SAGE ENVIRONMENTAL
A Terracon Company

March 6, 2025

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And

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RE: Request for EPA Applicability Determination of Clean Air Act
QSS Biosolids, LLC - Pyrolysis Facility (Site)
135 All American Way
North Kingstown, Rhode Island
SAGE/Terracon Project No. C096/L5247042

Dear Ms. Kilpatrick and Ms. Garcia,

On behalf of QSS Biosolids, LLC (QSSB), SAGE Environmental, Inc. (SAGE), A Terracon Company, formally requests the Environmental Protection Agency's (EPA) applicability determination and clarification regarding select New Source Performance Standards (NSPS) associated with a proposed sewage sludge pyrolysis facility. The facility is proposed to be located at 135 All American Way (Plat 180/Lots 19, 20, 21, and 22) in North Kingstown, Rhode Island (hereinafter referred to as "Facility" or "Site"). Vow ASA, including its affiliates and partners, has been engaged by QSSB to design a sewage sludge treatment process utilizing Vow's proprietary pyrolysis technology. Vow ASA is represented in this document as an associated party.

Executive Summary

The Clean Air Act (CAA) and related regulations establish permitting thresholds that classify facilities as either Major or Minor sources of emissions. Some regulations also specify emission standards, operating requirements, and permitting conditions based on the type of facility and/or emissions source. The regulatory requirements, including permitting processes, differ significantly between Major and Minor sources, resulting in notable differences in time and costs. The purpose of this correspondence is to document the exemptions from Major Source permitting requirements concerning the proposed sewage sludge pyrolysis Facility. The regulations discussed within, for which input from EPA is being sought, include:

- NSPS Subpart LLLL (Standards of Performance for New Stationary Sources: Emissions from Sewage Sludge Incineration);
- NSPS Subpart CCCC (Standards of Performance for New Stationary Sources: Emissions from Commercial and Industrial Solid Waste Incineration); and,
- NSPS Subpart O (Standards of Performance for Sewage Treatment Plants).

The following discussion demonstrates that sewage sludge pyrolysis does not meet the definition of incineration and, as such, does not require Major source air permitting. Based on the information detailed herein, the Facility will seek a Minor Source Air Permit in accordance with the RIDEM Air Pollution Control (APC) Regulations.

This correspondence is organized as follows:

- Pyrolysis Compared to Incineration
- Proposed Pyrolysis Facility Background
- Regulatory Discussion
- Summary and Recommendations

Pyrolysis Compared to Incineration

Pyrolysis of sewage sludge is a thermochemical treatment process that can be used to manage and reduce the volume of sewage sludge. The pyrolysis process involves heating dried feedstock material in an oxygen-limited environment to break down organic components and produce a carbon-rich solid byproduct, known as biochar, along with other gaseous byproducts (pyrolysis gas). The characteristics of biochar (e.g., surface area, pore structure, nutrient content, etc.) are dependent on the feedstock material. Pyrolysis does not meet the definition of, and is distinct from, incineration for several reasons, including process differentiation, emission profiles, final product value, and regulatory definitions.

As previously mentioned, pyrolysis is a process that occurs when feedstock material is heated in an oxygen-deprived environment, leading to the breakdown of organic materials into gases and biochar. In contrast, incineration involves the combustion of materials in the presence of oxygen, resulting in a flame and the production of gases, heat, and ash. The emissions produced by pyrolysis differ significantly from those of incineration. Pyrolysis typically generates fewer harmful pollutants that are often associated with combustion processes. In addition, pyrolysis produces valuable byproducts, such as pyrolysis gas, which can be used as renewable energy sources or feedstocks for other processes and biochar, which has several notable applications, including carbon sequestration, soil improvement, and contamination remediation. In contrast, the byproduct of incineration is primarily residual ash, which may contain heavy metals or other contaminants. Residual ash is often disposed of in landfills or specialized treatment facilities. Pyrolysis aligns with sustainability goals and waste-to-energy initiatives, contrasting with incineration, which primarily focuses on waste disposal.

The EPA has established definitions and regulatory frameworks for both incineration and thermal treatment processes. Pyrolysis fits more appropriately within the category of thermal treatment technologies that utilize controlled thermal decomposition rather than combustion, which is the basis of incineration. Pyrolysis can also contribute to waste reduction and resource recovery, making it a more environmentally friendly option compared to traditional incineration.

Based on this information and the details presented in the following sections, pyrolysis does not meet the definition of incineration for air permitting purposes.

Proposed Pyrolysis Facility Background

This pyrolysis Facility is being proposed as an alternative solution to the current methods of treating and disposing of sewage sludge in Rhode Island, as aging incineration infrastructure and limited landfill capacity present challenges for future disposal options. Furthermore, other disposal practices, such as land application, are under increased regulatory scrutiny due to the presence of emerging contaminants in some sewage sludge.

The Facility is currently in the process of being designed and is proposed for construction within the Quonset Industrial Park at 135 All American Way in North Kingstown, Rhode Island. Upon approval, construction is anticipated to begin in 2027, with the anticipated Facility commissioning/optimization period planned for 2028. The Facility will be equipped with an enclosed reception area, wet feedstock storage silos, sewage sludge dryers, dried feedstock silos, feedstock pelletizers, and electrically heated pyrolysis reactors. The conveyance systems between these Facility components will be enclosed. The Facility will also be equipped with pollution control equipment consisting of a biotrickling filter, two-stage scrubber system, and carbon adsorber for odorous emissions related to reception and drying operations as well as a thermal oxidizer and catalytic filter related to emissions from the pyrolysis process.

Once constructed, the Facility will have the capacity to pyrolyze up to approximately 160 tons of sewage sludge per day *via* two (2) pyrolysis reactors. The process generates biochar and a pyrolysis gas. The proposed Facility will recover the energy in the pyrolysis gas as heat through combustion in the thermal oxidizer units. This heat will be recovered in a thermal oil loop and used to dry the feedstock, and surplus heat will be utilized to produce electricity. Additional detail of the Facility operations and the proposed QSSB pyrolysis system are further described below and included in **Attachment A** to aid in the Agency's determination.

Regulatory Discussion

The following sections provide a discussion of the regulations identified as potentially applicable to the proposed Facility, for which input from EPA is being sought, as it relates to the currently proposed sewage sludge pyrolysis Facility. In addition, SAGE has researched other entities which have successfully sought, and been granted, an EPA determination that the identified select regulations do not apply to pyrolysis and/or gasification facilities that are similar to the proposed Facility. The following sections provide supporting details on such determinations of inapplicability by EPA.

NSPS Subpart LLLL – Standards of Performance for New Sewage Sludge Incineration Units

The Standards of Performance for New Sewage Sludge Incineration Units (NSPS Subpart LLLL) applies to Sewage Sludge Incinerators (SSI) for which construction commenced after October 14, 2010, or for which modification commenced after September 21, 2011. The proposed QSSB pyrolysis unit does not meet the definition of an SSI unit.

> "Sewage sludge incineration (SSI) unit" is defined in 40 CFR §60.4930 as:
>
> *an incineration unit combusting sewage sludge for the purpose of reducing the volume of the sewage sludge by removing combustible matter. Sewage sludge incineration unit designs include fluidized bed and multiple hearths. A SSI unit also includes, but is not limited to, the sewage sludge feed system, auxiliary fuel feed system, grate system, flue gas system, waste heat recovery equipment, if any, and bottom ash system. The SSI unit includes all ash handling systems connected to the bottom ash handling system. The combustion unit bottom ash system ends at the truck loading station or similar equipment that transfers the ash to final disposal. The SSI unit does not include air pollution control equipment or the stack.*
>
> "Sewage sludge" is defined as:
>
> *solid, semi-solid, or liquid residue generated during the treatment of domestic sewage in a treatment works. Sewage sludge includes, but is not limited to, domestic septage; scum or solids removed in primary, secondary, or advanced wastewater treatment processes; and a material derived from sewage sludge. Sewage sludge does not include ash generated during the firing of sewage sludge in a sewage sludge incineration unit or grit and screenings generated during preliminary treatment of domestic sewage in a treatment works.*

In addition, in publishing the final rule Subpart LLLL, EPA described an SSI unit as "*an enclosed device or devices using controlled flame combustion that burns sewage sludge for the purpose of reducing the volume of sewage sludge by removing combustible matter.*"

Based on these definitions, Subpart LLLL does not apply to the proposed QSSB sewage sludge pyrolysis facility. The proposed Facility does not meet the definition of an SSI unit, as the pyrolysis units are not designed to combust sewage sludge (i.e., no flame). As described above, pyrolysis is distinct from incineration/combustion, which is performed in the presence of excess oxygen, resulting in the oxidation of the material. Pyrolysis occurs under oxygen-deprived conditions such that combustion cannot occur. The process does not rely on combustion or oxidation as incineration does. Additionally, the proposed design will not include the use of a controlled flame to combust the sewage sludge. During pyrolysis, pyrolysis gas will be produced from the flameless heating of sewage sludge in electrically heated pyrolysis reactors. The resulting pyrolysis gas will be combusted in thermal oxidizers as part of the air pollution control system. Notably, the definition of sewage sludge does not include gases of any kind, including pyrolysis gas. Therefore, SAGE is of the opinion that this does not meet the definition of an SSI because the material being combusted as part of this process is not a solid, semi-solid, or liquid residue and therefore does not meet the definition of sewage sludge. Rather, the pyrolysis gas consists of the volatile constituents, including water vapor, volatile organic compounds, and inorganic gases, that are liberated from the sewage sludge during the flameless heating process.

