates. Foul condensates were piped directly to the first basin of a multi-stage ASB. Samples were collected at two locations (just prior to addition of peroxide and just following the addition point) over a five-day period to assess impacts on sulfide concentrations. Samples were analyzed using direct injection GC/PFPD (NCASI Method RSC-02.02; NCASI 2007). H_2O_2 was added as a 50% solution at a rate of 1.78 gallons per minute (GPM) to the foul condensate stream, which had a flow rate of 3 MGD, resulting in a concentration of approximately 0.51 g H_2O_2/L of foul condensate. The average reduction in sulfide concentration was over 79%, as illustrated in Figure 5.3.

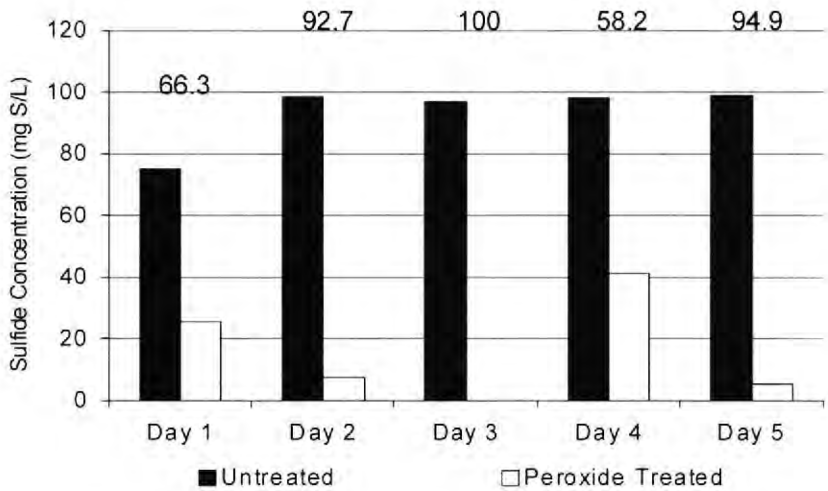

Figure 5.3 Sulfide Concentrations after Peroxide Addition (0.51 g/L) to a Foul Condensate [numbers above bars represent percent reductions in total sulfide observed each day]

Dosage and retention time trends were evaluated using a screening technique that involved collecting 25-mL samples in a 500-mL bottle that was closed and agitated for one minute. The cap was removed and a Jerome air monitor was used to measure volatile H_2S in the headspace. The effect of peroxide dose and retention time are illustrated in Figure 5.4. Reductions of >90% were observed after the first minute, and at some dosage rates they increased modestly with additional retention time. Figure 5.5 illustrates trends for doses of 0.5 and 1.0 GPM of a 50% H_2O_2 solution to the 3 MGD foul condensate at the four sampling locations (drop legs 1 through 4). Although some variability was observed, a significant reduction in sulfide was observed at the first drop leg under both addition rates investigated and increased gradually as the foul condensate progressed through the drop legs.

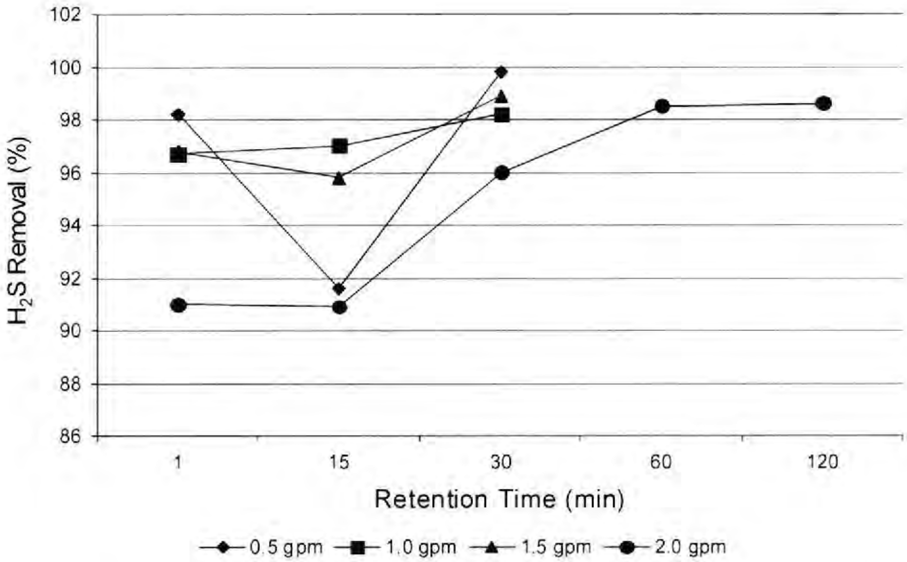

Figure 5.4 Effect of Hydrogen Peroxide Dose (0.14, 0.29, 0.43, and 0.56 g/L) and Retention Time on Sulfide Removal Efficiency [headspace measurements]

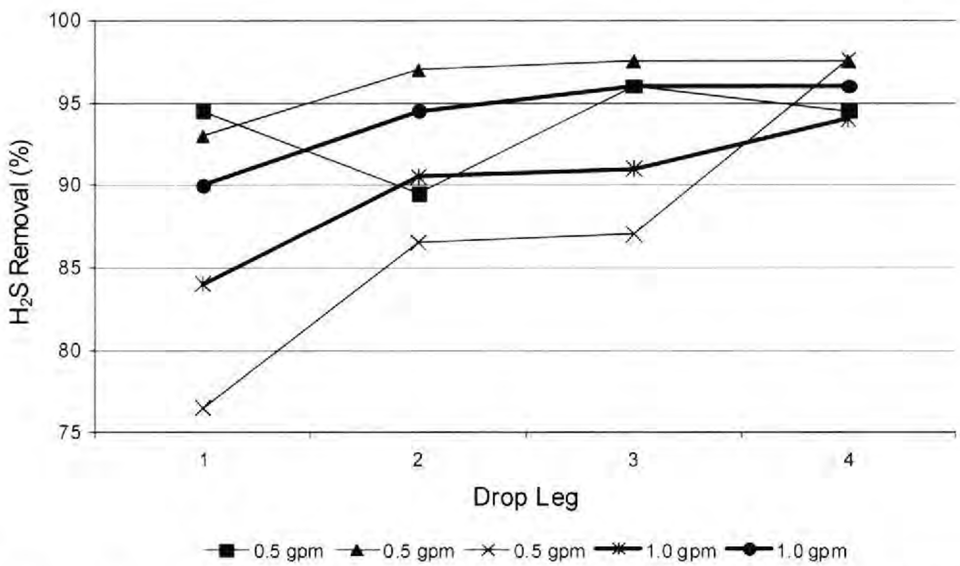

Figure 5.5 Effect of Hydrogen Peroxide Dose (0.14, 0.29, 0.43, and 0.56 g/L) and Sample Location on Sulfide Removal Efficiency [headspace measurements]

Another example of H_2O_2 use at a bleached kraft mill is illustrated in Figure 5.6. The mill conducted a bench study prior to an odor reduction trial to determine the dose-response curve for peroxide addition to foul condensates. Foul condensates were treated with the oxidant (50% H_2O_2; density 1.2 g/mL) volumes shown in the figure (equivalent to 0.14, 0.29, 0.43, and 0.56 g H_2O_2/L of foul condensate) at 50°C for 30 minutes in sealed vials. Samples were removed and analyzed by direct aqueous injection GC/sulfur chemiluminescence detectors (SCD) for sulfide, MeSH, DMS, and

DMDS. The data indicate that sulfide and MeSH were readily removed, but that DMS required significantly higher doses to achieve equivalent levels of removal. DMDS was not removed and in fact increased with peroxide dose, presumably due to oxidation of MeSH.

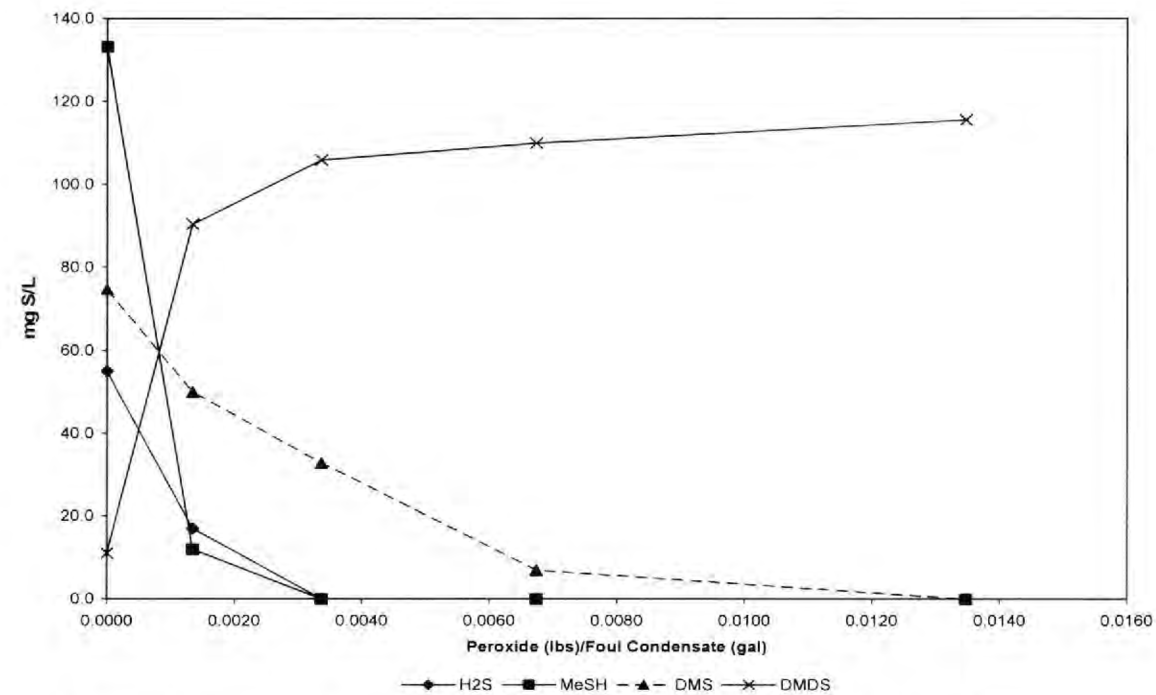

Figure 5.6 Hydrogen Peroxide Dose-Response Curve for Treatment of Foul Condensates

Following the bench studies, a mill trial was conducted over a five day period. H_2O_2 was added to the foul condensate tank (pH 9.0 to 9.3) at a rate of 1 gallon (100% H_2O_2) to every 500 gallons of condensate, which is equivalent to 2.8 g H_2O_2/L of foul condensate. This addition point provided a retention time of ~30 minutes prior to the WWTP. The trial resulted in overall average reductions in sulfide, MeSH, and DMS of 38.8, 64.6, and -3.9%, respectively (Table 5.1). The level of DMDS increased (probably due to oxidation of MeSH to DMDS) during the addition but reportedly did not affect overall odor from the WWTP (NCASI files). The mill continues to feed H_2O_2 to the foul condensate and has reported a reduction in odor at the WWTP.

Table 5.1 Percent Reduction in Hydrogen Sulfide, Methyl Mercaptan, and Dimethyl Sulfide during a Peroxide Addition Trial Conducted in a Foul Condensate

Day of Study	H_2S	MeSH	DMS
1	26.1	67.3	-20.8
2	68.3	74.7	16.5
3	38.1	57.0	1.9
4	36.4	60.0	2.6
5	25.3	63.8	-19.5
Average	38.8	64.6	-3.86

WASTEWATER TREATMENT PLANT – SUPPORTING INFORMATION
BASELINE ACTUAL EMISSIONS

May/July 2022 Baseline Emissions Calculations

H_2S, TRS Compounds, and VOC

New-Indy Catawba - Catawba, SC

		Method: GC/SCD Reduced Sulfur Analysis (Average)			
Sample Date	**Sample Location**	**ALS H2S, ppb**	**ALS DMDS, ppb**	**ALS DMS, ppb**	**ALS MMC, ppb**
2021/2022	Avg. ASB Influent (2021 and 2022)	252	86.78	199	2.60
5/17/2022	Foul Condensate (prior to H_2O_2)	105,667	6,633	14,667	8,267
	Predicted % Reduction from H_2O_2	0.99	MMC converted into DMDS	0.90	0.99
	Foul Condensate (after H_2O_2)	1,057	14,647	1,467	82.67
7/19/2022	Foul Condensate (prior to H_2O_2)	58,333	5,633	5,400	3,900
	Predicted % Reduction from H_2O_2	0.99	MMC converted into DMDS	0.90	0.99
	Foul Condensate (after H_2O_2)	583	9,414	540	39.00
7/20/2022	Foul Condensate (prior to H_2O_2)	76,200	6,932	7,140	7,393
	Predicted % Reduction from H_2O_2	0.99	MMC converted into DMDS	0.90	0.99
	Foul Condensate (after H_2O_2)	762	14,099	714	73.93
7/21/2022	Foul Condensate (prior to H_2O_2)	62,500	8,967	9,200	6,533
	Predicted % Reduction from H_2O_2	0.99	MMC converted into DMDS	0.90	0.99
	Foul Condensate (after H_2O_2)	625	15,300	920	65.33
		ALS H2S, ppm	**ALS DMDS, ppm**	**ALS DMS, ppm**	**ALS MMC, ppm**
Flow Weight Average Loading Calculation	Avg. Foul Condensate Concentration (after peroxide)	0.76	13.36	0.91	0.07
	Avg. ASB Inlet Concentration	0.25	0.09	0.20	2.60E-03
	Avg. Hardpipe Flow, MGD	0.34			
	Avg. ASB Inlet Flow, MGD	23.96			
	Total Flow	24.30			
	Flow Weight. Avg. Loading (ppm)	**0.2593**	**0.2712**	**0.2088**	**0.0035**
Results and Emissions Factors Calculation	**H2SSIM/WATER9 Results**	**H2S, g/s**	**DMDS, g/s**	**DMS, g/s**	**MMC, g/s**
	ASB Zone 1	Multiple H2SSIM runs.	0.10	0.15	2.74E-03
	ASB Zone 2		1.43E-03	3.05E-03	4.63E-05
	ASB Zone 3		2.57E-05	1.01E-04	1.43E-06
	Total ASB		**0.10**	**0.16**	**2.78E-03**
	Baseline Emissions Factor 2200 ODTP/day	**H2S, lb/ODTP**	**DMDS, lb/ODTP**	**DMS, lb/ODTP**	**MMC, lb/ODTP**
	Baseline Emissions Factor	**1.51E-02**	**1.14E-02**	**1.85E-02**	**3.28E-04**

```
Type of unit is
1 Total water added at the unit (l/s)       50      0
2 Area of openings at unit (cm2)                    50
3 Radius of drop pipe (cm)                          5
4 Drop length to conduit (cm)                       61
5 Humidity of inlet air (%)                         40
6 Temperature of air (C)                            25
7 Drain air velocity (ft/min)                       84
8 manhole air velocity (ft/min)                     128
9 Conduit air velocity (ft/min)                     66
10 Wind speed (cm/s at 10 m)                        447
11 distance to next unit (cm)                       500
12 slope of underflow conduit                       .015
13 friction factor liquid                           .016
14 friction factor gas                              .006
15 radius of underflow conduit (cm)                 12
16 Underflow T (C)                                  25
17 oscillation cycle time (min)                     5
18 design collection velocities  (ft/s)             2
19 design branch line fraction full                 .4

Type of unit is
8 HL partition flag=1, adjust for sorption          0
9 unit recycle convergence number                   200
10 oil molecular weight                             0
11 oil density  (g/cc)                              0
12 NaUT 1=municipal 2=industrial  3=turb.           0
13 NaUT 1=mass tr. 2=equil                          0
14 parts biomass per 1000 parts COD
15 oil water partition method 0=owpc
16 use UNIFAC aqueous data base =1
17 specify mass transfer for unit, =1
18 Use biomass for unit option, =1
19 biogrowth Monod half concentration ppm

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment


                       WWTP\BAE\TRS\WATER9\ASB V5 3/14/2023 2:17:21 PM  19:17:08
COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment
1 Description of unit                       11    ASB Zone 1
2 Wastewater temperature   (C)                    34.08
3 length of aeration unit (m)                     295
4 width of aeration unit (m)                      295
5 depth of aeration unit (m)                      1.4
6 Area of agitation (each aerator,m2)             135
7 Total number of agitators in the unit           31
8 Power of agitation (each aerator,HP)            75
9 Impeller diameter (cm)                          49.53
10 Impeller rotation (RPM)                        1200
11 Agitator mechanical efficiency                 0.83
12 aerator effectiveness, alpha                   0.83
13 if there is plug flow, enter 1                 0
14 Overall biorate (mg/g bio-hr)                  19
15 Aeration air flow (m3/s)                       0
16 active biomass, aeration (g/l)                 0.3
17 If covered, then enter 1                       0
18 special input                                  0
19 pH  (enter 0 for no pH adjustment)             7.04

Properties of DIMETHYL DISULFIDE at 34.1 deg.C (93.3 deg.F)
```

```
   hl= 0.001714 atm-m3/mol       vp= 45.945 mmHg (0.88868 psia)
       95.2 y/x
       0.068011 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.041e-05 cm2/s  dv= 0.088022 cm2/s
Compound flow rate from inlet water is 0.26179 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 31.792 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 237.766.
kl is estimated as 5.971e-06 m/s.
kg is estimated as 0.005598 m/s.  Model: 2
kg is estimated as 0.005598 m/s.  Model: 2
The Schmidt number is 1.70412.
The friction velocity is 37.398 m/s
kg is estimated as 0.012927 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.11564 m/s.
kl (agitated)is estimated as 0.017486 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 2.753e-04 m/s.
 The effective stripping time (surface + diffused air) is 84.752 minutes. (1.41254
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1907.493 min. (31.792 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                        0.11781
   KL aerated (m/s)                        0.017486
   KL OVERALL AERATED (m/s)                0.005609
   KG quiescent (m/s)                      0.005703
   KL quiescent (m/s)                      5.971e-06
   KL OVERALL QUIESCENT (m/s)              5.883e-06
   KL OVERALL (m/s)                        2.753e-04
   air stripping time constant (min)       84.752
   FRACTION SURFACE VOLATILIZED            0.36432
   FRACTION SUBMERGED VOLATILIZED          0.
   TOTAL FRACTION VOLATILIZED              0.36432
   FRACTION BIOLOGICALLY REMOVED           0.61949
   FRACTION ABSORBED                       0.
   TOTAL AIR EMISSIONS  (g/s)              0.095374
                   (Mg/year)               3.00772
   EMISSION FACTOR  (g/cm2-s)              1.096e-10
   UNIT EXIT CONCENTRATION (ppmw)          0.003981
DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream


                    WWTP\BAE\TRS\WATER9\ASB V5 3/14/2023 2:17:21 PM  19:17:08
COMPOUND: DIMETHYL DISULFIDE

Type of unit is system exit stream
1 Description of unit                    12    def.system exit st

   TOTAL AIR EMISSIONS  (g/s)              0.
```

```
                 (Mg/year)                0.
   EMISSION FACTOR  (g/cm2-s)             1.096e-10
   UNIT EXIT CONCENTRATION (ppmw)         6.079e-06
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain
```



```
COMPOUND: DIMETHYL DISULFIDE

Type of unit is open hub drain
1 Description of unit                         13    default open hub d
2 Underflow T (C)                                   43.89
3 Total water added at the unit (l/s)               0
4 Area of openings at unit (cm2)                    50
5 Radius of drop pipe (cm)                          5
6 Drop length to conduit (cm)                       61
7 Open surface=1                                    1
8 Subsurface entrance=1                             0
9 subsurface exit =1                                0
10 radius of underflow conduit (cm)                 12
11 distance to next unit (cm)                       500
12 slope of underflow conduit                       0.015
16 velocity air at drain opening (ft/min)           84
17 municipal waste in conduit =1                    0
18 Assume equilibrium in unit, =1                   0
19 pH  (enter 0 for no pH adjustment)               8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1064.53 l/s.
   Weight fraction down is  2.712E-07
   Gas concentration in  0 mol fraction.
   Gas flow  1064.53 L/s
   Weight fraction out at base of drop is  2.45916666343852E-07
   fraction transferred in the drain drop from hub is .093228
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.093228
   fraction loss in unit                    0.
   fraction loss in line run                0.
   component upstream of unit, g/s          0.
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             3.134e-19
   mol fract. headspace vent base           6.978e-06
   headspace flow out vent (cc/s)           -1.065e+06
   headspace flow down line (cc/s)          1.065e+06
   KG surface (m/s)                         1860.422
   KL surface (m/s)                         6.37e-09
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.2887
   total component into unit, g/s           0.26179
   TOTAL AIR EMISSIONS  (g/s)               0.026915
                 (Mg/year)                  0.84879
   EMISSION FACTOR  (g/cm2-s)               1.096e-10
   UNIT EXIT CONCENTRATION (ppmw)           0.24592
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment
```



```
COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment
1 Description of unit                         17    ASB Zone 3
```

```
2 Wastewater temperature   (C)                  30.01
3 length of aeration unit (m)                   376
4 width of aeration unit (m)                    188
5 depth of aeration unit (m)                    0.91
6 Area of agitation (each aerator,m2)           135
7 Total number of agitators in the unit         6
8 Power of agitation (each aerator,HP)          75
9 Impeller diameter (cm)                        49.53
10 Impeller rotation (RPM)                      1200
11 Agitator mechanical efficiency               0.83
12 aerator effectiveness, alpha                 0.83
13 if there is plug flow, enter 1               0
14 Overall biorate (mg/g bio-hr)                19
15 Aeration air flow (m3/s)                     0
16 active biomass, aeration (g/l)               0.3
17 If covered, then enter 1                     0
18 special input                                0
19 pH  (enter 0 for no pH adjustment)           7.42

Properties of DIMETHYL DISULFIDE at 30. deg.C (86. deg.F)
   hl= 0.00141 atm-m3/mol      vp= 37.814 mmHg (0.7314 psia)
       78.352 y/x
       0.056726 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.027e-05 cm2/s  dv= 0.085991 cm2/s
Compound flow rate from inlet water is 1.411e-04 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 16.785 hr.
____Biomass production_______________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 5.918e-06 m/s.
kg is estimated as 0.005575 m/s.  Model: 2
kg is estimated as 0.005575 m/s.  Model: 2
The Schmidt number is 1.74436.
The friction velocity is 37.398 m/s
kg is estimated as 0.012742 m/s.  Model: 3
________Agitated surface__________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.1143 m/s.
kl (agitated)is estimated as 0.015772 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 5.972e-05 m/s.
 The effective stripping time (surface + diffused air) is 253.944 minutes. (4.2324
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1007.112 min. (16.785 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                        0.11644
   KL aerated (m/s)                        0.015772
   KL OVERALL AERATED (m/s)                0.004711
   KG quiescent (m/s)                      0.005679
   KL quiescent (m/s)                      5.918e-06
   KL OVERALL QUIESCENT (m/s)              5.813e-06
   KL OVERALL (m/s)                        5.972e-05
   air stripping time constant (min)       253.944
```

```
   FRACTION SURFACE VOLATILIZED              0.18189
   FRACTION SUBMERGED VOLATILIZED            0.
   TOTAL FRACTION VOLATILIZED                0.18189
   FRACTION BIOLOGICALLY REMOVED             0.77225
   FRACTION ABSORBED                         0.
   TOTAL AIR EMISSIONS  (g/s)                2.567e-05
                     (Mg/year)               8.094e-04
   EMISSION FACTOR  (g/cm2-s)                3.631e-14
   UNIT EXIT CONCENTRATION (ppmw)            6.079e-06
DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment


                    WWTP\BAE\TRS\WATER9\ASB V5 3/14/2023 2:17:21 PM  19:17:08
COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment
1 Description of unit                       18     ASB Zone 2
2 Wastewater temperature   (C)                     32.08
3 length of aeration unit (m)                      368
4 width of aeration unit (m)                       184
5 depth of aeration unit (m)                       0.97
6 Area of agitation (each aerator,m2)              135
7 Total number of agitators in the unit            15
8 Power of agitation (each aerator,HP)             75
9 Impeller diameter (cm)                           49.53
10 Impeller rotation (RPM)                         1200
11 Agitator mechanical efficiency                  0.83
12 aerator effectiveness, alpha                    0.83
13 if there is plug flow, enter 1                  0
14 Overall biorate (mg/g bio-hr)                   19
15 Aeration air flow (m3/s)                        0
16 active biomass, aeration (g/l)                  0.3
17 If covered, then enter 1                        0
18 special input                                   0
19 pH  (enter 0 for no pH adjustment)              7.24

Properties of DIMETHYL DISULFIDE at 32.1 deg.C (89.7 deg.F)
   hl= 0.001558 atm-m3/mol      vp= 41.785 mmHg (0.80821 psia)
       86.579 y/x
       0.062258 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.034e-05 cm2/s  dv= 0.087022 cm2/s
Compound flow rate from inlet water is 0.004238 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 17.139 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 5.945e-06 m/s.
kg is estimated as 0.005633 m/s.  Model: 2
kg is estimated as 0.005633 m/s.  Model: 2
The Schmidt number is 1.72371.
The friction velocity is 37.398 m/s
kg is estimated as 0.012836 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
```

kg (agitated)is estimated as 0.11498 m/s.
kl (agitated)is estimated as 0.016622 m/s.
The specified and growth biomass is 0.3 g/L.
The effective KL (surface + diffused air) is 1.598e-04 m/s.
The effective stripping time (surface + diffused air) is 101.198 minutes.
(1.68663 hrs.)
The pump mixing time is 5 x the pumping recirculaion time, 0. min.
The ratio of the mixing to the striping (surface + diffused air) is 0.
The mean residence time is 1028.32 min. (17.139 hr.)
The ratio of the pump mixing to the residence time is 0.

KG aerated (m/s)	0.11714
KL aerated (m/s)	0.016622
KL OVERALL AERATED (m/s)	0.005152
KG quiescent (m/s)	0.005738
KL quiescent (m/s)	5.945e-06
KL OVERALL QUIESCENT (m/s)	5.85e-06
KL OVERALL (m/s)	1.598e-04
air stripping time constant (min)	101.198
FRACTION SURFACE VOLATILIZED	0.33837
FRACTION SUBMERGED VOLATILIZED	0.
TOTAL FRACTION VOLATILIZED	0.33837
FRACTION BIOLOGICALLY REMOVED	0.62833
FRACTION ABSORBED	0.
TOTAL AIR EMISSIONS (g/s)	0.001434
(Mg/year)	0.045218
EMISSION FACTOR (g/cm2-s)	2.118e-12
UNIT EXIT CONCENTRATION (ppmw)	1.326e-04

Type of unit is

1 Total water added at the unit (l/s)	50	0
2 Area of openings at unit (cm2)		50
3 Radius of drop pipe (cm)		5
4 Drop length to conduit (cm)		61
5 Humidity of inlet air (%)		40
6 Temperature of air (C)		25
7 Drain air velocity (ft/min)		84
8 manhole air velocity (ft/min)		128
9 Conduit air velocity (ft/min)		66
10 Wind speed (cm/s at 10 m)		447
11 distance to next unit (cm)		500
12 slope of underflow conduit		.015
13 friction factor liquid		.016
14 friction factor gas		.006
15 radius of underflow conduit (cm)		12
16 Underflow T (C)		25
17 oscillation cycle time (min)		5
18 design collection velocities (ft/s)		2
19 design branch line fraction full		.4

Type of unit is

8 HL partition flag=1, adjust for sorption	0
9 unit recycle convergence number	200
10 oil molecular weight	0
11 oil density (g/cc)	0
12 NaUT 1=municipal 2=industrial 3=turb.	0
13 NaUT 1=mass tr. 2=equil	0
14 parts biomass per 1000 parts COD	
15 oil water partition method 0=owpc	
16 use UNIFAC aqueous data base =1	
17 specify mass transfer for unit, =1	
18 Use biomass for unit option, =1	
19 biogrowth Monod half concentration ppm	

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment

COMPOUND: DIMETHYL SULFIDE (DMS)

Type of unit is aerated biotreatment

1 Description of unit	11	ASB Zone 1
2 Wastewater temperature (C)		34.08
3 length of aeration unit (m)		295
4 width of aeration unit (m)		295
5 depth of aeration unit (m)		1.4
6 Area of agitation (each aerator,m2)		135
7 Total number of agitators in the unit		31
8 Power of agitation (each aerator,HP)		75
9 Impeller diameter (cm)		49.53
10 Impeller rotation (RPM)		1200
11 Agitator mechanical efficiency		0.83
12 aerator effectiveness, alpha		0.83
13 if there is plug flow, enter 1		0
14 Overall biorate (mg/g bio-hr)		19
15 Aeration air flow (m3/s)		0
16 active biomass, aeration (g/l)		0.3
17 If covered, then enter 1		0
18 special input		0
19 pH (enter 0 for no pH adjustment)		7.04

Properties of DIMETHYL SULFIDE (DMS) at 34.1 deg.C (93.3 deg.F)

```
   hl= 0.002924 atm-m3/mol      vp= 704.653 mmHg (13.629 psia)
       162.463 y/x
       0.11606 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr         dl= 1.504e-05 cm2/s  dv= 0.14765 cm2/s
Compound flow rate from inlet water is 0.19189 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 31.792 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 237.766.
kl is estimated as 7.634e-06 m/s.
kg is estimated as 0.007917 m/s.  Model: 2
kg is estimated as 0.007917 m/s.  Model: 2
The Schmidt number is 1.01591.
The friction velocity is 37.398 m/s
kg is estimated as 0.017873 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.14978 m/s.
kl (agitated)is estimated as 0.021024 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 4.77e-04 m/s.
 The effective stripping time (surface + diffused air) is 48.915 minutes. (0.81526
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1907.493 min. (31.792 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                          0.15258
   KL aerated (m/s)                          0.021024
   KL OVERALL AERATED (m/s)                  0.009769
   KG quiescent (m/s)                        0.008066
   KL quiescent (m/s)                        7.634e-06
   KL OVERALL QUIESCENT (m/s)                7.574e-06
   KL OVERALL (m/s)                          4.77e-04
   air stripping time constant (min)         48.915
   FRACTION SURFACE VOLATILIZED              0.80226
   FRACTION SUBMERGED VOLATILIZED            0.
   TOTAL FRACTION VOLATILIZED                0.80226
   FRACTION BIOLOGICALLY REMOVED             0.17717
   FRACTION ABSORBED                         0.
   TOTAL AIR EMISSIONS  (g/s)                0.15394
                 (Mg/year)                   4.85471
   EMISSION FACTOR  (g/cm2-s)                1.769e-10
   UNIT EXIT CONCENTRATION (ppmw)            0.003708
DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream


                      WWTP\BAE\TRS\WATER9\ASB V5 3/14/2023 2:17:21 PM  19:18:13
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is system exit stream
1 Description of unit                       12    def.system exit st

   TOTAL AIR EMISSIONS  (g/s)                0.
```

```
                (Mg/year)                   0.
   EMISSION FACTOR  (g/cm2-s)              1.769e-10
   UNIT EXIT CONCENTRATION (ppmw)          1.362e-05
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain


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COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is open hub drain
1 Description of unit                      13    default open hub d
2 Underflow T (C)                                43.89
3 Total water added at the unit (l/s)            0
4 Area of openings at unit (cm2)                 50
5 Radius of drop pipe (cm)                       5
6 Drop length to conduit (cm)                    61
7 Open surface=1                                 1
8 Subsurface entrance=1                          0
9 subsurface exit =1                             0
10 radius of underflow conduit (cm)              12
11 distance to next unit (cm)                    500
12 slope of underflow conduit                    0.015
16 velocity air at drain opening (ft/min)        84
17 municipal waste in conduit =1                 0
18 Assume equilibrium in unit, =1                0
19 pH  (enter 0 for no pH adjustment)            8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1064.53 l/s.
   Weight fraction down is  2.088E-07
   Gas concentration in  0 mol fraction.
   Gas flow  1064.53 L/s
   Weight fraction out at base of drop is  1.80253671574623E-07
   fraction transferred in the drain drop from hub is .136716
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.13672
   fraction loss in unit                    0.
   fraction loss in line run                0.
   component upstream of unit, g/s          0.
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             4.509e-19
   mol fract. headspace vent base           1.195e-05
   headspace flow out vent (cc/s)           -1.065e+06
   headspace flow down line (cc/s)          1.065e+06
   KG surface (m/s)                         2626.947
   KL surface (m/s)                         8.245e-09
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.22227
   total component into unit, g/s           0.19189
   TOTAL AIR EMISSIONS  (g/s)               0.030388
                (Mg/year)                   0.95833
   EMISSION FACTOR  (g/cm2-s)               1.769e-10
   UNIT EXIT CONCENTRATION (ppmw)           0.18025
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment


                   WWTP\BAE\TRS\WATER9\ASB V5 3/14/2023 2:17:21 PM  19:18:13
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is aerated biotreatment
1 Description of unit                      17    ASB Zone 3
```

```
2 Wastewater temperature   (C)                   30.01
3 length of aeration unit (m)                    376
4 width of aeration unit (m)                     188
5 depth of aeration unit (m)                     0.91
6 Area of agitation (each aerator,m2)            135
7 Total number of agitators in the unit          6
8 Power of agitation (each aerator,HP)           75
9 Impeller diameter (cm)                         49.53
10 Impeller rotation (RPM)                       1200
11 Agitator mechanical efficiency                0.83
12 aerator effectiveness, alpha                  0.83
13 if there is plug flow, enter 1                0
14 Overall biorate (mg/g bio-hr)                 19
15 Aeration air flow (m3/s)                      0
16 active biomass, aeration (g/l)                0.3
17 If covered, then enter 1                      0
18 special input                                 0
19 pH  (enter 0 for no pH adjustment)            7.42

Properties of DIMETHYL SULFIDE  (DMS) at 30. deg.C (86. deg.F)
   hl= 0.002519 atm-m3/mol      vp= 606.985 mmHg (11.74 psia)
       139.945 y/x
       0.10132 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.485e-05 cm2/s  dv= 0.14425 cm2/s
Compound flow rate from inlet water is 1.708e-04 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 16.785 hr.
    ____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 7.566e-06 m/s.
kg is estimated as 0.007884 m/s.  Model: 2
kg is estimated as 0.007884 m/s.  Model: 2
The Schmidt number is 1.03989.
The friction velocity is 37.398 m/s
kg is estimated as 0.017611 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.14804 m/s.
kl (agitated)is estimated as 0.018962 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 1.053e-04 m/s.
 The effective stripping time (surface + diffused air) is 144.073 minutes.
 (2.40122 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1007.112 min. (16.785 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                          0.15081
   KL aerated (m/s)                          0.018962
   KL OVERALL AERATED (m/s)                  0.00854
   KG quiescent (m/s)                        0.008032
   KL quiescent (m/s)                        7.566e-06
   KL OVERALL QUIESCENT (m/s)                7.497e-06
   KL OVERALL (m/s)                          1.053e-04
   air stripping time constant (min)         144.073
```

```
   FRACTION SURFACE VOLATILIZED                0.59355
   FRACTION SUBMERGED VOLATILIZED              0.
   TOTAL FRACTION VOLATILIZED                  0.59355
   FRACTION BIOLOGICALLY REMOVED               0.32154
   FRACTION ABSORBED                           0.
   TOTAL AIR EMISSIONS  (g/s)                  1.014e-04
                    (Mg/year)                  0.003197
   EMISSION FACTOR  (g/cm2-s)                  1.434e-13
   UNIT EXIT CONCENTRATION (ppmw)              1.362e-05
DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment


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COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is aerated biotreatment
1 Description of unit                          18    ASB Zone 2
2 Wastewater temperature   (C)                       32.08
3 length of aeration unit (m)                        368
4 width of aeration unit (m)                         184
5 depth of aeration unit (m)                         0.97
6 Area of agitation (each aerator,m2)                135
7 Total number of agitators in the unit              15
8 Power of agitation (each aerator,HP)               75
9 Impeller diameter (cm)                             49.53
10 Impeller rotation (RPM)                           1200
11 Agitator mechanical efficiency                    0.83
12 aerator effectiveness, alpha                      0.83
13 if there is plug flow, enter 1                    0
14 Overall biorate (mg/g bio-hr)                     19
15 Aeration air flow (m3/s)                          0
16 active biomass, aeration (g/l)                    0.3
17 If covered, then enter 1                          0
18 special input                                     0
19 pH  (enter 0 for no pH adjustment)                7.24

Properties of DIMETHYL SULFIDE  (DMS) at 32.1 deg.C (89.7 deg.F)
   hl= 0.002719 atm-m3/mol      vp= 655.201 mmHg (12.673 psia)
       151.062 y/x
       0.10863 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr           dl= 1.495e-05 cm2/s  dv= 0.14597 cm2/s
Compound flow rate from inlet water is 0.003948 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 17.139 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 7.6e-06 m/s.
kg is estimated as 0.007966 m/s.  Model: 2
kg is estimated as 0.007966 m/s.  Model: 2
The Schmidt number is 1.02758.
The friction velocity is 37.398 m/s
kg is estimated as 0.017744 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
```

kg (agitated)is estimated as 0.14892 m/s.
kl (agitated)is estimated as 0.019984 m/s.
The specified and growth biomass is 0.3 g/L.
The effective KL (surface + diffused air) is 2.809e-04 m/s.
The effective stripping time (surface + diffused air) is 57.552 minutes. (0.9592 hrs.)
The pump mixing time is 5 x the pumping recirculaion time, 0. min.
The ratio of the mixing to the striping (surface + diffused air) is 0.
The mean residence time is 1028.32 min. (17.139 hr.)
The ratio of the pump mixing to the residence time is 0.