Supporting Documentation for Subpart LLLL

Ecoremedy - Edmonds, Washington (Pyrolysis/Gasification)

EPA Region 10 issued an applicability determination dated September 9, 2021, finding that Subpart LLLL does not apply to the Ecoremedy sewage sludge pyrolysis/gasification facility in Edmonds, Washington.

> *"Based on all the information provided in connection with your request for an applicability determination, we conclude that Subpart LLLL does not apply to the proposed Ecoremedy gasification unit for the City of Edmonds because the unit is not an "SSI unit." It is not an SSI unit, as defined in 40 CFR §60.4930, because it does not combust sewage, also as defined in section 60.4930."*

According to information submitted to EPA in support of this determination of inapplicability, Ecoremedy indicated that there is no flame or burning involved in the gasification process, as the conversion of the biosolids feedstock to syngas takes place in an oxygen deficient environment. In addition, the combustion of syngas occurs in an oxidizing unit, where no sewage sludge solids, semi-solids, or liquids remain. Please note that pyrolysis and gasification are similar as they are both thermal decomposition processes. Pyrolysis occurs in the full absence or near absence of oxygen, leading to the production of solid and gaseous products, whereas gasification occurs in a partial absence of oxygen, primarily producing some biochar and syngas. A copy of the Edmonds, Washington determination of inapplicability is included in **Attachment B.**

BioForceTech - Silicon Valley, California (Pyrolysis)

EPA Region 9 issued a determination letter to BioForceTech (BFT) on July 25, 2016, for a sewage sludge pyrolysis facility at the Silicon Valley wastewater treatment plant in Redwood City, CA.

> *"EPA determines, based on the information provided and the statements made by BFT, that:*
>
> 1. *The pyrolysis reactor in the BFT process is not an SSI unit as that term is defined in the SSI NSPS, because there is no flame in the pyrolysis reactor; and*
> 2. *The syn-gas is a gas and is not a solid, semi-solid or liquid. Therefore, the syn-gas is not sewage sludge (even though it is derived from sewage sludge) as that term is defined in the SSI NSPS; therefore, the FLOX® chamber is not combusting sewage sludge and therefore also not an SSI unit.*
>
> *Consequently, the BFT pyrolysis system is not subject to the requirements in the SSI NSPS."*

According to information submitted to EPA in support of this determination of inapplicability, BioForceTech indicated that biosolids will be transferred into a pyrolysis reactor following dewatering/drying steps. The elevated temperatures and lack of oxygen in the pyrolysis reactor would then produce a flow of high-heat-content pyrolysis gas, which is then combusted in a separate oxidation unit. Copies of the Silicon Valley BFT facility permit application and referenced determinations of inapplicability are included in **Attachment C.**

NSPS Subpart CCCC - Standards of Performance for Commercial and Industrial Solid Waste Incineration Units

Commercial and industrial solid waste incineration (CISWI) units are subject to the requirements of the Standards of Performance for Commercial and Industrial Solid Waste Incineration Units (NSPS Subpart CCCC) if the unit commenced construction after June 4, 2010, or commenced reconstruction or modification after August 7, 2013. §60.2265 which defines a CISWI unit as the following:

> *"Any distinct operating unit of any commercial or industrial facility that combusts, or has combusted in the preceding 6 months, any solid waste as that term is defined in 40 CFR part 241. If the operating unit burns materials other than traditional fuels as defined in §241.2 that have been discarded, and you do not keep and produce records as required by §60.2175(v), the operating unit is a CISWI unit. While not all CISWI units will include all of the following components, a CISWI unit includes, but is not limited to, the solid waste feed system, grate system, flue gas system, waste heat recovery equipment, if any, and bottom ash system. The CISWI unit does not include air pollution control equipment or the stack. The CISWI unit boundary starts at the solid waste hopper (if applicable) and extends through two areas: The combustion unit flue gas system, which ends immediately after the last combustion chamber or after the waste heat recovery equipment, if any; and the combustion unit bottom ash system, which ends at the truck loading station or similar equipment that transfers the ash to final disposal. The CISWI unit includes all ash handling systems connected to the bottom ash handling system."*

Similar to the above discussion related to Subpart LLLL, the proposed pyrolysis Facility does not meet the definition of an incineration unit. The definitions state that an incineration unit must combust fuel with a flame, and the fuel must be in a solid state. As previously described, pyrolysis is distinct from incineration/combustion, which is performed in the presence of excess oxygen, resulting in the oxidation of the material. Instead, pyrolysis occurs in a flameless, oxygen-deprived environment such that combustion does not occur. The process does not rely on combustion or oxidation as incineration does. Additionally, the proposed design will not include the use of a controlled flame to combust the sewage sludge. The heat from the combustion will be recovered in a thermal oil loop and used to dry the feedstock, and surplus heat will be utilized to produce electricity.

Supporting Documentation for Subpart CCCC

BioForceTech - Silicon Valley, California (Pyrolysis)

As previously mentioned, EPA Region 9 issued a determination letter to BFT on July 25, 2016, for a sewage sludge pyrolysis facility at the Silicon Valley wastewater treatment plant in Redwood City, CA. The determination letter provided further clarification on the definition of an incineration unit under Subpart CCCC. The determination states that an incineration unit must combust fuel with a flame. In addition, the fuel must be in a solid state. Due to the determination made by the U.S. EPA, the proposed project from BFT did not fit the definition of a CISWI unit in accordance with the guidelines. Copies of the Silicon Valley BFT facility permit and determinations of inapplicability are included in **Attachment C.**

Carbon Black Global - Dunlap, Tennessee (Gasification)

EPA Region 4 previously provided a determination letter, on March 2, 2017, to Carbon Black Global that confirmed that Subpart CCCC is not applicable to gasification. The Carbon Black Global unit performs gasification of a variety of carbon-based waste feedstocks, including wood. The unit does not perform gasification of sewage sludge.

Please note that pyrolysis and gasification are similar, as they are both thermal decomposition processes. Pyrolysis occurs in the full absence or near absence of oxygen, leading to the production of solid and gaseous products, whereas gasification occurs in a partial absence of oxygen, primarily producing some biochar and syngas. In their rationale to EPA, Carbon Black Global indicated that during the gasification process, the flame never makes contact with the feedstock material. Additionally, the fuel source and air/oxygen source are cut off, and the gasification unit is sealed to prevent combustion within the gasification unit. The unit was reportedly equipped with holes at the top of the vessel that draw all syngas upwards and into the scrubber *via* pressure differentiation; however, this design is not conducive to combustion. Therefore, as the gasification process begins, there is no longer sufficient air/oxygen, and therefore combustion does not occur. In the determination letter, the EPA recognized that gasification, by itself, is not combustion. EPA determined that the process design regulates the presence of oxygen in the gasification unit to prevent combustion of the waste feedstock. Even though the feedstock is wood, and not sewage sludge, the argument remains that the gasification process is not considered combustion/incineration. Therefore, EPA concluded that the unit did not qualify as "*any distinct operating unit of any commercial or industrial facility that combusts, or has combusted in the preceding 6 months, any solid waste as that term is defined in 40 CFR part CBG. 241.*" For this reason, Subpart CCCC did not apply to the gasification process. A copy of the Carbon Black Global determination of inapplicability is included in **Attachment D.**

NSPS Subpart O – Standards of Performance for Sewage Treatment Plants

The applicability section of the Standards of Performance for Sewage Treatment Plants (NSPS Subpart O) states that *"[the] affected facility is each incinerator that combusts wastes containing more than 10 percent sewage sludge (dry basis) produced by municipal sewage treatment plants, or each incinerator that charges more than 1000 kg (2205 lb) per day municipal sewage sludge (dry basis)".*

Although Subpart O does not define "incinerator", the following definition for "sewage sludge incinerator' was included as 40 CFR § 60.151(a) in the Subpart O proposed rule:

> *"Sewage Sludge Incinerator" means any combustion device used in the processes of burning sewage sludge for the primary purpose of solids sterilization and to reduce the volume of waste by removing combustible matter but does not include portable facilities or facilities used solely for burning scum or other floatable materials, recalcining lime, or regenerating activated carbon.*

The definition of an SSI is specific to the terms 'burning' and 'incineration' rather than inclusive of other terms such as, 'gasification' or 'pyrolysis'. A search of EPA information and policy documents did not identify any existing EPA guidance/determinations on the potential applicability of Subpart O to municipal sewage sludge pyrolysis. Lacking such guidance, SAGE opines that the rationale provided to

EPA with respect to Subparts CCCC and LLLL (see above) may be applied to Subpart O. In accordance with the EPA's previous determinations that pyrolysis and gasification are not synonymous with incineration, and the combustion of pyrolysis gas or syngas is not considered combustion of sewage sludge, the same logic and determination may reasonably apply as it relates to the definition of a sewage sludge incinerator under Subpart O. As such, this Subpart is not applicable to the proposed facility.

Supporting Documentation for Subpart O

Ecoremedy - Edmonds, Washington (Pyrolysis)

In addition to the EPA submission and determinations noted above, Ecoremedy (the project proponent) submitted a Notice of Construction Worksheet (#12135) to the Puget Sound Clean Air Agency providing extensive rationale as to why Subpart O is not applicable to their pyrolysis facility.

A copy of this worksheet may be found in **Attachment E.**

Summary and Recommendations

The QSSB facility will have similar operating characteristics to the pyrolysis and gasification units evaluated by EPA in the above mentioned determinations. The proposed pyrolysis reactors flamelessly convert sewage sludge to pyrolysis gas and biochar, and the pyrolysis gas is oxidized in a physically separate unit from the pyrolysis unit. No oxidation of pyrolysis gas occurs in the presence of sewage sludge. Based on this process information, it is SAGE's opinion that the aforementioned Subparts are not applicable to the proposed sewage sludge pyrolysis facility.

Based on the above discussion and attached supporting materials, we respectfully request EPA's confirmation that sewage sludge pyrolysis is not incineration by definition and is therefore not subject to Major source permitting requirements. The facility will pursue a Minor Source Air Permit per the RIDEM Air Pollution Control Regulations.

We appreciate your time and attention to this matter. Should you need additional information, please contact the undersigned.

Sincerely,

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Attachments

ATTACHMENT A

PROCESS DESCRIPTION

For Permit Application

101510-CRS-P-RD-0001 – Revision: C

C	03.Mar.2025	Issued for Information	HPD	PC	OKS
B	22.Jan.2025	Issued for Information	HPD	PC	OKS
A	14.Jun.2024	Issued for Information	HPD	ING	OKS
Rev	**Date** (dd.mmm.yyyy)	**Reason for Issue**	**Made By**	**Chkd. By**	**Appr. By**

Document Title

PROCESS DESCRIPTION FOR PERMIT APPLICATION

Project Title QSS – Sewage Sludge Pyrolysis	**Acceptance Codes** ☐ 1 Accepted ☐ 2 Accepted w/ Comments ☐ 3 Not Accepted ☐ 4 For Information Only ☐ 5 Interface Frozen
System / Equipment Pyrolysis System	
Tag / Node Number(s) Complete System	**Date** / **Signature**

Originator VOW	**Client** QUONSET SOIL SOLUTIONS PEOPLE. PLANET. PURPOSE.
Originator Details VOW ASA Wergelandsveien 7 0244 Oslo NORWAY	**Client Dietails** QSS Biosolids, LLC 2000 Chapel View Boulevard, Suite 500 Cranston, RI 02920 UNITED STATES OF AMERICA
Originator Ref. No. 101510	**Client PO No.** 23-04-006

Originator Doc. No.	**Orig. Rev.**	**Client Doc. No.**	**Client Rev.**
101510-CRS-P-RD-0001	C	-	-

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1 ABBREVIATIONS

ACF	Activated Carbon Filter
BTF	Biological Trickling Filter
CF	Catalytic Filter
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CS	Chemical Scrubber
DAF	Dry Ash Free
DS	Dry Solids
H_2	Hydrogen gas
H_2O	Water/Water vapor
HCl	Hydrogen Chloride
HF	Hydrogen Fluoride
HR	Heat Recovery
Kg	Kilo
MC	Moisture Content
MJ	Mega Joule
MW	Mega Watt
O_2	Oxygen gas
N	Nitrogen
N_2	Nitrogen gas
NOx	Nitrous Oxides
PFAS	Per- and polyfluoroalkyl substances
PM	Particulate Matter
SCR	Selective Catalytic Reduction
SO_2	Sulfur dioxide
SO_3	Sulfur trioxide
TO	Thermal Oxidizer
VOCs	Volatile Organic Compounds
QSS	Quonset Soil Solutions

2 INTRODUCTION

The world's population is increasing and as cities grow in population and area, efficient and safe handling of sewage is becoming increasingly important. Wastewater treatment generates two products: purified water and sewage sludge. Sewage sludges are typically contaminated by PFAS, heavy metals, other organic and inorganic chemical compounds, and micro plastics. These contaminants can leach into soil and water systems ending up in humans and animals through our water and food.

Sewage sludge face increasing scrutiny for traditional disposal methods and beneficial use pathways are being explored. Pyrolysis has emerged as a beneficial solution for sewage sludge treatment. Through high temperature pyrolysis with appropriate treatment conditions, the sewage sludge is transformed to a biochar free from organic pollutants such as PFAS and microplastics, and heavy metals are bound and immobilized.

2.1 Pyrolysis and its products

Pyrolysis is the thermo-chemical conversion of biomass in a low-oxygen environment. It converts organic residues into pyrolysis gas and a stable form of carbon, biochar. In the Pyrolysis Process the sewage sludge undergoes thermal decomposition, where organic materials break down into solid, carbon-rich biochar, with the release of volatile gases that can be utilized for energy recovery.

Biochar is a porous, carbonaceous material with a broad range of applications where the contained carbon remains stored as a long-term carbon sink. While the natural degradation of organic carbon leads to the release of greenhouse gases like CO_2 or CH_4 into the atmosphere, the stable carbon fraction in biochar is extremely durable. Unless it is burned, it resists weathering/degradation and remains stable for way beyond the relevant time scales of several centuries. The temperature and conditions of pyrolysis determine the characteristics of the final biochar product. The biochar has several uses such as soil amendment in agriculture, in materials for the construction industry or as sorbents in contaminated soils.

Pyrolysis Gas refers to the gaseous products produced during the process of pyrolysis. During pyrolysis, volatile matter is decomposed into energy rich gas which can be used to generate renewable industrial heat. This heat can be used to dry incoming sewage sludge and excess heat can be used to offset natural gas consumption or generate electricity. The Pyrolysis Gas contains typically VOCs, CO_2, CO, H_2, N_2 and H_2O.

2.2 Odorous Compounds in Sewage Sludge

Odorous airstreams from sewage sludge are a common environmental concern in wastewater treatment plants and areas where sewage sludge is processed or stored. These airstreams contain gases released from the sewage sludge during its decomposition or treatment processes.

Types of odorous compounds in sewage sludge can be Hydrogen Sulfide (H_2S), Ammonia (NH_3), Volatile Fatty Acids (VFAs), Mercaptans and Other Sulfur Compounds.

Odorous airstreams from sewage sludge can be of nuisance and environmental concern, but with proper management and treatment methods, these odors will be greatly reduced or eliminated.

3 PROCESS OVERVIEW

In brief, the plant will be treating dewatered sewage sludge (Wet Feedstock) in a thermochemical process called pyrolysis to remove organic pollutants from the solids and produce a biochar that can be safely used for various end-applications.

Pyrolysis gas generated during the process is converted into thermal energy through thermal oxidation and heat recovery to hot oil. The energy in the hot oil will be used to dry the Wet Feedstock received at the plant.

The system is delivered with a state-of-the-art emission control system for flue gas treatment, tailored for the Feedstock. The plant will collect all odorous air streams for treatment in a dedicated Odor Control Plant. The plant will be designed with two independent treatment lines.

The plant will have two stacks with emissions to air, one with the treated flue gas from combustion of Pyrolysis Gas and one from the Odor Control Plant.