KG aerated (m/s)	0.15171
KL aerated (m/s)	0.019984
KL OVERALL AERATED (m/s)	0.009148
KG quiescent (m/s)	0.008115
KL quiescent (m/s)	7.6e-06
KL OVERALL QUIESCENT (m/s)	7.537e-06
KL OVERALL (m/s)	2.809e-04
air stripping time constant (min)	57.552
FRACTION SURFACE VOLATILIZED	0.77311
FRACTION SUBMERGED VOLATILIZED	0.
TOTAL FRACTION VOLATILIZED	0.77311
FRACTION BIOLOGICALLY REMOVED	0.18362
FRACTION ABSORBED	0.
TOTAL AIR EMISSIONS (g/s)	0.003052
(Mg/year)	0.096247
EMISSION FACTOR (g/cm2-s)	4.507e-12
UNIT EXIT CONCENTRATION (ppmw)	1.605e-04

```
Type of unit is
1 Total water added at the unit (l/s)        50      0
2 Area of openings at unit (cm2)                     50
3 Radius of drop pipe (cm)                           5
4 Drop length to conduit (cm)                        61
5 Humidity of inlet air (%)                          40
6 Temperature of air (C)                             25
7 Drain air velocity (ft/min)                        84
8 manhole air velocity (ft/min)                      128
9 Conduit air velocity (ft/min)                      66
10 Wind speed (cm/s at 10 m)                         447
11 distance to next unit (cm)                        500
12 slope of underflow conduit                        .015
13 friction factor liquid                            .016
14 friction factor gas                               .006
15 radius of underflow conduit (cm)                  12
16 Underflow T (C)                                   25
17 oscillation cycle time (min)                      5
18 design collection velocities  (ft/s)              2
19 design branch line fraction full                  .4

Type of unit is
8 HL partition flag=1, adjust for sorption           0
9 unit recycle convergence number                    200
10 oil molecular weight                              0
11 oil density  (g/cc)                               0
12 NaUT 1=municipal 2=industrial  3=turb.            0
13 NaUT 1=mass tr. 2=equil                           0
14 parts biomass per 1000 parts COD
15 oil water partition method 0=owpc
16 use UNIFAC aqueous data base =1
17 specify mass transfer for unit, =1
18 Use biomass for unit option, =1
19 biogrowth Monod half concentration ppm

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment


                       WWTP\BAE\TRS\WATER9\ASB V5 3/14/2023 2:17:21 PM  19:18:53
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment
1 Description of unit                        11     ASB Zone 1
2 Wastewater temperature   (C)                      34.08
3 length of aeration unit (m)                       295
4 width of aeration unit (m)                        295
5 depth of aeration unit (m)                        1.4
6 Area of agitation (each aerator,m2)               135
7 Total number of agitators in the unit             31
8 Power of agitation (each aerator,HP)              75
9 Impeller diameter (cm)                            49.53
10 Impeller rotation (RPM)                          1200
11 Agitator mechanical efficiency                   0.83
12 aerator effectiveness, alpha                     0.83
13 if there is plug flow, enter 1                   0
14 Overall biorate (mg/g bio-hr)                    19
15 Aeration air flow (m3/s)                         0
16 active biomass, aeration (g/l)                   0.3
17 If covered, then enter 1                         0
18 special input                                    0
19 pH  (enter 0 for no pH adjustment)               7.04

Properties of METHANETHIOL(methyl mercaptan) at 34.1 deg.C (93.3 deg.F)
```

```
   hl= 0.004158 atm-m3/mol        vp= 2272.142 mmHg (43.948 psia)
       230.99 y/x
       0.16502 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr           dl= 1.525e-05 cm2/s  dv= 0.23702 cm2/s
Compound flow rate from inlet water is 0.003078 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 31.792 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 237.766.
kl is estimated as 7.703e-06 m/s.
kg is estimated as 0.010871 m/s.  Model: 2
kg is estimated as 0.010871 m/s.  Model: 2
The Schmidt number is 0.63285.
The friction velocity is 37.398 m/s
kg is estimated as 0.024173 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.18977 m/s.
kl (agitated)is estimated as 0.021167 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 6.265e-04 m/s.
 The effective stripping time (surface + diffused air) is 37.242 minutes. (0.62071
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1907.493 min. (31.792 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                        0.19332
   KL aerated (m/s)                        0.021167
   KL OVERALL AERATED (m/s)                0.012876
   KG quiescent (m/s)                      0.011075
   KL quiescent (m/s)                      7.703e-06
   KL OVERALL QUIESCENT (m/s)              7.672e-06
   KL OVERALL (m/s)                        6.265e-04
   air stripping time constant (min)       37.242
   FRACTION SURFACE VOLATILIZED            0.88891
   FRACTION SUBMERGED VOLATILIZED          0.
   TOTAL FRACTION VOLATILIZED              0.88891
   FRACTION BIOLOGICALLY REMOVED           0.093739
   FRACTION ABSORBED                       0.
   TOTAL AIR EMISSIONS  (g/s)              0.002736
                    (Mg/year)              0.086272
   EMISSION FACTOR  (g/cm2-s)              3.144e-12
   UNIT EXIT CONCENTRATION (ppmw)          5.017e-05
DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream


                    WWTP\BAE\TRS\WATER9\ASB V5 3/14/2023 2:17:21 PM  19:18:53
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is system exit stream
1 Description of unit                      12    def.system exit st

   TOTAL AIR EMISSIONS  (g/s)              0.
```

```
                  (Mg/year)                 0.
   EMISSION FACTOR  (g/cm2-s)               3.144e-12
   UNIT EXIT CONCENTRATION (ppmw)           1.458e-07
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain
```



```
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is open hub drain
1 Description of unit                       13    default open hub d
2 Underflow T (C)                                 43.89
3 Total water added at the unit (l/s)             0
4 Area of openings at unit (cm2)                  50
5 Radius of drop pipe (cm)                        5
6 Drop length to conduit (cm)                     61
7 Open surface=1                                  1
8 Subsurface entrance=1                           0
9 subsurface exit =1                              0
10 radius of underflow conduit (cm)               12
11 distance to next unit (cm)                     500
12 slope of underflow conduit                     0.015
16 velocity air at drain opening (ft/min)         84
17 municipal waste in conduit =1                  0
18 Assume equilibrium in unit, =1                 0
19 pH  (enter 0 for no pH adjustment)             8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1064.53 l/s.
   Weight fraction down is  3.5E-09
   Gas concentration in  0 mol fraction.
   Gas flow  1064.53 L/s
   Weight fraction out at base of drop is  2.89099406807993E-09
   fraction transferred in the drain drop from hub is .174002
   fraction loss in waste1 drop to hub      0.
   fraction loss in waste2 drop to hub      0.
   fraction loss in waste3 drop to hub      0.
   fraction loss in collection hub drop     0.174
   fraction loss in unit                    0.
   fraction loss in line run                0.
   component upstream of unit, g/s          0.
   mol fract. headspace upstream (y)        0.
   headspace at conduit discharge, y        0.
   headspace end of conduit (y)             9.429e-21
   mol fract. headspace vent base           3.292e-07
   headspace flow out vent (cc/s)           -1.065e+06
   headspace flow down line (cc/s)          1.065e+06
   KG surface (m/s)                         3602.086
   KL surface (m/s)                         8.324e-09
   flow of waste down hub (l/s)             0.
   component flow in waste into unit (g/s)  0.003726
   total component into unit, g/s           0.003078
   TOTAL AIR EMISSIONS  (g/s)               6.483e-04
                  (Mg/year)                 0.020445
   EMISSION FACTOR  (g/cm2-s)               3.144e-12
   UNIT EXIT CONCENTRATION (ppmw)           0.002891
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment
```



```
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment
1 Description of unit                       17    ASB Zone 3
```

```
2 Wastewater temperature   (C)                      30.01
3 length of aeration unit (m)                       376
4 width of aeration unit (m)                        188
5 depth of aeration unit (m)                        0.91
6 Area of agitation (each aerator,m2)               135
7 Total number of agitators in the unit             6
8 Power of agitation (each aerator,HP)              75
9 Impeller diameter (cm)                            49.53
10 Impeller rotation (RPM)                          1200
11 Agitator mechanical efficiency                   0.83
12 aerator effectiveness, alpha                     0.83
13 if there is plug flow, enter 1                   0
14 Overall biorate (mg/g bio-hr)                    19
15 Aeration air flow (m3/s)                         0
16 active biomass, aeration (g/l)                   0.3
17 If covered, then enter 1                         0
18 special input                                    0
19 pH  (enter 0 for no pH adjustment)               7.42

Properties of METHANETHIOL(methyl mercaptan) at 30. deg.C (86. deg.F)
   hl= 0.003687 atm-m3/mol      vp= 2014.774 mmHg (38.97 psia)
       204.826 y/x
       0.14829 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.505e-05 cm2/s  dv= 0.23155 cm2/s
Compound flow rate from inlet water is 1.957e-06 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 16.785 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 7.635e-06 m/s.
kg is estimated as 0.010826 m/s.  Model: 2
kg is estimated as 0.010826 m/s.  Model: 2
The Schmidt number is 0.64779.
The friction velocity is 37.398 m/s
kg is estimated as 0.023814 m/s.  Model: 3
________Agitated surface__________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.18756 m/s.
kl (agitated)is estimated as 0.019092 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 1.391e-04 m/s.
 The effective stripping time (surface + diffused air) is 109.038 minutes.
 (1.81731 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1007.112 min. (16.785 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                              0.19108
   KL aerated (m/s)                              0.019092
   KL OVERALL AERATED (m/s)                      0.011483
   KG quiescent (m/s)                            0.011029
   KL quiescent (m/s)                            7.635e-06
   KL OVERALL QUIESCENT (m/s)                    7.6e-06
   KL OVERALL (m/s)                              1.391e-04
   air stripping time constant (min)             109.038
```

```
   FRACTION SURFACE VOLATILIZED              0.7324
   FRACTION SUBMERGED VOLATILIZED            0.
   TOTAL FRACTION VOLATILIZED                0.7324
   FRACTION BIOLOGICALLY REMOVED             0.1883
   FRACTION ABSORBED                         0.
   TOTAL AIR EMISSIONS  (g/s)                1.433e-06
                    (Mg/year)                4.52e-05
   EMISSION FACTOR  (g/cm2-s)                2.028e-15
   UNIT EXIT CONCENTRATION (ppmw)            1.458e-07
DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment


                    WWTP\BAE\TRS\WATER9\ASB V5 3/14/2023 2:17:21 PM  19:18:53
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment
1 Description of unit                          18     ASB Zone 2
2 Wastewater temperature    (C)                       32.08
3 length of aeration unit (m)                         368
4 width of aeration unit (m)                          184
5 depth of aeration unit (m)                          0.97
6 Area of agitation (each aerator,m2)                 135
7 Total number of agitators in the unit               15
8 Power of agitation (each aerator,HP)                75
9 Impeller diameter (cm)                              49.53
10 Impeller rotation (RPM)                            1200
11 Agitator mechanical efficiency                     0.83
12 aerator effectiveness, alpha                       0.83
13 if there is plug flow, enter 1                     0
14 Overall biorate (mg/g bio-hr)                      19
15 Aeration air flow (m3/s)                           0
16 active biomass, aeration (g/l)                     0.3
17 If covered, then enter 1                           0
18 special input                                      0
19 pH  (enter 0 for no pH adjustment)                 7.24

Properties of METHANETHIOL(methyl mercaptan) at 32.1 deg.C (89.7 deg.F)
   hl= 0.003921 atm-m3/mol      vp= 2142.771 mmHg (41.446 psia)
       217.838 y/x
       0.15664 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr            dl= 1.515e-05 cm2/s  dv= 0.23433 cm2/s
Compound flow rate from inlet water is 5.341e-05 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 17.139 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 7.67e-06 m/s.
kg is estimated as 0.010938 m/s.  Model: 2
kg is estimated as 0.010938 m/s.  Model: 2
The Schmidt number is 0.64013.
The friction velocity is 37.398 m/s
kg is estimated as 0.023996 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
```

kg (agitated)is estimated as 0.18868 m/s.
kl (agitated)is estimated as 0.020121 m/s.
The specified and growth biomass is 0.3 g/L.
The effective KL (surface + diffused air) is 3.715e-04 m/s.
The effective stripping time (surface + diffused air) is 43.518 minutes. (0.72529 hrs.)
The pump mixing time is 5 x the pumping recirculaion time, 0. min.
The ratio of the mixing to the striping (surface + diffused air) is 0.
The mean residence time is 1028.32 min. (17.139 hr.)
The ratio of the pump mixing to the residence time is 0.

KG aerated (m/s)	0.19222
KL aerated (m/s)	0.020121
KL OVERALL AERATED (m/s)	0.012174
KG quiescent (m/s)	0.011143
KL quiescent (m/s)	7.67e-06
KL OVERALL QUIESCENT (m/s)	7.637e-06
KL OVERALL (m/s)	3.715e-04
air stripping time constant (min)	43.518
FRACTION SURFACE VOLATILIZED	0.86584
FRACTION SUBMERGED VOLATILIZED	0.
TOTAL FRACTION VOLATILIZED	0.86584
FRACTION BIOLOGICALLY REMOVED	0.097514
FRACTION ABSORBED	0.
TOTAL AIR EMISSIONS (g/s)	4.625e-05
(Mg/year)	0.001458
EMISSION FACTOR (g/cm2-s)	6.83e-14
UNIT EXIT CONCENTRATION (ppmw)	1.838e-06

BAE H2S Factor
Summary of H2SSIM Inputs and Outputs

Windspeed: 3.55 mph

H2SSIM Inputs

5/17/2022

	Zone 1	Zone 2	Zone 3
DO	1.57	4.63	4.66
Temp	87.52	83.91	80.19
pH	6.77	7.19	7.44
Length	968	1208	1235
Width	968	604	617
Aerators	31	15	6
Total HP	2325	1125	450

	Main Inlet	Hardpipe	Units
Flow	25.11	0.35	MGD
Total Sulfide	0.060	1.06	mg/L
Sulfate	390	390	mg/L

H2SSIM Outputs

	Zone 1	Zone 2	Zone 3	Total ASB	
H2S g/s	0.07	0.02	0.02	**0.111**	g/s
				1723	ODTP
				0.012	lb/ODTP

7/19/2022

	Zone 1	Zone 2	Zone 3
DO	1.57	4.63	4.66
Temp	96.27	93.37	89.26
pH	7.17	7.37	7.48
Length	968	1208	1235
Width	968	604	617
Aerators	31	15	6

	Main Inlet	Hardpipe	Units
Flow	25.32	0.42	MGD
Total Sulfide	0.921	0.583	mg/L
Sulfate	390	390	mg/L

	Zone 1	Zone 2	Zone 3	Total ASB	
H2S g/s	0.09	0.03	0.02	**0.144**	g/s
				1900	ODTP
				0.014	lb/ODTP

7/20/2022

	Zone 1	Zone 2	Zone 3
DO	1.57	4.63	4.66
Temp	94.80	91.27	87.57
pH	7.10	7.22	7.39
Length	968	1208	1235
Width	968	604	617
Aerators	31	15	6

	Main Inlet	Hardpipe	Units
Flow	25.48	0.39	MGD
Total Sulfide	0.053	0.762	mg/L
Sulfate	390	390	mg/L

	Zone 1	Zone 2	Zone 3	Total ASB	
H2S g/s	0.06	0.03	0.02	**0.111**	g/s
				1900	ODTP
				0.011	lb/ODTP
				0.01	

7/21/2022

	Zone 1	Zone 2	Zone 3
DO	1.57	4.63	4.66
Temp	94.76	90.42	87.08
pH	7.10	7.19	7.35
Length	968	1208	1235
Width	968	604	617
Aerators	31	15	6

	Main Inlet	Hardpipe	Units
Flow	19.93	0.19	MGD
Total Sulfide	0.094	0.625	mg/L
Sulfate	390	390	mg/L

	Zone 1	Zone 2	Zone 3	Total ASB	
H2S g/s	0.06	0.03	0.02	**0.111**	g/s
				940	ODTP
				0.022	lb/ODTP

*DO are based on average of all DO readings from 2021 and 2022 Subpart S performance testing.

AVG: **0.015** lb/ODTP

NCASI WASTEWATER HYDROGEN SULFIDE EMISSIONS SIMULATOR (H2SSIM)

Version 1.3

5/17/2022

Data Type 1. Site Identification

Company Name	New-Indy
Facility Name	Catawba SC
Basin Name	ASB

Data Type 2. Model Zone Information

Number of Zones	3
Zone Location of Hardpipe	1
Type of Basin	ASB

Data Type 3. Load Characteristics

Loading Characteristics	Main Influent	Hardpipe	Units
Flow	25.11	0.35	MGD
Total Sulfide	0.06	1.057	mg/L
Sulfate	390	390	mg/L

Data Type 4. Atmospheric Conditions

Windspeed	3.55	mph
Ambient Temperature	79	F

Data Type 5. Zone Physical and Chemical Conditions

Zone Condition	Zone 1	Zone 2	Zone 3	Zone 4	Units
Dissolved Oxygen	1.571780303	4.6275	4.659734848		mg/L
Temperature	87.52	83.91	80.19		F
pH	6.77	7.19	7.44		s.u.
Redox Condition	Aerobic	Aerobic	Aerobic	Aerobic	
Length	968	1208	1235		feet
Width	968	604	617		feet
Depth	4.5	3.2	3		feet
Mixing	Moderat	Moderat	Moderat		
Number of Aerators	31	15	6		
Total Horsepower	2325	1125	450		HP
Impellor Size	1.625	1.625	1.625		feet
Impellor RPM	1200	1200	1200		RPM
Diffused Air Flow	0	0	0		cms
Weir Height	0	0	0		feet

Model Controls

Run H2SSIM

View Parameters

Clear Input Sheet

H2SSIM Results

5/17/2022

Basin Emissions		Units
Total Emissions (H_2S)	0.111	gms/s
Total Emissions (H_2S)	7726.8	lbs/yr
Total Emissions (H_2S)	3.9	tons/yr
Total Emissions (H_2S)	3.5	tonnes/yr
Emission Flux (H_2S)	15.5	gms/m^2 yr

Zone Emissions	Zone 1	Zone 2	Zone 3	Zone 4	Units
Zone Emissions (H_2S)	0.07	0.02	0.02		gms/s
Zone Emissions (H_2S)	4978.9	1486.3	1261.7		lbs/yr
Emission Flux (H_2S)	25.9	9.9	8.1		gms/m^2 yr
Liquid Conc. (Total Sulfide)	0.003	0.001	0.000		mg/L
Liquid Sulfide Load (lbs/yr)	34.400	6.200	5.200		lbs/yr

Percent Inlet Sulfide Removed	-35.4%

Current Parameters	
kgen	0.25
ThetaGen	1.06
KDO	0.05
KSO4	10
kanox	0.006
ThetaOx	1.05
m	1
n	0.2
MLVSS	272.2
O_2 Transfer Coeff.	2
alpha 1	0.83
alpha 2	0.6

NCASI WASTEWATER HYDROGEN SULFIDE EMISSIONS SIMULATOR (H2SSIM)

Version 1.3

7/19/2022

Data Type 1. Site Identification

Company Name	New-Indy
Facility Name	Catawba SC
Basin Name	ASB

Data Type 2. Model Zone Information

Number of Zones	3
Zone Location of Hardpipe	1
Type of Basin	ASB

Data Type 3. Load Characteristics

Loading Characteristics	Main Influent	Hardpipe	Units
Flow	25.32	0.42	MGD
Total Sulfide	0.921	0.583	mg/L
Sulfate	390	390	mg/L

Data Type 4. Atmospheric Conditions

Windspeed	3.55	mph
Ambient Temperature	79	F

Data Type 5. Zone Physical and Chemical Conditions

Zone Condition	Zone 1	Zone 2	Zone 3	Zone 4	Units
Dissolved Oxygen	1.571780303	4.6275	4.659734848		mg/L
Temperature	96.27	93.37	89.26		F
pH	7.17	7.37	7.48		s.u.
Redox Condition	Aerobic	Aerobic	Aerobic	Aerobic	
Length	968	1208	1235		feet
Width	968	604	617		feet
Depth	4.5	3.2	3		feet
Mixing	Moderat	Moderat	Moderat		
Number of Aerators	31	15	6		
Total Horsepower	2325	1125	450		HP
Impellor Size	1.625	1.625	1.625		feet
Impellor RPM	1200	1200	1200		RPM
Diffused Air Flow	0	0	0		cms
Weir Height	0	0	0		feet

Model Controls

Run H2SSIM

View Parameters

Clear Input Sheet

H2SSIM Results

7/19/2022

Basin Emissions		Units
Total Emissions (H_2S)	0.145	gms/s
Total Emissions (H_2S)	10050.3	lbs/yr
Total Emissions (H_2S)	5.0	tons/yr
Total Emissions (H_2S)	4.6	tonnes/yr
Emission Flux (H_2S)	20.2	gms/m^2 yr

Zone Emissions	Zone 1	Zone 2	Zone 3	Zone 4	Units
Zone Emissions (H_2S)	0.09	0.03	0.02		gms/s
Zone Emissions (H_2S)	6430.8	1936.5	1683.0		lbs/yr
Emission Flux (H_2S)	33.5	13.0	10.8		gms/m^2 yr
Liquid Conc. (Total Sulfide)	0.005	0.000	0.000		mg/L
Liquid Sulfide Load (lbs/yr)	60.200	6.100	5.400		lbs/yr

Percent Inlet Sulfide Removed	86.0%

Current Parameters	
kgen	0.25
ThetaGen	1.06
KDO	0.05
KSO4	10
kanox	0.006
ThetaOx	1.05
m	1
n	0.2
MLVSS	272.2
O_2 Transfer Coeff.	2
alpha 1	0.83
alpha 2	0.6

NCASI WASTEWATER HYDROGEN SULFIDE EMISSIONS SIMULATOR (H2SSIM)

Version 1.3

7/20/2022

Data Type 1. Site Identification

Company Name	New-Indy
Facility Name	Catawba SC
Basin Name	ASB

Data Type 2. Model Zone Information

Number of Zones	3
Zone Location of Hardpipe	1
Type of Basin	ASB

Data Type 3. Load Characteristics

Loading Characteristics	Main Influent	Hardpipe	Units
Flow	25.48	0.39	MGD
Total Sulfide	0.053	0.762	mg/L
Sulfate	390	390	mg/L

Data Type 4. Atmospheric Conditions

Windspeed	3.55	mph
Ambient Temperature	79	F

Data Type 5. Zone Physical and Chemical Conditions

Zone Condition	Zone 1	Zone 2	Zone 3	Zone 4	Units
Dissolved Oxygen	1.571780303	4.6275	4.659734848		mg/L
Temperature	94.8	91.27	87.57		F
pH	7.1	7.22	7.39		s.u.
Redox Condition	Aerobic	Aerobic	Aerobic	Aerobic	
Length	968	1208	1235		feet
Width	968	604	617		feet
Depth	4.5	3.2	3		feet
Mixing	Moderat	Moderat	Moderat		
Number of Aerators	31	15	6		
Total Horsepower	2325	1125	450		HP
Impellor Size	1.625	1.625	1.625		feet
Impellor RPM	1200	1200	1200		RPM
Diffused Air Flow	0	0	0		cms
Weir Height	0	0	0		feet

Model Controls

Run H2SSIM

View Parameters

Clear Input Sheet

H2SSIM Results

7/20/2022

Basin Emissions		Units
Total Emissions (H_2S)	0.111	gms/s
Total Emissions (H_2S)	7721.2	lbs/yr
Total Emissions (H_2S)	3.9	tons/yr
Total Emissions (H_2S)	3.5	tonnes/yr
Emission Flux (H_2S)	15.5	gms/m^2 yr

Zone Emissions	Zone 1	Zone 2	Zone 3	Zone 4	Units
Zone Emissions (H_2S)	0.06	0.03	0.02		gms/s
Zone Emissions (H_2S)	4266.3	1852.9	1602.0		lbs/yr
Emission Flux (H_2S)	22.2	12.4	10.3		gms/m^2 yr
Liquid Conc. (Total Sulfide)	0.002	0.001	0.000		mg/L
Liquid Sulfide Load (lbs/yr)	26.800	6.300	5.600		lbs/yr

Percent Inlet Sulfide Removed	-54.1%

Current Parameters	
kgen	0.25
ThetaGen	1.06
KDO	0.05
KSO4	10
kanox	0.006
ThetaOx	1.05
m	1
n	0.2
MLVSS	272.2
O_2 Transfer Coeff.	2
alpha 1	0.83
alpha 2	0.6

NCASI WASTEWATER HYDROGEN SULFIDE EMISSIONS SIMULATOR (H2SSIM)
Version 1.3

7/21/2022

Data Type 1. Site Identification

Company Name	New-Indy
Facility Name	Catawba SC
Basin Name	ASB

Data Type 2. Model Zone Information

Number of Zones	3
Zone Location of Hardpipe	1
Type of Basin	ASB

Data Type 3. Load Characteristics

Loading Characteristics	Main Influent	Hardpipe	Units
Flow	19.93	0.19	MGD
Total Sulfide	0.094	0.625	mg/L
Sulfate	390	390	mg/L

Data Type 4. Atmospheric Conditions

Windspeed	3.55	mph
Ambient Temperature	79	F

Data Type 5. Zone Physical and Chemical Conditions

Zone Condition	Zone 1	Zone 2	Zone 3	Zone 4	Units
Dissolved Oxygen	1.571780303	4.6275	4.659734848		mg/L
Temperature	94.76	90.42	87.08		F
pH	7.1	7.19	7.35		s.u.
Redox Condition	Aerobic	Aerobic	Aerobic	Aerobic	
Length	968	1208	1235		feet
Width	968	604	617		feet
Depth	4.5	3.2	3		feet
Mixing	Moderat	Moderat	Moderat		
Number of Aerators	31	15	6		
Total Horsepower	2325	1125	450		HP
Impellor Size	1.625	1.625	1.625		feet
Impellor RPM	1200	1200	1200		RPM
Diffused Air Flow	0	0	0		cms
Weir Height	0	0	0		feet

Model Controls

Run H2SSIM

View Parameters

Clear Input Sheet

H2SSIM Results 7/21/2022

Basin Emissions		Units
Total Emissions (H_2S)	0.111	gms/s
Total Emissions (H_2S)	7700.8	lbs/yr
Total Emissions (H_2S)	3.9	tons/yr
Total Emissions (H_2S)	3.5	tonnes/yr
Emission Flux (H_2S)	15.5	gms/m^2 yr

Zone Emissions	Zone 1	Zone 2	Zone 3	Zone 4	Units
Zone Emissions (H_2S)	0.06	0.03	0.02		gms/s
Zone Emissions (H_2S)	4305.7	1814.2	1580.9		lbs/yr
Emission Flux (H_2S)	22.4	12.1	10.1		gms/m^2 yr
Liquid Conc. (Total Sulfide)	0.002	0.001	0.000		mg/L
Liquid Sulfide Load (lbs/yr)	21.300	5.000	4.400		lbs/yr

Percent Inlet Sulfide Removed	-27.1%

Current Parameters	
kgen	0.25
ThetaGen	1.06
KDO	0.05
KSO4	10
kanox	0.006
ThetaOx	1.05
m	1
n	0.2
MLVSS	272.2
O_2 Transfer Coeff.	2
alpha 1	0.83
alpha 2	0.6

WASTEWATER TREATMENT PLANT – SUPPORTING INFORMATION PROJECTED ACTUAL EMISSIONS

New Stripper Scenario - Projected Actual Emissions

H_2S, TRS Compounds, and VOC

New-Indy Catawba - Catawba, SC

Concentration Loadings	**H2S, ppm**	**DMDS, ppm**	**DMS, ppm**	**MMC, ppm**
No Hardpipe flow (foul or stripped)	N/A	N/A	N/A	N/A
ASB Influent (Wastewater)	0.25	0.09	0.20	0.0026
Flow Weighted Loading:	0.25	0.09	0.20	2.60E-03
WATER9 Results	**H2S, g/s**	**DMDS, g/s**	**DMS, g/s**	**MMC, g/s**
ASB Zone 1	0.07	0.03	0.15	2.13E-03
ASB Zone 2	0.03	5.03E-04	3.19E-03	3.77E-05
ASB Zone 3	0.02	9.42E-06	1.11E-04	1.22E-06
Total ASB	**0.12**	**0.03**	**0.16**	**2.17E-03**
PAE Emissions Factors	**H2S, lb/ODTP**	**DMDS, lb/ODTP**	**DMS, lb/ODTP**	**MMC, lb/ODTP**
Total ASB	**1.03E-02**	**2.81E-03**	**1.36E-02**	**1.88E-04**

Hardpipe Flow (Foul or Stripped Condensate)	0	MGD
Post-Project ASB Influent Flow:	25.48	MGD
Total ASB Flow:	25.48	MGD
Total ASB Flow:	1116.47	L/s
Pulp Production	2200	ODTP/day

	MW
H2S	34
DMDS	94
DMS	62
MMC	48

Type of unit is		
1 Total water added at the unit (l/s)	50	0
2 Area of openings at unit (cm2)		50
3 Radius of drop pipe (cm)		5
4 Drop length to conduit (cm)		61
5 Humidity of inlet air (%)		40
6 Temperature of air (C)		25
7 Drain air velocity (ft/min)		84
8 manhole air velocity (ft/min)		128
9 Conduit air velocity (ft/min)		66
10 Wind speed (cm/s at 10 m)		447
11 distance to next unit (cm)		500
12 slope of underflow conduit		.015
13 friction factor liquid		.016
14 friction factor gas		.006
15 radius of underflow conduit (cm)		12
16 Underflow T (C)		25
17 oscillation cycle time (min)		5
18 design collection velocities (ft/s)		2
19 design branch line fraction full		.4

Type of unit is	
8 HL partition flag=1, adjust for sorption	0
9 unit recycle convergence number	200
10 oil molecular weight	0
11 oil density (g/cc)	0
12 NaUT 1=municipal 2=industrial 3=turb.	0
13 NaUT 1=mass tr. 2=equil	0
14 parts biomass per 1000 parts COD	
15 oil water partition method 0=owpc	
16 use UNIFAC aqueous data base =1	
17 specify mass transfer for unit, =1	
18 Use biomass for unit option, =1	
19 biogrowth Monod half concentration ppm	

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment

WWTP\PAE\New
Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM 19:27:50
COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment		
1 Description of unit	11	ASB Zone 1
2 Wastewater temperature (C)		34.08
3 length of aeration unit (m)		295
4 width of aeration unit (m)		295
5 depth of aeration unit (m)		1.4
6 Area of agitation (each aerator,m2)		135
7 Total number of agitators in the unit		31
8 Power of agitation (each aerator,HP)		75
9 Impeller diameter (cm)		49.53
10 Impeller rotation (RPM)		1200
11 Agitator mechanical efficiency		0.83
12 aerator effectiveness, alpha		0.83
13 if there is plug flow, enter 1		0
14 Overall biorate (mg/g bio-hr)		19
15 Aeration air flow (m3/s)		0
16 active biomass, aeration (g/l)		0.3
17 If covered, then enter 1		0
18 special input		0
19 pH (enter 0 for no pH adjustment)		7.04

Properties of DIMETHYL DISULFIDE at 34.1 deg.C (93.3 deg.F)

```
   hl= 0.001714 atm-m3/mol      vp= 45.945 mmHg (0.88868 psia)
       95.2 y/x
       0.068011 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.041e-05 cm2/s  dv= 0.088022 cm2/s
Compound flow rate from inlet water is 0.087838 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 30.325 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 237.766.
kl is estimated as 5.971e-06 m/s.
kg is estimated as 0.005598 m/s.  Model: 2
kg is estimated as 0.005598 m/s.  Model: 2
The Schmidt number is 1.70412.
The friction velocity is 37.398 m/s
kg is estimated as 0.012927 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.11564 m/s.
kl (agitated)is estimated as 0.017486 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 2.753e-04 m/s.
 The effective stripping time (surface + diffused air) is 84.752 minutes. (1.41254
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1819.519 min. (30.325 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                        0.11781
   KL aerated (m/s)                        0.017486
   KL OVERALL AERATED (m/s)                0.005609
   KG quiescent (m/s)                      0.005703
   KL quiescent (m/s)                      5.971e-06
   KL OVERALL QUIESCENT (m/s)              5.883e-06
   KL OVERALL (m/s)                        2.753e-04
   air stripping time constant (min)       84.752
   FRACTION SURFACE VOLATILIZED            0.36393
   FRACTION SUBMERGED VOLATILIZED          0.
   TOTAL FRACTION VOLATILIZED              0.36393
   FRACTION BIOLOGICALLY REMOVED           0.61912
   FRACTION ABSORBED                       0.
   TOTAL AIR EMISSIONS  (g/s)              0.031967
                     (Mg/year)             1.00811
   EMISSION FACTOR  (g/cm2-s)              3.673e-11
   UNIT EXIT CONCENTRATION (ppmw)          0.001334
DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream
```



```
COMPOUND: DIMETHYL DISULFIDE

Type of unit is system exit stream
1 Description of unit                     12    def.system exit st

   TOTAL AIR EMISSIONS  (g/s)              0.
```

```
                 (Mg/year)              0.
   EMISSION FACTOR  (g/cm2-s)           3.673e-11
   UNIT EXIT CONCENTRATION (ppmw)       2.231e-06
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain

                                                         WWTP\PAE\New
  Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:27:50
COMPOUND: DIMETHYL DISULFIDE

Type of unit is open hub drain
1 Description of unit                      13    default open hub d
2 Underflow T (C)                                43.89
3 Total water added at the unit (l/s)            0
4 Area of openings at unit (cm2)                 50
5 Radius of drop pipe (cm)                       5
6 Drop length to conduit (cm)                    61
7 Open surface=1                                 1
8 Subsurface entrance=1                          0
9 subsurface exit =1                             0
10 radius of underflow conduit (cm)              12
11 distance to next unit (cm)                    500
12 slope of underflow conduit                    0.015
16 velocity air at drain opening (ft/min)        84
17 municipal waste in conduit =1                 0
18 Assume equilibrium in unit, =1                0
19 pH  (enter 0 for no pH adjustment)            8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1116 l/s.
   Weight fraction down is  8.680001E-08
   Gas concentration in  0 mol fraction.
   Gas flow  1116 L/s
   Weight fraction out at base of drop is  7.87078550837274E-08
   fraction transferred in the drain drop from hub is .093228
   fraction loss in waste1 drop to hub     0.
   fraction loss in waste2 drop to hub     0.
   fraction loss in waste3 drop to hub     0.
   fraction loss in collection hub drop    0.093228
   fraction loss in unit                   0.
   fraction loss in line run               0.
   component upstream of unit, g/s         0.
   mol fract. headspace upstream (y)       0.
   headspace at conduit discharge, y       0.
   headspace end of conduit (y)            9.876e-20
   mol fract. headspace vent base          2.233e-06
   headspace flow out vent (cc/s)          -1.116e+06
   headspace flow down line (cc/s)         1.116e+06
   KG surface (m/s)                        1932.406
   KL surface (m/s)                        6.575e-09
   flow of waste down hub (l/s)            0.
   component flow in waste into unit (g/s) 0.096869
   total component into unit, g/s          0.087838
   TOTAL AIR EMISSIONS  (g/s)              0.009031
                 (Mg/year)                 0.2848
   EMISSION FACTOR  (g/cm2-s)              3.673e-11
   UNIT EXIT CONCENTRATION (ppmw)          0.078708
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment

                                                         WWTP\PAE\New
  Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:27:50
COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment
1 Description of unit                      17    ASB Zone 3
```

2 Wastewater temperature (C)	30.01
3 length of aeration unit (m)	376
4 width of aeration unit (m)	188
5 depth of aeration unit (m)	0.91
6 Area of agitation (each aerator,m2)	135
7 Total number of agitators in the unit	6
8 Power of agitation (each aerator,HP)	75
9 Impeller diameter (cm)	49.53
10 Impeller rotation (RPM)	1200
11 Agitator mechanical efficiency	0.83
12 aerator effectiveness, alpha	0.83
13 if there is plug flow, enter 1	0
14 Overall biorate (mg/g bio-hr)	19
15 Aeration air flow (m3/s)	0
16 active biomass, aeration (g/l)	0.3
17 If covered, then enter 1	0
18 special input	0
19 pH (enter 0 for no pH adjustment)	7.42

```
Properties of DIMETHYL DISULFIDE at 30. deg.C (86. deg.F)
   hl= 0.00141 atm-m3/mol      vp= 37.814 mmHg (0.7314 psia)
       78.352 y/x
       0.056726 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.027e-05 cm2/s  dv= 0.085991 cm2/s
Compound flow rate from inlet water is 5.19e-05 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 16.011 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 5.918e-06 m/s.
kg is estimated as 0.005575 m/s.  Model: 2
kg is estimated as 0.005575 m/s.  Model: 2
The Schmidt number is 1.74436.
The friction velocity is 37.398 m/s
kg is estimated as 0.012742 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.1143 m/s.
kl (agitated)is estimated as 0.015772 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 5.972e-05 m/s.
 The effective stripping time (surface + diffused air) is 253.944 minutes. (4.2324
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 960.664 min. (16.011 hr.)
 The ratio of the pump mixing to the residence time is 0.
```

KG aerated (m/s)	0.11644
KL aerated (m/s)	0.015772
KL OVERALL AERATED (m/s)	0.004711
KG quiescent (m/s)	0.005679
KL quiescent (m/s)	5.918e-06
KL OVERALL QUIESCENT (m/s)	5.813e-06
KL OVERALL (m/s)	5.972e-05
air stripping time constant (min)	253.944

```
   FRACTION SURFACE VOLATILIZED              0.18149
   FRACTION SUBMERGED VOLATILIZED            0.
   TOTAL FRACTION VOLATILIZED                0.18149
   FRACTION BIOLOGICALLY REMOVED             0.77054
   FRACTION ABSORBED                         0.
   TOTAL AIR EMISSIONS  (g/s)                9.419e-06
                    (Mg/year)                2.97e-04
   EMISSION FACTOR  (g/cm2-s)                1.332e-14
   UNIT EXIT CONCENTRATION (ppmw)            2.231e-06
DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment

                                                                     WWTP\PAE\New
  Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:27:50
COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment
1 Description of unit                          18    ASB Zone 2
2 Wastewater temperature   (C)                       32.08
3 length of aeration unit (m)                        368
4 width of aeration unit (m)                         184
5 depth of aeration unit (m)                         0.97
6 Area of agitation (each aerator,m2)                135
7 Total number of agitators in the unit              15
8 Power of agitation (each aerator,HP)               75
9 Impeller diameter (cm)                             49.53
10 Impeller rotation (RPM)                           1200
11 Agitator mechanical efficiency                    0.83
12 aerator effectiveness, alpha                      0.83
13 if there is plug flow, enter 1                    0
14 Overall biorate (mg/g bio-hr)                     19
15 Aeration air flow (m3/s)                          0
16 active biomass, aeration (g/l)                    0.3
17 If covered, then enter 1                          0
18 special input                                     0
19 pH  (enter 0 for no pH adjustment)                7.24

Properties of DIMETHYL DISULFIDE at 32.1 deg.C (89.7 deg.F)
   hl= 0.001558 atm-m3/mol       vp= 41.785 mmHg (0.80821 psia)
       86.579 y/x
       0.062258 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.034e-05 cm2/s  dv= 0.087022 cm2/s
Compound flow rate from inlet water is 0.001489 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 16.348 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 5.945e-06 m/s.
kg is estimated as 0.005633 m/s.  Model: 2
kg is estimated as 0.005633 m/s.  Model: 2
The Schmidt number is 1.72371.
The friction velocity is 37.398 m/s
kg is estimated as 0.012836 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
```

kg (agitated)is estimated as 0.11498 m/s.
kl (agitated)is estimated as 0.016622 m/s.
The specified and growth biomass is 0.3 g/L.
The effective KL (surface + diffused air) is 1.598e-04 m/s.
The effective stripping time (surface + diffused air) is 101.198 minutes. (1.68663 hrs.)
The pump mixing time is 5 x the pumping recirculaion time, 0. min.
The ratio of the mixing to the striping (surface + diffused air) is 0.
The mean residence time is 980.894 min. (16.348 hr.)
The ratio of the pump mixing to the residence time is 0.

KG aerated (m/s)	0.11714
KL aerated (m/s)	0.016622
KL OVERALL AERATED (m/s)	0.005152
KG quiescent (m/s)	0.005738
KL quiescent (m/s)	5.945e-06
KL OVERALL QUIESCENT (m/s)	5.85e-06
KL OVERALL (m/s)	1.598e-04
air stripping time constant (min)	101.198
FRACTION SURFACE VOLATILIZED	0.33782
FRACTION SUBMERGED VOLATILIZED	0.
TOTAL FRACTION VOLATILIZED	0.33782
FRACTION BIOLOGICALLY REMOVED	0.62732
FRACTION ABSORBED	0.
TOTAL AIR EMISSIONS (g/s)	5.03e-04
(Mg/year)	0.015863
EMISSION FACTOR (g/cm2-s)	7.429e-13
UNIT EXIT CONCENTRATION (ppmw)	4.65e-05

Type of unit is

1 Total water added at the unit (l/s)	50	0
2 Area of openings at unit (cm2)		50
3 Radius of drop pipe (cm)		5
4 Drop length to conduit (cm)		61
5 Humidity of inlet air (%)		40
6 Temperature of air (C)		25
7 Drain air velocity (ft/min)		84
8 manhole air velocity (ft/min)		128
9 Conduit air velocity (ft/min)		66
10 Wind speed (cm/s at 10 m)		447
11 distance to next unit (cm)		500
12 slope of underflow conduit		.015
13 friction factor liquid		.016
14 friction factor gas		.006
15 radius of underflow conduit (cm)		12
16 Underflow T (C)		25
17 oscillation cycle time (min)		5
18 design collection velocities (ft/s)		2
19 design branch line fraction full		.4

Type of unit is

8 HL partition flag=1, adjust for sorption	0
9 unit recycle convergence number	200
10 oil molecular weight	0
11 oil density (g/cc)	0
12 NaUT 1=municipal 2=industrial 3=turb.	0
13 NaUT 1=mass tr. 2=equil	0
14 parts biomass per 1000 parts COD	
15 oil water partition method 0=owpc	
16 use UNIFAC aqueous data base =1	
17 specify mass transfer for unit, =1	
18 Use biomass for unit option, =1	
19 biogrowth Monod half concentration ppm	

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment

WWTP\PAE\New
Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM 19:28:26
COMPOUND: DIMETHYL SULFIDE (DMS)

Type of unit is aerated biotreatment

1 Description of unit	11	ASB Zone 1
2 Wastewater temperature (C)		34.08
3 length of aeration unit (m)		295
4 width of aeration unit (m)		295
5 depth of aeration unit (m)		1.4
6 Area of agitation (each aerator,m2)		135
7 Total number of agitators in the unit		31
8 Power of agitation (each aerator,HP)		75
9 Impeller diameter (cm)		49.53
10 Impeller rotation (RPM)		1200
11 Agitator mechanical efficiency		0.83
12 aerator effectiveness, alpha		0.83
13 if there is plug flow, enter 1		0
14 Overall biorate (mg/g bio-hr)		19
15 Aeration air flow (m3/s)		0
16 active biomass, aeration (g/l)		0.3
17 If covered, then enter 1		0
18 special input		0
19 pH (enter 0 for no pH adjustment)		7.04

Properties of DIMETHYL SULFIDE (DMS) at 34.1 deg.C (93.3 deg.F)

```
  hl= 0.002924 atm-m3/mol      vp= 704.653 mmHg (13.629 psia)
      162.463 y/x
      0.11606 g/L gas per g/L liquid
  Temperature adjustment factor = 1.046 ^(T-25), deg. C
  kl= 0. L/g-hr          dl= 1.504e-05 cm2/s  dv= 0.14765 cm2/s
Compound flow rate from inlet water is 0.19163 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 30.325 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 237.766.
kl is estimated as 7.634e-06 m/s.
kg is estimated as 0.007917 m/s.  Model: 2
kg is estimated as 0.007917 m/s.  Model: 2
The Schmidt number is 1.01591.
The friction velocity is 37.398 m/s
kg is estimated as 0.017873 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.14978 m/s.
kl (agitated)is estimated as 0.021024 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 4.77e-04 m/s.
 The effective stripping time (surface + diffused air) is 48.915 minutes. (0.81526
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1819.519 min. (30.325 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                      0.15258
   KL aerated (m/s)                      0.021024
   KL OVERALL AERATED (m/s)              0.009769
   KG quiescent (m/s)                    0.008066
   KL quiescent (m/s)                    7.634e-06
   KL OVERALL QUIESCENT (m/s)            7.574e-06
   KL OVERALL (m/s)                      4.77e-04
   air stripping time constant (min)     48.915
   FRACTION SURFACE VOLATILIZED          0.80146
   FRACTION SUBMERGED VOLATILIZED        0.
   TOTAL FRACTION VOLATILIZED            0.80146
   FRACTION BIOLOGICALLY REMOVED         0.17699
   FRACTION ABSORBED                     0.
   TOTAL AIR EMISSIONS  (g/s)            0.15358
                   (Mg/year)             4.84331
   EMISSION FACTOR  (g/cm2-s)            1.765e-10
   UNIT EXIT CONCENTRATION (ppmw)        0.0037
DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream
```



```
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is system exit stream
1 Description of unit                   12    def.system exit st

   TOTAL AIR EMISSIONS  (g/s)            0.
```

```
                    (Mg/year)                   0.
   EMISSION FACTOR  (g/cm2-s)                   1.765e-10
   UNIT EXIT CONCENTRATION (ppmw)               1.485e-05
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain

                                                                    WWTP\PAE\New
  Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:28:26
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is open hub drain
1 Description of unit                          13    default open hub d
2 Underflow T (C)                                    43.89
3 Total water added at the unit (l/s)                0
4 Area of openings at unit (cm2)                     50
5 Radius of drop pipe (cm)                           5
6 Drop length to conduit (cm)                        61
7 Open surface=1                                     1
8 Subsurface entrance=1                              0
9 subsurface exit =1                                 0
10 radius of underflow conduit (cm)                  12
11 distance to next unit (cm)                        500
12 slope of underflow conduit                        0.015
16 velocity air at drain opening (ft/min)            84
17 municipal waste in conduit =1                     0
18 Assume equilibrium in unit, =1                    0
19 pH  (enter 0 for no pH adjustment)                8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1116 l/s.
   Weight fraction down is  1.989E-07
   Gas concentration in  0 mol fraction.
   Gas flow  1116 L/s
   Weight fraction out at base of drop is  1.71707119336225E-07
   fraction transferred in the drain drop from hub is .136716
   fraction loss in waste1 drop to hub         0.
   fraction loss in waste2 drop to hub         0.
   fraction loss in waste3 drop to hub         0.
   fraction loss in collection hub drop        0.13672
   fraction loss in unit                       0.
   fraction loss in line run                   0.
   component upstream of unit, g/s             0.
   mol fract. headspace upstream (y)           0.
   headspace at conduit discharge, y           0.
   headspace end of conduit (y)                4.229e-19
   mol fract. headspace vent base              1.138e-05
   headspace flow out vent (cc/s)              -1.116e+06
   headspace flow down line (cc/s)             1.116e+06
   KG surface (m/s)                            2728.591
   KL surface (m/s)                            8.51e-09
   flow of waste down hub (l/s)                0.
   component flow in waste into unit (g/s)     0.22197
   total component into unit, g/s              0.19163
   TOTAL AIR EMISSIONS  (g/s)                  0.030347
                    (Mg/year)                  0.95703
   EMISSION FACTOR  (g/cm2-s)                  1.765e-10
   UNIT EXIT CONCENTRATION (ppmw)              0.17171
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment

                                                                    WWTP\PAE\New
  Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:28:26
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is aerated biotreatment
1 Description of unit                          17    ASB Zone 3
```

```
2 Wastewater temperature   (C)                30.01
3 length of aeration unit (m)                 376
4 width of aeration unit (m)                  188
5 depth of aeration unit (m)                  0.91
6 Area of agitation (each aerator,m2)         135
7 Total number of agitators in the unit       6
8 Power of agitation (each aerator,HP)        75
9 Impeller diameter (cm)                      49.53
10 Impeller rotation (RPM)                    1200
11 Agitator mechanical efficiency             0.83
12 aerator effectiveness, alpha               0.83
13 if there is plug flow, enter 1             0
14 Overall biorate (mg/g bio-hr)              19
15 Aeration air flow (m3/s)                   0
16 active biomass, aeration (g/l)             0.3
17 If covered, then enter 1                   0
18 special input                              0
19 pH  (enter 0 for no pH adjustment)         7.42

Properties of DIMETHYL SULFIDE  (DMS) at 30. deg.C (86. deg.F)
   hl= 0.002519 atm-m3/mol       vp= 606.985 mmHg (11.74 psia)
       139.945 y/x
       0.10132 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr           dl= 1.485e-05 cm2/s  dv= 0.14425 cm2/s
Compound flow rate from inlet water is 1.869e-04 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 16.011 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 7.566e-06 m/s.
kg is estimated as 0.007884 m/s.  Model: 2
kg is estimated as 0.007884 m/s.  Model: 2
The Schmidt number is 1.03989.
The friction velocity is 37.398 m/s
kg is estimated as 0.017611 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.14804 m/s.
kl (agitated)is estimated as 0.018962 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 1.053e-04 m/s.
 The effective stripping time (surface + diffused air) is 144.073 minutes.
 (2.40122 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 960.664 min. (16.011 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                         0.15081
   KL aerated (m/s)                         0.018962
   KL OVERALL AERATED (m/s)                 0.00854
   KG quiescent (m/s)                       0.008032
   KL quiescent (m/s)                       7.566e-06
   KL OVERALL QUIESCENT (m/s)               7.497e-06
   KL OVERALL (m/s)                         1.053e-04
   air stripping time constant (min)        144.073
```

FRACTION SURFACE VOLATILIZED 0.59112
FRACTION SUBMERGED VOLATILIZED 0.
TOTAL FRACTION VOLATILIZED 0.59112
FRACTION BIOLOGICALLY REMOVED 0.32022
FRACTION ABSORBED 0.
TOTAL AIR EMISSIONS (g/s) 1.105e-04
(Mg/year) 0.003484
EMISSION FACTOR (g/cm2-s) 1.563e-13
UNIT EXIT CONCENTRATION (ppmw) 1.485e-05

DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment

WWTP\PAE\New Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM 19:28:26
COMPOUND: DIMETHYL SULFIDE (DMS)

Type of unit is aerated biotreatment

1 Description of unit	18	ASB Zone 2
2 Wastewater temperature (C)		32.08
3 length of aeration unit (m)		368
4 width of aeration unit (m)		184
5 depth of aeration unit (m)		0.97
6 Area of agitation (each aerator,m2)		135
7 Total number of agitators in the unit		15
8 Power of agitation (each aerator,HP)		75
9 Impeller diameter (cm)		49.53
10 Impeller rotation (RPM)		1200
11 Agitator mechanical efficiency		0.83
12 aerator effectiveness, alpha		0.83
13 if there is plug flow, enter 1		0
14 Overall biorate (mg/g bio-hr)		19
15 Aeration air flow (m3/s)		0
16 active biomass, aeration (g/l)		0.3
17 If covered, then enter 1		0
18 special input		0
19 pH (enter 0 for no pH adjustment)		7.24

Properties of DIMETHYL SULFIDE (DMS) at 32.1 deg.C (89.7 deg.F)
hl= 0.002719 atm-m3/mol vp= 655.201 mmHg (12.673 psia)
151.062 y/x
0.10863 g/L gas per g/L liquid
Temperature adjustment factor = 1.046 ^(T-25), deg. C
k1= 0. L/g-hr dl= 1.495e-05 cm2/s dv= 0.14597 cm2/s
Compound flow rate from inlet water is 0.004129 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 16.348 hr.
____Biomass production________________
The biomass production rate is 0.mg/hr. (0. mg/L)
The fraction dissolved solids converted is 0. .
The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 7.6e-06 m/s.
kg is estimated as 0.007966 m/s. Model: 2
kg is estimated as 0.007966 m/s. Model: 2
The Schmidt number is 1.02758.
The friction velocity is 37.398 m/s
kg is estimated as 0.017744 m/s. Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.

kg (agitated)is estimated as 0.14892 m/s.
kl (agitated)is estimated as 0.019984 m/s.
The specified and growth biomass is 0.3 g/L.
The effective KL (surface + diffused air) is 2.809e-04 m/s.
The effective stripping time (surface + diffused air) is 57.552 minutes. (0.9592 hrs.)
The pump mixing time is 5 x the pumping recirculaion time, 0. min.
The ratio of the mixing to the striping (surface + diffused air) is 0.
The mean residence time is 980.894 min. (16.348 hr.)
The ratio of the pump mixing to the residence time is 0.

KG aerated (m/s)	0.15171
KL aerated (m/s)	0.019984
KL OVERALL AERATED (m/s)	0.009148
KG quiescent (m/s)	0.008115
KL quiescent (m/s)	7.6e-06
KL OVERALL QUIESCENT (m/s)	7.537e-06
KL OVERALL (m/s)	2.809e-04
air stripping time constant (min)	57.552
FRACTION SURFACE VOLATILIZED	0.7715
FRACTION SUBMERGED VOLATILIZED	0.
TOTAL FRACTION VOLATILIZED	0.7715
FRACTION BIOLOGICALLY REMOVED	0.18324
FRACTION ABSORBED	0.
TOTAL AIR EMISSIONS (g/s)	0.003185
(Mg/year)	0.10045
EMISSION FACTOR (g/cm2-s)	4.704e-12
UNIT EXIT CONCENTRATION (ppmw)	1.675e-04

Type of unit is

1 Total water added at the unit (l/s)	50	0
2 Area of openings at unit (cm2)		50
3 Radius of drop pipe (cm)		5
4 Drop length to conduit (cm)		61
5 Humidity of inlet air (%)		40
6 Temperature of air (C)		25
7 Drain air velocity (ft/min)		84
8 manhole air velocity (ft/min)		128
9 Conduit air velocity (ft/min)		66
10 Wind speed (cm/s at 10 m)		447
11 distance to next unit (cm)		500
12 slope of underflow conduit		.015
13 friction factor liquid		.016
14 friction factor gas		.006
15 radius of underflow conduit (cm)		12
16 Underflow T (C)		25
17 oscillation cycle time (min)		5
18 design collection velocities (ft/s)		2
19 design branch line fraction full		.4

Type of unit is

8 HL partition flag=1, adjust for sorption	0
9 unit recycle convergence number	200
10 oil molecular weight	0
11 oil density (g/cc)	0
12 NaUT 1=municipal 2=industrial 3=turb.	0
13 NaUT 1=mass tr. 2=equil	0
14 parts biomass per 1000 parts COD	
15 oil water partition method 0=owpc	
16 use UNIFAC aqueous data base =1	
17 specify mass transfer for unit, =1	
18 Use biomass for unit option, =1	
19 biogrowth Monod half concentration ppm	

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment

WWTP\PAE\New
Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM 19:28:58
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment

1 Description of unit	11	ASB Zone 1
2 Wastewater temperature (C)		34.08
3 length of aeration unit (m)		295
4 width of aeration unit (m)		295
5 depth of aeration unit (m)		1.4
6 Area of agitation (each aerator,m2)		135
7 Total number of agitators in the unit		31
8 Power of agitation (each aerator,HP)		75
9 Impeller diameter (cm)		49.53
10 Impeller rotation (RPM)		1200
11 Agitator mechanical efficiency		0.83
12 aerator effectiveness, alpha		0.83
13 if there is plug flow, enter 1		0
14 Overall biorate (mg/g bio-hr)		19
15 Aeration air flow (m3/s)		0
16 active biomass, aeration (g/l)		0.3
17 If covered, then enter 1		0
18 special input		0
19 pH (enter 0 for no pH adjustment)		7.04

Properties of METHANETHIOL(methyl mercaptan) at 34.1 deg.C (93.3 deg.F)

```
   hl= 0.004158 atm-m3/mol      vp= 2272.142 mmHg (43.948 psia)
        230.99 y/x
        0.16502 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.525e-05 cm2/s  dv= 0.23702 cm2/s
Compound flow rate from inlet water is 0.002397 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 30.325 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 237.766.
kl is estimated as 7.703e-06 m/s.
kg is estimated as 0.010871 m/s.  Model: 2
kg is estimated as 0.010871 m/s.  Model: 2
The Schmidt number is 0.63285.
The friction velocity is 37.398 m/s
kg is estimated as 0.024173 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.18977 m/s.
kl (agitated)is estimated as 0.021167 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 6.265e-04 m/s.
 The effective stripping time (surface + diffused air) is 37.242 minutes. (0.62071
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1819.519 min. (30.325 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                         0.19332
   KL aerated (m/s)                         0.021167
   KL OVERALL AERATED (m/s)                 0.012876
   KG quiescent (m/s)                       0.011075
   KL quiescent (m/s)                       7.703e-06
   KL OVERALL QUIESCENT (m/s)               7.672e-06
   KL OVERALL (m/s)                         6.265e-04
   air stripping time constant (min)        37.242
   FRACTION SURFACE VOLATILIZED             0.88816
   FRACTION SUBMERGED VOLATILIZED           0.
   TOTAL FRACTION VOLATILIZED               0.88816
   FRACTION BIOLOGICALLY REMOVED            0.09366
   FRACTION ABSORBED                        0.
   TOTAL AIR EMISSIONS  (g/s)               0.002129
                    (Mg/year)               0.06713
   EMISSION FACTOR  (g/cm2-s)               2.446e-12
   UNIT EXIT CONCENTRATION (ppmw)           3.904e-05
DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream

                                                               WWTP\PAE\New
  Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:28:58
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is system exit stream
1 Description of unit                      12    def.system exit st

   TOTAL AIR EMISSIONS  (g/s)              0.
```

```
                    (Mg/year)                  0.
   EMISSION FACTOR  (g/cm2-s)                  2.446e-12
   UNIT EXIT CONCENTRATION (ppmw)              1.24e-07
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain
  Project C:\BoxDrive\Box\ALL4 Client Files\New-Indy Catawba\CONFIDENTIAL\Parker
  Poe Privileged and Confidential\New Stripper Permitting\Emissions\WWTP\PAE\New
  Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:28:58
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is open hub drain
1 Description of unit                         13     default open hub d
2 Underflow T (C)                                    43.89
3 Total water added at the unit (l/s)                0
4 Area of openings at unit (cm2)                     50
5 Radius of drop pipe (cm)                           5
6 Drop length to conduit (cm)                        61
7 Open surface=1                                     1
8 Subsurface entrance=1                              0
9 subsurface exit =1                                 0
10 radius of underflow conduit (cm)                  12
11 distance to next unit (cm)                        500
12 slope of underflow conduit                        0.015
16 velocity air at drain opening (ft/min)            84
17 municipal waste in conduit =1                     0
18 Assume equilibrium in unit, =1                    0
19 pH  (enter 0 for no pH adjustment)                8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1116 l/s.
   Weight fraction down is  2.6E-09
   Gas concentration in  0 mol fraction.
   Gas flow  1116 L/s
   Weight fraction out at base of drop is  2.14759568570224E-09
   fraction transferred in the drain drop from hub is .174002
   fraction loss in waste1 drop to hub         0.
   fraction loss in waste2 drop to hub         0.
   fraction loss in waste3 drop to hub         0.
   fraction loss in collection hub drop        0.174
   fraction loss in unit                       0.
   fraction loss in line run                   0.
   component upstream of unit, g/s             0.
   mol fract. headspace upstream (y)           0.
   headspace at conduit discharge, y           0.
   headspace end of conduit (y)                6.896e-21
   mol fract. headspace vent base              2.445e-07
   headspace flow out vent (cc/s)              -1.116e+06
   headspace flow down line (cc/s)             1.116e+06
   KG surface (m/s)                            3741.46
   KL surface (m/s)                            8.591e-09
   flow of waste down hub (l/s)                0.
   component flow in waste into unit (g/s)     0.002902
   total component into unit, g/s              0.002397
   TOTAL AIR EMISSIONS  (g/s)                  5.049e-04
                    (Mg/year)                  0.015922
   EMISSION FACTOR  (g/cm2-s)                  2.446e-12
   UNIT EXIT CONCENTRATION (ppmw)              0.002148
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment

                                                                 WWTP\PAE\New
  Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:28:58
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment
1 Description of unit                         17     ASB Zone 3
```

```
2 Wastewater temperature   (C)                 30.01
3 length of aeration unit (m)                  376
4 width of aeration unit (m)                   188
5 depth of aeration unit (m)                   0.91
6 Area of agitation (each aerator,m2)          135
7 Total number of agitators in the unit        6
8 Power of agitation (each aerator,HP)         75
9 Impeller diameter (cm)                       49.53
10 Impeller rotation (RPM)                     1200
11 Agitator mechanical efficiency              0.83
12 aerator effectiveness, alpha                0.83
13 if there is plug flow, enter 1              0
14 Overall biorate (mg/g bio-hr)               19
15 Aeration air flow (m3/s)                    0
16 active biomass, aeration (g/l)              0.3
17 If covered, then enter 1                    0
18 special input                               0
19 pH  (enter 0 for no pH adjustment)          7.42

Properties of METHANETHIOL(methyl mercaptan) at 30. deg.C (86. deg.F)
   hl= 0.003687 atm-m3/mol       vp= 2014.774 mmHg (38.97 psia)
       204.826 y/x
       0.14829 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr           dl= 1.505e-05 cm2/s  dv= 0.23155 cm2/s
Compound flow rate from inlet water is 1.671e-06 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 16.011 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 7.635e-06 m/s.
kg is estimated as 0.010826 m/s.  Model: 2
kg is estimated as 0.010826 m/s.  Model: 2
The Schmidt number is 0.64779.
The friction velocity is 37.398 m/s
kg is estimated as 0.023814 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.18756 m/s.
kl (agitated)is estimated as 0.019092 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 1.391e-04 m/s.
 The effective stripping time (surface + diffused air) is 109.038 minutes.
 (1.81731 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 960.664 min. (16.011 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                         0.19108
   KL aerated (m/s)                         0.019092
   KL OVERALL AERATED (m/s)                 0.011483
   KG quiescent (m/s)                       0.011029
   KL quiescent (m/s)                       7.635e-06
   KL OVERALL QUIESCENT (m/s)               7.6e-06
   KL OVERALL (m/s)                         1.391e-04
   air stripping time constant (min)        109.038
```

```
   FRACTION SURFACE VOLATILIZED              0.7296
   FRACTION SUBMERGED VOLATILIZED            0.
   TOTAL FRACTION VOLATILIZED                0.7296
   FRACTION BIOLOGICALLY REMOVED             0.18759
   FRACTION ABSORBED                         0.
   TOTAL AIR EMISSIONS  (g/s)                1.219e-06
                     (Mg/year)               3.844e-05
   EMISSION FACTOR  (g/cm2-s)                1.724e-15
   UNIT EXIT CONCENTRATION (ppmw)            1.24e-07
DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment

                                                                  WWTP\PAE\New
  Stripper Scenario\ASB New Stripper V5 3/14/2023 1:52:24 PM  19:28:58
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment
1 Description of unit                       18    ASB Zone 2
2 Wastewater temperature    (C)                   32.08
3 length of aeration unit (m)                     368
4 width of aeration unit (m)                      184
5 depth of aeration unit (m)                      0.97
6 Area of agitation (each aerator,m2)             135
7 Total number of agitators in the unit           15
8 Power of agitation (each aerator,HP)            75
9 Impeller diameter (cm)                          49.53
10 Impeller rotation (RPM)                        1200
11 Agitator mechanical efficiency                 0.83
12 aerator effectiveness, alpha                   0.83
13 if there is plug flow, enter 1                 0
14 Overall biorate (mg/g bio-hr)                  19
15 Aeration air flow (m3/s)                       0
16 active biomass, aeration (g/l)                 0.3
17 If covered, then enter 1                       0
18 special input                                  0
19 pH  (enter 0 for no pH adjustment)             7.24

Properties of METHANETHIOL(methyl mercaptan) at 32.1 deg.C (89.7 deg.F)
   hl= 0.003921 atm-m3/mol      vp= 2142.771 mmHg (41.446 psia)
       217.838 y/x
       0.15664 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.515e-05 cm2/s  dv= 0.23433 cm2/s
Compound flow rate from inlet water is 4.357e-05 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 16.348 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 7.67e-06 m/s.
kg is estimated as 0.010938 m/s.  Model: 2
kg is estimated as 0.010938 m/s.  Model: 2
The Schmidt number is 0.64013.
The friction velocity is 37.398 m/s
kg is estimated as 0.023996 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
```

kg (agitated)is estimated as 0.18868 m/s.
kl (agitated)is estimated as 0.020121 m/s.
The specified and growth biomass is 0.3 g/L.
The effective KL (surface + diffused air) is 3.715e-04 m/s.
The effective stripping time (surface + diffused air) is 43.518 minutes. (0.72529 hrs.)
The pump mixing time is 5 x the pumping recirculaion time, 0. min.
The ratio of the mixing to the striping (surface + diffused air) is 0.
The mean residence time is 980.894 min. (16.348 hr.)
The ratio of the pump mixing to the residence time is 0.