3.1 Simplified Block Diagram

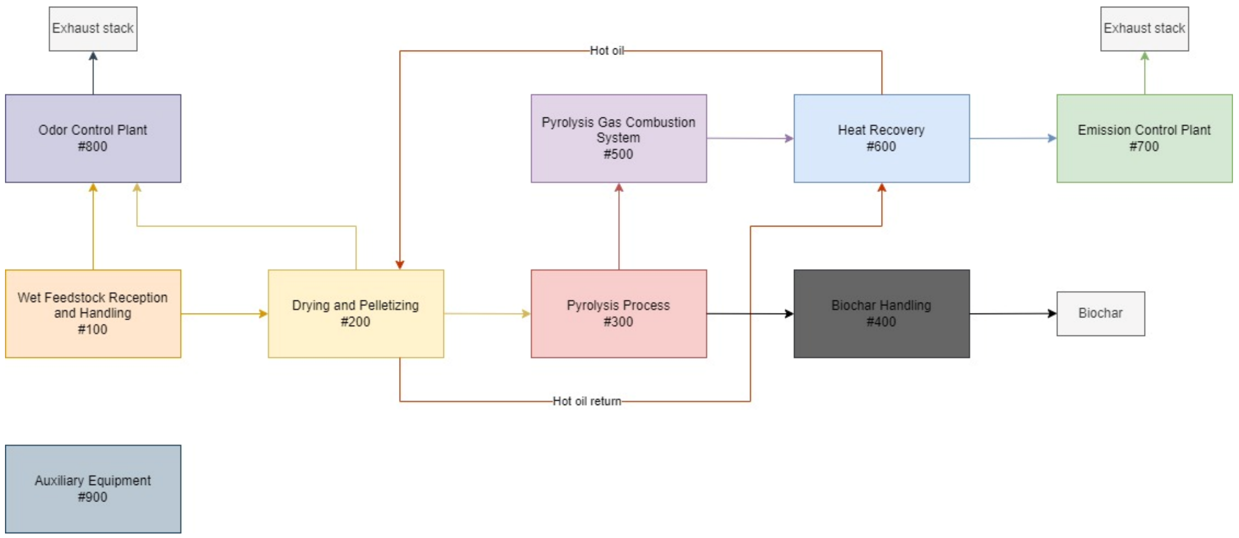


Figure 1 Simplified Block diagram

3.2 Area Description and Scope Responsibility

Table 1 Area description and scope responsibility

PROCESS AREA	DESCRIPTION	SCOPE RESPONSIBILITY
#100	Wet Feedstock Reception and Handling	VOW ASA
#200	Drying and Pelletizing	VOW ASA
#300	Pyrolysis Process	VOW ASA
#400	Biochar Handling	VOW ASA/ QSS
#500	Pyrolysis Gas Combustion System	VOW ASA
#600	Heat Recovery	VOW ASA
#700	Emission Control Plant	VOW ASA
#800	Odor Control Plant	VOW ASA
#900	Auxiliary equipment	VOW ASA
	Civil/Facility	QSS

3.3 Overview of Plant Layout

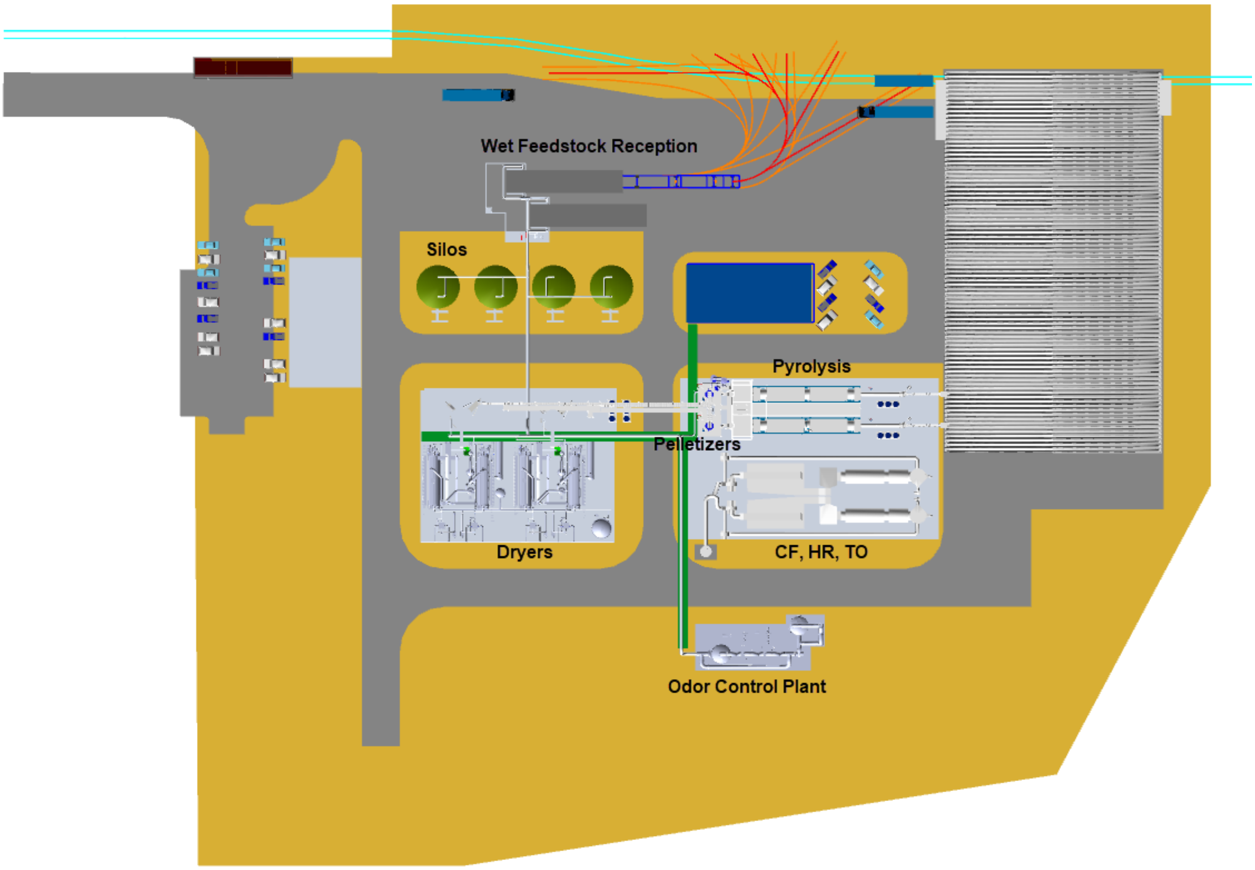


Figure 2 Overview of Plant Layout.

CF = Catalytic Filter, HR = Heat Recovery, TO = Thermal Oxidizers

4 PROCESS DESCRIPTION BY AREA

4.1 #100 – Wet Feedstock Reception and Handling

The plant will, in full operation, process large quantities of sewage sludge (Wet Feedstock) that has been dewatered to 25% dry solids (DS) at a remote location. The Wet Feedstock is transported to the site by trucks. It is expected that the Wet Feedstock will arrive five days a week, in a 12-hour window per day, Monday to Friday. The Wet Feedstock Reception has been sized accordingly, with approximately 4 days of buffer volume in the Wet Feedstock Silos to allow for an adequate buffer over weekends.

4.1.1 Weighbridge

Each truck that arrives on site will pass through a weighbridge (delivered by others) that will be located just after the entrance gate of the plant. The trucks will have to be weighed at arrival and when leaving the plant. This will ensure good control of the amount of Wet Feedstock that is received at the plant.

4.1.2 Wet Feedstock Reception Building & Transport to Silos

Two Wet Feedstock Reception Buildings are planned to optimize the delivery schedule and allow for maintenance stops. Each Wet Feedstock Reception Building will consist of two main zones, a truck cleaning zone and a reception bin zone. The trucks will back into the Wet Feedstock Reception Building for off-loading of the feedstock, first passing through the cleaning zone and then arriving in front of the reception bin for discharge. The trucks will have moving floors that will convey the Wet Feedstock out of the truck and into the reception bin. The reception bin will be a push floor container with two discharge screws. The Wet Feedstock will then be pumped to the silos by positive displacement pumps, through a closed piping system. The reception bin will have a lid which opens when the truck is ready to discharge the Wet Feedstock and close once the truck has finished. The truck will then drive forward into the cleaning zone where the trucks' exterior surfaces will be cleaned to avoid any spill to the environment outside of the Wet Feedstock Reception Building. Once the truck is cleaned, the gate will open and the truck will drive out and over the weighbridge for weight recording, and finally out through the gate of the plant.

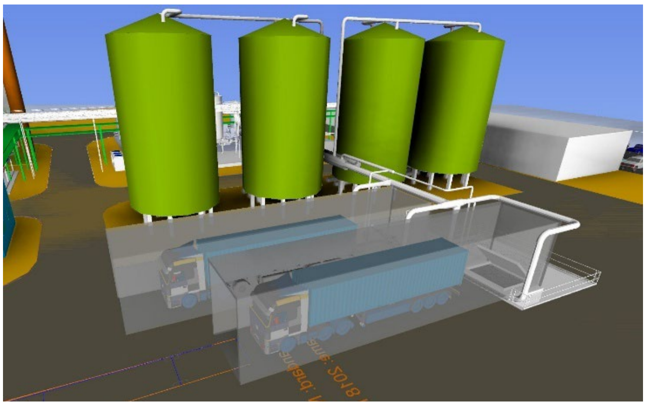


Figure 3 Wet Feedstock Reception Building and Wet Feedstock Silos

4.1.3 Wet Feedstock Silos and Transport to Dryers

Four silos of 800 m^3 are planned to be able to buffer Wet Feedstock for approximately 4 days of operation. Buffer silos are used in the system to balance the mass flow of Wet Feedstock prior to further processing through drying and pyrolysis. Buffer silos will provide autonomy in the system when performing maintenance on other equipment, as well as serve as a buffer to last over long-weekends. Water-tight moving floor silos with outlet screws will be used, ensuring a closed system with no leakages to the surrounding area. All four silos will be able to receive Wet Feedstock from both Wet Feedstock Reception Buildings and further pump their content to both dryers. The Wet Feedstock will be pumped by positive displacement pumps, through a closed piping system to the dryers.