KG aerated (m/s)	0.19222
KL aerated (m/s)	0.020121
KL OVERALL AERATED (m/s)	0.012174
KG quiescent (m/s)	0.011143
KL quiescent (m/s)	7.67e-06
KL OVERALL QUIESCENT (m/s)	7.637e-06
KL OVERALL (m/s)	3.715e-04
air stripping time constant (min)	43.518
FRACTION SURFACE VOLATILIZED	0.86431
FRACTION SUBMERGED VOLATILIZED	0.
TOTAL FRACTION VOLATILIZED	0.86431
FRACTION BIOLOGICALLY REMOVED	0.097342
FRACTION ABSORBED	0.
TOTAL AIR EMISSIONS (g/s)	3.766e-05
(Mg/year)	0.001188
EMISSION FACTOR (g/cm2-s)	5.562e-14
UNIT EXIT CONCENTRATION (ppmw)	1.497e-06

Backup Stripper Scenario - Projected Actual Emissions

H_2S, TRS Compounds, and VOC

New-Indy Catawba - Catawba, SC

Concentration Loadings	**H2S, ppm**	**DMDS, ppm**	**DMS, ppm**	**MMC, ppm**
Design Foul Condensate Loadings to Backup Stripper	147	15.00	17.00	16.00
Backup Stripper TRS Removal Efficiency	0.98	0.98	0.98	0.98
Stripped Condensate to Hardpipe	2.93	0.30	0.34	0.32
Avg. ASB Inlet (2021 and 2022)	0.25	0.09	0.20	0.0026
Flow Weighted Loading:	0.38	0.10	0.21	0.02
WATER9 Results	**H2S, g/s**	**DMDS, g/s**	**DMS, g/s**	**MMC, g/s**
ASB Zone 1	0.08	0.04	0.17	0.01
ASB Zone 2	0.03	6.14E-04	3.60E-03	2.73E-04
ASB Zone 3	0.02	1.20E-05	1.31E-04	9.23E-06
Total ASB	**0.13**	**0.04**	**0.17**	**0.02**
PAE Emissions Factors	**H2S, lb/ODTP**	**DMDS, lb/ODTP**	**DMS, lb/ODTP**	**MMC, lb/ODTP**
Total ASB	**1.09E-02**	**3.28E-03**	**1.47E-02**	**1.30E-03**

Post-Project Stripped Condensate Flow:	850	gpm
Post-Project Stripped Condensate Flow:	1.22	MGD
Post-Project ASB Influent Flow:	25.48	MGD
Total ASB Flow:	26.71	MGD
Total ASB Flow:	1170	L/s
Pulp Production	2200	ODTP/day

	MW
H2S	34
DMDS	94
DMS	62
MMC	48

Type of unit is		
1 Total water added at the unit (l/s)	50	0
2 Area of openings at unit (cm2)		50
3 Radius of drop pipe (cm)		5
4 Drop length to conduit (cm)		61
5 Humidity of inlet air (%)		40
6 Temperature of air (C)		25
7 Drain air velocity (ft/min)		84
8 manhole air velocity (ft/min)		128
9 Conduit air velocity (ft/min)		66
10 Wind speed (cm/s at 10 m)		447
11 distance to next unit (cm)		500
12 slope of underflow conduit		.015
13 friction factor liquid		.016
14 friction factor gas		.006
15 radius of underflow conduit (cm)		12
16 Underflow T (C)		25
17 oscillation cycle time (min)		5
18 design collection velocities (ft/s)		2
19 design branch line fraction full		.4

Type of unit is	
8 HL partition flag=1, adjust for sorption	0
9 unit recycle convergence number	200
10 oil molecular weight	0
11 oil density (g/cc)	0
12 NaUT 1=municipal 2=industrial 3=turb.	0
13 NaUT 1=mass tr. 2=equil	0
14 parts biomass per 1000 parts COD	
15 oil water partition method 0=owpc	
16 use UNIFAC aqueous data base =1	
17 specify mass transfer for unit, =1	
18 Use biomass for unit option, =1	
19 biogrowth Monod half concentration ppm	

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment

WWTP\PAE\Old Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM 11:39:37
COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment		
1 Description of unit	11	ASB Zone 1
2 Wastewater temperature (C)		34.08
3 length of aeration unit (m)		295
4 width of aeration unit (m)		295
5 depth of aeration unit (m)		1.4
6 Area of agitation (each aerator,m2)		135
7 Total number of agitators in the unit		31
8 Power of agitation (each aerator,HP)		75
9 Impeller diameter (cm)		49.53
10 Impeller rotation (RPM)		1200
11 Agitator mechanical efficiency		0.83
12 aerator effectiveness, alpha		0.83
13 if there is plug flow, enter 1		0
14 Overall biorate (mg/g bio-hr)		19
15 Aeration air flow (m3/s)		0
16 active biomass, aeration (g/l)		0.3
17 If covered, then enter 1		0
18 special input		0
19 pH (enter 0 for no pH adjustment)		7.04

Properties of DIMETHYL DISULFIDE at 34.1 deg.C (93.3 deg.F)

```
  hl= 0.001714 atm-m3/mol      vp= 45.945 mmHg (0.88868 psia)
      95.2 y/x
      0.068011 g/L gas per g/L liquid
  Temperature adjustment factor = 1.046 ^(T-25), deg. C
  kl= 0. L/g-hr          dl= 1.041e-05 cm2/s  dv= 0.088022 cm2/s
Compound flow rate from inlet water is 0.10249 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 28.926 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 237.766.
kl is estimated as 5.971e-06 m/s.
kg is estimated as 0.005598 m/s.  Model: 2
kg is estimated as 0.005598 m/s.  Model: 2
The Schmidt number is 1.70412.
The friction velocity is 37.398 m/s
kg is estimated as 0.012927 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.11564 m/s.
kl (agitated)is estimated as 0.017486 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 2.753e-04 m/s.
 The effective stripping time (surface + diffused air) is 84.752 minutes. (1.41254
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1735.541 min. (28.926 hr.)
 The ratio of the pump mixing to the residence time is 0.
  KG aerated (m/s)                      0.11781
  KL aerated (m/s)                      0.017486
  KL OVERALL AERATED (m/s)              0.005609
  KG quiescent (m/s)                    0.005703
  KL quiescent (m/s)                    5.971e-06
  KL OVERALL QUIESCENT (m/s)            5.883e-06
  KL OVERALL (m/s)                      2.753e-04
  air stripping time constant (min)     84.752
  FRACTION SURFACE VOLATILIZED          0.36364
  FRACTION SUBMERGED VOLATILIZED        0.
  TOTAL FRACTION VOLATILIZED            0.36364
  FRACTION BIOLOGICALLY REMOVED         0.6186
  FRACTION ABSORBED                     0.
  TOTAL AIR EMISSIONS  (g/s)            0.037268
                    (Mg/year)           1.17529
  EMISSION FACTOR  (g/cm2-s)            4.282e-11
  UNIT EXIT CONCENTRATION (ppmw)        0.001555
DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream
```



```
COMPOUND: DIMETHYL DISULFIDE

Type of unit is system exit stream
1 Description of unit                  12    def.system exit st

  TOTAL AIR EMISSIONS  (g/s)            0.
```

```
                  (Mg/year)                    0.
   EMISSION FACTOR  (g/cm2-s)                  4.282e-11
   UNIT EXIT CONCENTRATION (ppmw)              2.847e-06
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain
```



```
COMPOUND: DIMETHYL DISULFIDE

Type of unit is open hub drain
1 Description of unit                          13    default open hub d
2 Underflow T (C)                                    43.89
3 Total water added at the unit (l/s)                0
4 Area of openings at unit (cm2)                     50
5 Radius of drop pipe (cm)                           5
6 Drop length to conduit (cm)                        61
7 Open surface=1                                     1
8 Subsurface entrance=1                              0
9 subsurface exit =1                                 0
10 radius of underflow conduit (cm)                  12
11 distance to next unit (cm)                        500
12 slope of underflow conduit                        0.015
16 velocity air at drain opening (ft/min)            84
17 municipal waste in conduit =1                     0
18 Assume equilibrium in unit, =1                    0
19 pH  (enter 0 for no pH adjustment)                8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1170 l/s.
   Weight fraction down is  9.66E-08
   Gas concentration in  0 mol fraction.
   Gas flow  1170 L/s
   Weight fraction out at base of drop is  8.7594214355091E-08
   fraction transferred in the drain drop from hub is .093228
   fraction loss in waste1 drop to hub         0.
   fraction loss in waste2 drop to hub         0.
   fraction loss in waste3 drop to hub         0.
   fraction loss in collection hub drop        0.093228
   fraction loss in unit                       0.
   fraction loss in line run                   -7.27e-08
   component upstream of unit, g/s             0.
   mol fract. headspace upstream (y)           0.
   headspace at conduit discharge, y           0.
   headspace end of conduit (y)                1.082e-19
   mol fract. headspace vent base              2.486e-06
   headspace flow out vent (cc/s)              -1.17e+06
   headspace flow down line (cc/s)             1.17e+06
   KG surface (m/s)                            2007.233
   KL surface (m/s)                            6.787e-09
   flow of waste down hub (l/s)                0.
   component flow in waste into unit (g/s)     0.11302
   total component into unit, g/s              0.10249
   TOTAL AIR EMISSIONS  (g/s)                  0.010537
                  (Mg/year)                    0.33229
   EMISSION FACTOR  (g/cm2-s)                  4.282e-11
   UNIT EXIT CONCENTRATION (ppmw)              0.087594
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment
```



```
COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment
1 Description of unit                          17    ASB Zone 3
```

```
2 Wastewater temperature   (C)                  30.01
3 length of aeration unit (m)                   376
4 width of aeration unit (m)                    188
5 depth of aeration unit (m)                    0.91
6 Area of agitation (each aerator,m2)           135
7 Total number of agitators in the unit         6
8 Power of agitation (each aerator,HP)          75
9 Impeller diameter (cm)                        49.53
10 Impeller rotation (RPM)                      1200
11 Agitator mechanical efficiency               0.83
12 aerator effectiveness, alpha                 0.83
13 if there is plug flow, enter 1               0
14 Overall biorate (mg/g bio-hr)                19
15 Aeration air flow (m3/s)                     0
16 active biomass, aeration (g/l)               0.3
17 If covered, then enter 1                     0
18 special input                                0
19 pH  (enter 0 for no pH adjustment)           7.42

Properties of DIMETHYL DISULFIDE at 30. deg.C (86. deg.F)
   hl= 0.00141 atm-m3/mol      vp= 37.814 mmHg (0.7314 psia)
       78.352 y/x
       0.056726 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr           dl= 1.027e-05 cm2/s  dv= 0.085991 cm2/s
Compound flow rate from inlet water is 6.639e-05 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.272 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 5.918e-06 m/s.
kg is estimated as 0.005575 m/s.  Model: 2
kg is estimated as 0.005575 m/s.  Model: 2
The Schmidt number is 1.74436.
The friction velocity is 37.398 m/s
kg is estimated as 0.012742 m/s.  Model: 3
________Agitated surface__________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.1143 m/s.
kl (agitated)is estimated as 0.015772 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 5.972e-05 m/s.
 The effective stripping time (surface + diffused air) is 253.944 minutes. (4.2324
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 916.326 min. (15.272 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                           0.11644
   KL aerated (m/s)                           0.015772
   KL OVERALL AERATED (m/s)                   0.004711
   KG quiescent (m/s)                         0.005679
   KL quiescent (m/s)                         5.918e-06
   KL OVERALL QUIESCENT (m/s)                 5.813e-06
   KL OVERALL (m/s)                           5.972e-05
   air stripping time constant (min)          253.944
```

```
   FRACTION SURFACE VOLATILIZED              0.18107
   FRACTION SUBMERGED VOLATILIZED            0.
   TOTAL FRACTION VOLATILIZED                0.18107
   FRACTION BIOLOGICALLY REMOVED             0.76875
   FRACTION ABSORBED                         0.
   TOTAL AIR EMISSIONS  (g/s)                1.202e-05
                    (Mg/year)                3.791e-04
   EMISSION FACTOR  (g/cm2-s)                1.7e-14
   UNIT EXIT CONCENTRATION (ppmw)            2.847e-06
DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment

                                                                  WWTP\PAE\Old
  Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM  11:39:37
COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment
1 Description of unit                          18    ASB Zone 2
2 Wastewater temperature    (C)                      32.08
3 length of aeration unit (m)                        368
4 width of aeration unit (m)                         184
5 depth of aeration unit (m)                         0.97
6 Area of agitation (each aerator,m2)                135
7 Total number of agitators in the unit              15
8 Power of agitation (each aerator,HP)               75
9 Impeller diameter (cm)                             49.53
10 Impeller rotation (RPM)                           1200
11 Agitator mechanical efficiency                    0.83
12 aerator effectiveness, alpha                      0.83
13 if there is plug flow, enter 1                    0
14 Overall biorate (mg/g bio-hr)                     19
15 Aeration air flow (m3/s)                          0
16 active biomass, aeration (g/l)                    0.3
17 If covered, then enter 1                          0
18 special input                                     0
19 pH  (enter 0 for no pH adjustment)                7.24

Properties of DIMETHYL DISULFIDE at 32.1 deg.C (89.7 deg.F)
   hl= 0.001558 atm-m3/mol       vp= 41.785 mmHg (0.80821 psia)
       86.579 y/x
       0.062258 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.034e-05 cm2/s  dv= 0.087022 cm2/s
Compound flow rate from inlet water is 0.00182 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.594 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 5.945e-06 m/s.
kg is estimated as 0.005633 m/s.  Model: 2
kg is estimated as 0.005633 m/s.  Model: 2
The Schmidt number is 1.72371.
The friction velocity is 37.398 m/s
kg is estimated as 0.012836 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
```

kg (agitated)is estimated as 0.11498 m/s.
kl (agitated)is estimated as 0.016622 m/s.
The specified and growth biomass is 0.3 g/L.
The effective KL (surface + diffused air) is 1.598e-04 m/s.
The effective stripping time (surface + diffused air) is 101.198 minutes. (1.68663 hrs.)
The pump mixing time is 5 x the pumping recirculaion time, 0. min.
The ratio of the mixing to the striping (surface + diffused air) is 0.
The mean residence time is 935.622 min. (15.594 hr.)
The ratio of the pump mixing to the residence time is 0.

KG aerated (m/s)	0.11714
KL aerated (m/s)	0.016622
KL OVERALL AERATED (m/s)	0.005152
KG quiescent (m/s)	0.005738
KL quiescent (m/s)	5.945e-06
KL OVERALL QUIESCENT (m/s)	5.85e-06
KL OVERALL (m/s)	1.598e-04
air stripping time constant (min)	101.198
FRACTION SURFACE VOLATILIZED	0.33725
FRACTION SUBMERGED VOLATILIZED	0.
TOTAL FRACTION VOLATILIZED	0.33725
FRACTION BIOLOGICALLY REMOVED	0.62627
FRACTION ABSORBED	0.
TOTAL AIR EMISSIONS (g/s)	6.138e-04
(Mg/year)	0.019356
EMISSION FACTOR (g/cm2-s)	9.065e-13
UNIT EXIT CONCENTRATION (ppmw)	5.674e-05

```
Type of unit is
1 Total water added at the unit (l/s)       50      0
2 Area of openings at unit (cm2)                    50
3 Radius of drop pipe (cm)                          5
4 Drop length to conduit (cm)                       61
5 Humidity of inlet air (%)                         40
6 Temperature of air (C)                            25
7 Drain air velocity (ft/min)                       84
8 manhole air velocity (ft/min)                     128
9 Conduit air velocity (ft/min)                     66
10 Wind speed (cm/s at 10 m)                        447
11 distance to next unit (cm)                       500
12 slope of underflow conduit                       .015
13 friction factor liquid                           .016
14 friction factor gas                              .006
15 radius of underflow conduit (cm)                 12
16 Underflow T (C)                                  25
17 oscillation cycle time (min)                     5
18 design collection velocities  (ft/s)             2
19 design branch line fraction full                 .4

Type of unit is
8 HL partition flag=1, adjust for sorption          0
9 unit recycle convergence number                   200
10 oil molecular weight                             0
11 oil density  (g/cc)                              0
12 NaUT 1=municipal 2=industrial  3=turb.           0
13 NaUT 1=mass tr. 2=equil                          0
14 parts biomass per 1000 parts COD
15 oil water partition method 0=owpc
16 use UNIFAC aqueous data base =1
17 specify mass transfer for unit, =1
18 Use biomass for unit option, =1
19 biogrowth Monod half concentration ppm

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment

                                                                        WWTP\PAE\Old
  Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM  19:24:18
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is aerated biotreatment
1 Description of unit                       11     ASB Zone 1
2 Wastewater temperature   (C)                     34.08
3 length of aeration unit (m)                      295
4 width of aeration unit (m)                       295
5 depth of aeration unit (m)                       1.4
6 Area of agitation (each aerator,m2)              135
7 Total number of agitators in the unit            31
8 Power of agitation (each aerator,HP)             75
9 Impeller diameter (cm)                           49.53
10 Impeller rotation (RPM)                         1200
11 Agitator mechanical efficiency                  0.83
12 aerator effectiveness, alpha                    0.83
13 if there is plug flow, enter 1                  0
14 Overall biorate (mg/g bio-hr)                   19
15 Aeration air flow (m3/s)                        0
16 active biomass, aeration (g/l)                  0.3
17 If covered, then enter 1                        0
18 special input                                   0
19 pH  (enter 0 for no pH adjustment)              7.04

Properties of DIMETHYL SULFIDE  (DMS) at 34.1 deg.C (93.3 deg.F)
```

```
   hl= 0.002924 atm-m3/mol      vp= 704.653 mmHg (13.629 psia)
       162.463 y/x
       0.11606 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.504e-05 cm2/s  dv= 0.14765 cm2/s
Compound flow rate from inlet water is 0.20746 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 28.926 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 237.766.
kl is estimated as 7.634e-06 m/s.
kg is estimated as 0.007917 m/s.  Model: 2
kg is estimated as 0.007917 m/s.  Model: 2
The Schmidt number is 1.01591.
The friction velocity is 37.398 m/s
kg is estimated as 0.017873 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.14978 m/s.
kl (agitated)is estimated as 0.021024 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 4.77e-04 m/s.
 The effective stripping time (surface + diffused air) is 48.915 minutes. (0.81526
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1735.541 min. (28.926 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                          0.15258
   KL aerated (m/s)                          0.021024
   KL OVERALL AERATED (m/s)                  0.009769
   KG quiescent (m/s)                        0.008066
   KL quiescent (m/s)                        7.634e-06
   KL OVERALL QUIESCENT (m/s)                7.574e-06
   KL OVERALL (m/s)                          4.77e-04
   air stripping time constant (min)         48.915
   FRACTION SURFACE VOLATILIZED              0.80063
   FRACTION SUBMERGED VOLATILIZED            0.
   TOTAL FRACTION VOLATILIZED                0.80063
   FRACTION BIOLOGICALLY REMOVED             0.17681
   FRACTION ABSORBED                         0.
   TOTAL AIR EMISSIONS  (g/s)                0.1661
                    (Mg/year)                5.23815
   EMISSION FACTOR  (g/cm2-s)                1.909e-10
   UNIT EXIT CONCENTRATION (ppmw)            0.004001
DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream

                                                                   WWTP\PAE\Old
  Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM  19:24:18
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is system exit stream
1 Description of unit                       12    def.system exit st

   TOTAL AIR EMISSIONS  (g/s)                0.
```

```
                  (Mg/year)                0.
   EMISSION FACTOR  (g/cm2-s)              1.909e-10
   UNIT EXIT CONCENTRATION (ppmw)          1.753e-05
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain
```



```
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is open hub drain
1 Description of unit                        13    default open hub d
2 Underflow T (C)                                  43.89
3 Total water added at the unit (l/s)              0
4 Area of openings at unit (cm2)                   50
5 Radius of drop pipe (cm)                         5
6 Drop length to conduit (cm)                      61
7 Open surface=1                                   1
8 Subsurface entrance=1                            0
9 subsurface exit =1                               0
10 radius of underflow conduit (cm)                12
11 distance to next unit (cm)                      500
12 slope of underflow conduit                      0.015
16 velocity air at drain opening (ft/min)          84
17 municipal waste in conduit =1                   0
18 Assume equilibrium in unit, =1                  0
19 pH  (enter 0 for no pH adjustment)              8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1170 l/s.
   Weight fraction down is  2.054E-07
   Gas concentration in  0 mol fraction.
   Gas flow  1170 L/s
   Weight fraction out at base of drop is  1.77318497496617E-07
   fraction transferred in the drain drop from hub is .136716
   fraction loss in waste1 drop to hub     0.
   fraction loss in waste2 drop to hub     0.
   fraction loss in waste3 drop to hub     0.
   fraction loss in collection hub drop    0.13672
   fraction loss in unit                   0.
   fraction loss in line run               0.
   component upstream of unit, g/s         0.
   mol fract. headspace upstream (y)       0.
   headspace at conduit discharge, y       0.
   headspace end of conduit (y)            4.299e-19
   mol fract. headspace vent base          1.175e-05
   headspace flow out vent (cc/s)          -1.17e+06
   headspace flow down line (cc/s)         1.17e+06
   KG surface (m/s)                        2834.248
   KL surface (m/s)                        8.784e-09
   flow of waste down hub (l/s)            0.
   component flow in waste into unit (g/s) 0.24032
   total component into unit, g/s          0.20746
   TOTAL AIR EMISSIONS  (g/s)              0.032855
                  (Mg/year)                1.03613
   EMISSION FACTOR  (g/cm2-s)              1.909e-10
   UNIT EXIT CONCENTRATION (ppmw)          0.17732
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment
```



```
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is aerated biotreatment
1 Description of unit                        17    ASB Zone 3
```

```
2 Wastewater temperature   (C)                 30.01
3 length of aeration unit (m)                  376
4 width of aeration unit (m)                   188
5 depth of aeration unit (m)                   0.91
6 Area of agitation (each aerator,m2)          135
7 Total number of agitators in the unit        6
8 Power of agitation (each aerator,HP)         75
9 Impeller diameter (cm)                       49.53
10 Impeller rotation (RPM)                     1200
11 Agitator mechanical efficiency              0.83
12 aerator effectiveness, alpha                0.83
13 if there is plug flow, enter 1              0
14 Overall biorate (mg/g bio-hr)               19
15 Aeration air flow (m3/s)                    0
16 active biomass, aeration (g/l)              0.3
17 If covered, then enter 1                    0
18 special input                               0
19 pH  (enter 0 for no pH adjustment)          7.42

Properties of DIMETHYL SULFIDE  (DMS) at 30. deg.C (86. deg.F)
   hl= 0.002519 atm-m3/mol       vp= 606.985 mmHg (11.74 psia)
       139.945 y/x
       0.10132 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr           dl= 1.485e-05 cm2/s  dv= 0.14425 cm2/s
Compound flow rate from inlet water is 2.217e-04 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.272 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 7.566e-06 m/s.
kg is estimated as 0.007884 m/s.  Model: 2
kg is estimated as 0.007884 m/s.  Model: 2
The Schmidt number is 1.03989.
The friction velocity is 37.398 m/s
kg is estimated as 0.017611 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.14804 m/s.
kl (agitated)is estimated as 0.018962 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 1.053e-04 m/s.
 The effective stripping time (surface + diffused air) is 144.073 minutes.
 (2.40122 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 916.326 min. (15.272 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                         0.15081
   KL aerated (m/s)                         0.018962
   KL OVERALL AERATED (m/s)                 0.00854
   KG quiescent (m/s)                       0.008032
   KL quiescent (m/s)                       7.566e-06
   KL OVERALL QUIESCENT (m/s)               7.497e-06
   KL OVERALL (m/s)                         1.053e-04
   air stripping time constant (min)        144.073
```

```
   FRACTION SURFACE VOLATILIZED                0.5886
   FRACTION SUBMERGED VOLATILIZED              0.
   TOTAL FRACTION VOLATILIZED                  0.5886
   FRACTION BIOLOGICALLY REMOVED               0.31886
   FRACTION ABSORBED                           0.
   TOTAL AIR EMISSIONS  (g/s)                  1.305e-04
                  (Mg/year)                    0.004115
   EMISSION FACTOR  (g/cm2-s)                  1.846e-13
   UNIT EXIT CONCENTRATION (ppmw)              1.753e-05
DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment
```

```
                                                                   WWTP\PAE\Old
  Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM  19:24:18
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is aerated biotreatment
1 Description of unit                        18     ASB Zone 2
2 Wastewater temperature   (C)                      32.08
3 length of aeration unit (m)                       368
4 width of aeration unit (m)                        184
5 depth of aeration unit (m)                        0.97
6 Area of agitation (each aerator,m2)               135
7 Total number of agitators in the unit             15
8 Power of agitation (each aerator,HP)              75
9 Impeller diameter (cm)                            49.53
10 Impeller rotation (RPM)                          1200
11 Agitator mechanical efficiency                   0.83
12 aerator effectiveness, alpha                     0.83
13 if there is plug flow, enter 1                   0
14 Overall biorate (mg/g bio-hr)                    19
15 Aeration air flow (m3/s)                         0
16 active biomass, aeration (g/l)                   0.3
17 If covered, then enter 1                         0
18 special input                                    0
19 pH  (enter 0 for no pH adjustment)               7.24

Properties of DIMETHYL SULFIDE  (DMS) at 32.1 deg.C (89.7 deg.F)
   hl= 0.002719 atm-m3/mol      vp= 655.201 mmHg (12.673 psia)
       151.062 y/x
       0.10863 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.495e-05 cm2/s  dv= 0.14597 cm2/s
Compound flow rate from inlet water is 0.004681 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.594 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 7.6e-06 m/s.
kg is estimated as 0.007966 m/s.  Model: 2
kg is estimated as 0.007966 m/s.  Model: 2
The Schmidt number is 1.02758.
The friction velocity is 37.398 m/s
kg is estimated as 0.017744 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
```

kg (agitated)is estimated as 0.14892 m/s.
kl (agitated)is estimated as 0.019984 m/s.
The specified and growth biomass is 0.3 g/L.
The effective KL (surface + diffused air) is 2.809e-04 m/s.
The effective stripping time (surface + diffused air) is 57.552 minutes. (0.9592 hrs.)
The pump mixing time is 5 x the pumping recirculaion time, 0. min.
The ratio of the mixing to the striping (surface + diffused air) is 0.
The mean residence time is 935.622 min. (15.594 hr.)
The ratio of the pump mixing to the residence time is 0.

KG aerated (m/s)	0.15171
KL aerated (m/s)	0.019984
KL OVERALL AERATED (m/s)	0.009148
KG quiescent (m/s)	0.008115
KL quiescent (m/s)	7.6e-06
KL OVERALL QUIESCENT (m/s)	7.537e-06
KL OVERALL (m/s)	2.809e-04
air stripping time constant (min)	57.552
FRACTION SURFACE VOLATILIZED	0.76981
FRACTION SUBMERGED VOLATILIZED	0.
TOTAL FRACTION VOLATILIZED	0.76981
FRACTION BIOLOGICALLY REMOVED	0.18284
FRACTION ABSORBED	0.
TOTAL AIR EMISSIONS (g/s)	0.003604
(Mg/year)	0.11365
EMISSION FACTOR (g/cm2-s)	5.322e-12
UNIT EXIT CONCENTRATION (ppmw)	1.895e-04

```
Type of unit is
1 Total water added at the unit (l/s)       50      0
2 Area of openings at unit (cm2)                    50
3 Radius of drop pipe (cm)                          5
4 Drop length to conduit (cm)                       61
5 Humidity of inlet air (%)                         40
6 Temperature of air (C)                            25
7 Drain air velocity (ft/min)                       84
8 manhole air velocity (ft/min)                     128
9 Conduit air velocity (ft/min)                     66
10 Wind speed (cm/s at 10 m)                        447
11 distance to next unit (cm)                       500
12 slope of underflow conduit                       .015
13 friction factor liquid                           .016
14 friction factor gas                              .006
15 radius of underflow conduit (cm)                 12
16 Underflow T (C)                                  25
17 oscillation cycle time (min)                     5
18 design collection velocities  (ft/s)             2
19 design branch line fraction full                 .4

Type of unit is
8 HL partition flag=1, adjust for sorption          0
9 unit recycle convergence number                   200
10 oil molecular weight                             0
11 oil density  (g/cc)                             0
12 NaUT 1=municipal 2=industrial  3=turb.           0
13 NaUT 1=mass tr. 2=equil                          0
14 parts biomass per 1000 parts COD
15 oil water partition method 0=owpc
16 use UNIFAC aqueous data base =1
17 specify mass transfer for unit, =1
18 Use biomass for unit option, =1
19 biogrowth Monod half concentration ppm

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment

                                                                    WWTP\PAE\Old
  Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM  19:25:00
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment
1 Description of unit                       11     ASB Zone 1
2 Wastewater temperature   (C)                     34.08
3 length of aeration unit (m)                      295
4 width of aeration unit (m)                       295
5 depth of aeration unit (m)                       1.4
6 Area of agitation (each aerator,m2)              135
7 Total number of agitators in the unit            31
8 Power of agitation (each aerator,HP)             75
9 Impeller diameter (cm)                           49.53
10 Impeller rotation (RPM)                         1200
11 Agitator mechanical efficiency                  0.83
12 aerator effectiveness, alpha                    0.83
13 if there is plug flow, enter 1                  0
14 Overall biorate (mg/g bio-hr)                   19
15 Aeration air flow (m3/s)                        0
16 active biomass, aeration (g/l)                  0.3
17 If covered, then enter 1                        0
18 special input                                   0
19 pH  (enter 0 for no pH adjustment)              7.04

Properties of METHANETHIOL(methyl mercaptan) at 34.1 deg.C (93.3 deg.F)
```

```
   hl= 0.004158 atm-m3/mol       vp= 2272.142 mmHg (43.948 psia)
       230.99 y/x
       0.16502 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.525e-05 cm2/s  dv= 0.23702 cm2/s
Compound flow rate from inlet water is 0.016622 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 28.926 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 237.766.
kl is estimated as 7.703e-06 m/s.
kg is estimated as 0.010871 m/s.  Model: 2
kg is estimated as 0.010871 m/s.  Model: 2
The Schmidt number is 0.63285.
The friction velocity is 37.398 m/s
kg is estimated as 0.024173 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.18977 m/s.
kl (agitated)is estimated as 0.021167 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 6.265e-04 m/s.
 The effective stripping time (surface + diffused air) is 37.242 minutes. (0.62071
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1735.541 min. (28.926 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                         0.19332
   KL aerated (m/s)                         0.021167
   KL OVERALL AERATED (m/s)                 0.012876
   KG quiescent (m/s)                       0.011075
   KL quiescent (m/s)                       7.703e-06
   KL OVERALL QUIESCENT (m/s)               7.672e-06
   KL OVERALL (m/s)                         6.265e-04
   air stripping time constant (min)        37.242
   FRACTION SURFACE VOLATILIZED             0.88738
   FRACTION SUBMERGED VOLATILIZED           0.
   TOTAL FRACTION VOLATILIZED               0.88738
   FRACTION BIOLOGICALLY REMOVED            0.093577
   FRACTION ABSORBED                        0.
   TOTAL AIR EMISSIONS  (g/s)               0.01475
                     (Mg/year)              0.46517
   EMISSION FACTOR  (g/cm2-s)               1.695e-11
   UNIT EXIT CONCENTRATION (ppmw)           2.705e-04
DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream
```



```
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is system exit stream
1 Description of unit                       12    def.system exit st

   TOTAL AIR EMISSIONS  (g/s)               0.
```

```
                   (Mg/year)                  0.
   EMISSION FACTOR  (g/cm2-s)                 1.695e-11
   UNIT EXIT CONCENTRATION (ppmw)             9.387e-07
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain
```



```
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is open hub drain
1 Description of unit                        13    default open hub d
2 Underflow T (C)                                  43.89
3 Total water added at the unit (l/s)              0
4 Area of openings at unit (cm2)                   50
5 Radius of drop pipe (cm)                         5
6 Drop length to conduit (cm)                      61
7 Open surface=1                                   1
8 Subsurface entrance=1                            0
9 subsurface exit =1                               0
10 radius of underflow conduit (cm)                12
11 distance to next unit (cm)                      500
12 slope of underflow conduit                      0.015
16 velocity air at drain opening (ft/min)          84
17 municipal waste in conduit =1                   0
18 Assume equilibrium in unit, =1                  0
19 pH  (enter 0 for no pH adjustment)              8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1170 l/s.
   Weight fraction down is  1.72E-08
   Gas concentration in  0 mol fraction.
   Gas flow  1170 L/s
   Weight fraction out at base of drop is  1.42071711698917E-08
   fraction transferred in the drain drop from hub is .174002
   fraction loss in waste1 drop to hub        0.
   fraction loss in waste2 drop to hub        0.
   fraction loss in waste3 drop to hub        0.
   fraction loss in collection hub drop       0.174
   fraction loss in unit                      0.
   fraction loss in line run                  0.
   component upstream of unit, g/s            0.
   mol fract. headspace upstream (y)          0.
   headspace at conduit discharge, y          0.
   headspace end of conduit (y)               4.491e-20
   mol fract. headspace vent base             1.618e-06
   headspace flow out vent (cc/s)             -1.17e+06
   headspace flow down line (cc/s)            1.17e+06
   KG surface (m/s)                           3886.338
   KL surface (m/s)                           8.868e-09
   flow of waste down hub (l/s)               0.
   component flow in waste into unit (g/s)    0.020124
   total component into unit, g/s             0.016622
   TOTAL AIR EMISSIONS  (g/s)                 0.003502
                   (Mg/year)                  0.11043
   EMISSION FACTOR  (g/cm2-s)                 1.695e-11
   UNIT EXIT CONCENTRATION (ppmw)             0.014207
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment
```



```
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment
1 Description of unit                        17    ASB Zone 3
```

```
2 Wastewater temperature   (C)                    30.01
3 length of aeration unit (m)                     376
4 width of aeration unit (m)                      188
5 depth of aeration unit (m)                      0.91
6 Area of agitation (each aerator,m2)             135
7 Total number of agitators in the unit           6
8 Power of agitation (each aerator,HP)            75
9 Impeller diameter (cm)                          49.53
10 Impeller rotation (RPM)                        1200
11 Agitator mechanical efficiency                 0.83
12 aerator effectiveness, alpha                   0.83
13 if there is plug flow, enter 1                 0
14 Overall biorate (mg/g bio-hr)                  19
15 Aeration air flow (m3/s)                       0
16 active biomass, aeration (g/l)                 0.3
17 If covered, then enter 1                       0
18 special input                                  0
19 pH  (enter 0 for no pH adjustment)             7.42

Properties of METHANETHIOL(methyl mercaptan) at 30. deg.C (86. deg.F)
   hl= 0.003687 atm-m3/mol      vp= 2014.774 mmHg (38.97 psia)
       204.826 y/x
       0.14829 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.505e-05 cm2/s  dv= 0.23155 cm2/s
Compound flow rate from inlet water is 1.27e-05 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.272 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 7.635e-06 m/s.
kg is estimated as 0.010826 m/s.  Model: 2
kg is estimated as 0.010826 m/s.  Model: 2
The Schmidt number is 0.64779.
The friction velocity is 37.398 m/s
kg is estimated as 0.023814 m/s.  Model: 3
________Agitated surface__________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.18756 m/s.
kl (agitated)is estimated as 0.019092 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 1.391e-04 m/s.
 The effective stripping time (surface + diffused air) is 109.038 minutes.
 (1.81731 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 916.326 min. (15.272 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                          0.19108
   KL aerated (m/s)                          0.019092
   KL OVERALL AERATED (m/s)                  0.011483
   KG quiescent (m/s)                        0.011029
   KL quiescent (m/s)                        7.635e-06
   KL OVERALL QUIESCENT (m/s)                7.6e-06
   KL OVERALL (m/s)                          1.391e-04
   air stripping time constant (min)         109.038
```

```
   FRACTION SURFACE VOLATILIZED              0.72669
   FRACTION SUBMERGED VOLATILIZED            0.
   TOTAL FRACTION VOLATILIZED                0.72669
   FRACTION BIOLOGICALLY REMOVED             0.18684
   FRACTION ABSORBED                         0.
   TOTAL AIR EMISSIONS  (g/s)                9.23e-06
                    (Mg/year)                2.911e-04
   EMISSION FACTOR  (g/cm2-s)                1.306e-14
   UNIT EXIT CONCENTRATION (ppmw)            9.387e-07
DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment

                                                                  WWTP\PAE\Old
  Stripper Scenario\ASB Old Stripper V7 3/16/2023 1:51:43 PM  19:25:00
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment
1 Description of unit                        18     ASB Zone 2
2 Wastewater temperature   (C)                      32.08
3 length of aeration unit (m)                       368
4 width of aeration unit (m)                        184
5 depth of aeration unit (m)                        0.97
6 Area of agitation (each aerator,m2)               135
7 Total number of agitators in the unit             15
8 Power of agitation (each aerator,HP)              75
9 Impeller diameter (cm)                            49.53
10 Impeller rotation (RPM)                          1200
11 Agitator mechanical efficiency                   0.83
12 aerator effectiveness, alpha                     0.83
13 if there is plug flow, enter 1                   0
14 Overall biorate (mg/g bio-hr)                    19
15 Aeration air flow (m3/s)                         0
16 active biomass, aeration (g/l)                   0.3
17 If covered, then enter 1                         0
18 special input                                    0
19 pH  (enter 0 for no pH adjustment)               7.24

Properties of METHANETHIOL(methyl mercaptan) at 32.1 deg.C (89.7 deg.F)
   hl= 0.003921 atm-m3/mol      vp= 2142.771 mmHg (41.446 psia)
       217.838 y/x
       0.15664 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.515e-05 cm2/s  dv= 0.23433 cm2/s
Compound flow rate from inlet water is 3.165e-04 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.594 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 7.67e-06 m/s.
kg is estimated as 0.010938 m/s.  Model: 2
kg is estimated as 0.010938 m/s.  Model: 2
The Schmidt number is 0.64013.
The friction velocity is 37.398 m/s
kg is estimated as 0.023996 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
```

kg (agitated)is estimated as 0.18868 m/s.
kl (agitated)is estimated as 0.020121 m/s.
The specified and growth biomass is 0.3 g/L.
The effective KL (surface + diffused air) is 3.715e-04 m/s.
The effective stripping time (surface + diffused air) is 43.518 minutes. (0.72529 hrs.)
The pump mixing time is 5 x the pumping recirculaion time, 0. min.
The ratio of the mixing to the striping (surface + diffused air) is 0.
The mean residence time is 935.622 min. (15.594 hr.)
The ratio of the pump mixing to the residence time is 0.