Figure 4 Example of a Wet Feedstock Silo.

4.1.4 Points of Emission

4.1.4.1 Weighbridge

No emissions are expected from the Weighbridge as the trucks will be closed.

4.1.4.2 Wet Feedstock Reception Building & Transport to Silos

The trucks will enter the Wet Feedstock Reception Building by a gate which will open and close immediately before and after the truck has entered the building. The Wet Feedstock Reception Building will enclose the trucks completely when they empty the Wet Feedstock into the reception bin and during cleaning of the trucks afterwards. The airflow through the building will be designed to keep the building at a slight under pressure to control odors from escaping. The only time the building will be open to the surrounding area is when the trucks enter and leave the building. The emptying of the trucks will only happen when the gate is closed. The reception bin will have a lid that will close between each filling to minimize the odors in the building and odor when opening the gate when the trucks are leaving. Air will be evacuated in separate channels from the back of the Wet Feedstock Reception Building to ensure that the flow of air always will be directed away from the entrance gate. One channel will draw air from the main building and another channel from the reception bin. All ventilation air will be directed towards the main Odor Control Plant at the site to avoid any odor and uncontrolled air emissions.

No air emissions are expected when pumping the Wet Feedstock to the silos as this will be a closed system.

4.1.4.3 Wet Feedstock Silos

The Wet Feedstock Silos headspace will have a negative pressure. The headspace gases will be extracted from the top and delivered to the main Odor Control Plant to control and reduce odor and emissions to the atmosphere.

No air emissions are expected when pumping the Wet Feedstock to the dryers as this will be a closed system.

4.2 #200 – Drying and Pelletizing

After initial receival and storage, the Wet Feedstock enters the drying stage. Drying is required to ensure consistency and efficiency in the pyrolysis step. Before the Wet Feedstock can enter the pyrolysis process, the water content needs to be reduced, ideally to approximately 10 %.

4.2.1 Dryer Technology

A Disc Dryer has been chosen for this plant. Two Disc Dryer systems will be installed in parallel.

The Disc Dryer is designed for indirect heating by hot oil. The product to be dried is slowly, but vigorously, transported from the inlet to the outlet end by a paddle system mounted on the disc periphery. Product discharge is done continuously by a speed-controlled extraction screw conveyor. The discs are mounted on a heavy central shaft with a highly efficient condensate removal system integrated. Scraper bars ensure agitation between the discs, which is necessary for efficient evaporation. The moisture evaporated from the product is collected in a high-top vapor dome and continuously removed. The vapor will pass through an internal scrubbing system for heat recovery and condensation of the moisture in the exhaust gas.

The dryer is a closed system and has been optimized to reduce wear and potential leakages. It uses specially designed claws inside each disc to mount the two sides of the plates together. This gives it a superior mechanical strength, departing from the conventional approach that relies on stay bolts to secure disc plates in position. The design effectively eliminates the potential for leaks originating from stay bolt welds. The disc design has a smooth surface that secures maximum heat transfer, increases the level of self-cleaning and reduces fouling problems. The dryer is operating under a slight vacuum to avoid emissions to the atmosphere.

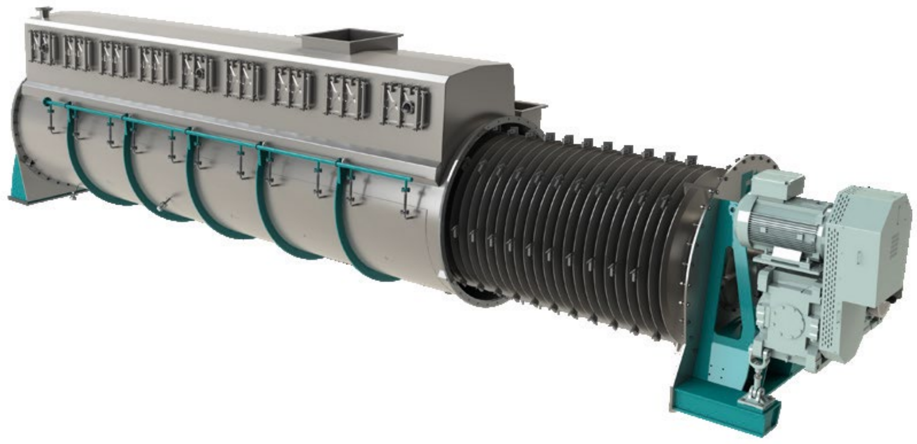


Figure 5 Outside and inside of a Disk Dryer

4.2.2 Transport of Dried Feedstock to Dried Feedstock Silo

The Dried Feedstock will be transported out from the dryer by an inclined tubular screw conveyor, through a bucket elevator and discharged into the Dried Feedstock Silo by a horizontal screw conveyor. This is a dust tight system to ensure no emissions of particulate matter to the atmosphere.

4.2.3 Dried Feedstock Silos

The Dried Feedstock is stored in silos for buffering before the downstream pyrolysis process. This is to ensure that operational variations in the upstream process does not immediately impact the pyrolysis process. Each storage silo will be sized to give the needed autonomy to the system ensuring adequate buffer capacity of the system during routine maintenance and short unplanned downtime.

Two silos of 80 m^3 are planned to be able to buffer approximately 10 hours of operation. The sliding frame silos will be equipped with level and temperature monitors, explosion relief vents, top mounted dust filter and connection for inert gas purging. The inert gas will provide an oxygen reduced environment in the silos' headspace.

Figure 6 Example of Dried Feedstock Silos

4.2.4 Transport of Dried Feedstock to Pelletizer

From each silo the Dried Feedstock will be transported by closed chain conveyors to the pelletizer systems. A crossover is installed at the pelletizer inlet so that both Dried Feedstock Silos can feed both pelletizer units. The conveyors are dust tight to ensure no emissions of particulate matter to the atmosphere.

4.2.5 Pelletizer

The main purpose of the pelletizer is to minimize fines in the downstream equipment. This reduces the need for maintenance and increases the lifetime of the downstream Pyrolysis Gas Combustion System. Two independent lines of pelletizer systems are placed in parallel. Both Dried Feedstock Silos can feed both pelletizers, and both pelletizers can feed either of the Pyrolysis Reactors. The pelletizers can also be bypassed, sending un-pelletized Dried Feedstock directly to the Pyrolysis Reactors. This ensures full flexibility and allows for maintenance work without stopping the Pyrolysis Reactors. When feeding un-pelletized

Dried Feedstock, slightly more maintenance is most likely required on downstream equipment.

The Dried Feedstock will enter the Pelletizer via a pre-bin and screw conveyors to ensure continuous and adjustable flow. To optimize the pelletizing process, a conditioner with water injection mixes the product with the water before it enters the pellet mill. The pellet mill presses the feedstock into pellets.

To reduce dust in the piping and downstream Odor Control Plant, a filter is used on the airstream from the pellet mill.

Figure 7 Example of a Pelletizer

4.2.6 Points of Emission

4.2.6.1 Dryer

The dryer is a closed system and the exhaust air from the dryer will be directed to the Odor Control Plant for treatment.

4.2.6.2 Transport of Dried Feedstock to Dried Feedstock Silo

Aspiration of the Dried Feedstock conveyors will be done through the headspace of the Dried Feedstock Silos where the air will be evacuated to the Odor Control Plant.

4.2.6.3 Dried Feedstock Silos

The Dried Feedstock Silos will have a negative pressure in the headspace and the outlet gas will be led to the Odor Control Plant to control and reduce emissions to the atmosphere. The gas extraction point will be at the top of the silos. To reduce dust in the downstream piping and the Odor Control Plant, a top mounted filter will be installed on the gas extraction point at each silo.

4.2.6.4 Transport of Dried Feedstock to Pelletizer

No emissions are expected when conveying the Dried Feedstock from the Dried Feedstock Silos to the pelletizer, as this will be a closed system. However, the conveyors will be aspirated through the up- and down-stream equipment, either the Dried Feedstock Silo or the Pelletizer, and sent to the Odor Control Plant to control and reduce emissions to the atmosphere.

4.2.6.5 Pelletizer

The Pelletizers will be continuously aspirated to ensure a slight under pressure in the Pelletizer to avoid any uncontrolled emissions to the atmosphere. To reduce dust in the piping and in the downstream Odor Control Plant a filter is used on the airstream from the Pelletizer. The filtered air will then be led to the Odor Control Plant to control and reduce emissions to the atmosphere.

4.3 #300 – Pyrolysis Process

4.3.1 Pyrolysis Infeed System

The Dried & Pelletized Feedstock will be transferred to the Pyrolysis Reactor through an infeed system consisting of:

1. Infeed screw
2. A bucket conveyor to gently lift the Dried & Pelletized Feedstock from the Pelletizer to a hopper to minimize breakage of the pellet and dust.
3. Dried & Pelletized Feedstock hopper, to have a small buffering volume to ensure a steady and continuous flow into the Pyrolysis Reactor.
4. An air-lock system to ensure that there will be no air ingress into the Pyrolysis Reactor from the feed-side.
5. Inclined screw with a water lock for fire suppression purposes

A crossover will be installed upstream the hopper to ensure flexibility of the feeding system. The infeed system provides feed rate control into the Pyrolysis Reactor and is a part of the overall process control scheme.

4.3.2 Pyrolysis Reactors

The pyrolysis plant will be delivered with two independent Pyrolysis Reactors. The two parallel reactors ensure flexibility on the desired flow of the system and redundancy. One reactor is displayed in Figure 8.

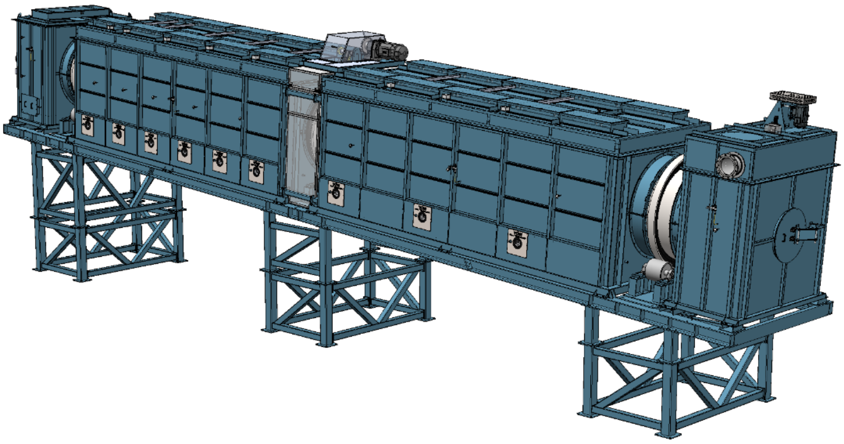


Figure 8 Layout of one pyrolysis reactor, two identical lines will be installed in parallel

The reactors are indirectly heated rotary kilns that are configured to operate with electricity as the heat source.

The Dried & Pelletized Feedstock enters the reactor at one end through a screw conveyor. The Dried & Pelletized Feedstock in the pyrolysis chamber is conveyed through the reactor by rotation of the drum and remains in continuous contact with the heat source (rotating drum wall) while it is being transferred. The particles of the Dried & Pelletized Feedstock are therefore heated in a uniform manner while passing through the reactor.

The Pyrolysis Process is expected to operate in the range 600 – 750 °C. The temperature of the product can be separately adjusted in each Pyrolysis Reactor up to 750 °C by varying the temperature in the reactor. Residence time of the product within the reactor can be controlled by the rotation speed of the drum.

The Pyrolysis Process will create pyrolysis gas and biochar. Hot pyrolysis gas will exit the Pyrolysis Reactor at the hot end and be transferred to the Pyrolysis Gas Combustion System by a fan at the gas outlet. The biochar will exit through a chute in the lower end of the reactor and will enter the Biochar Cooling Screw.

4.3.3 Biochar Cooling Screw

For cooling of the biochar, a cooled screw conveyor is used, cooling the biochar from the pyrolysis temperature to < 60 °C. The cooler is equipped with the possibility for nitrogen purging and a water spray system for moisturizing the biochar to the required humidity for safe storage and handling, and emergency fire-fighting purposes. At the outlet of the cooling screw there is an airlock, ensuring no air ingress into the system. The cooling screw is air- and dust tight.

Figure 9 Cooling screw

4.3.4 Location of airlocks in the Pyrolysis Process

The Pyrolysis System is design to minimize the air ingress to the Pyrolysis Reactor. This is ensured by having an airlock on the Pyrolysis Infeed System and a second airlock after the Biochar Cooling Screw, as indicated by the red circles in Figure 10.

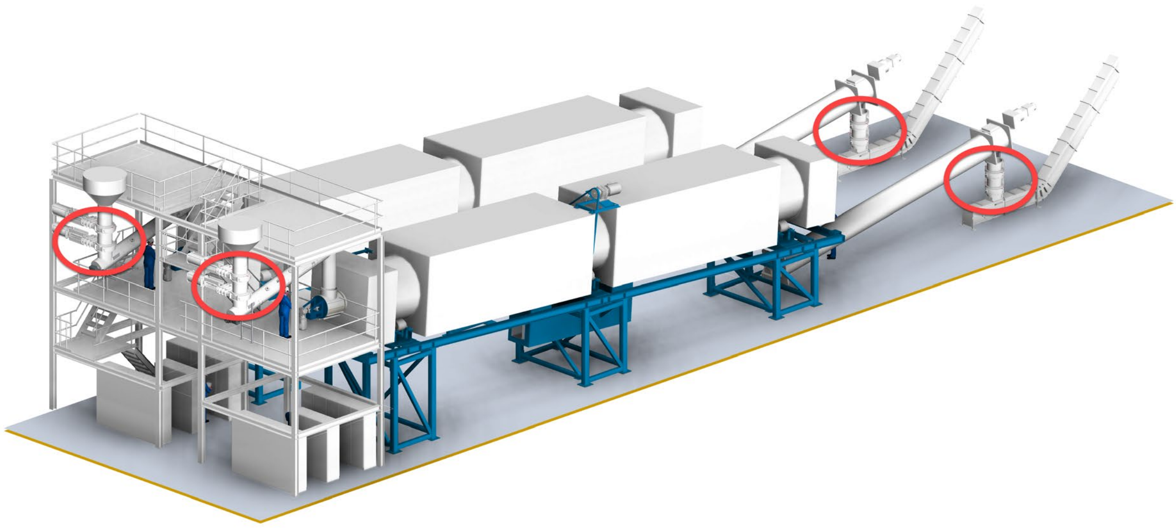


Figure 10 Pyrolysis System. Red circles indicating airlock systems.

4.3.5 Points of Emission

4.3.5.1 Pyrolysis Infeed System

No emissions are expected from the Pyrolysis Infeed System, as this will be a closed system.

4.3.5.2 Pyrolysis Process

The Pyrolysis Process will have two main products: pyrolysis gas and biochar. The pyrolysis gas will be transferred in closed piping to the Pyrolysis Gas Combustion System, followed by Heat Recovery and the Emission Control Plant. The treated flue gas will then be released to the atmosphere.

The Pyrolysis Reactors operate at a slight under-pressure to ensure that any potential minor leaks do not result in the release of process gas to the environment in the production facilities.

4.3.5.3 Biochar Cooling Screw

The Biochar Cooling Screw is a closed process, and no air emissions are expected from this stage.

4.4 #400 – Biochar Handling

4.4.1 Biochar Transport from Cooler to Biochar Logistics Station

After cooling and moisturizing, the biochar is transported with closed chain conveyors to the Biochar Logistics Station. The chute between the Biochar Cooling Screw and transport screw may be purged with nitrogen to avoid air ingress into the Biochar Cooling Screw.

4.4.2 Biochar Logistics Station

A big bag packing station will be used for packaging and storing the biochar. A distribution screw will be used between the stations, and automated valves will ensure correct filling of each big bag. The bags will be blanketed with nitrogen and sealed to avoid evaporation of the water and air ingress. The packing station will be in a separate building. The big bags will be transported out of the site either by trucks or rail.

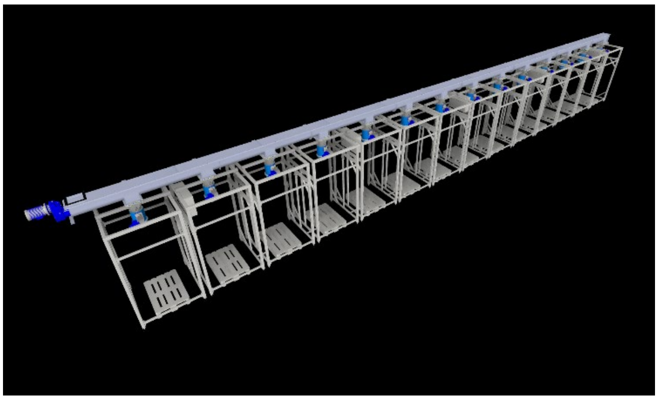


Figure 11 Example of a biochar packing station

4.4.3 Points of Emission

4.4.3.1 Biochar Transport from Cooler to Biochar Logistics Station

The Biochar Transport Screw is considered a closed system with no air emissions to the surrounding area.

4.4.3.2 Biochar Logistics Station

The packing station is considered a closed system with no air emissions expected from this stage.