KG aerated (m/s)	0.19222
KL aerated (m/s)	0.020121
KL OVERALL AERATED (m/s)	0.012174
KG quiescent (m/s)	0.011143
KL quiescent (m/s)	7.67e-06
KL OVERALL QUIESCENT (m/s)	7.637e-06
KL OVERALL (m/s)	3.715e-04
air stripping time constant (min)	43.518
FRACTION SURFACE VOLATILIZED	0.86271
FRACTION SUBMERGED VOLATILIZED	0.
TOTAL FRACTION VOLATILIZED	0.86271
FRACTION BIOLOGICALLY REMOVED	0.097161
FRACTION ABSORBED	0.
TOTAL AIR EMISSIONS (g/s)	2.731e-04
(Mg/year)	0.008611
EMISSION FACTOR (g/cm2-s)	4.033e-13
UNIT EXIT CONCENTRATION (ppmw)	1.086e-05

No Stripper Scenario - Projected Actual Emissions

H_2S, TRS Compounds, and VOC

New-Indy Catawba - Catawba, SC

Concentration Loadings	**H2S, ppm**	**DMDS, ppm**	**DMS, ppm**	**MMC, ppm**
Design Foul Condensate Loadings (prior to H2O2)	147	15.00	17.00	16.00
Predicted % Reduction from H_2O_2	0.99	MMC converted into DMDS	0.90	0.99
Foul Condensate (after H_2O_2)	1.47	30.51	1.70	0.16
Avg. ASB Inlet (2021 and 2022)	0.25	0.09	0.20	0.0026
Flow Weighted Loading:	0.31	1.48	0.27	9.82E-03
H2SSIM/WATER9 Results	**H2S, g/s**	**DMDS, g/s**	**DMS, g/s**	**MMC, g/s**
ASB Zone 1	0.08	0.57	0.22	8.40E-03
ASB Zone 2	0.03	9.43E-03	4.70E-03	1.56E-04
ASB Zone 3	0.02	1.85E-04	1.70E-04	5.26E-06
Total ASB	**0.12**	**0.58**	**0.22**	**8.56E-03**
PAE Emissions Factors	**H2S, lb/ODTP**	**DMDS, lb/ODTP**	**DMS, lb/ODTP**	**MMC, lb/ODTP**
Total ASB	**1.06E-02**	**5.04E-02**	**1.92E-02**	**7.42E-04**

Post-Project Foul Condensate Flow:	850	gpm
Post-Project Foul Condensate Flow:	1.22	MGD
Post-Project ASB Influent Flow:	25.48	MGD
Total ASB Flow:	26.71	MGD
Total ASB Flow:	1170	L/s
Pulp Production	2200	ODTP/day

	MW
H2S	34
DMDS	94
DMS	62
MMC	48

Type of unit is		
1 Total water added at the unit (l/s)	50	0
2 Area of openings at unit (cm2)		50
3 Radius of drop pipe (cm)		5
4 Drop length to conduit (cm)		61
5 Humidity of inlet air (%)		40
6 Temperature of air (C)		25
7 Drain air velocity (ft/min)		84
8 manhole air velocity (ft/min)		128
9 Conduit air velocity (ft/min)		66
10 Wind speed (cm/s at 10 m)		447
11 distance to next unit (cm)		500
12 slope of underflow conduit		.015
13 friction factor liquid		.016
14 friction factor gas		.006
15 radius of underflow conduit (cm)		12
16 Underflow T (C)		25
17 oscillation cycle time (min)		5
18 design collection velocities (ft/s)		2
19 design branch line fraction full		.4

Type of unit is	
8 HL partition flag=1, adjust for sorption	0
9 unit recycle convergence number	200
10 oil molecular weight	0
11 oil density (g/cc)	0
12 NaUT 1=municipal 2=industrial 3=turb.	0
13 NaUT 1=mass tr. 2=equil	0
14 parts biomass per 1000 parts COD	
15 oil water partition method 0=owpc	
16 use UNIFAC aqueous data base =1	
17 specify mass transfer for unit, =1	
18 Use biomass for unit option, =1	
19 biogrowth Monod half concentration ppm	

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment

WWTP\PAE\Hardpipe Scenario\ASB Hardpipe Scenario V7
3/16/2023 1:47:24 PM 19:20:20
COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment		
1 Description of unit	11	ASB Zone 1
2 Wastewater temperature (C)		34.08
3 length of aeration unit (m)		295
4 width of aeration unit (m)		295
5 depth of aeration unit (m)		1.4
6 Area of agitation (each aerator,m2)		135
7 Total number of agitators in the unit		31
8 Power of agitation (each aerator,HP)		75
9 Impeller diameter (cm)		49.53
10 Impeller rotation (RPM)		1200
11 Agitator mechanical efficiency		0.83
12 aerator effectiveness, alpha		0.83
13 if there is plug flow, enter 1		0
14 Overall biorate (mg/g bio-hr)		19
15 Aeration air flow (m3/s)		0
16 active biomass, aeration (g/l)		0.3
17 If covered, then enter 1		0
18 special input		0
19 pH (enter 0 for no pH adjustment)		7.04

```
Properties of DIMETHYL DISULFIDE at 34.1 deg.C (93.3 deg.F)
   hl= 0.001714 atm-m3/mol      vp= 45.945 mmHg (0.88868 psia)
       95.2 y/x
       0.068011 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.041e-05 cm2/s  dv= 0.088022 cm2/s
Compound flow rate from inlet water is 1.57133 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 28.926 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 237.766.
kl is estimated as 5.971e-06 m/s.
kg is estimated as 0.005598 m/s.  Model: 2
kg is estimated as 0.005598 m/s.  Model: 2
The Schmidt number is 1.70412.
The friction velocity is 37.398 m/s
kg is estimated as 0.012927 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.11564 m/s.
kl (agitated)is estimated as 0.017486 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 2.753e-04 m/s.
 The effective stripping time (surface + diffused air) is 84.752 minutes. (1.41254
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1735.541 min. (28.926 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                        0.11781
   KL aerated (m/s)                        0.017486
   KL OVERALL AERATED (m/s)                0.005609
   KG quiescent (m/s)                      0.005703
   KL quiescent (m/s)                      5.971e-06
   KL OVERALL QUIESCENT (m/s)              5.883e-06
   KL OVERALL (m/s)                        2.753e-04
   air stripping time constant (min)       84.752
   FRACTION SURFACE VOLATILIZED            0.36452
   FRACTION SUBMERGED VOLATILIZED          0.
   TOTAL FRACTION VOLATILIZED              0.36452
   FRACTION BIOLOGICALLY REMOVED           0.61768
   FRACTION ABSORBED                       0.
   TOTAL AIR EMISSIONS  (g/s)              0.57278
                 (Mg/year)                 18.063
   EMISSION FACTOR  (g/cm2-s)              6.582e-10
   UNIT EXIT CONCENTRATION (ppmw)          0.023907
DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream
```



```
COMPOUND: DIMETHYL DISULFIDE

Type of unit is system exit stream
1 Description of unit                     12    def.system exit st
```

```
   TOTAL AIR EMISSIONS  (g/s)                 0.
                  (Mg/year)                   0.
   EMISSION FACTOR  (g/cm2-s)                 6.582e-10
   UNIT EXIT CONCENTRATION (ppmw)             4.376e-05
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain
```



```
COMPOUND: DIMETHYL DISULFIDE

Type of unit is open hub drain
1 Description of unit                          13    default open hub d
2 Underflow T (C)                                    43.89
3 Total water added at the unit (l/s)                0
4 Area of openings at unit (cm2)                     50
5 Radius of drop pipe (cm)                           5
6 Drop length to conduit (cm)                        61
7 Open surface=1                                     1
8 Subsurface entrance=1                              0
9 subsurface exit =1                                 0
10 radius of underflow conduit (cm)                  12
11 distance to next unit (cm)                        500
12 slope of underflow conduit                        0.015
16 velocity air at drain opening (ft/min)            84
17 municipal waste in conduit =1                     0
18 Assume equilibrium in unit, =1                    0
19 pH  (enter 0 for no pH adjustment)                8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1170 l/s.
   Weight fraction down is  1.4811E-06
   Gas concentration in  0 mol fraction.
   Gas flow  1170 L/s
   Weight fraction out at base of drop is  1.3430203399053E-06
   fraction transferred in the drain drop from hub is .093228
   fraction loss in waste1 drop to hub        0.
   fraction loss in waste2 drop to hub        0.
   fraction loss in waste3 drop to hub        0.
   fraction loss in collection hub drop       0.093228
   fraction loss in unit                      0.
   fraction loss in line run                  0.
   component upstream of unit, g/s            0.
   mol fract. headspace upstream (y)          0.
   headspace at conduit discharge, y          0.
   headspace end of conduit (y)               1.659e-18
   mol fract. headspace vent base             3.811e-05
   headspace flow out vent (cc/s)             -1.17e+06
   headspace flow down line (cc/s)            1.17e+06
   KG surface (m/s)                           2007.233
   KL surface (m/s)                           6.787e-09
   flow of waste down hub (l/s)               0.
   component flow in waste into unit (g/s)    1.73289
   total component into unit, g/s             1.57133
   TOTAL AIR EMISSIONS  (g/s)                 0.16155
                  (Mg/year)                   5.09474
   EMISSION FACTOR  (g/cm2-s)                 6.582e-10
   UNIT EXIT CONCENTRATION (ppmw)             1.34302
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment
```

```
COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment
1 Description of unit                      17    ASB Zone 3
2 Wastewater temperature    (C)                  30.01
3 length of aeration unit (m)                    376
4 width of aeration unit (m)                     188
5 depth of aeration unit (m)                     0.91
6 Area of agitation (each aerator,m2)            135
7 Total number of agitators in the unit          6
8 Power of agitation (each aerator,HP)           75
9 Impeller diameter (cm)                         49.53
10 Impeller rotation (RPM)                       1200
11 Agitator mechanical efficiency                0.83
12 aerator effectiveness, alpha                  0.83
13 if there is plug flow, enter 1                0
14 Overall biorate (mg/g bio-hr)                 19
15 Aeration air flow (m3/s)                      0
16 active biomass, aeration (g/l)                0.3
17 If covered, then enter 1                      0
18 special input                                 0
19 pH  (enter 0 for no pH adjustment)            7.42

Properties of DIMETHYL DISULFIDE at 30. deg.C (86. deg.F)
   hl= 0.00141 atm-m3/mol      vp= 37.814 mmHg (0.7314 psia)
       78.352 y/x
       0.056726 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.027e-05 cm2/s  dv= 0.085991 cm2/s
Compound flow rate from inlet water is 0.00102 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.272 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 5.918e-06 m/s.
kg is estimated as 0.005575 m/s.  Model: 2
kg is estimated as 0.005575 m/s.  Model: 2
The Schmidt number is 1.74436.
The friction velocity is 37.398 m/s
kg is estimated as 0.012742 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.1143 m/s.
kl (agitated)is estimated as 0.015772 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 5.972e-05 m/s.
 The effective stripping time (surface + diffused air) is 253.944 minutes. (4.2324
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 916.326 min. (15.272 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                        0.11644
   KL aerated (m/s)                        0.015772
   KL OVERALL AERATED (m/s)                0.004711
   KG quiescent (m/s)                      0.005679
```

```
   KL quiescent (m/s)                          5.918e-06
   KL OVERALL QUIESCENT (m/s)                  5.813e-06
   KL OVERALL (m/s)                            5.972e-05
   air stripping time constant (min)           253.944
   FRACTION SURFACE VOLATILIZED                0.18107
   FRACTION SUBMERGED VOLATILIZED              0.
   TOTAL FRACTION VOLATILIZED                  0.18107
   FRACTION BIOLOGICALLY REMOVED               0.76875
   FRACTION ABSORBED                           0.
   TOTAL AIR EMISSIONS  (g/s)                  1.848e-04
                     (Mg/year)                 0.005827
   EMISSION FACTOR  (g/cm2-s)                  2.614e-13
   UNIT EXIT CONCENTRATION (ppmw)              4.376e-05
DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment


                       WWTP\PAE\Hardpipe Scenario\ASB Hardpipe Scenario V7
  3/16/2023 1:47:24 PM  19:20:20
COMPOUND: DIMETHYL DISULFIDE

Type of unit is aerated biotreatment
1 Description of unit                           18    ASB Zone 2
2 Wastewater temperature   (C)                        32.08
3 length of aeration unit (m)                         368
4 width of aeration unit (m)                          184
5 depth of aeration unit (m)                          0.97
6 Area of agitation (each aerator,m2)                 135
7 Total number of agitators in the unit               15
8 Power of agitation (each aerator,HP)                75
9 Impeller diameter (cm)                              49.53
10 Impeller rotation (RPM)                            1200
11 Agitator mechanical efficiency                     0.83
12 aerator effectiveness, alpha                       0.83
13 if there is plug flow, enter 1                     0
14 Overall biorate (mg/g bio-hr)                      19
15 Aeration air flow (m3/s)                           0
16 active biomass, aeration (g/l)                     0.3
17 If covered, then enter 1                           0
18 special input                                      0
19 pH  (enter 0 for no pH adjustment)                 7.24

Properties of DIMETHYL DISULFIDE at 32.1 deg.C (89.7 deg.F)
   hl= 0.001558 atm-m3/mol      vp= 41.785 mmHg (0.80821 psia)
       86.579 y/x
       0.062258 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr          dl= 1.034e-05 cm2/s  dv= 0.087022 cm2/s
Compound flow rate from inlet water is 0.027971 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.594 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 5.945e-06 m/s.
kg is estimated as 0.005633 m/s.  Model: 2
kg is estimated as 0.005633 m/s.  Model: 2
The Schmidt number is 1.72371.
The friction velocity is 37.398 m/s
kg is estimated as 0.012836 m/s.  Model: 3
```

________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.11498 m/s.
kl (agitated)is estimated as 0.016622 m/s.
The specified and growth biomass is 0.3 g/L.
The effective KL (surface + diffused air) is 1.598e-04 m/s.
The effective stripping time (surface + diffused air) is 101.198 minutes.
(1.68663 hrs.)
The pump mixing time is 5 x the pumping recirculaion time, 0. min.
The ratio of the mixing to the striping (surface + diffused air) is 0.
The mean residence time is 935.622 min. (15.594 hr.)
The ratio of the pump mixing to the residence time is 0.

KG aerated (m/s)	0.11714
KL aerated (m/s)	0.016622
KL OVERALL AERATED (m/s)	0.005152
KG quiescent (m/s)	0.005738
KL quiescent (m/s)	5.945e-06
KL OVERALL QUIESCENT (m/s)	5.85e-06
KL OVERALL (m/s)	1.598e-04
air stripping time constant (min)	101.198
FRACTION SURFACE VOLATILIZED	0.33728
FRACTION SUBMERGED VOLATILIZED	0.
TOTAL FRACTION VOLATILIZED	0.33728
FRACTION BIOLOGICALLY REMOVED	0.62623
FRACTION ABSORBED	0.
TOTAL AIR EMISSIONS (g/s)	0.009434
(Mg/year)	0.29751
EMISSION FACTOR (g/cm2-s)	1.393e-11
UNIT EXIT CONCENTRATION (ppmw)	8.721e-04

Type of unit is			
1 Total water added at the unit (l/s)	50	0	
2 Area of openings at unit (cm2)		50	
3 Radius of drop pipe (cm)		5	
4 Drop length to conduit (cm)		61	
5 Humidity of inlet air (%)		40	
6 Temperature of air (C)		25	
7 Drain air velocity (ft/min)		84	
8 manhole air velocity (ft/min)		128	
9 Conduit air velocity (ft/min)		66	
10 Wind speed (cm/s at 10 m)		447	
11 distance to next unit (cm)		500	
12 slope of underflow conduit		.015	
13 friction factor liquid		.016	
14 friction factor gas		.006	
15 radius of underflow conduit (cm)		12	
16 Underflow T (C)		25	
17 oscillation cycle time (min)		5	
18 design collection velocities (ft/s)		2	
19 design branch line fraction full		.4	

Type of unit is	
8 HL partition flag=1, adjust for sorption	0
9 unit recycle convergence number	200
10 oil molecular weight	0
11 oil density (g/cc)	0
12 NaUT 1=municipal 2=industrial 3=turb.	0
13 NaUT 1=mass tr. 2=equil	0
14 parts biomass per 1000 parts COD	
15 oil water partition method 0=owpc	
16 use UNIFAC aqueous data base =1	
17 specify mass transfer for unit, =1	
18 Use biomass for unit option, =1	
19 biogrowth Monod half concentration ppm	

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment

WWTP\PAE\Hardpipe Scenario\ASB Hardpipe Scenario V7
3/16/2023 1:47:24 PM 19:21:06
COMPOUND: DIMETHYL SULFIDE (DMS)

Type of unit is aerated biotreatment		
1 Description of unit	11	ASB Zone 1
2 Wastewater temperature (C)		34.08
3 length of aeration unit (m)		295
4 width of aeration unit (m)		295
5 depth of aeration unit (m)		1.4
6 Area of agitation (each aerator,m2)		135
7 Total number of agitators in the unit		31
8 Power of agitation (each aerator,HP)		75
9 Impeller diameter (cm)		49.53
10 Impeller rotation (RPM)		1200
11 Agitator mechanical efficiency		0.83
12 aerator effectiveness, alpha		0.83
13 if there is plug flow, enter 1		0
14 Overall biorate (mg/g bio-hr)		19
15 Aeration air flow (m3/s)		0
16 active biomass, aeration (g/l)		0.3
17 If covered, then enter 1		0
18 special input		0
19 pH (enter 0 for no pH adjustment)		7.04

```
Properties of DIMETHYL SULFIDE  (DMS) at 34.1 deg.C (93.3 deg.F)
   hl= 0.002924 atm-m3/mol       vp= 704.653 mmHg (13.629 psia)
       162.463 y/x
       0.11606 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr           dl= 1.504e-05 cm2/s  dv= 0.14765 cm2/s
Compound flow rate from inlet water is 0.27039 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 28.926 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 237.766.
kl is estimated as 7.634e-06 m/s.
kg is estimated as 0.007917 m/s.  Model: 2
kg is estimated as 0.007917 m/s.  Model: 2
The Schmidt number is 1.01591.
The friction velocity is 37.398 m/s
kg is estimated as 0.017873 m/s.  Model: 3
________Agitated surface__________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.14978 m/s.
kl (agitated)is estimated as 0.021024 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 4.77e-04 m/s.
 The effective stripping time (surface + diffused air) is 48.915 minutes. (0.81526
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1735.541 min. (28.926 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                           0.15258
   KL aerated (m/s)                           0.021024
   KL OVERALL AERATED (m/s)                   0.009769
   KG quiescent (m/s)                         0.008066
   KL quiescent (m/s)                         7.634e-06
   KL OVERALL QUIESCENT (m/s)                 7.574e-06
   KL OVERALL (m/s)                           4.77e-04
   air stripping time constant (min)          48.915
   FRACTION SURFACE VOLATILIZED               0.80064
   FRACTION SUBMERGED VOLATILIZED             0.
   TOTAL FRACTION VOLATILIZED                 0.80064
   FRACTION BIOLOGICALLY REMOVED              0.1768
   FRACTION ABSORBED                          0.
   TOTAL AIR EMISSIONS  (g/s)                 0.21648
                     (Mg/year)                6.82699
   EMISSION FACTOR  (g/cm2-s)                 2.488e-10
   UNIT EXIT CONCENTRATION (ppmw)             0.005215
DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream


                       WWTP\PAE\Hardpipe Scenario\ASB Hardpipe Scenario V7
  3/16/2023 1:47:24 PM  19:21:06
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is system exit stream
1 Description of unit                      12    def.system exit st
```

```
   TOTAL AIR EMISSIONS  (g/s)                  0.
                     (Mg/year)                 0.
   EMISSION FACTOR  (g/cm2-s)                  2.488e-10
   UNIT EXIT CONCENTRATION (ppmw)              2.285e-05
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain
```



```
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is open hub drain
1 Description of unit                          13    default open hub d
2 Underflow T (C)                                    43.89
3 Total water added at the unit (l/s)                0
4 Area of openings at unit (cm2)                     50
5 Radius of drop pipe (cm)                           5
6 Drop length to conduit (cm)                        61
7 Open surface=1                                     1
8 Subsurface entrance=1                              0
9 subsurface exit =1                                 0
10 radius of underflow conduit (cm)                  12
11 distance to next unit (cm)                        500
12 slope of underflow conduit                        0.015
16 velocity air at drain opening (ft/min)            84
17 municipal waste in conduit =1                     0
18 Assume equilibrium in unit, =1                    0
19 pH  (enter 0 for no pH adjustment)                8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1170 l/s.
   Weight fraction down is  2.677E-07
   Gas concentration in  0 mol fraction.
   Gas flow  1170 L/s
   Weight fraction out at base of drop is  2.31101058606837E-07
   fraction transferred in the drain drop from hub is .136716
   fraction loss in waste1 drop to hub         0.
   fraction loss in waste2 drop to hub         0.
   fraction loss in waste3 drop to hub         0.
   fraction loss in collection hub drop        0.13672
   fraction loss in unit                       0.
   fraction loss in line run                   0.
   component upstream of unit, g/s             0.
   mol fract. headspace upstream (y)           0.
   headspace at conduit discharge, y           0.
   headspace end of conduit (y)                5.603e-19
   mol fract. headspace vent base              1.532e-05
   headspace flow out vent (cc/s)              -1.17e+06
   headspace flow down line (cc/s)             1.17e+06
   KG surface (m/s)                            2834.248
   KL surface (m/s)                            8.784e-09
   flow of waste down hub (l/s)                0.
   component flow in waste into unit (g/s)     0.31321
   total component into unit, g/s              0.27039
   TOTAL AIR EMISSIONS  (g/s)                  0.042821
                     (Mg/year)                 1.3504
   EMISSION FACTOR  (g/cm2-s)                  2.488e-10
   UNIT EXIT CONCENTRATION (ppmw)              0.2311
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment
```

WWTP\PAE\Hardpipe Scenario\ASB Hardpipe Scenario V7
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COMPOUND: DIMETHYL SULFIDE (DMS)

Type of unit is aerated biotreatment

1 Description of unit	17	ASB Zone 3
2 Wastewater temperature (C)		30.01
3 length of aeration unit (m)		376
4 width of aeration unit (m)		188
5 depth of aeration unit (m)		0.91
6 Area of agitation (each aerator,m2)		135
7 Total number of agitators in the unit		6
8 Power of agitation (each aerator,HP)		75
9 Impeller diameter (cm)		49.53
10 Impeller rotation (RPM)		1200
11 Agitator mechanical efficiency		0.83
12 aerator effectiveness, alpha		0.83
13 if there is plug flow, enter 1		0
14 Overall biorate (mg/g bio-hr)		19
15 Aeration air flow (m3/s)		0
16 active biomass, aeration (g/l)		0.3
17 If covered, then enter 1		0
18 special input		0
19 pH (enter 0 for no pH adjustment)		7.42

Properties of DIMETHYL SULFIDE (DMS) at 30. deg.C (86. deg.F)
hl= 0.002519 atm-m3/mol vp= 606.985 mmHg (11.74 psia)
139.945 y/x
0.10132 g/L gas per g/L liquid
Temperature adjustment factor = 1.046 ^(T-25), deg. C
k1= 0. L/g-hr dl= 1.485e-05 cm2/s dv= 0.14425 cm2/s
Compound flow rate from inlet water is 2.889e-04 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.272 hr.
____Biomass production________________
The biomass production rate is 0.mg/hr. (0. mg/L)
The fraction dissolved solids converted is 0. .
The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 7.566e-06 m/s.
kg is estimated as 0.007884 m/s. Model: 2
kg is estimated as 0.007884 m/s. Model: 2
The Schmidt number is 1.03989.
The friction velocity is 37.398 m/s
kg is estimated as 0.017611 m/s. Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.14804 m/s.
kl (agitated)is estimated as 0.018962 m/s.
The specified and growth biomass is 0.3 g/L.
The effective KL (surface + diffused air) is 1.053e-04 m/s.
The effective stripping time (surface + diffused air) is 144.073 minutes.
(2.40122 hrs.)
The pump mixing time is 5 x the pumping recirculaion time, 0. min.
The ratio of the mixing to the striping (surface + diffused air) is 0.
The mean residence time is 916.326 min. (15.272 hr.)
The ratio of the pump mixing to the residence time is 0.

KG aerated (m/s)	0.15081
KL aerated (m/s)	0.018962
KL OVERALL AERATED (m/s)	0.00854
KG quiescent (m/s)	0.008032

```
   KL quiescent (m/s)                            7.566e-06
   KL OVERALL QUIESCENT (m/s)                    7.497e-06
   KL OVERALL (m/s)                              1.053e-04
   air stripping time constant (min)             144.073
   FRACTION SURFACE VOLATILIZED                  0.5886
   FRACTION SUBMERGED VOLATILIZED                0.
   TOTAL FRACTION VOLATILIZED                    0.5886
   FRACTION BIOLOGICALLY REMOVED                 0.31886
   FRACTION ABSORBED                             0.
   TOTAL AIR EMISSIONS  (g/s)                    1.701e-04
                     (Mg/year)                   0.005363
   EMISSION FACTOR  (g/cm2-s)                    2.406e-13
   UNIT EXIT CONCENTRATION (ppmw)                2.285e-05
DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment


                       WWTP\PAE\Hardpipe Scenario\ASB Hardpipe Scenario V7
  3/16/2023 1:47:24 PM  19:21:06
COMPOUND: DIMETHYL SULFIDE  (DMS)

Type of unit is aerated biotreatment
1 Description of unit                              18    ASB Zone 2
2 Wastewater temperature   (C)                           32.08
3 length of aeration unit (m)                            368
4 width of aeration unit (m)                             184
5 depth of aeration unit (m)                             0.97
6 Area of agitation (each aerator,m2)                    135
7 Total number of agitators in the unit                  15
8 Power of agitation (each aerator,HP)                   75
9 Impeller diameter (cm)                                 49.53
10 Impeller rotation (RPM)                               1200
11 Agitator mechanical efficiency                        0.83
12 aerator effectiveness, alpha                          0.83
13 if there is plug flow, enter 1                        0
14 Overall biorate (mg/g bio-hr)                         19
15 Aeration air flow (m3/s)                              0
16 active biomass, aeration (g/l)                        0.3
17 If covered, then enter 1                              0
18 special input                                         0
19 pH  (enter 0 for no pH adjustment)                    7.24

Properties of DIMETHYL SULFIDE  (DMS) at 32.1 deg.C (89.7 deg.F)
   hl= 0.002719 atm-m3/mol       vp= 655.201 mmHg (12.673 psia)
       151.062 y/x
       0.10863 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   k1= 0. L/g-hr           dl= 1.495e-05 cm2/s  dv= 0.14597 cm2/s
Compound flow rate from inlet water is 0.006101 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.594 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 7.6e-06 m/s.
kg is estimated as 0.007966 m/s.  Model: 2
kg is estimated as 0.007966 m/s.  Model: 2
The Schmidt number is 1.02758.
The friction velocity is 37.398 m/s
kg is estimated as 0.017744 m/s.  Model: 3
```

________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.14892 m/s.
kl (agitated)is estimated as 0.019984 m/s.
The specified and growth biomass is 0.3 g/L.
The effective KL (surface + diffused air) is 2.809e-04 m/s.
The effective stripping time (surface + diffused air) is 57.552 minutes. (0.9592 hrs.)
The pump mixing time is 5 x the pumping recirculaion time, 0. min.
The ratio of the mixing to the striping (surface + diffused air) is 0.
The mean residence time is 935.622 min. (15.594 hr.)
The ratio of the pump mixing to the residence time is 0.

KG aerated (m/s)	0.15171
KL aerated (m/s)	0.019984
KL OVERALL AERATED (m/s)	0.009148
KG quiescent (m/s)	0.008115
KL quiescent (m/s)	7.6e-06
KL OVERALL QUIESCENT (m/s)	7.537e-06
KL OVERALL (m/s)	2.809e-04
air stripping time constant (min)	57.552
FRACTION SURFACE VOLATILIZED	0.76981
FRACTION SUBMERGED VOLATILIZED	0.
TOTAL FRACTION VOLATILIZED	0.76981
FRACTION BIOLOGICALLY REMOVED	0.18284
FRACTION ABSORBED	0.
TOTAL AIR EMISSIONS (g/s)	0.004697
(Mg/year)	0.14812
EMISSION FACTOR (g/cm2-s)	6.937e-12
UNIT EXIT CONCENTRATION (ppmw)	2.469e-04

Type of unit is

1 Total water added at the unit (l/s)	50	0
2 Area of openings at unit (cm2)		50
3 Radius of drop pipe (cm)		5
4 Drop length to conduit (cm)		61
5 Humidity of inlet air (%)		40
6 Temperature of air (C)		25
7 Drain air velocity (ft/min)		84
8 manhole air velocity (ft/min)		128
9 Conduit air velocity (ft/min)		66
10 Wind speed (cm/s at 10 m)		447
11 distance to next unit (cm)		500
12 slope of underflow conduit		.015
13 friction factor liquid		.016
14 friction factor gas		.006
15 radius of underflow conduit (cm)		12
16 Underflow T (C)		25
17 oscillation cycle time (min)		5
18 design collection velocities (ft/s)		2
19 design branch line fraction full		.4

Type of unit is

8 HL partition flag=1, adjust for sorption	0
9 unit recycle convergence number	200
10 oil molecular weight	0
11 oil density (g/cc)	0
12 NaUT 1=municipal 2=industrial 3=turb.	0
13 NaUT 1=mass tr. 2=equil	0
14 parts biomass per 1000 parts COD	
15 oil water partition method 0=owpc	
16 use UNIFAC aqueous data base =1	
17 specify mass transfer for unit, =1	
18 Use biomass for unit option, =1	
19 biogrowth Monod half concentration ppm	

DETAILED CALCULATIONS at Unit 11 ASB Zone 1
Type: aerated biotreatment

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COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment

1 Description of unit	11	ASB Zone 1
2 Wastewater temperature (C)		34.08
3 length of aeration unit (m)		295
4 width of aeration unit (m)		295
5 depth of aeration unit (m)		1.4
6 Area of agitation (each aerator,m2)		135
7 Total number of agitators in the unit		31
8 Power of agitation (each aerator,HP)		75
9 Impeller diameter (cm)		49.53
10 Impeller rotation (RPM)		1200
11 Agitator mechanical efficiency		0.83
12 aerator effectiveness, alpha		0.83
13 if there is plug flow, enter 1		0
14 Overall biorate (mg/g bio-hr)		19
15 Aeration air flow (m3/s)		0
16 active biomass, aeration (g/l)		0.3
17 If covered, then enter 1		0
18 special input		0
19 pH (enter 0 for no pH adjustment)		7.04

```
Properties of METHANETHIOL(methyl mercaptan) at 34.1 deg.C (93.3 deg.F)
   hl= 0.004158 atm-m3/mol      vp= 2272.142 mmHg (43.948 psia)
       230.99 y/x
       0.16502 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.525e-05 cm2/s  dv= 0.23702 cm2/s
Compound flow rate from inlet water is 0.009471 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 28.926 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 237.766.
kl is estimated as 7.703e-06 m/s.
kg is estimated as 0.010871 m/s.  Model: 2
kg is estimated as 0.010871 m/s.  Model: 2
The Schmidt number is 0.63285.
The friction velocity is 37.398 m/s
kg is estimated as 0.024173 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.18977 m/s.
kl (agitated)is estimated as 0.021167 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 6.265e-04 m/s.
 The effective stripping time (surface + diffused air) is 37.242 minutes. (0.62071
 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 1735.541 min. (28.926 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                        0.19332
   KL aerated (m/s)                        0.021167
   KL OVERALL AERATED (m/s)                0.012876
   KG quiescent (m/s)                      0.011075
   KL quiescent (m/s)                      7.703e-06
   KL OVERALL QUIESCENT (m/s)              7.672e-06
   KL OVERALL (m/s)                        6.265e-04
   air stripping time constant (min)       37.242
   FRACTION SURFACE VOLATILIZED            0.88738
   FRACTION SUBMERGED VOLATILIZED          0.
   TOTAL FRACTION VOLATILIZED              0.88738
   FRACTION BIOLOGICALLY REMOVED           0.093578
   FRACTION ABSORBED                       0.
   TOTAL AIR EMISSIONS  (g/s)              0.008404
                    (Mg/year)              0.26504
   EMISSION FACTOR  (g/cm2-s)              9.657e-12
   UNIT EXIT CONCENTRATION (ppmw)          1.541e-04
DETAILED CALCULATIONS at Unit 12 def.system exit st
Type: system exit stream


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COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is system exit stream
1 Description of unit                     12    def.system exit st
```

```
   TOTAL AIR EMISSIONS  (g/s)                 0.
                    (Mg/year)                 0.
   EMISSION FACTOR  (g/cm2-s)                 9.657e-12
   UNIT EXIT CONCENTRATION (ppmw)             5.348e-07
DETAILED CALCULATIONS at Unit 13 default open hub d
Type: open hub drain
```



```
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is open hub drain
1 Description of unit                        13    default open hub d
2 Underflow T (C)                                  43.89
3 Total water added at the unit (l/s)              0
4 Area of openings at unit (cm2)                   50
5 Radius of drop pipe (cm)                         5
6 Drop length to conduit (cm)                      61
7 Open surface=1                                   1
8 Subsurface entrance=1                            0
9 subsurface exit =1                               0
10 radius of underflow conduit (cm)                12
11 distance to next unit (cm)                      500
12 slope of underflow conduit                      0.015
16 velocity air at drain opening (ft/min)          84
17 municipal waste in conduit =1                   0
18 Assume equilibrium in unit, =1                  0
19 pH  (enter 0 for no pH adjustment)              8.9

 Equilibrium partitioning in drain drop hub is assumed.
   Total drain flow is  1170 l/s.
   Weight fraction down is  9.8E-09
   Gas concentration in  0 mol fraction.
   Gas flow  1170 L/s
   Weight fraction out at base of drop is  8.09478308097639E-09
   fraction transferred in the drain drop from hub is .174002
   fraction loss in waste1 drop to hub        0.
   fraction loss in waste2 drop to hub        0.
   fraction loss in waste3 drop to hub        0.
   fraction loss in collection hub drop       0.174
   fraction loss in unit                      0.
   fraction loss in line run                  0.
   component upstream of unit, g/s            0.
   mol fract. headspace upstream (y)          0.
   headspace at conduit discharge, y          0.
   headspace end of conduit (y)               2.559e-20
   mol fract. headspace vent base             9.217e-07
   headspace flow out vent (cc/s)             -1.17e+06
   headspace flow down line (cc/s)            1.17e+06
   KG surface (m/s)                           3886.338
   KL surface (m/s)                           8.868e-09
   flow of waste down hub (l/s)               0.
   component flow in waste into unit (g/s)    0.011466
   total component into unit, g/s             0.009471
   TOTAL AIR EMISSIONS  (g/s)                 0.001995
                    (Mg/year)                 0.062918
   EMISSION FACTOR  (g/cm2-s)                 9.657e-12
   UNIT EXIT CONCENTRATION (ppmw)             0.008095
DETAILED CALCULATIONS at Unit 17 ASB Zone 3
Type: aerated biotreatment
```

```
COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment
1 Description of unit                          17    ASB Zone 3
2 Wastewater temperature   (C)                       30.01
3 length of aeration unit (m)                        376
4 width of aeration unit (m)                         188
5 depth of aeration unit (m)                         0.91
6 Area of agitation (each aerator,m2)                135
7 Total number of agitators in the unit              6
8 Power of agitation (each aerator,HP)               75
9 Impeller diameter (cm)                             49.53
10 Impeller rotation (RPM)                           1200
11 Agitator mechanical efficiency                    0.83
12 aerator effectiveness, alpha                      0.83
13 if there is plug flow, enter 1                    0
14 Overall biorate (mg/g bio-hr)                     19
15 Aeration air flow (m3/s)                          0
16 active biomass, aeration (g/l)                    0.3
17 If covered, then enter 1                          0
18 special input                                     0
19 pH  (enter 0 for no pH adjustment)                7.42

Properties of METHANETHIOL(methyl mercaptan) at 30. deg.C (86. deg.F)
   hl= 0.003687 atm-m3/mol       vp= 2014.774 mmHg (38.97 psia)
       204.826 y/x
       0.14829 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr           dl= 1.505e-05 cm2/s  dv= 0.23155 cm2/s
Compound flow rate from inlet water is 7.237e-06 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.272 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 329.675.
kl is estimated as 7.635e-06 m/s.
kg is estimated as 0.010826 m/s.  Model: 2
kg is estimated as 0.010826 m/s.  Model: 2
The Schmidt number is 0.64779.
The friction velocity is 37.398 m/s
kg is estimated as 0.023814 m/s.  Model: 3
________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.18756 m/s.
kl (agitated)is estimated as 0.019092 m/s.
    The specified and growth biomass is 0.3 g/L.
 The effective KL (surface + diffused air) is 1.391e-04 m/s.
 The effective stripping time (surface + diffused air) is 109.038 minutes.
 (1.81731 hrs.)
 The pump mixing time is 5 x the pumping recirculaion time, 0. min.
 The ratio of the mixing to the striping (surface + diffused air) is 0.
 The mean residence time is 916.326 min. (15.272 hr.)
 The ratio of the pump mixing to the residence time is 0.
   KG aerated (m/s)                           0.19108
   KL aerated (m/s)                           0.019092
   KL OVERALL AERATED (m/s)                   0.011483
   KG quiescent (m/s)                         0.011029
```

```
   KL quiescent (m/s)                       7.635e-06
   KL OVERALL QUIESCENT (m/s)               7.6e-06
   KL OVERALL (m/s)                         1.391e-04
   air stripping time constant (min)        109.038
   FRACTION SURFACE VOLATILIZED             0.72669
   FRACTION SUBMERGED VOLATILIZED           0.
   TOTAL FRACTION VOLATILIZED               0.72669
   FRACTION BIOLOGICALLY REMOVED            0.18684
   FRACTION ABSORBED                        0.
   TOTAL AIR EMISSIONS  (g/s)               5.259e-06
                     (Mg/year)              1.658e-04
   EMISSION FACTOR  (g/cm2-s)               7.439e-15
   UNIT EXIT CONCENTRATION (ppmw)           5.348e-07
DETAILED CALCULATIONS at Unit 18 ASB Zone 2
Type: aerated biotreatment


                    WWTP\PAE\Hardpipe Scenario\ASB Hardpipe Scenario V7
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COMPOUND: METHANETHIOL(methyl mercaptan)

Type of unit is aerated biotreatment
1 Description of unit                        18    ASB Zone 2
2 Wastewater temperature   (C)                     32.08
3 length of aeration unit (m)                      368
4 width of aeration unit (m)                       184
5 depth of aeration unit (m)                       0.97
6 Area of agitation (each aerator,m2)              135
7 Total number of agitators in the unit            15
8 Power of agitation (each aerator,HP)             75
9 Impeller diameter (cm)                           49.53
10 Impeller rotation (RPM)                         1200
11 Agitator mechanical efficiency                  0.83
12 aerator effectiveness, alpha                    0.83
13 if there is plug flow, enter 1                  0
14 Overall biorate (mg/g bio-hr)                   19
15 Aeration air flow (m3/s)                        0
16 active biomass, aeration (g/l)                  0.3
17 If covered, then enter 1                        0
18 special input                                   0
19 pH  (enter 0 for no pH adjustment)              7.24

Properties of METHANETHIOL(methyl mercaptan) at 32.1 deg.C (89.7 deg.F)
   hl= 0.003921 atm-m3/mol      vp= 2142.771 mmHg (41.446 psia)
       217.838 y/x
       0.15664 g/L gas per g/L liquid
   Temperature adjustment factor = 1.046 ^(T-25), deg. C
   kl= 0. L/g-hr          dl= 1.515e-05 cm2/s  dv= 0.23433 cm2/s
Compound flow rate from inlet water is 1.803e-04 g/s.
Compound flow rate from inlet vent is 0. g/s.
Compound flow rate from inlet duct is 0. g/s.
Submerged aeration rate from inlet vent is 0. m3/s.
Total submerged aeration is 0. m3/s.
The residence time in the unit is 15.594 hr.
____Biomass production________________
    The biomass production rate is 0.mg/hr. (0. mg/L)
    The fraction dissolved solids converted is 0. .
    The estimated biomass exit concentration is 0. mg/L.
________Quiescent wind shear surface___Springer_
The fetch to depth ratio is 302.703.
kl is estimated as 7.67e-06 m/s.
kg is estimated as 0.010938 m/s.  Model: 2
kg is estimated as 0.010938 m/s.  Model: 2
The Schmidt number is 0.64013.
The friction velocity is 37.398 m/s
kg is estimated as 0.023996 m/s.  Model: 3
```

________Agitated surface___________________
The rotation speed is 125.654 radians per second.
The rotation factor NRW is 2.052e+06.
The power number NPR is 7.881e-04.
The rotation factor NFR is 797.027.
kg (agitated)is estimated as 0.18868 m/s.
kl (agitated)is estimated as 0.020121 m/s.
The specified and growth biomass is 0.3 g/L.
The effective KL (surface + diffused air) is 3.715e-04 m/s.
The effective stripping time (surface + diffused air) is 43.518 minutes. (0.72529 hrs.)
The pump mixing time is 5 x the pumping recirculaion time, 0. min.
The ratio of the mixing to the striping (surface + diffused air) is 0.
The mean residence time is 935.622 min. (15.594 hr.)
The ratio of the pump mixing to the residence time is 0.

KG aerated (m/s)	0.19222
KL aerated (m/s)	0.020121
KL OVERALL AERATED (m/s)	0.012174
KG quiescent (m/s)	0.011143
KL quiescent (m/s)	7.67e-06
KL OVERALL QUIESCENT (m/s)	7.637e-06
KL OVERALL (m/s)	3.715e-04
air stripping time constant (min)	43.518
FRACTION SURFACE VOLATILIZED	0.86271
FRACTION SUBMERGED VOLATILIZED	0.
TOTAL FRACTION VOLATILIZED	0.86271
FRACTION BIOLOGICALLY REMOVED	0.097161
FRACTION ABSORBED	0.
TOTAL AIR EMISSIONS (g/s)	1.556e-04
(Mg/year)	0.004907
EMISSION FACTOR (g/cm2-s)	2.298e-13
UNIT EXIT CONCENTRATION (ppmw)	6.185e-06

PAE H2S Factor
Summary of H2SSIM Inputs and Outputs

PAE - No Stripper Scenario	Zone 1	Zone 2	Zone 3
DO	1.57	4.63	4.66
Temp	93.34	89.74	86.02
pH	7.04	7.24	7.42
Length	968	1208	1235
Width	968	604	617
Aerators	31	15	6

	Main Inlet	Hardpipe	Units
Flow	25.48	1.22	MGD
Total Sulfide	0.252	1.47	mg/L
Sulfate	390	390	mg/L

	Zone 1	Zone 2	Zone 3	Total ASB	
H2S g/s	0.08	0.03	0.02	**0.122**	g/s
				2200	ODTP/day
				1.06E-02	lb/ODTP

PAE - Backup Stripper	Zone 1	Zone 2	Zone 3
DO	1.57	4.63	4.66
Temp	93.34	89.74	86.02
pH	7.04	7.24	7.42
Length	968	1208	1235
Width	968	604	617
Aerators	31	15	6

	Main Inlet	Hardpipe	Units
Flow	25.48	1.22	MGD
Total Sulfide	0.252	2.93	mg/L
Sulfate	390	390	mg/L

	Zone 1	Zone 2	Zone 3	Total ASB	
H2S g/s	0.08	0.03	0.02	**0.126**	g/s
				2200	ODTP/day
				1.09E-02	lb/ODTP

PAE - New Stripper	Zone 1	Zone 2	Zone 3
DO	1.57	4.63	4.66
Temp	93.34	89.74	86.02
pH	7.04	7.24	7.42
Length	968	1208	1235
Width	968	604	617
Aerators	31	15	6

	Main Inlet	Hardpipe	Units
Flow	25.48	0.00	MGD
Total Sulfide	0.252	0.00	mg/L
Sulfate	390	390	mg/L

	Zone 1	Zone 2	Zone 3	Total ASB	
H2S g/s	0.07	0.03	0.02	**0.119**	
				2200	ODTP/day
				1.03E-02	lb/ODTP

*DO are based on average of all DO readings from 2021 and 2022 Subpart S performance testing.

ASB

nation

cs

Hardpipe	Units
	MGD
	mg/L
390	mg/L

litions

mph
F

Temperature	93.34	89.74	86.02		F
pH	7.04	7.24	7.42		s.u.
Redox Condition	Aerobic	Aerobic	Aerobic	Aerobic	
Length	968	1208	1235		feet
Width	968	604	617		feet
Depth	4.5	3.2	3		feet
Mixing	Moderat	Moderat	Moderat		
Number of Aerators	31	15	6		
Total Horsepower	2325	1125	450		HP
Impellor Size	1.625	1.625	1.625		feet
Impellor RPM	1200	1200	1200		RPM
Diffused Air Flow	0	0	0		cms
Weir Height	0	0	0		feet

Run H2SSIM

View Parameters

Clear Input Sheet

H2SSIM Results

New Stripper Scenario

Basin Emissions		Units
Total Emissions (H_2S)	0.119	gms/s
Total Emissions (H_2S)	8271.8	lbs/yr
Total Emissions (H_2S)	4.1	tons/yr
Total Emissions (H_2S)	3.8	tonnes/yr
Emission Flux (H_2S)	16.6	gms/m^2 yr

Zone Emissions	Zone 1	Zone 2	Zone 3	Zone 4	Units
Zone Emissions (H_2S)	0.07	0.03	0.02		gms/s
Zone Emissions (H_2S)	4987.3	1762.5	1522.0		lbs/yr
Emission Flux (H_2S)	26.0	11.8	9.8		gms/m^2 yr
Liquid Conc. (Total Sulfide)	0.003	0.001	0.000		mg/L
Liquid Sulfide Load (lbs/yr)	36.300	6.200	5.400		lbs/yr

Percent Inlet Sulfide Removed	57.7%

Current Parameters	
kgen	0.25
ThetaGen	1.06
KDO	0.05
KSO4	10
kanox	0.006
ThetaOx	1.05
m	1
n	0.2
MLVSS	272.2
O_2 Transfer Coeff.	2
alpha 1	0.83
alpha 2	0.6

ASB

nation

cs

	Hardpipe	Units
	1.22	MGD
	2.93	mg/L
	390	mg/L

litions

	mph
	F

Temperature	93.34	89.74	86.02		F
pH	7.04	7.24	7.42		s.u.
Redox Condition	Aerobic	Aerobic	Aerobic	Aerobic	
Length	968	1208	1235		feet
Width	968	604	617		feet
Depth	4.5	3.2	3		feet
Mixing	Moderat	Moderat	Moderat		
Number of Aerators	31	15	6		
Total Horsepower	2325	1125	450		HP
Impellor Size	1.625	1.625	1.625		feet
Impellor RPM	1200	1200	1200		RPM
Diffused Air Flow	0	0	0		cms
Weir Height	0	0	0		feet

Run H2SSIM

View Parameters

Clear Input Sheet

H2SSIM Results

Backup Stripper
Scenario

Basin Emissions		Units
Total Emissions (H_2S)	0.126	gms/s
Total Emissions (H_2S)	8765.3	lbs/yr
Total Emissions (H_2S)	4.4	tons/yr
Total Emissions (H_2S)	4.0	tonnes/yr
Emission Flux (H_2S)	17.6	gms/m^2 yr

Zone Emissions	Zone 1	Zone 2	Zone 3	Zone 4	Units
Zone Emissions (H_2S)	0.08	0.03	0.02		gms/s
Zone Emissions (H_2S)	5479.5	1763.8	1521.9		lbs/yr
Emission Flux (H_2S)	28.6	11.8	9.8		gms/m^2 yr
Liquid Conc. (Total Sulfide)	0.004	0.001	0.000		mg/L
Liquid Sulfide Load (lbs/yr)	45.000	6.500	5.700		lbs/yr

Percent Inlet Sulfide Removed	71.2%

Current Parameters	
kgen	0.25
ThetaGen	1.06
KDO	0.05
KSO4	10
kanox	0.006
ThetaOx	1.05
m	1
n	0.2
MLVSS	272.2
O_2 Transfer Coeff.	2
alpha 1	0.83
alpha 2	0.6

ASB

nation

cs

	Hardpipe	Units
	1.22	MGD
	1.47	mg/L
	390	mg/L

litions

	mph
	F

Temperature	93.34	89.74	86.02		F
pH	7.04	7.24	7.42		s.u.
Redox Condition	Aerobic	Aerobic	Aerobic	Aerobic	
Length	968	1208	1235		feet
Width	968	604	617		feet
Depth	4.5	3.2	3		feet
Mixing	Moderat	Moderat	Moderat		
Number of Aerators	31	15	6		
Total Horsepower	2325	1125	450		HP
Impellor Size	1.625	1.625	1.625		feet
Impellor RPM	1200	1200	1200		RPM
Diffused Air Flow	0	0	0		cms
Weir Height	0	0	0		feet

Run H2SSIM

View Parameters

Clear Input Sheet

H2SSIM Results

No Stripper Scenario

Basin Emissions		Units
Total Emissions (H_2S)	0.123	gms/s
Total Emissions (H_2S)	8518.1	lbs/yr
Total Emissions (H_2S)	4.3	tons/yr
Total Emissions (H_2S)	3.9	tonnes/yr
Emission Flux (H_2S)	17.1	gms/m^2 yr

Zone Emissions	Zone 1	Zone 2	Zone 3	Zone 4	Units
Zone Emissions (H_2S)	0.08	0.03	0.02		gms/s
Zone Emissions (H_2S)	5232.9	1763.2	1521.9		lbs/yr
Emission Flux (H_2S)	27.3	11.8	9.8		gms/m^2 yr
Liquid Conc. (Total Sulfide)	0.003	0.001	0.000		mg/L
Liquid Sulfide Load (lbs/yr)	41.500	6.500	5.700		lbs/yr

Percent Inlet Sulfide Removed	65.9%

Current Parameters	
kgen	0.25
ThetaGen	1.06
KDO	0.05
KSO4	10
kanox	0.006
ThetaOx	1.05
m	1
n	0.2
MLVSS	272.2
O_2 Transfer Coeff.	2
alpha 1	0.83
alpha 2	0.6

Methanol PAE Emissions Factors

Methanol PAE Scenarios	Hardpipe ppm	Hardpipe Flow, MGD	Air Stripping g/s	Pulp Production	Methanol Emissions Factor lb/ODTP
New Stripper	N/A	N/A	3.47	2200	0.30
Backup Stripper	2095	1.22	17.63	2200	1.53
No Stripper	3809	1.22	26.69	2200	2.31

Design MeOH:	1620	lb/hr
	16	lb/ODT

K C FORMS - CALCULATING FRACTION BIODEGRADED

: PAE - New Stripper Scenario

ns: Enter data in green shaded sections of this page of this spreadsheet only.

EATMENT UNIT DESCRIPTION

	Units	Zone 1	Zone 2	Zone 3
75 HP Aerators	#	31	15	6
100 HP Aerators	#	0	0	0
epower	HP	2325	1125	450
ure	C	35.4	33.5	31.3
	ft	968	1,208	1,235
	ft	968	604	617
epth	ft	4.5	3.2	3
otation	rpm	1200	1200	1200
rea per 75 HP aerator	ft2	1452	1452	1452
rea per 100 HP aerator	ft2	2206	2206	2206
iameter	in	19.5	19.5	19.5

II. OVERALL PARAMS - individual flows

	Flow MGD	MeOH mg/L	
Inlet Stream **	25.48	60.0	AVG ASB Inlet, 2021 and 2022
Condensate Stream	0.0	0	
Outlet	25.5	5.1	AVG ASB Effluent, 2021 and 20

** *except condensate flow*

NA - individual flow/conc data not available

LL PARAMS - total flows

		Flow m3/sec	Flow MGD	MeOH mg/L
oncentration			25.5	60.0
oncentration				5.10
ed	mph			3.8

III. HAP DATA

Methanol

	Units	Inlet	Average Zone Concentration Zone 1	Zone 2	Zone 3
Conc.	mg/L	60.0	7.4	5.4	3.2
Temp.	F		95.7	92.3	88.3
			12%	**9%**	**5%**

Expected zone concentration reductions similar to 2022 c

No Hardpipe Stream

LTS	
hanol	%
odegraded	86.3
r emissions	5.2
emaining in unit effluent	8.5

APPENDIX C FORMS - CALCULATING FRACTION BIODEGRADED
PARAMETERS FOR CALCULATING MASS TRANSFER COEFIICIENTS

Data Date: PAE - New Stripper Scenario

	Diff in Water cm2/s	Diff in Air cm2/s	Henry's Law atm-m3/mol	Equil. Ratio (Hc) or (Keq) m3 liq to m3 gas	MW g/mol	ScG	Antoine Eqtn b	Antoine Eqtn c
Methanol	1.64E-05	0.150	5.19E-06	2.12E-04	32.0	1.006	1474	229.13
Acetaldehyde	1.41E-05	0.124	8.77E-05	3.58E-03	45.1	1.216	1600	291.8
MEK	9.80E-06	0.081	1.30E-04	5.31E-03	72.1	1.867	1305	229.27

General

	Units	Value	Name
viscosity of air	g/cm-s	0.000181	va
viscosity of water	g/cm-s	0.002	vw
density of air	g/cm3	0.0012	da
density of water	g/cm3	1	dw
MW of air	g/mol	29	Mwa
MW of water	g/mol	18	MWw
Diff of O2 in H2O	cm2/s	2.40E-05	DO2w
grav const.	lb-ft/s2/lb	32.17	g
R	atm-m3/mol K	8.21E-05	R_
Aerator Motor Eff	fraction	0.85	AerEff
O2 Trans Correct		0.83	Beta
Wind Speed	m/s	1.69	U
Diff of Ether	m/s	8.50E-06	Dether
O2 Trans	lb O2/HP-h	3	J

TURBULENT
KL Params

	Zone 1	Zone 2	Zone 3
w	126.3	126.3	126.3
Re	2.07E+06	2.07E+06	2.07E+06
PI	35063	35063	35063
Power Number, p	7.92E-04	7.92E-04	7.92E-04
Fr	8.06E+02	8.06E+02	8.06E+02
Total TurbArea (ft2)	45012	21780	8712
Total TurbArea (m2)	4181.6	2023.4	809.3
Frac. Agitated	0.048	0.030	0.011
(by surface aerators)			
QUIESCENT			
Depth	1.37	0.98	0.92
SurfArea (ft2)	937472	729750	762343
SurfArea (m2)	87208.33	67885.00	70916.98
F/D Ratio	243	301	328
ScL - Methanol	NA	NA	NA
ScL - Acetaldehyde	NA	NA	NA
ScL - MEK	NA	NA	NA
U* (Friction Velocity)	NA	NA	NA

These Parameters are used when F/D < 14 **AND** U > 3.25 m/s

DIFFUSED

	Zone 1	Zone 2	Zone 3
Air flow, cfm	0	0	0
Air flow, m3/s	0.000	0.000	0.000

PENDIX C FORMS - CALCULATING FRACTION BIODEGRADED
lculating Mass Transfer Coefficient KL for Various Zones

ta Date: **PAE - New Stripper Scenario**

		Surface Aeration										
		Turbulent Area			Quiescent Area							
						kL, m/s						
							U10 > 3.25					
	Temp Adj H	**kG** m/s	**kL** m/s	**KL turb** m/s	**kG** m/s	**U10 < 3.25**	F/D<14	14<F/D<51.2	F/D>51.2	**kL** m/s	**KL quisc** m/s	**KL overall** m/s
ne1												
ethanol	8.77E-06	1.55E-01	2.27E-02	5.37E-05	3.82E-03	4.31E-06	NA	3.38E-06	1.16E-06	4.31E-06	1.01E-06	3.54E-06
ne 2												
ethanol	7.99E-06	1.55E-01	2.17E-02	4.92E-05	3.88E-03	4.31E-06	NA	4.06E-06	1.16E-06	4.31E-06	9.57E-07	2.40E-06
ne 3												
ethanol	7.16E-06	1.55E-01	2.06E-02	4.44E-05	3.87E-03	4.31E-06	NA	4.37E-06	1.16E-06	4.31E-06	8.82E-07	1.38E-06

FORM XIII. DATA FORM FOR THE ESTIMATION OF MULTIPLE ZONE BIODEGRADATION FROM UNIT CONCENTRATIONS

Data Date: PAE - New Stripper Scenario

NAME OF THE FACILITY		
COMPOUND for site specific biorate determination		**Methanol**
Number of zones in the biological treatment unit	1	
VOLUME of full-scale system (cubic meters)	2	250372.98
Average DEPTH of the full-scale system (meters)	3	1.0878333
FLOW RATE of wastewater to the unit (m3/s)	4	1.116
FLOW RATE of condensate to the unit (m3/s)	5	0.000
Total wastewater flowrate - (including condensates) (m3/s)	5-A	1.116
ESTIMATE OF KL (m/s)	6	*see table*
Concentration in the wastewater treated in the unit (mg/L)	7	60
Concentration in the condensates (mg/L)	8	0
Concentration in wastewater (total - inc. cond) in (mg/L)	8-A	60
Concentration in the effluent (mg/L)	9	5.0982378

TOTAL INLET FLOW (m3/s) line 4 plus the number on line 5 (or 5-A)	10	1.116	
TOTAL RESIDENCE TIME (s) line 2 divided by line 10.	11	224279	2.60 days
TOTAL AREA OF IMPOUNDMENT (m2) line 2 divided by line 3	12	230157	

Lines 13 through 15 Not Used

Zone Number	Concentration for zone, Ci (mg/L)	Area of the zone, A (m2)	Estimate of KL in the zone (m/s)	AIR STRIPPING KL A Ci (g/s)	
1	7.38608521	87091.1501	3.54365E-06	2.2795	0.308621
2	5.393164807	67793.7816	2.39719E-06	0.8765	0.162515
3	3.166816433	70821.6825	1.37942E-06	0.309	0.097693
4					
5					
6					
TOTALS - sum for each zone.	15	225706.614	16	3.47	

Removal by air stripping (g/s). Line 16.	17	3.47
Loading in effluent (g/s). Line 9 times line 10.	18	5.69
Total loading (g/s). {(line 5*line 8)+(line 4*line 7)} or {line 5-A*line 8-A}.	19	67.0
Removal by biodegradation (g/s) Line 19 minus (line 17 + line 18).	20	57.8
Fraction biodegraded: Divide line 20 by line 19.	21	0.863
Fraction air emissions: Divide line 17 by line 19.	22	0.052
Fraction remaining in unit effluent. Divide line 18 by 19.	23	0.085

‹ C FORMS - CALCULATING FRACTION BIODEGRADED

: PAE - Old Stripper Scenario

ns: Enter data in green shaded sections of this page of this spreadsheet only.

:ATMENT UNIT DESCRIPTION

	Units	Zone 1	Zone 2	Zone 3
' 75 HP Aerators	#	31	15	6
' 100 HP Aerators	#	0	0	0
epower	HP	2325	1125	450
ıre	C	35.4	33.5	31.3
	ft	968	1,208	1,235
	ft	968	604	617
›epth	ft	4.5	3.2	3
›tation	rpm	1200	1200	1200
›rea per 75 HP aerator	ft2	1452	1452	1452
›rea per 100 HP aerator	ft2	2206	2206	2206
iameter	in	19.5	19.5	19.5

II. OVERALL PARAMS - individual flows

	Flow MGD	MeOH mg/L
Inlet Stream **	25.48	59.5
Condensate Stream	1.2	2,095
Outlet	26.7	5.1

** *except condensate flow*

NA - individual flow/conc data not available

‹LL PARAMS - total flows

		Flow m3/sec	Flow MGD	MeOH mg/L
›ncentration			26.7	152.8
›ncentration				5.10
›d	mph			3.8

III. HAP DATA

Methanol

	Units	Inlet	Zone 1	Zone 2	Zone 3
			Average Zone Concentration		
Conc.	mg/L	152.8	41.9	24.2	7.6
Temp.	F		95.7	92.3	88.3
			27%	**16%**	**5%**

Avg. 2021/2022 Zone Reductions

LTS	
ıanol	%
odegraded	86.8
r emissions	9.9
›maining in unit effluent	3.3

APPENDIX C FORMS - CALCULATING FRACTION BIODEGRADED
PARAMETERS FOR CALCULATING MASS TRANSFER COEFIICIENTS

Data Date: PAE - Old Stripper Scenario

	Diff in Water cm2/s	Diff in Air cm2/s	Henry's Law atm-m3/mol	Equil. Ratio (Hc) or (Keq) m3 liq to m3 gas	MW g/mol	ScG	Antoine Eqtn b	Antoine Eqtn c
Methanol	1.64E-05	0.150	5.19E-06	2.12E-04	32.0	1.006	1474	229.13
Acetaldehyde	1.41E-05	0.124	8.77E-05	3.58E-03	45.1	1.216	1600	291.8
MEK	9.80E-06	0.081	1.30E-04	5.31E-03	72.1	1.867	1305	229.27

General

	Units	Value	Name
viscosity of air	g/cm-s	0.000181	va
viscosity of water	g/cm-s	0.002	vw
density of air	g/cm3	0.0012	da
density of water	g/cm3	1	dw
MW of air	g/mol	29	Mwa
MW of water	g/mol	18	MWw
Diff of O2 in H2O	cm2/s	2.40E-05	DO2w
grav const.	lb-ft/s2/lb	32.17	g
R	atm-m3/mol K	8.21E-05	R_
Aerator Motor Eff	fraction	0.85	AerEff
O2 Trans Correct		0.83	Beta
Wind Speed	m/s	1.69	U
Diff of Ether	m/s	8.50E-06	Dether
O2 Trans	lb O2/HP-h	3	J

TURBULENT
KL Params

	Zone 1	Zone 2	Zone 3
w	126.3	126.3	126.3
Re	2.07E+06	2.07E+06	2.07E+06
Pl	35063	35063	35063
Power Number, p	7.92E-04	7.92E-04	7.92E-04
Fr	8.06E+02	8.06E+02	8.06E+02
Total TurbArea (ft2)	45012	21780	8712
Total TurbArea (m2)	4181.6	2023.4	809.3
Frac. Agitated (by surface aerators)	0.048	0.030	0.011
QUIESCENT			
Depth	1.37	0.98	0.92
SurfArea (ft2)	937472	729750	762343
SurfArea (m2)	87208.33	67885.00	70916.98
F/D Ratio	243	301	328
ScL - Methanol	NA	NA	NA
ScL - Acetaldehyde	NA	NA	NA
ScL - MEK	NA	NA	NA
U* (Friction Velocity)	NA	NA	NA

These Parameters are used when F/D < 14 **AND** U > 3.25 m/s

DIFFUSED

	Zone 1	Zone 2	Zone 3
Air flow, cfm	0	0	0
Air flow, m3/s	0.000	0.000	0.000

PPENDIX C FORMS - CALCULATING FRACTION BIODEGRADED
alculating Mass Transfer Coefficient KL for Various Zones

ata Date: PAE - Old Stripper Scenario

	Surface Aeration												
		Turbulent Area			Quiescient Area								
						kL, m/s							
	Temp Adj H	kG m/s	kL m/s	KL turb m/s	kG m/s	U10 < 3.25	U10 > 3.25 F/D<14	U10 > 3.25 14<F/D<51.2	U10 > 3.25 F/D>51.2	kL m/s	KL quisc m/s	KL overall m/s
ne1												
ethanol	8.77E-06	1.55E-01	2.27E-02	5.37E-05	3.82E-03	4.31E-06	NA	3.38E-06	1.16E-06	4.31E-06	1.01E-06	3.54E-06
ne 2												
ethanol	7.99E-06	1.55E-01	2.17E-02	4.92E-05	3.88E-03	4.31E-06	NA	4.06E-06	1.16E-06	4.31E-06	9.57E-07	2.40E-06
ne 3												
ethanol	7.16E-06	1.55E-01	2.06E-02	4.44E-05	3.87E-03	4.31E-06	NA	4.37E-06	1.16E-06	4.31E-06	8.82E-07	1.38E-06

FORM XIII. DATA FORM FOR THE ESTIMATION OF MULTIPLE ZONE BIODEGRADATION FROM UNIT CONCENTRATIONS

Data Date: PAE - Old Stripper Scenario

NAME OF THE FACILITY		
COMPOUND for site specific biorate determination		**Methanol**
Number of zones in the biological treatment unit	1	
VOLUME of full-scale system (cubic meters)	2	250372.98
Average DEPTH of the full-scale system (meters)	3	1.0878333
FLOW RATE of wastewater to the unit (m3/s)	4	1.116
FLOW RATE of condensate to the unit (m3/s)	5	0.054
Total wastewater flowrate - (including condensates) (m3/s)	5-A	1.170
ESTIMATE OF KL (m/s)	6	*see table*
Concentration in the wastewater treated in the unit (mg/L)	7	59.511413
Concentration in the condensates (mg/L)	8	2094.7948
Concentration in wastewater (total - inc. cond) in (mg/L)	8-A	152.79058
Concentration in the effluent (mg/L)	9	5.0982378

TOTAL INLET FLOW (m3/s) line 4 plus the number on line 5 (or 5-A)	10	1.170	
TOTAL RESIDENCE TIME (s) line 2 divided by line 10.	11	214000	2.48 days
TOTAL AREA OF IMPOUNDMENT (m2) line 2 divided by line 3	12	230157	

Lines 13 through 15 Not Used

Zone Number	Concentration for zone, Ci (mg/L)	Area of the zone, A (m2)	Estimate of KL in the zone (m/s)	AIR STRIPPING KL A Ci (g/s)	
1	41.94854003	87091.1501	3.54365E-06	12.9462	0.308621
2	24.242506	67793.7816	2.39719E-06	3.9398	0.162515
3	7.579459633	70821.6825	1.37942E-06	0.740	0.097693
4					
5					
6					
TOTALS - sum for each zone.	15	225706.614	16	17.63	

Removal by air stripping (g/s). Line 16.	17	17.63
Loading in effluent (g/s). Line 9 times line 10.	18	5.96
Total loading (g/s). {(line 5*line 8)+(line 4*line 7)} or {line 5-A*line 8-A}.	19	178.8
Removal by biodegradation (g/s) Line 19 minus (line 17 + line 18).	20	155.2
Fraction biodegraded: Divide line 20 by line 19.	21	0.868
Fraction air emissions: Divide line 17 by line 19.	22	0.099
Fraction remaining in unit effluent. Divide line 18 by 19.	23	0.033

DIX C FORMS - CALCULATING FRACTION BIODEGRADED

ıte: PAE - No Stripper

ːions: Enter data in green shaded sections of this page of this spreadsheet only.