4.5 #500 – Pyrolysis Gas Combustion Systems

The Pyrolysis Gas Combustion System comprises a multi-stage Thermal Oxidizer. Two Thermal Oxidizers are installed, one per treatment line. The Thermal Oxidizer is a pollution control device used to treat and remove harmful volatile organic compounds (VOCs), hazardous air pollutants (HAPs), and other compounds found in the Pyrolysis Gas. High temperatures oxidize pollutants, converting them into less harmful substances.

Recirculation of treated flue gas from the Emission Control Plant will control the temperature and minimize the formation of NOx. The Thermal Oxidizer will operate between sufficient residence time and temperature to destroy organic contaminants, VOCs and odor causing contaminants. The Thermal Oxidizer can operate on Pyrolysis Gas, Natural Gas or any combination of both.

The Thermal Oxidizer is provided with an emergency vent stack to divert exhaust directly to atmosphere upon loss of plant power/ mechanical failure. The emergency vent is only activated in emergency situations to avoid equipment damage or life-threatening conditions after a multi-point failure. The emergency vent is only activated while the plant is shutting down and is, under no circumstance, utilized during normal plant operation. The emergency vent may be exercised regularly to ensure availability in an emergency situation. However, this will not cause any additional emissions.

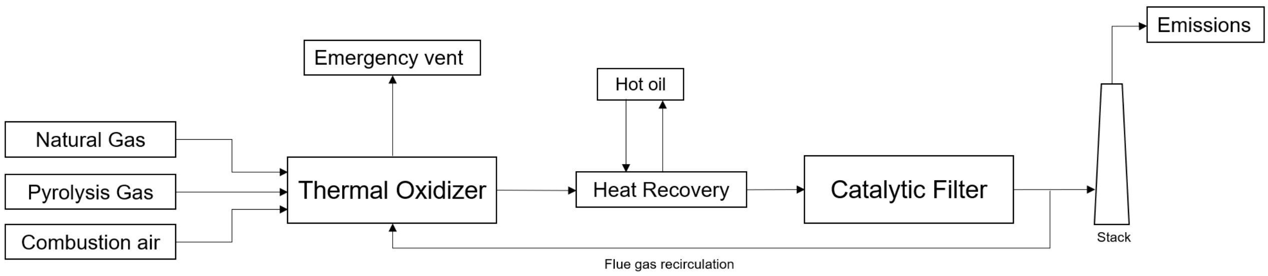


Figure 12 Pyrolysis Gas Combustion System

4.5.1 Points of Emission

During normal operation there will be no uncontrolled air emissions from the Thermal Oxidizer. In an emergency situation, the possibly partially oxidized exhaust will be directed to the atmosphere through the emergency vent stack.

4.6 #600 – Heat Recovery

The flue gas leaving the Thermal Oxidizer is passed through a heat recovery device, which heats a heat transfer fluid (thermal oil, Therminol 66) for process heating purposes.

Heat exchangers downstream of each Thermal Oxidizer will extract heat from the flue gas. The heat exchangers and thermal oil system are designed and sized to maximize heat recovery and to cool the exhaust stream for emission treatment. The main consumers of the recovered heat are the Wet Feedstock dryers.

The thermal oil is heated to ~260 °C. Pump stations and expansion tanks are utilized to deliver and buffer the flow. Control valves and instruments regulate flow to the heat consumers.

The thermal oil system is a closed loop system with no waste streams. The thermal oil cooler is designed to radiate the full heat load of the system if consumers are not available during maintenance or shutdown periods.

Under normal operation, waste heat directly radiated from the thermal oil cooler is minimized. If consumers are offline or unable to use all the heat available in the thermal oil, the excess heat is radiated at the thermal oil cooler to maintain design temperature on the cool thermal oil return.

During initial start-up of the system, process derived heat from the pyrolysis process will not be available for heat consumers (dryers). The thermal oil system will, under these circumstances, be heated by Natural Gas until the pyrolysis process is reliably supplying heat. Natural Gas will be used as fuel to heat the Thermal Oxidizer until it reaches the temperature required for combustion of the Pyrolysis Gas, the hot oil has reached 260 °C and the dryers are running. During cold start of the dryers, a regime will be implemented minimizing the run time with Natural Gas.

4.6.1 Points of Emission

The thermal oil system is a closed loop, and no air emissions are expected from this stage. The flue gas leaving the heat recovery unit is directed to the Emission Control Plant for further treatment.

4.7 #700 – Emission Control Plant

After the flue gas exits the heat recovery unit after the Thermal Oxidizer, it is passed to the Emission Control Plant for further treatment.

4.7.1 Catalytic Filter

A high temperature ceramic/ catalytic bag filter technology is selected to significantly reduce pollutants such as NOx, SOx, HF and PM in the flue gas. Two Catalytic Filters will be installed, one for each treatment line.

This filter combines traditional filtration methods with catalytic processes to enhance pollutant removal efficiency. This ensures that the emissions comply with environmental regulations, contributing to improved air quality and reduced environmental impact.

The catalytic material embedded within the filter facilitates chemical reactions that convert harmful pollutants into less harmful substances. Specifically, nitrogen oxides (NOx) are converted into nitrogen and water through selective catalytic reduction (SCR), while sulfur oxides (SOx) are transformed into less harmful compounds using dry sorbent injection method.

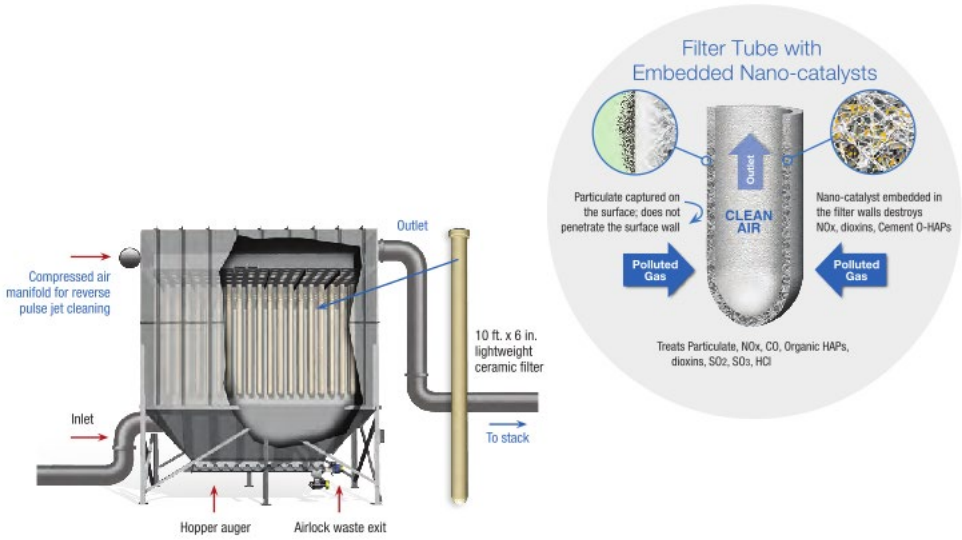


Figure 13 Ceramic catalytic filter

The fabric filter captures particulate matter on its surface, achieving high removal efficiency. This technology is advantageous for its ability to control multiple pollutants in a single system and its high efficiency.

The system includes a bank of many self-supporting ¾" thick ceramic filter tubes with embedded catalyst. Filter life is 5-10 years and performs the following duties:

- Acid Gas Control: The system will have a dry sorbent injection of calcium or sodium based sorbents (hydrated lime, sodium bicarbonate and trona) to remove SO_2, SO_3, HCl and HF (Figure 14, 1.). Powdered sorbents are injected upstream of the filters and the reaction by-products are captured as particulate at the filters. The SO_2 removal reaction occurs within the duct leading to the filters and at the sorbent cake that accumulates on the surface of the filters. The chemical reaction of the sorbent with the acid gas creates a solid particle that is captured on the filters, along with the unreacted sorbent and the process particulate.

- NOx Control: NOx will be controlled by two mechanisms to enhance the performance. Firstly, by injection of urea, used as a reactant to remove NOx. (Figure 14, 2.). Secondly, a catalytic filter. The catalytic filter uses nano-bits of catalyst embedded in their walls to facilitate the selective catalytic reduction (SCR) of NOx by NH_3. (Figure 14, 4. And Figure 13). The large reactive surface area of the micronized catalyst produces a high NOx removal at temperatures lower than standard SCR. Good results start at 175 °C and improve to 95 % removal at 232 °C and above. The unique structure of the filters captures process particulate on its outer surface, keeping it away from the nano-catalyst inside the filter walls (Figure 13). This prevents PM blinding and poisoning of the catalyst, and greatly extends the catalyst life compared to standard SCR.

- Particulate Control: The filter removes particulates from gas sources above 150 °C, including PM10, PM2.5, and submicron. Heavier loadings require more frequent pulse-jet cleaning of the filters, but outlet levels remain the same as traditional bag filters (Figure 14, 4.).