REATMENT UNIT DESCRIPTION

	Units	Zone 1	Zone 2	Zone 3
of 75 HP Aerators	#	31	15	6
of 100 HP Aerators	#	0	0	0
ɔrsepower	HP	2325	1125	450
ature	C	35.4	33.5	31.3
	ft	968	1,208	1,235
	ft	968	604	617
ɛ Depth	ft	4.5	3.2	3
Rotation	rpm	1200	1200	1200
ı Area per 75 HP aerator	ft2	1452	1452	1452
ı Area per 100 HP aerator	ft2	2206	2206	2206
Diameter	in	19.5	19.5	19.5

II. OVERALL PARAMS - individual flows

	Flow MGD	MeOH mg/L
Inlet Stream **	25.48	59.5
Condensate Stream	1.2	3,809
Outlet	26.7	5.1

** *except condensate flow*

NA - individual flow/conc data not available

RALL PARAMS - total flows

		Flow m3/sec	Flow MGD	MeOH mg/L
Concentration			26.7	231.3
Concentration				5.09824
ɔeed	mph			3.8

III. HAP DATA

Methanol

	Units	Inlet	Average Zone Concentration Zone 1	Zone 2	Zone 3
Conc.	mg/L	231.3	63.5	36.7	11.5
Temp.	F		95.7	92.3	88.3
			27%	16%	5%

Avg. 2021/2022 Zone Reductions

ƐULTS

ethanol	%
biodegraded	87.9
air emissions	9.9
remaining in unit effluent	2.2

APPENDIX C FORMS - CALCULATING FRACTION BIODEGRADED
PARAMETERS FOR CALCULATING MASS TRANSFER COEFIICIENTS

Data Date: PAE - No Stripper

	Diff in Water cm2/s	Diff in Air cm2/s	Henry's Law atm-m3/mol	Equil. Ratio (Hc) or (Keq) m3 liq to m3 gas	MW g/mol	ScG	Antoine Eqtn b	Antoine Eqtn c
Methanol	1.64E-05	0.150	5.19E-06	2.12E-04	32.0	1.006	1474	229.13
Acetaldehyde	1.41E-05	0.124	8.77E-05	3.58E-03	45.1	1.216	1600	291.8
MEK	9.80E-06	0.081	1.30E-04	5.31E-03	72.1	1.867	1305	229.27

General

	Units	Value	Name
viscosity of air	g/cm-s	0.000181	va
viscosity of water	g/cm-s	0.002	vw
density of air	g/cm3	0.0012	da
density of water	g/cm3	1	dw
MW of air	g/mol	29	Mwa
MW of water	g/mol	18	MWw
Diff of O2 in H2O	cm2/s	2.40E-05	DO2w
grav const.	lb-ft/s2/lb	32.17	g
R	atm-m3/mol K	8.21E-05	R_
Aerator Motor Eff	fraction	0.85	AerEff
O2 Trans Correct		0.83	Beta
Wind Speed	m/s	1.69	U
Diff of Ether	m/s	8.50E-06	Dether
O2 Trans	lb O2/HP-h	3	J

TURBULENT
KL Params

	Zone 1	Zone 2	Zone 3
w	126.3	126.3	126.3
Re	2.07E+06	2.07E+06	2.07E+06
PI	35063	35063	35063
Power Number, p	7.92E-04	7.92E-04	7.92E-04
Fr	8.06E+02	8.06E+02	8.06E+02
Total TurbArea (ft2)	45012	21780	8712
Total TurbArea (m2)	4181.6	2023.4	809.3
Frac. Agitated (by surface aerators)	0.048	0.030	0.011
QUIESCENT			
Depth	1.37	0.98	0.92
SurfArea (ft2)	937472	729750	762343
SurfArea (m2)	87208.33	67885.00	70916.98
F/D Ratio	243	301	328
ScL - Methanol	NA	NA	NA
ScL - Acetaldehyde	NA	NA	NA
ScL - MEK	NA	NA	NA
U* (Friction Velocity)	NA	NA	NA

These Parameters are used when F/D < 14 **AND** U > 3.25 m/s

DIFFUSED

	Zone 1	Zone 2	Zone 3
Air flow, cfm	0	0	0
Air flow, m3/s	0.000	0.000	0.000

'PENDIX C FORMS - CALCULATING FRACTION BIODEGRADED

ılculating Mass Transfer Coefficient KL for Various Zones

ıta Date: PAE - No Stripper

	Surface Aeration											
		Turbulent Area			Quiescent Area							
						kL, m/s						
							U10 > 3.25					
	Temp Adj H	kG m/s	kL m/s	KL turb m/s	kG m/s	U10 < 3.25	F/D<14	14<F/D<51.2	F/D>51.2	kL m/s	KL quisc m/s	KL overall m/s
ıne1 ethanol	8.77E-06	1.55E-01	2.27E-02	5.37E-05	3.82E-03	4.31E-06	NA	3.38E-06	1.16E-06	4.31E-06	1.01E-06	3.54E-06
ıne 2 ethanol	7.99E-06	1.55E-01	2.17E-02	4.92E-05	3.88E-03	4.31E-06	NA	4.06E-06	1.16E-06	4.31E-06	9.57E-07	2.40E-06
ıne 3 ethanol	7.16E-06	1.55E-01	2.06E-02	4.44E-05	3.87E-03	4.31E-06	NA	4.37E-06	1.16E-06	4.31E-06	8.82E-07	1.38E-06

FORM XIII. DATA FORM FOR THE ESTIMATION OF MULTIPLE ZONE BIODEGRADATION FROM UNIT CONCENTRATIONS

Data Date: PAE - No Stripper

NAME OF THE FACILITY		
COMPOUND for site specific biorate determination		**Methanol**
Number of zones in the biological treatment unit	1	
VOLUME of full-scale system (cubic meters)	2	250372.98
Average DEPTH of the full-scale system (meters)	3	1.0878333
FLOW RATE of wastewater to the unit (m3/s)	4	1.116
FLOW RATE of condensate to the unit (m3/s)	5	0.054
Total wastewater flowrate - (including condensates) (m3/s)	5-A	1.170
ESTIMATE OF KL (m/s)	6	*see table*
Concentration in the wastewater treated in the unit (mg/L)	7	59.511413
Concentration in the condensates (mg/L)	8	3808.7177
Concentration in wastewater (total - inc. cond) in (mg/L)	8-A	231.34146
Concentration in the effluent (mg/L)	9	5.0982378

TOTAL INLET FLOW (m3/s) line 4 plus the number on line 5 (or 5-A)	10	1.170	
TOTAL RESIDENCE TIME (s) line 2 divided by line 10.	11	214000	2.48 days
TOTAL AREA OF IMPOUNDMENT (m2) line 2 divided by line 3	12	230157	

Lines 13 through 15 Not Used

Zone Number	Concentration for zone, Ci (mg/L)	Area of the zone, A (m2)	Estimate of KL in the zone (m/s)	AIR STRIPPING KL A Ci (g/s)	
1	63.5146271	87091.1501	3.54365E-06	19.6019	0.308621
2	36.70577636	67793.7816	2.39719E-06	5.9652	0.162515
3	11.47612174	70821.6825	1.37942E-06	1.121	0.097693
4					
5					
6					
TOTALS - sum for each zone.	15	225706.614	16	26.69	

Removal by air stripping (g/s). Line 16.	17	26.69
Loading in effluent (g/s). Line 9 times line 10.	18	5.96
Total loading (g/s). {(line 5*line 8)+(line 4*line 7)} or {line 5-A*line 8-A}.	19	270.7
Removal by biodegradation (g/s) Line 19 minus (line 17 + line 18).	20	238.0
Fraction biodegraded: Divide line 20 by line 19.	21	0.879
Fraction air emissions: Divide line 17 by line 19.	22	0.099
Fraction remaining in unit effluent. Divide line 18 by 19.	23	0.022

APPENDIX C - AIR DISPERSION MODELING DOCUMENTATION

Background:

New-Indy Catawba initially submitted an updated ambient air dispersion modeling analysis in support of the New Condensate Stripper Construction Permit Application (application) in March 2023. Facility-wide modeling of hydrogen sulfide (H_2S), methyl mercaptan (MMC), and total reduced sulfur (TRS) compounds was conducted using the source parameters, meteorology, and receptor network provided by SCDHEC, with the exception of the additional secondary containment tank (Source ID NEWSPLTK) and associated structure (Structure ID NEWSPLTK) that were included in the March 8, 2023 modeling submitted to SCDHEC.

For WWTP sources, New-Indy Catawba used the maximum actual emissions rates as submitted in the October 2021 analysis (for H_2S, and TRS) and corresponding MMC emissions rates, with the exception of the ASB. Based on U.S. EPA's direction, the October 2021 modeling analysis was performed using WWTP emissions rates derived from the RSK-175 method results, rather than the ALS GC method results.

Refined emissions rates reflecting the new steam stripper operation and foul condensate flow for the ASB were developed in support of the application based on ALS GC method results. Due to the ASB being the only WWTP source impacted by the new condensate steam stripper, New-Indy Catawba initially submitted the ambient air dispersion modeling analysis with the updated ASB emissions rates (ALS GC method), but did not change the emissions rates of the other WWTP sources from the October 2021 modeling analysis (RSK-175 method).

The emissions rates used in the original application's modeling analysis were most recently provided to SCDHEC in New-Indy Catawba's July 6, 2023 response.

In discussions and communications after submittal of the original application, SCDHEC has directed New-Indy Catawba to update the air dispersion modeling analysis with emissions rates for all of the WWTP sources based on the ALS GC method results, specifically in the August 25, 2023 email from Katharine Buckner (SCDHEC). This updated air dispersion modeling analysis was submitted in October 2023.

Discussion of Updated WWTP Emissions Rates:

The average ALS GC results from the July 2021 sampling were used to estimate actual emissions rates, which was then scaled up to a maximum emissions rate using the ratio of the July 2021 actual pulp production to a max of 2700 ADTP/day. The modeling analysis is based on these maximum emissions rates. There are no changes to the Post Aeration Basin, Holding Pond (H_2S only), and Sludge Pond emissions rates, as they were not dependent upon July 2021 liquid sulfur sampling results.

Air Dispersion Modeling Results:

The air dispersion modeling analysis was conducted using the updated ALS emissions rates for WWTP sources as discussed above, with the same source parameters and emissions rates for non-WWTP sources and the Post-Aeration Basin as the original modeling analysis for the application. Results of the air dispersion modeling analysis demonstrate that ambient concentrations are below the relevant standards for H_2S, MM, and TRS for each averaging period.

New-Indy Catawba, LLC
2023 New Steam Stripper Application

Pollutant	Standard[a]	Averaging Period[b]	Modeled Concentration ($\mu g/m^3$)	UTM Easting (m)	UTM Northing (m)	Rank[a]	Standard[a][c][d] ($\mu g/m^3$)
H_2S	MAAC	24-hour	20.20	511,397.27	3,856,649.76	1st High	140
	EPA Action Level	30-minute	100.80	511,249.70	3,856,644.83	1-hour 1st High	837
MMC	MAAC	24-hour	9.46	510,115.55	3,856,041.31	1st High	10
	EPA Action Level	30-minute	48.00	510,209.41	3,856,039.95	1-hour 1st High	57,000
TRS	MAAC	24-hour	77.25	511,249.70	3,856,644.83	1st High	140
	EPA Action Level	30-minute	385.32	510,143.86	3,855,999.18	1-hour 1st High	837

(a) https://scdhec.gov/sites/default/files/media/document/BAQ_SC%20Modeling%20Guidelines_10.15.18_revised%204.15.19.pdf.

(b) 30-minute averaging period to be compared against maximum 1-hour modeled concentration, per DHEC October 6, 2021 request.

(c) TRS does not have a SC Standard - compare to H_2S.

(d) Methyl Mercaptan does not have an established AEGL-1 value due to insufficient data. Comparison of modeled concentrations are to the 30-minute AEGL-2 value for MMC only.

APPENDIX D -
BACKUP STRIPPER METHANOL MODE ADDENDUM

Background

The construction permit application for the New Condensate Steam Stripper project (Project) was originally submitted in March 2023. The application was updated in April 2024 to reflect the final project description and project emissions calculations at the request of SCDHEC.

The Mill currently utilizes a dual-treatment approach for compliance with the pulping condensate standards of 40 CFR Part 63, Subpart S. The Mill currently operates the existing steam stripper in "methanol mode", which prioritizes operation of the existing condensate steam stripper to remove or "strip" both total reduced sulfur (TRS) compounds and methanol while being fed ~350 gallons per minute (gpm) of foul condensates. Any excess foul condensate flow is treated with hydrogen peroxide to chemically oxidize the hydrogen sulfide into either elemental sulfur or sulfate, then sent via hardpipe to the aerated stabilization basin (ASB) for biological treatment of methanol. When operating in methanol mode, stripped condensates are recycled to the Brownstock Washers, as needed, or discharged to the ASB via the sewer.

Upon installation of the new steam stripper, the existing steam stripper will operate as a backup steam stripper during periods of downtime on the new steam stripper. As part of the Project, the Mill is proposing to operate the backup steam stripper in "TRS mode," which entails feeding all of the foul condensates collected at the mill to the backup steam stripper (nominally 850 gpm). No foul condensates would be sent directly down the hardpipe when the backup steam stripper is in TRS mode.

In TRS mode, the backup steam stripper is expected to still be capable of stripping all of the TRS compounds from the foul condensates (nominal >98% removal). However, due to the higher feed rate of foul condensates to the backup stripper, it is not expected to still be capable of stripping all of the methanol (nominal 45% removal expected). Consequently, the stripped condensate would need to be sent via existing hardpipe to the ASB for further biological treatment of methanol, consistent with the PAE calculations. Emissions calculations for the backup stripper in TRS mode were presented in the original construction permit application submitted in March 2023.

The Mill has been required to operate the existing steam stripper in methanol mode. As such, the Mill is unable to gather meaningful trial data for confirmation of the expected performance of the existing steam stripper operating in TRS mode. After further discussions with SCDHEC concerning the potential technical limitations of gathering data on TRS mode, the Mill provided SCDHEC an update to the PSD applicability calculations to include the alternate operating scenario of the backup stripper operating in methanol mode (i.e., the backup stripper operating as it currently does as the primary, existing stripper). This information, also provided in this updated application, demonstrates that operating the backup stripper in either TRS or methanol mode results in no change to the PSD applicability conclusions of the project.

Methanol Mode Emissions

This section addresses the differences in the project emissions calculations between the backup stripper operating in either TRS or methanol mode. For each pollutant, New-Indy presented emissions factors for both operating modes in the Appendix B calculations, but the worst-case operating mode was used for PSD applicability calculations to demonstrate the flexibility between the two modes.

One key difference between the two operating modes is that methanol mode requires more steam fed to the stripper. Generally, the Mill has updated the post-project emissions calculations for products of combustion resulting from generation of steam for the backup stripper to account for the higher steam requirements of methanol mode, which results in a small increase in post-project emissions from the original application submittal. Since the existing stripper has operated in methanol mode during the entirety of the baseline, steam heat input for the projected backup stripper methanol mode scenario was assumed to equal the baseline value.

Emissions resulting from the incineration of the backup stripper off gases (SOG) in the combination boilers vary, particularly for VOC and TRS compounds (and consequently SO_2), based on how much of these compounds are present in the SOG prior to combustion, which depends on several variables, including stripper feed flow rate and stripper removal efficiency. The operating mode of the backup stripper affects both of these variables. Although methanol mode results in a higher stripper removal efficiency, it is at a reduced feed rate, which would both impact the mass of VOC and TRS compounds present in the SOG.

For simplicity, New-Indy based emissions from the backup stripper SOG incineration on the assumption that 100% of the VOC and TRS compounds present in the full volume of foul condensates would be stripped into the SOG and then result in incineration emissions. This is the most conservative SOG emissions calculation as it assumes a 100% stripper removal efficiency for both VOC and TRS compounds at the full foul condensate flow rate (nominal 850 gpm).

The key difference between the backup stripper operating modes is the post-project emissions from the ASB. When the backup stripper is in TRS mode, the ASB would receive up to 850 gpm of condensate that has been stripped of TRS compounds but still containing ~55% of its original methanol. When the backup stripper is in methanol mode, the ASB would receive ~500 gpm of foul condensate. TRS compounds would be treated with hydrogen peroxide addition and the methanol would be treated biologically in the ASB.

Appendix B includes the H2SSIM, WATER9, and Form XIII calculations for determining the ASB emissions factors for VOC, TRS, and H_2S when the backup stripper is operating in TRS mode. This appendix includes H2SSIM, WATER9, and Form XIII calculations for the ASB VOC, TRS, and H_2S emissions factors when the backup stripper is operating in methanol mode.

New-Indy used the worst-case emissions factor between the two scenarios for each pollutant's PSD applicability calculations to demonstrate that PSD is not triggered during post-project periods that the backup stripper must be operated, whether it operates in TRS or methanol mode.

Backup Stripper (Methanol Mode) Scenario - Projected Actual Emissions
H_2S, TRS Compounds, and VOC
New-Indy Catawba - Catawba, SC

Concentration Loadings	H2S, ppm	DMDS, ppm	DMS, ppm	MMC, ppm
Design Foul Condensate Loadings (prior to H2O2)	147	15.00	17.00	16.00
Predicted % Reduction from H_2O_2	0.99	MMC converted into DMDS	0.90	0.99
Foul Condensate (after H_2O_2)	1.47	30.51	1.70	0.16
Avg. ASB Inlet (2021 and 2022)	0.25	0.09	0.20	0.0026
Flow Weighted Loading:	0.29	0.92	0.24	6.93E-03
H2SSIM/WATER9 Results	**H2S, g/s**	**DMDS, g/s**	**DMS, g/s**	**MMC, g/s**
ASB Zone 1	0.07	0.35	0.19	5.81E-03
ASB Zone 2	0.03	5.66E-03	4.06E-03	1.06E-04
ASB Zone 3	0.02	1.09E-04	1.45E-04	3.51E-06
Total ASB	**0.12**	**0.36**	**0.19**	**5.92E-03**
PAE Emissions Factors	**H2S, lb/ODTP**	**DMDS, lb/ODTP**	**DMS, lb/ODTP**	**MMC, lb/ODTP**
Total ASB	**1.05E-02**	**3.08E-02**	**1.69E-02**	**5.12E-04**

Post-Project Foul Condensate Flow:	500	gpm
Post-Project Foul Condensate Flow:	0.72	MGD
Post-Project ASB Influent Flow:	25.48	MGD
Total ASB Flow:	26.20	MGD
Total ASB Flow:	1148	L/s
Pulp Production	2200	ODTP/day

	MW
H2S	34
DMDS	94
DMS	62
MMC	48

NCASI WASTEWATER HYDROGEN SULFIDE EMISSIONS SIMULATOR (H2SSIM)
Version 1.3

Data Type 1. Site Identification

Company Name	New-Indy
Facility Name	Catawba SC
Basin Name	ASB

Data Type 2. Model Zone Information

Number of Zones	3
Zone Location of Hardpipe	1
Type of Basin	ASB

Data Type 3. Load Characteristics

Loading Characteristics	Main Influent	Hardpipe	Units
Flow	25.48	0.72	MGD
Total Sulfide	0.252	1.47	mg/L
Sulfate	390	390	mg/L

Data Type 4. Atmospheric Conditions

Windspeed	3.55	mph
Ambient Temperature	79	F

Data Type 5. Zone Physical and Chemical Conditions

Zone Condition	Zone 1	Zone 2	Zone 3	Zone 4	Units
Dissolved Oxygen	1.57	4.63	4.66		mg/L
Temperature	93.34	89.74	86.02		F
pH	7.04	7.24	7.42		s.u.
Redox Condition	Aerobic	Aerobic	Aerobic	Aerobic	
Length	968	1208	1235		feet
Width	968	604	617		feet
Depth	4.5	3.2	3		feet
Mixing	Moderat	Moderat	Moderat		
Number of Aerators	31	15	6		
Total Horsepower	2325	1125	450		HP
Impellor Size	1.625	1.625	1.625		feet
Impellor RPM	1200	1200	1200		RPM
Diffused Air Flow	0	0	0		cms
Weir Height	0	0	0		feet

Model Controls

Run H2SSIM

View Parameters

Clear Input Sheet

H2SSIM Results

Backup Stripper Methanol Mode Scenario

Basin Emissions		Units
Total Emissions (H_2S)	0.121	gms/s
Total Emissions (H_2S)	8417.2	lbs/yr
Total Emissions (H_2S)	4.2	tons/yr
Total Emissions (H_2S)	3.8	tonnes/yr
Emission Flux (H_2S)	16.9	gms/m^2 yr

Zone Emissions	Zone 1	Zone 2	Zone 3	Zone 4	Units
Zone Emissions (H_2S)	0.07	0.03	0.02		gms/s
Zone Emissions (H_2S)	5132.3	1762.9	1521.9		lbs/yr
Emission Flux (H_2S)	26.7	11.8	9.8		gms/m^2 yr
Liquid Conc. (Total Sulfide)	0.003	0.001	0.000		mg/L
Liquid Sulfide Load (lbs/yr)	39.300	6.400	5.600		lbs/yr

Percent Inlet Sulfide Removed	63.0%

Current Parameters	
kgen	0.25
ThetaGen	1.06
KDO	0.05
KSO4	10
kanox	0.006
ThetaOx	1.05
m	1
n	0.2
MLVSS	272.2
O_2 Transfer Coeff.	2
alpha 1	0.83
alpha 2	0.6

SUMMARY FOR EMISSIONS AT UNIT 11 ASB Zone 1 aerated biotreatment
03-14-2024 09:38:13

COMPOUND NAME	conc in (ppmw)	fe air	fe bio	conc out (ppmw)	emissions (g/s)
DIMETHYL DISULFIDE	8.367e-1	0.36428	0.61827	1.46e-2	3.499e-1
DIMETHYL SULFIDE (DMS)	2.074e-1	0.80097	0.17688	4.593e-3	1.907e-1
HYDROGEN SULFIDE	2.835e-1	0.98155	0.	5.231e-3	3.195e-1
METHANETHIOL(methyl mercaptan)	5.699e-3	0.8877	0.09361	1.065e-4	5.808e-3
Total rate for all compounds					8.658e-1

SUMMARY FOR EMISSIONS AT UNIT 17 ASB Zone 3 aerated biotreatment
03-14-2024 09:38:13

COMPOUND NAME	conc in (ppmw)	fe air	fe bio	conc out (ppmw)	emissions (g/s)
DIMETHYL DISULFIDE	5.231e-4	0.18124	0.76948	2.578e-5	1.088e-4
DIMETHYL SULFIDE (DMS)	2.136e-4	0.58962	0.31941	1.943e-5	1.446e-4
HYDROGEN SULFIDE	2.231e-4	0.88747	0.	2.511e-5	2.273e-4
METHANETHIOL(methyl mercaptan)	4.197e-6	0.72787	0.18714	3.567e-7	3.507e-6
Total rate for all compounds					4.842e-4

SUMMARY FOR EMISSIONS AT UNIT 18 ASB Zone 2 aerated biotreatment
03-14-2024 09:38:13

COMPOUND NAME	conc in (ppmw)	fe air	fe bio	conc out (ppmw)	emissions (g/s)
DIMETHYL DISULFIDE	1.46e-2	0.3375	0.62668	5.231e-4	5.658e-3
DIMETHYL SULFIDE (DMS)	4.593e-3	0.7705	0.183	2.136e-4	4.063e-3
HYDROGEN SULFIDE	5.231e-3	0.95735	0.	2.231e-4	5.749e-3
METHANETHIOL(methyl mercaptan)	1.065e-4	0.86336	0.09723	4.197e-6	1.056e-4
Total rate for all compounds					1.558e-2

APPENDIX C FORMS - CALCULATING FRACTION BIODEGRADED

Data Date: PAE - Backup Stripper (Methanol Mode)

Instructions: Enter data in green shaded sections of this page of this spreadsheet only.

I. BIOTREATMENT UNIT DESCRIPTION

	Units	Zone 1	Zone 2	Zone 3
Number of 75 HP Aerators	#	31	15	6
Number of 100 HP Aerators	#	0	0	0
Total Horsepower	HP	2325	1125	450
Temperature	C	35.4	33.5	31.3
Length	ft	968	1,208	1,235
Width	ft	968	604	617
Average Depth	ft	4.5	3.2	3
Aerator Rotation	rpm	1200	1200	1200
Agitation Area per 75 HP aerator	ft2	1452	1452	1452
Agitation Area per 100 HP aerator	ft2	2206	2206	2206
Impellor Diameter	in	19.5	19.5	19.5

II. OVERALL PARAMS - individual flows

	Flow MGD	MeOH mg/L
Inlet Stream **	25.48	59.5
Condensate Stream	0.7	3,809
Outlet	26.2	5.1

** *except condensate flow*

NA - individual flow/conc data not available

II. OVERALL PARAMS - total flows

	Flow m3/sec	Flow MGD	MeOH mg/L
Influent Concentration		26.2	162.5
Effluent Concentration			5.09824
Wind Speed	mph		3.8

III. HAP DATA

Methanol	Units	Inlet	Zone 1	Zone 2	Zone 3	Detect Limit
			Average Zone Concentration			
Conc.	mg/L	162.5	44.6	25.8	8.1	0.5
Temp.	F		95.7	92.3	88.3	

	Zone 1	Zone 2	Zone 3
Avg. 2021/2022 Zone Reductions	**27%**	**16%**	**5%**

IV. RESULTS

fbio - Methanol	%
Fraction biodegraded	86.8
Fraction air emissions	10.1
Fraction remaining in unit effluent	3.1

APPENDIX C FORMS - CALCULATING FRACTION BIODEGRADED
PARAMETERS FOR CALCULATING MASS TRANSFER COEFIICIENTS

Data Date: PAE - Backup Stripper (Methanol Mode)

	Diff in Water cm2/s	Diff in Air cm2/s	Henry's Law atm-m3/mol	Equil. Ratio (Hc) or (Keq) m3 liq to m3 gas	MW g/mol	ScG	Antoine Eqtn b	Antoine Eqtn c
Methanol	1.64E-05	0.150	5.19E-06	2.12E-04	32.0	1.006	1474	229.13
Acetaldehyde	1.41E-05	0.124	8.77E-05	3.58E-03	45.1	1.216	1600	291.8
MEK	9.80E-06	0.081	1.30E-04	5.31E-03	72.1	1.867	1305	229.27

General

	Units	Value	Name
viscosity of air	g/cm-s	0.000181	va
viscosity of water	g/cm-s	0.002	vw
density of air	g/cm3	0.0012	da
density of water	g/cm3	1	dw
MW of air	g/mol	29	Mwa
MW of water	g/mol	18	MWw
Diff of O2 in H2O	cm2/s	2.40E-05	DO2w
grav const.	lb-ft/s2/lb	32.17	g
R	atm-m3/mol K	8.21E-05	R_
Aerator Motor Eff	fraction	0.85	AerEff
O2 Trans Correct		0.83	Beta
Wind Speed	m/s	1.69	U
Diff of Ether	m/s	8.50E-06	Dether
O2 Trans	lb O2/HP-h	3	J

TURBULENT
KL Params

		Zone 1	Zone 2	Zone 3
	w	126.3	126.3	126.3
	Re	2.07E+06	2.07E+06	2.07E+06
	PI	35063	35063	35063
	Power Number, p	7.92E-04	7.92E-04	7.92E-04
	Fr	8.06E+02	8.06E+02	8.06E+02
	Total TurbArea (ft2)	45012	21780	8712
	Total TurbArea (m2)	4181.6	2023.4	809.3
	Frac. Agitated (by surface aerators)	0.048	0.030	0.011
	QUIESCENT			
	Depth	1.37	0.98	0.92
	SurfArea (ft2)	937472	729750	762343
	SurfArea (m2)	87208.33	67885.00	70916.98
	F/D Ratio	243	301	328
These Parameters are used when F/D < 14 **AND** U > 3.25 m/s	ScL - Methanol	NA	NA	NA
	ScL - Acetaldehyde	NA	NA	NA
	ScL - MEK	NA	NA	NA
	U* (Friction Velocity)	NA	NA	NA
	DIFFUSED			
	Air flow, cfm	0	0	0
	Air flow, m3/s	0.000	0.000	0.000

APPENDIX C FORMS - CALCULATING FRACTION BIODEGRADED
Calculating Mass Transfer Coefficient KL for Various Zones

Data Date: **PAE - Backup Stripper (Methanol Mode)**

Surface Aeration												
		Turbulent Area			Quiescient Area							
						kL, m/s						
	Temp Adj H	kG m/s	kL m/s	KL turb m/s	kG m/s	U10 < 3.25	U10 > 3.25 F/D<14	U10 > 3.25 14<F/D<51.2	U10 > 3.25 F/D>51.2	kL m/s	KL quisc m/s	KL overall m/s
Zone1												
Methanol	8.77E-06	1.55E-01	2.27E-02	5.37E-05	3.82E-03	4.31E-06	NA	3.38E-06	1.16E-06	4.31E-06	1.01E-06	3.54E-06
Zone 2												
Methanol	7.99E-06	1.55E-01	2.17E-02	4.92E-05	3.88E-03	4.31E-06	NA	4.06E-06	1.16E-06	4.31E-06	9.57E-07	2.40E-06
Zone 3												
Methanol	7.16E-06	1.55E-01	2.06E-02	4.44E-05	3.87E-03	4.31E-06	NA	4.37E-06	1.16E-06	4.31E-06	8.82E-07	1.38E-06

FORM XIII. DATA FORM FOR THE ESTIMATION OF MULTIPLE ZONE BIODEGRADATION FROM UNIT CONCENTRATIONS

Data Date: PAE - Backup Stripper (Methanol Mode)

NAME OF THE FACILITY		
COMPOUND for site specific biorate determination		**Methanol**
Number of zones in the biological treatment unit	1	
VOLUME of full-scale system (cubic meters)	2	250372.98
Average DEPTH of the full-scale system (meters)	3	1.0878333
FLOW RATE of wastewater to the unit (m3/s)	4	1.116
FLOW RATE of condensate to the unit (m3/s)	5	0.032
Total wastewater flowrate - (including condensates) (m3/s)	5-A	1.148
ESTIMATE OF KL (m/s)	6	*see table*
Concentration in the wastewater treated in the unit (mg/L)	7	59.511413
Concentration in the condensates (mg/L)	8	3809
Concentration in wastewater (total - inc. cond) in (mg/L)	8-A	162.53984
Concentration in the effluent (mg/L)	9	5.0982378

TOTAL INLET FLOW (m3/s) line 4 plus the number on line 5 (or 5-A)	10	1.148	
TOTAL RESIDENCE TIME (s) line 2 divided by line 10.	11	218116	2.52 days
TOTAL AREA OF IMPOUNDMENT (m2) line 2 divided by line 3	12	230157	

Lines 13 through 15 Not Used

Zone Number	Concentration for zone, Ci (mg/L)	Area of the zone, A (m2)	Estimate of KL in the zone (m/s)		AIR STRIPPING KL A Ci (g/s)	
1	44.62519102	87091.1501	3.54365E-06		13.7723	0.308621
2	25.78937099	67793.7816	2.39719E-06		4.1912	0.162515
3	8.06308953	70821.6825	1.37942E-06		0.788	0.097693
4						
5						
6						
TOTALS - sum for each zone.	15	225706.614		16	18.75	

Removal by air stripping (g/s). Line 16.	17	18.75
Loading in effluent (g/s). Line 9 times line 10.	18	5.85
Total loading (g/s). {(line 5*line 8)+(line 4*line 7)} or {line 5-A*line 8-A}.	19	186.6
Removal by biodegradation (g/s) Line 19 minus (line 17 + line 18).	20	162.0
Fraction biodegraded: Divide line 20 by line 19.	21	0.868
Fraction air emissions: Divide line 17 by line 19.	22	0.101
Fraction remaining in unit effluent. Divide line 18 by 19.	23	0.031

Buckner, Katharine

From:	Steven Moore <smoore@all4inc.com>
Sent:	Thursday, May 2, 2024 2:31 PM
To:	Rachel Davis; Buckner, Katharine
Cc:	Caleb Fetner; Sheryl Watkins
Subject:	Re: couple issues with the revised app
Attachments:	UPDATED Figure 2-1.pdf

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***

Improved Figure 2-1 attached. Please let us know if additional measures are needed.

Steven Moore / Senior Managing Consultant
D: 919.234.5981 / C: 864.616.4711 / Profile
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ALL4 // *STRATEGY WITH SOLUTION. PARTNERSHIP WITH A PURPOSE.*

From: Rachel Davis <Rachel.Davis@new-indycb.com>
Sent: Thursday, May 2, 2024 1:41 PM
To: Caleb Fetner <cfetner@all4inc.com>; Steven Moore <smoore@all4inc.com>; Sheryl Watkins <swatkins@all4inc.com>
Subject: Fwd: couple issues with the revised app

See Katharine's email below, she needs it ASAP please.

Rachel

From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Thursday, May 2, 2024 1:31:32 PM
To: Rachel Davis <Rachel.Davis@new-indycb.com>
Subject: RE: couple issues with the revised app

Please ask him to send it as soon as he can.

Thanks,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

Office: (803) 898-3213
bucknekk@dhec.sc.gov

S.C. Dept. of Health & Environmental Control
2600 Bull Street
Columbia, SC 29201

Connect: www.scdhec.gov Facebook Twitter

From: Buckner, Katharine
Sent: Thursday, May 2, 2024 1:26 PM
To: Rachel Davis <Rachel.Davis@new-indycb.com>
Subject: RE: couple issues with the revised app

Thanks Rachel.

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

Office: (803) 898-3213
bucknekk@dhec.sc.gov

S.C. Dept. of Health & Environmental Control
2600 Bull Street
Columbia, SC 29201

Connect: www.scdhec.gov Facebook Twitter

From: Rachel Davis <Rachel.Davis@new-indycb.com>
Sent: Thursday, May 2, 2024 1:04 PM
To: Buckner, Katharine <bucknekk@dhec.sc.gov>
Subject: Re: couple issues with the revised app

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Yes ma'am, it's the same version. I will forward your email to Caleb.

Rachel

From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Thursday, May 2, 2024 11:49:29 AM
To: Rachel Davis <Rachel.Davis@new-indycb.com>
Subject: couple issues with the revised app

External Email

Hey Rachel,

I have been through most of the revised application for the new stripper that you provided me at the site visit on Tuesday. A couple of figures and a couple of tables are blurry. There are quite a few pages in appendix B that were printed too large for the page. Can you provide replacements for these

Specifically,
Figure 2-1, pg 2-3
Table 3-1, pg 3-17 (there are two page 3-17, the first one is text, the second is the table)
Table 3-3, pg 3-24
Figure 5-6, pg B-21
Figure on pg B-22
Beginning after page B-115, several of the pages were printed too large for the paper size. These are H2SSIM outputs and Appendix C Forms. It was quite a few and page numbers were not on them.

I checked back on the one Caleb emailed on Monday. Only Figure 2-1 and a lot of the pages after B-115 are still the culprits. The pages after B-115 were pdfed as larger pages than 8x11.

We could use the one Caleb sent on Monday, but can you get the Figure 2-1 fixed? Is the emailed version the exact same as the copy you handed me on Tuesday?

Thanks,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

Office: (803) 898-3213
bucknekk@dhec.sc.gov

S.C. Dept. of Health & Environmental Control
2600 Bull Street
Columbia, SC 29201

Connect: www.scdhec.gov Facebook Twitter

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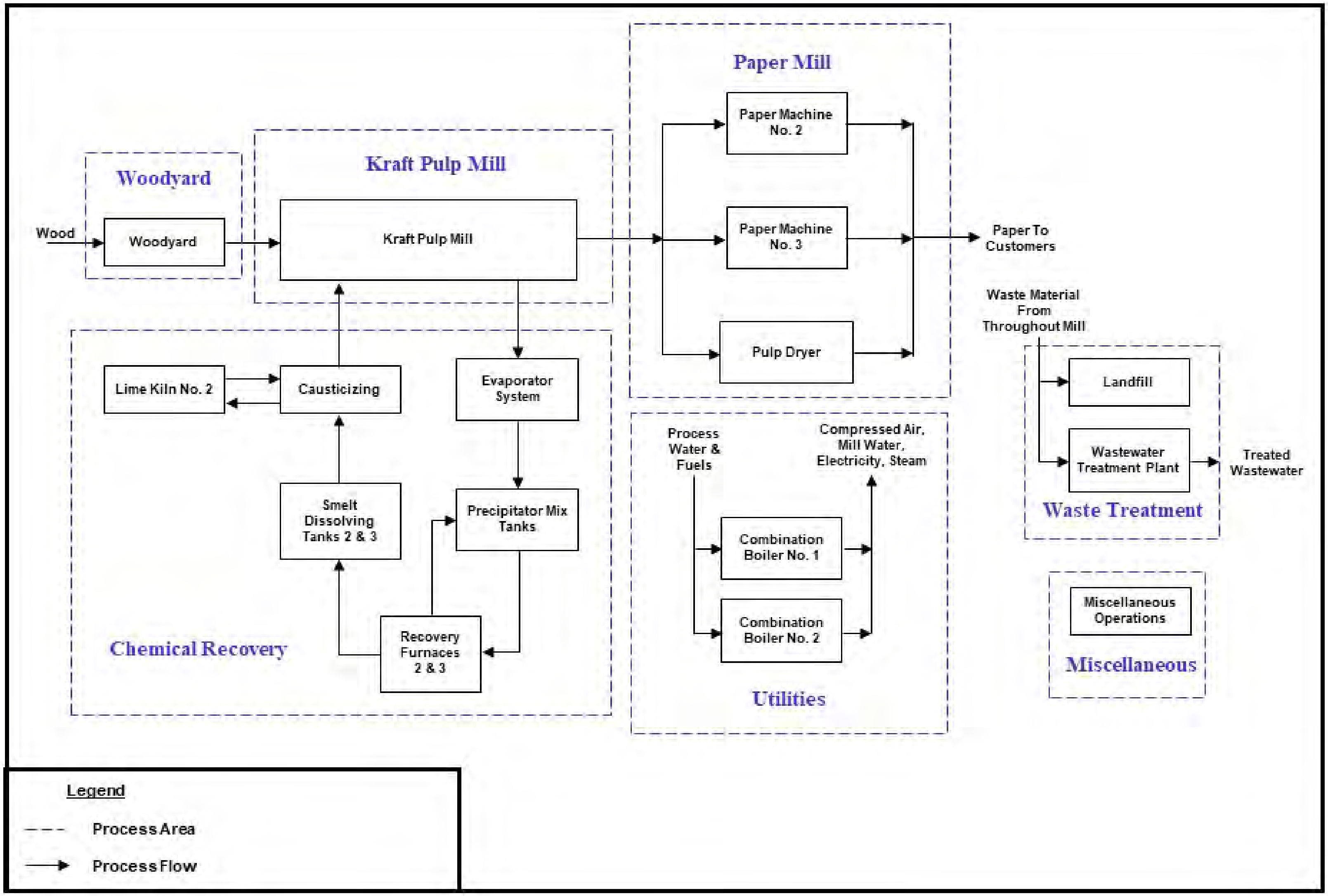
Figure 2-1 Simplified Mill Flow Diagram



Buckner, Katharine

From:	Sheryl Watkins <swatkins@all4inc.com>
Sent:	Tuesday, April 30, 2024 4:10 PM
To:	Buckner, Katharine
Cc:	Rachel Davis; Steven Moore; Caleb Fetner
Subject:	New-Indy Catawba - Comments on Condition B.26 (Revised Draft Construction Permit for the New Stripper)
Attachments:	RB3 revised SO2 BACT B.26 from DHEC (4-30-24).pdf

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***

Hi, Katharine! Thank you for providing the revised permit language for condition B.26 in the draft Construction Permit for the New Stripper (attached). On behalf of New-Indy Catawba, we have two requested clarifications to address that the original BACT analysis did not consider fossil fuel firing and is based on furnace design and proper operation (i.e., good combustion practices) when burning black liquor solids (PSD c/p-DA, issued March 16, 2006):

- First sentence: "(S.C. Regulation 61-62.5, Standard No. 7) The No. 3 Recovery Furnace is subject to the existing SO_2 BACT limits during black liquor solids firing of:"
- Second paragraph, third sentence: "Readings collected when black liquor solids are not fired in the recovery furnace ~~is shutdown or not operating~~ may not be used in the calculations."

Let us know if you have any questions and we would appreciate seeing a final version of the draft permit and sob. Thanks!

Sheryl Watkins, P.E. / Senior Technical Manager / ATL Office
swatkins@all4inc.com/ Direct: 678.293.9428 / Cell: 386.206.0266 / Profile / LinkedIn
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Buckner, Katharine

From:	Caleb Fetner <cfetner@all4inc.com>
Sent:	Tuesday, April 23, 2024 2:08 PM
To:	Buckner, Katharine
Cc:	Rachel Davis; Steven Moore; Sheryl Watkins
Subject:	RE: Questions on new stripper project
Attachments:	Response to DHEC questions posed in March 27 email (4-22-24).docx

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***

Hi Katharine,

Attached are New-Indy's responses to your questions below. Let us know if you have any questions.

Also – here are our comments on the Consent Decree and Ash Handling construction permits and SOBs.

DRAFT-2024-03-14_CP-50000175.v1.0 (Ash Handling CP)

- The current project description states that there is a "requirement to discontinue the practice of adding solids to the clarifier." The inherent operation of the clarifier involves sending solids, including fiber solids, in order to allow the solids to settle out of the wastewater for removal. The existing permit language would be at odds with the inherent operation of a clarifier. New-Indy is proposing to add the following clarifying sentence to the C/P to reconcile this issue.

  Page 3 of 11: *Permission is hereby granted to install and operate new equipment as part of meeting the requirement to discontinue the practice of adding solids to the clarifier, as directed by the federal Consent Decree entered in Civil No. 0:21-cv-02053-SAL, United States of America v. New-Indy Catawba, LLC, dated November 16, 2022 (Consent Decree). Specifically, the solids referred to in the Consent Decree are understood to be wet sluiced solids collected from the combination boilers.*

DRAFT-2024-03-14_CP-50000175.v1.0sob (Ash Handling SOB)

- Page 2 of 7: Combination Boiler No. 1, No. 7 conveyor to fly ash silo should be 3,100 lb/hr rather than 3,900 lb/hr.
- Page 3 of 7: PM_{10} and $PM_{2.5}$ controlled emissions should be both 0.096 tons/yr rather than 0.96 tons/yr.
- Page 5 of 7: 40 CFR 61 section edit as follows:

  Not Applicable

  The Dry Ash Handling System does not have any emissions of asbestos, coke oven emissions, radio nuclide, radon, vinyl chloride, benzene, and mercury. ~~However, t~~The system does emit beryllium and arsenic contained in the ash, however, these emissions are not from the types of industries or sources covered by the Part 61 NESHAPs.

Suggested edit to the facility descriptions in all four documents: *In 2021, the pulp production was converted from bleached to unbleached and utilizes one ~~two~~ paper machine and one pulp dryer. A second paper machine at the mill is currently idled.*

Caleb Fetner / Managing Consultant
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ALL4 // ***STRATEGY WITH SOLUTION. PARTNERSHIP WITH A PURPOSE.***

From: Buckner, Katharine <bucknekk@dhec.sc.gov>
Sent: Wednesday, March 27, 2024 3:23 PM
To: Rachel Davis <Rachel.Davis@new-indycb.com>; Sheryl Watkins <swatkins@all4inc.com>; Caleb Fetner <cfetner@all4inc.com>; Steven Moore <smoore@all4inc.com>
Subject: Questions on new stripper project

Hey Everyone,

I am working on addressing the comments in the SOB for the new stripper. I have some questions that pertain to or have arisen from that.

1. Each stripper has a condensate feed tank. What happens to the contents of one tank when the other stripper is operating? For example, the existing stripper will need to be operated, yet there is condensate in the new LP Steam Stripper Feed Tank. What happens to the contents of the new LP Steam Stripper Feed Tank? Will the contents stay put until the new stripper is operated again so that there are breathing losses from this tank that vent to the LVHC Collection System? Or will the contents be transferred to the existing stripper feed tank?
2. Is it expected that the LP Steam Stripper Rectified Liquid (SRL) Methanol Tank will always have material in it so that there are breathing losses from this tank that vent to the LVHC Collection System?
3. In comments in the SOB received on March 16, 2024, a request has been made to use the October 2021 SO2 testing of the combination boilers instead of conducting new testing. Will the operating scenario for the existing stripper during the October 2021 be the same after the equipment for the new stripper is installed? Will the operating scenario be the same as October 2021 with the new LP Steam Stripper Feed Tank and new LP Steam Stripper Rectified Liquid (SRL) Methanol Tank also venting to the LVHC collection system?
4. One of EPA's comments was is there vendor/company documentation to show the existing stripper can meet the removal targets, especially at the maximum foul condensate throughput of 850 gallons per minute?
5. DHEC's consent order says New-Indy shall optimize, operate, and maintain the existing steam stripper… (Conclusions of Law, item 5.). It is understood that this will be done once the new stripper is on line. How will the optimization be assessed for the existing stripper?
6. EPA commented that it was not clear that emission increases were presented for the No. 2 Recovery Furnace. Here is what the SOB says about it. Is there some language that can be added to make it clearer? Is the black liquor in a tank? Is the SRL added to that tank? Does that tank directly feed both No. 2 and No. 3 Recovery Furnaces? So what does the emission calculations present as far as the combustion of the black liquor in the recovery furnaces and increase in emissions? Is that the increase for one or both?

> SRL combustion in Nos. 2 or 3 Recovery Furnaces – SRL is added to the black liquor, which is combusted in the Nos. 2 and 3 Recovery Furnaces. Emissions from the combustion of SRL in the recovery furnaces were estimated. The SRL is expected to contain approximately 40% of the TRS, based on information provided by the vendor. Approximately 99% of the sulfur from the combustion of the TRS will be absorbed within the salt fume inside the recovery furnaces.

Please provide responses as soon as you can.

Thank you,

Katharine K. Buckner
Wood and Surface Coating Permit Section
Bureau of Air Quality – Air Permitting Division

Office: (803) 898-3213

bucknekk@dhec.sc.gov

S.C. Dept. of Health & Environmental Control
2600 Bull Street
Columbia, SC 29201

Connect: www.scdhec.gov Facebook Twitter

Response to questions posed in a March 27, 2024 email from Katharine Buckner.

I am working on addressing the comments in the SOB for the new stripper. I have some questions that pertain to or have arisen from that.

Q1: Each stripper has a condensate feed tank. What happens to the contents of one tank when the other stripper is operating? For example, the existing stripper will need to be operated, yet there is condensate in the new LP Steam Stripper Feed Tank. What happens to the contents of the new LP Steam Stripper Feed Tank? Will the contents stay put until the new stripper is operated again so that there are breathing losses from this tank that vent to the LVHC Collection System? Or will the contents be transferred to the existing stripper feed tank?

> R1: As there are not any back-up steam strippers that we are aware of in operation in the pulp and paper industry, the Mill will complete operation, startup, shutdown, and maintenance procedures for both the new and existing steam stripper as part of a written process hazard analysis for the "stripper system" upon startup of the new steam stripper. However, it is expected that when either stripper shuts down, there would be no attempt initially to draw down the process condensate in the tank. The tank would remain enclosed and any breathing losses would be vented to the closed vent LVHC collection system. If necessary from a safety or operational standpoint, the Mill would draw down the tank to a minimum level needed for standby position.

Q2: Is it expected that the LP Steam Stripper Rectified Liquid (SRL) Methanol Tank will always have material in it so that there are breathing losses from this tank that vent to the LVHC Collection System?

> R2: The Mill expects that when the SRL system is offline that there would be no attempt initially to draw down the SRL methanol in the tank. The tank would remain enclosed and any breathing losses would be vented to the closed vent LVHC collection system. If necessary from a safety or operational standpoint, the Mill would draw down the tank to a minimum level needed for standby position.

Q3: In comments in the SOB received on March 16, 2024, a request has been made to use the October 2021 SO2 testing of the combination boilers instead of conducting new testing. Will the operating scenario for the existing stripper during the October 2021 be the same after the equipment for the new stripper is installed? Will the operating scenario be the same as October 2021 with the new LP Steam Stripper Feed Tank and new LP Steam Stripper Rectified Liquid (SRL) Methanol Tank also venting to the LVHC collection system?

> R3: The lbs SO_2/ADTP emissions factor developed from the October 2021 SO_2 testing effort on the combination boilers is based on/representative of operating the existing steam stripper in "Methanol" Mode, which is representative of 98% removal of the TRS and greater than 92% removal of methanol from the pulping condensates, but at reduced condensate feed flow rate to the stripper. The mill would expect that the condensate feed flow rate to the stripper to be higher in the "TRS" Mode, with a higher expected TRS loading in the stripper off-gases (SOG), and a higher lbs SO_2/ADTP emissions factor at the combination boilers. Therefore, we expect to utilize the SO_2 emissions factor used in the PSD analysis for the new stripper SOG burning for the existing stripper SOG burning under both the "TRS"

and "Methanol" Modes of operation (Note: The October 2021 test showed the existing stripper SOG SO_2 emissions factor of 1.06 lb/ADTP as compared to the more conservative SO_2 emissions factor of 1.4 lb/ADTP used in the PSD analysis for the new stripper SOG).

The new and existing steam stripper feed tanks and SRL methanol tank will be or are (in the case of the existing steam stripper feed tank) vented to the existing LVHC system; therefore, the emissions will be captured and controlled in the No. 3 Recovery Furnace or combination boilers.

Q4: One of EPA's comments was is their vendor/company documentation to show the existing stripper can meet the removal targets, especially at the maximum foul condensate throughput of 850 gallons per minute?

R4: There is currently only limited (approximately 1 hour) operational data for the existing stripper operating at approximately 830 gpm. As the DHEC consent order requires that the Mill operate the existing steam stripper in "methanol" mode (i.e., higher steam to condensate feed ratio with target methanol removal efficiencies greater than 92% for compliance under 40 CFR 63, Subpart S), the Mill cannot currently operate the existing stripper in the total reduced sulfur (TRS) mode without violating the order. In "TRS" mode, the Mill would operate the existing backup stripper at a lower steam to feed ratio to achieve up to 850 gpm feed flow. As this information cannot be collected/evaluated until the new stripper is online, the Mill has provided project emissions increase calculations for operating the existing stripper in "methanol" mode. As emissions increases for all pollutants are below the PSD SER for both the "TRS" and "Methanol" modes, the Mill will have the option to run in either mode as a back-up to the new stripper system. TRS and methanol performance curves for the existing steam stripper will be established as part of the initial performance testing effort.

Q5: DHEC's consent order says New-Indy shall optimize, operate, and maintain the existing steam stripper… (Conclusions of Law, item 5.). It is understood that this will be done once the new stripper is online. How will the optimization be assessed for the existing stripper?

R5: The Mill plans to prepare a written startup and operating guide as part of the initial performance test that will establish the curve for removal efficiencies for TRS and methanol as a function of stripper steam to condensate feed ratio; thereby optimizing the its operation under the backup stripper scenarios.

Q6: EPA commented that it was not clear that emission increases were presented for the No. 2 Recovery Furnace. Here is what the SOB says about it. Is there some language that can be added to make it clearer? Is the black liquor in a tank? Is the SRL added to that tank? Does that tank directly feed both No. 2 and No. 3 Recovery Furnaces? So what does the emission calculations present as far as the combustion of the black liquor in the recovery furnaces and increase in emissions? Is that the increase for one or both?

SRL combustion in Nos. 2 or 3 Recovery Furnaces – SRL is added to the black liquor, which is combusted in the Nos. 2 and 3 Recovery Furnaces. Emissions from the combustion of SRL in the recovery furnaces were estimated. The SRL is expected to contain approximately 40% of the TRS, based on information provided by the vendor. Approximately 99% of the sulfur from the combustion of the TRS will be absorbed within the salt fume inside the recovery furnaces.

R6: The Mill will conduct testing on the inlet and outlet of the new steam stripper, which will demonstrate how much TRS is captured in the stripper off-gases and could potentially be condensed into the SRL. The Mill will also test for the sulfur content of the SRL stream to confirm the 40/60 split between the SRL and SRL LVHC. The Mill will also use the sulfur content of the SRL stream to demonstrate the sulfur loading from the SRL being mixed in the black liquor does not significantly impact the percent sulfur in the as-fired black liquor and; therefore, does not significantly change the emissions from the No. 2 Recovery Boiler with the expected inherent sulfur removal in the salt fume and recycled saltcake.

Buckner, Katharine

From:	Rachel Davis <Rachel.Davis@new-indycb.com>
Sent:	Tuesday, April 16, 2024 1:49 PM
To:	Buckner, Katharine
Cc:	McCaslin, Steve; Hardee, Christopher; smoore@all4inc.com; Caleb Fetner; Sheryl Watkins
Subject:	New Indy New Stripper Construction Permit follow up
Attachments:	2024-04-16 NICB RF3 SO2 CEMS-New Stripper Project.docx; 2024-04-16 RF3 Sulfur Balance.xlsx
Importance:	High

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Ms. Katharine, per our conversations concerning the SO2 CEMS for RB3 in the new stripper construction permit, please see the attached proposal for the operation of a temporary CEMS and supporting justification behind this proposal.

Please let me know if you have any questions.

Thank you and have a blessed day!

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ONE TEAM ONE MISSION
NEW-INDY CATAWBA

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New-Indy Catawba LLC
Additional Information in Support of the Construction Permit Application for the New Condensate Steam Stripper

New-Indy Catawba LLC (New-Indy Catawba) submitted a construction application for the New Condensate Steam Stripper (Project) to the SC DHEC Division of Air permitting on March 22, 2023 in accordance with the SC DHEC Consent Order to Correct Undesirable Levels of Air Contaminants, signed November 23, 2022 (Consent Order), the terms of which also include requirements of the EPA Consent Decree entered in Civil No. 0:21-cv-02053-SAL, *United States of America v. New-Indy Catawba, LLC, dated November 16, 2022 (Consent Decree)*. The construction permit application is currently under review by SCDHEC and the United States Environmental Protection Agency (U.S. EPA). SCDHEC, U.S EPA, and New-Indy Catawba are in discussions and New-Indy Catawba is providing the following additional information to support the technical review, statement of basis (SOB), and the draft air construction permit conditions that will undergo a 30-day public notice period for the Project:

- Proposed method for post-project demonstration that the project-related emissions increase for SO_2 does not exceed the Prevention of Significant Deterioration (PSD) significant emissions rate (SER) (i.e., the Project is not a major modification in regards to SO_2) and;
- Proposed compliance methodology post-project for demonstrating continuous compliance with the existing best available control technology (BACT) sulfur dioxide (SO_2) emissions limit for the No. 3 Recovery Furnace (Equipment ID No. 5105, RF3).

Proposed Method for Post-project Demonstration that the Project-related Emissions Increase for SO_2 Does Not Exceed the PSD SER (i.e., the Project is not a major modification in regards to SO_2).

Although the PSD applicability calculations submitted with the original application demonstrate a ~100 ton per year (tpy) decrease in SO2 project-related emissions, this conclusion is mainly dependent upon several variables, namely the sulfur capture in RF3.

After discussions with DHEC, New-Indy Catawba is proposing the following method to confirm the RF3 sulfur capture efficiency that was used in the construction permit application post-project.

Sulfur Capture in the No. 3 Recovery Furnace

Impact on PSD Calculations and Application Projected Value: The sulfur capture efficiency of RF3 was estimated to calculate the incremental increase in SO_2 emissions from incinerating stripper rectified liquid (SRL)/SRL LVHC and LVHC gases. The project-related emissions of SO_2 do not include emissions from black liquor solids (BLS)/natural gas firing, so the emissions calculation method in the application was based on applying the estimated sulfur capture efficiency to the pre-control emissions factors for the SRL/SRL LVHC and LVHC streams (i.e., the sulfur content of these streams converted to an SO_2 basis).

New-Indy Catawba expects to achieve greater than 99% sulfur capture in RF3 after completion of the project, but conservatively calculated post-project emissions in the construction permit application based on 99%.

Method: Temporary operation of an SO_2 continuous emissions monitoring system (CEMS) on RF3 pre and post-project. Demonstrating continuous compliance with the current BACT limit will confirm the sulfur capture and removal efficiency of the smelt bed salt fume is equal to or greater than 99 percent as represented in the construction permit application.

Project-related SO_2 emissions do NOT include the emissions resulting from BLS and natural gas firing (i.e., the installation of the new steam stripper and RF3 becoming primary control for existing LVHC gases does not affect the BLS or natural gas firing in RF3). Although the CEMS will provide actual emissions data from RF3, those emissions will include emissions from BLS and natural gas firing. As the SO_2 CEMS cannot differentiate SO_2 emissions resulting from BLS/natural gas firing and SO_2 emissions resulting from LVHC/SRL/SRL LVHC incineration, the proposed compliance method cannot be to simply compare the difference in pre-project SO_2 CEMS data and the post-project SO_2 CEMS data against the PSD SER.

Sulfur Balance

As demonstrated in the attached "RF3 Sulfur Balance.xlsx" spreadsheet, a sulfur balance around RF3 can be used to determine the sulfur capture efficiency. During current, pre-project operations, there are two input streams of sulfur to RF3:

1. Sulfur in the virgin BLS fed to the saltcake mix tank and,
2. Sulfur present in the recycled saltcake that is mixed with the virgin BLS prior to burning.

There are several potential output streams of sulfur from the RF3:

1. The majority of the sulfur that is captured in the smelt
2. Sulfur in SO2 emissions
3. Sulfur in TRS emissions
4. Sulfur in uncaptured saltcake that make up a portion of PM emissions
5. Sulfur in the captured saltcake that is recycled and mixed with virgin BLS.

Since Output (5) is recycled to become Input (2), those sulfur streams cancel each other out of the sulfur balance. The sulfur capture efficiency of RF3 can then be calculated as:

Sulfur Capture Efficiency % = 1 – [(sulfur emitted as SO2, TRS, and PM) /sulfur input to RF3]

New-Indy is providing in the attached spreadsheet an hourly sulfur balance around RF3, pre-project. Hourly sulfur input is calculated using recent sulfur content testing on the virgin liquor and the maximum hourly firing rate of BLS. The uncaptured sulfur (i.e., the sulfur emitted out of the stack) were calculated at the currently permitted emissions rates:

- SO2: BACT limit of 50 ppmdv @ 8% O2 (nominally equivalent to 126 lb/hr)
- TRS: Limit of 5 ppmdv @ 8% O2 (nominally equivalent to 6.7 lb/hr)
- PM: Limit of 0.025 gr/dscf @ 8% O2
    - Based on NCASI technical memo, sulfate compounds were assumed to make-up 63.6% of total filterable PM. It was assumed that all of the sulfate present in the filterable PM is sodium sulfate for purposes of conversion to a mass of sulfur basis.

This sulfur balance demonstrates that the RF3 (pre-project) achieves an estimated 99.1% sulfur capture efficiency in order to comply with its permitted emissions rates. Since the TRS and PM contributions to uncaptured sulfur are relatively small, **New-Indy is proposing that upon completion of the project, compliance via temporary CEMS with the SO2 BACT limit of 50 ppmdv @ 8% O2 on an annual average will also serve as demonstration that RF3 is achieving greater than 99% sulfur capture on an annual average that was used as the basis of the construction permit. In other words, New-Indy is demonstrating that compliance with the annual average BACT limit via the temporary CEMS will also confirm a key variable used in the PSD applicability calculations.**

It is important to note that upon completion of the project, there will be additional sulfur inputs to RF3 via the SRL/SRL LVHC/LVHC. Thus, an even higher sulfur capture efficiency than 99.1% will be demonstrated via compliance with the SO2 BACT limit.

New-Indy is proposing to use both the pre-project and post-project SO_2 CEMS data to demonstrate compliance with the annual average BACT limit. This will confirm the sulfur capture efficiency of 99% as assumed in the construction permit application to estimate the incremental increase in SO_2 emissions resulting from SRL/SRL LVHC/LVHC incineration in RF3. Confirming the sulfur capture efficiency will provide DHEC evidence that the project-related emissions of SO_2 do not increase greater than the SER. Specifically, New-Indy Catawba is proposing the following methodology:

1. Operate the temporary SO_2 CEMS for a period of approximately six (6) months PRIOR to installation and startup operation of the New Condensate Steam Stripper to establish/confirm the sulfur capture and removal efficiency in RF3. The CEMS will be installed as soon as feasible to maximize data capture prior to the Mill commencing burning LVHC gases in RF3.

2. Operate the temporary SO_2 CEMS for a period of approximately 24 months AFTER:

    a. The Mill commences burning LVHC gases in RF3 as the primary control method **and,**

    b. Startup operation of the New Condensate Steam Stripper and RF3 burning SRL/SRL LVHC.

Proposed Compliance Methodology for Continuous Compliance with the Existing BACT SO_2 Emissions Limit for the No. 3 Recovery Furnace

Due to this post-project PSD confirmation involving the temporary installation of a SO_2 CEMS on RF3, New-Indy is also providing a proposed temporary compliance methodology for the existing BACT SO_2 emissions limit for RF3.

Condition C.47 of Title V Operating Permit (TVOP) TV-2440-0005 limits SO_2 emissions from the No. 3 Recovery Furnace to 50 ppmv at 8% O_2 (dry basis) or 551 tpy on an annual average basis. Compliance is currently demonstrated by stack testing (3, 1-hr runs) once every 4 years, or annually if results exceed 50% of the emissions limit.

New-Indy proposes the following approach for demonstration of continuous compliance with the No. 3 Recovery Furnace SO_2 BACT limit during the temporary operation of the SO_2 CEMS, as well as the criteria for removing the CEMS after operation for an approved period of time:

- While the SO_2 CEMS is installed, demonstrate that the Mill meets the No. 3 Recovery Furnace SO_2 BACT emissions limits through calculation of the annual average SO_2 concentration and emissions rate from the SO_2 CEMS Data. The SO_2 CEMS concentration and emissions rate data will be calculated and rolled up on an hourly, daily, and on a 12-month rolling average basis and the 12-month rolling average calculated values will be compared the 50 ppmv at 8% O_2 (dry basis) and 551 tpy BACT emissions limits as follows:
    - Calculate the hourly corrected SO_2 concentration (ppmvd @ 8% O_2):

      *Hourly average corrected SO_2 concentration (ppmvd @ 8% O_2) = Measured raw ppmvd SO_2 CEMS (average for the hour) * (20.9 – actual %O_2 average for the hour)/(20.9 – 8)*

    - Calculate the daily and annual average corrected SO_2 concentration from valid hourly and daily SO_2 ppmvd @ 8% O_2:

$$Daily\ average\ corrected\ SO2\ concentration\ (\text{ppmvd @ 8\% O2}) = \frac{\sum_{i=1}^{24}[Valid\ hourly\ average\ corrected\ SO2\ concentration\ (\text{ppmvd @ 8\% O2})]}{\sum_{i=1}^{24}\frac{Valid\ hours}{day}}$$

$$Annaul\ average\ corrected\ SO2\ concentration\ (\text{ppmvd @ 8\% O2}) = \frac{\sum_{i=1}^{365}[Valid\ daily\ average\ corrected\ SO2\ concentration\ (\text{ppmvd @ 8\% O2})]}{\sum_{i=1}^{365}\frac{Valid\ days}{year}}$$

    - Calculate the hourly SO_2 emissions rate in lbs/hr:

      Hourly SO_2 emissions rate = (Hourly average ppmvd SO_2 corrected to 8% O_2) / (1e6 parts) (MW SO_2, 64.1 lb/lbmol) / (385 scf/lbmol)* (RF3 flow factor derived from stack test data in dscf @ 8% O_2 / TBLS) * (Hourly TBLS rate)*

      Note: The flow factor used in the equation above will be calculated as the average of the flow factors from the last three stack testing efforts.

- Daily SO_2 emissions rate (tons): Sum each valid 1-hour SO_2 emissions rate in lbs/hr / (2,000 lb/ton)

- 12-month SO_2 emissions rate (tons): Sum each valid Daily SO_2 emissions rate in tons for the first twelve-month period and then for each day thereafter on a rolling 12-month basis.

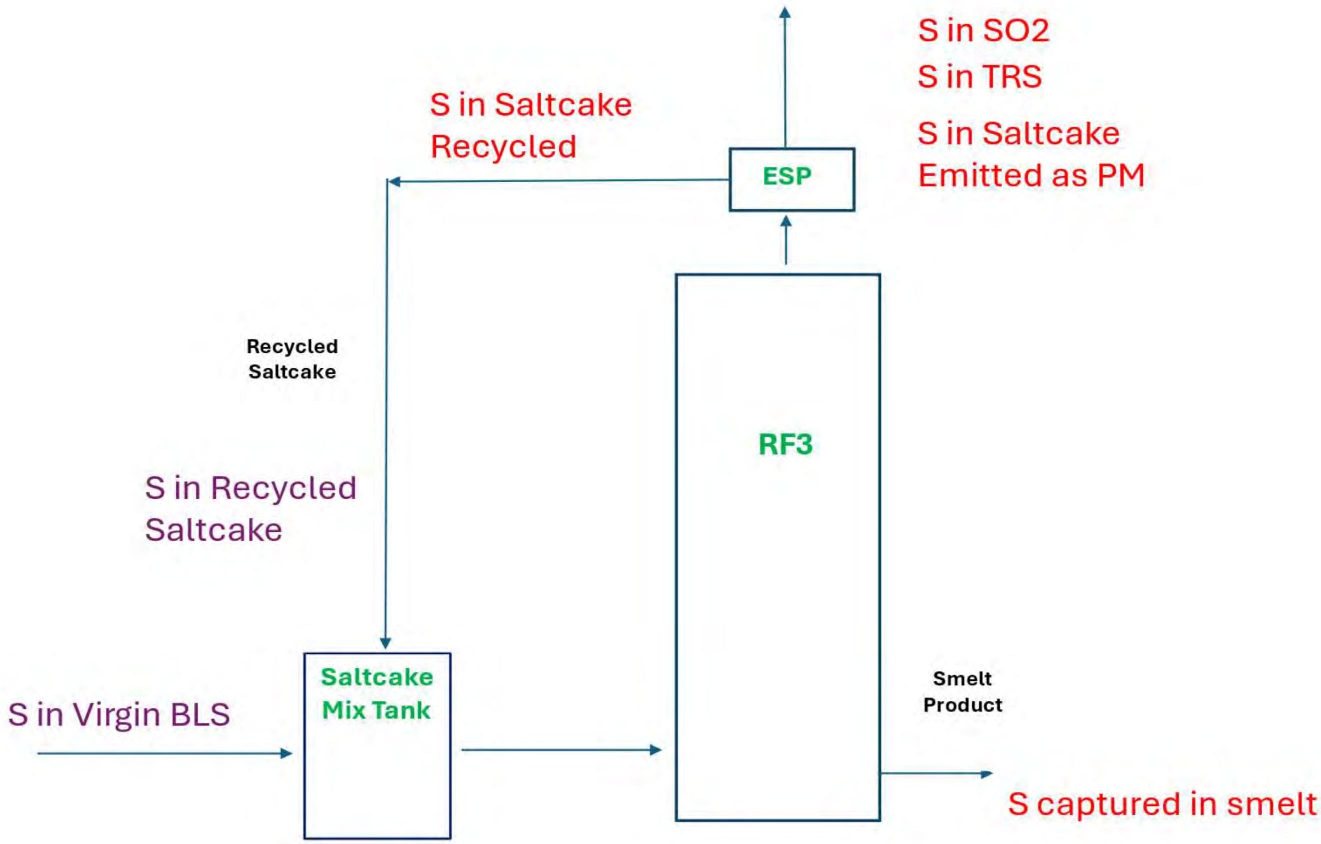
- **Criteria for removal of temporary SO_2 CEMS:** At the completion of the 24-month period following start-up of the new steam stripper, if the SO2 CEMS data (calculated as described above) demonstrates continuous compliance with the annual average SO2 BACT limit, that will also serve to confirm the RF3 salt fume absorbs sulfur and keeps it from forming SO_2 at 99% sulfur removal or above even after the additional sulfur input resulting from the project. This will provide justification for terminating operation of the SO_2 CEMS and institution of routine compliance testing for SO_2.

	Hourly Sulfur Input	
Virgin BLS	85	TBLS/hr
	5.31	% Sulfur, OD basis
	9,022.8	lbs, sulfur
	Hourly Sulfur Output (not captured)	
RB3 SO2	50	ppmdv @ 8% O2 (Permit Limit)
	126	lb/hr, SO2 (equivalent to 551 tpy)
	62.9	lbs, sulfur
RB3 TRS	5	ppmdv @ 8% O2 (Permit Limit)
	6.69	lb/hr, TRS as H2S
	6.3	lbs, sulfur
RB3 PM (saltcake)	0.025	gr/dscf@ 8% O2 (Permit Limit)
	54.1	lb/hr, PM
	34.4	lb/hr, sulfate (NCASI memo for interior mill)
	7.8	lbs, sulfur (assuming MW of sodium sulfate)
	Total Sulfur Not Captured	
	77.0	lbs, sulfur
	99.1%	sulfur capture
		[1 - (sulfur emitted/virgin BLS)]

Sodium Sulfate 142 g/mol

Sulfur balance was conducted on an hourly basis for ease of correlating to units of permitted emissions rates. The SO2 BACT limit is an annual average.

Sulfur In		Sulfur Out
S in Virgin BLS	=	S in Smelt/Green Liquor
~~S from salt cake recycle~~		~~S from salt cake recycle~~
		S in SO2 emissions RB3
		S in TRS emissions RB3
		S in saltcake portion of PM emissions


S in SO2
S in TRS
S in Saltcake Recycled
ESP
S in Saltcake Emitted as PM
Recycled Saltcake
RF3
S in Recycled Saltcake
Saltcake Mix Tank
S in Virgin BLS
Smelt Product
S captured in smelt