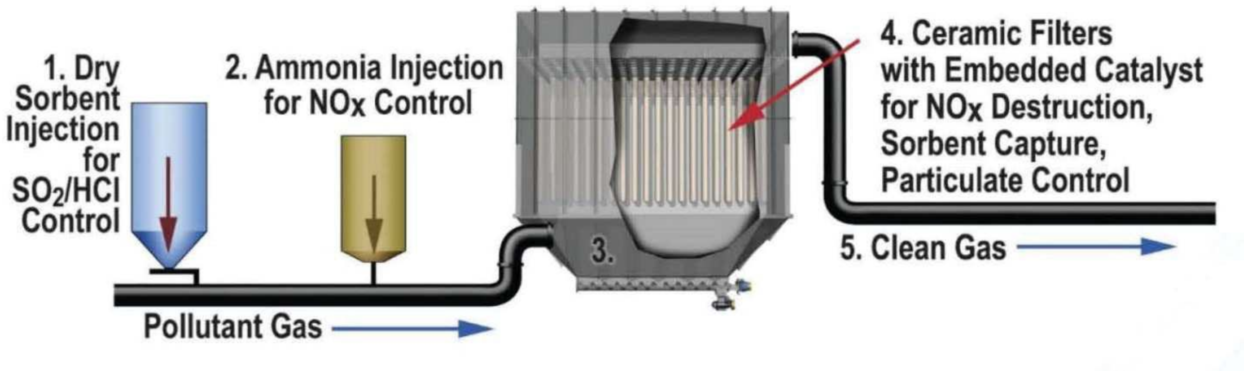


Figure 14 Example of Catalytic Filter as Emission Control Plant

4.7.2 Stack

After treatment in the Catalytic Filter the flue gas will be directed to a flue gas stack. Each Catalytic Filter will have their individual flue gas pipes but combined into a common stack. This will give one point of emission for the flue gas from both treatment lines.

4.7.3 Points of Emission

The catalytic filter is a closed system, and air emissions are only expected to be released in a controlled manner from the stacks after treatment.

4.8 #800 - Odor Control Plant

An Odor Control Plant will be located at the site to treat odorous airstreams from the following sources:

- Wet Feedstock Reception Buildings
- Wet Feedstock Reception Bins
- Wet Feedstock Silos
- Dryers
- Dried silos and conveyor systems
- Pelletizers

The Odor Control Plant shall remove hydrogen sulfide, ammonia, and odors from the air streams, using a biotrickling filter operating in series with Two-stage Chemical Scrubbing and an Activated Carbon Filter for final polishing.

4.8.1 **Odor Treatment Technology**

The treatment process consists of three technologies:

- Biotrickling Filter
- Two-stage Chemical Scrubbers
- Carbon Polishing System

4.8.1.1 BioTrickling Filter (BTF)

The BioTrickling Filter (BTF) uses biological technology with structured synthetic media to grow a colony of microorganisms that will oxidize a wide range of odorous compounds. The BTF is designed as a once-through, non-recirculating system. It will reduce the concentrations of compounds entering the chemical scrubber stages, thus reducing the expected chemical usage costs and ultimate operating cost. The BTF achieves nearly complete removal of H_2S and removes a large portion of the NH_3.

As illustrated in Figure 15, the air shall enter the system at the bottom of the BTF and flow upward through each of the media layers. The BTF hosts trillions of microorganisms that consume unwanted compounds. Irrigation water containing nutrients introduced at the top of the reactor trickles down through the media, sustaining the environment the microorganisms in the vessel need to thrive and rinsing the byproducts of metabolized compounds toward a drain in the reactor.

The drain water from the system will pass from the sump in the bottom of the reactor vessel and be piped to a discharge point. The BTF can facilitate the growth of both autotrophic and heterotrophic bacteria in a single reactor vessel, thus allowing the oxidation and removal of both organic and inorganic odors in a single reactor.

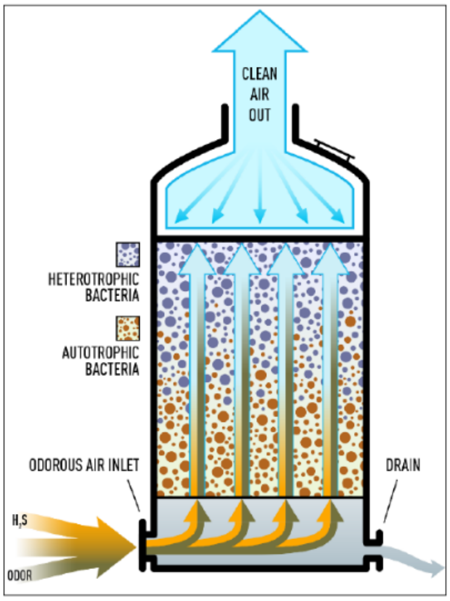


Figure 15 Biotrickling filter (BTF)

4.8.1.2 Chemical Scrubbers (CS)

The airstream is then ducted to the second-stage treatment in a 2-stage Chemical Scrubber System, which will remove most of the odorous compounds remaining after the BTF.

The air will pass through the first (acid) stage of the chemical scrubber, effectively removing ammonia, amines and other reduced nitrogen-based compounds to very low concentrations. The second (caustic / hypochlorite) stage will treat any remaining H_2S, methyl mercaptan, dimethyl sulfide and other ROSCs, and acidic gases, as well as VFAs, to very low levels.

The chemicals are sprayed down over the media as impacted air is forced upward, and the chemicals will then react with the odorous compounds. The clean air is released through a vent at the top of the treatment vessel to the third stage with polishing treatment in an Activated Carbon Filter. The waste streams from the Chemical Scrubbers will be led to a drain and further to the sewer system.

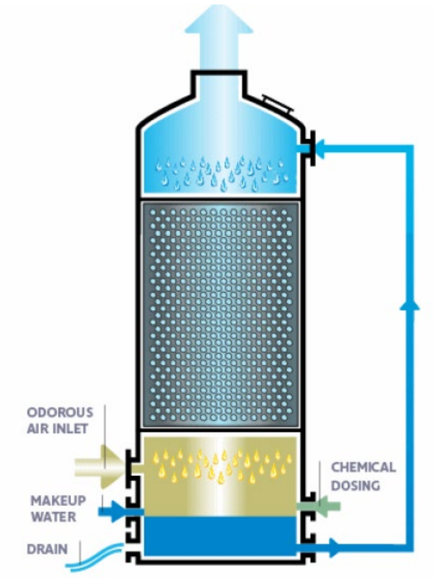


Figure 16 Chemical Scrubber (CS)

4.8.1.3 Activated Carbon Filter (ACF)

The final stage of treatment will further polish remaining odorous compounds using a vapor phase activated carbon adsorption system. The air shall enter the system (Figure 17, 1.) and flow through the activated carbon and other adsorptive media layer(s) (Figure 17, 2.), before being discharged into the atmosphere (Figure 17, 3.). Compounds are adsorbed by the large specific surface area provided by the media. The airstream is then released to the atmosphere via the exhaust stack at the top of the system vessel.

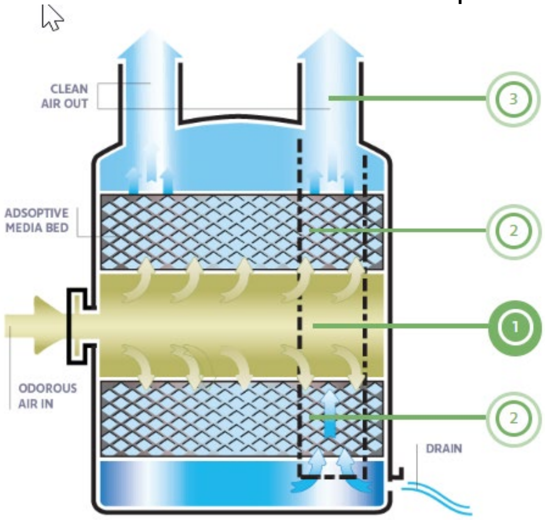


Figure 17 Activated Carbon Filter (ACF), 1. Foul air entry, 2. Dual carbon beds, 3. Releasing treated air

4.8.2 Points of Emission

The piping transferring the air streams to the Odor Control Plant is closed, and no air emissions are expected from this. The Biotrickling Filter, the Chemical Scrubbers and the Activated Carbon Filter are closed systems with a stack at the outlet of the Activated Carbon

Filter releasing the treated gas to the atmosphere. This will be the single point of air emissions from this system.

4.9 #900 – Auxiliary Systems

4.9.1 Electricity

The plant will require approximately 6 MW of installed electric capacity.

4.9.2 Natural Gas

Natural gas will be supplied to the site by local utility on a metered service with the pressure and flow rate to be determined by the utility. If required, a booster station will be installed to maintain the pressure and flow to the plant. Approximately 950 Nm^3/hour of Natural Gas is expected to be used in the Thermal Oxidizer for approximately 24 hours during cold start-up of the system. In normal operation no use of Natural Gas is expected.

4.9.3 Water

Water will be consumed in several of the process steps in the plant. The water consumption is expected to be approximately 70 m^3/day.

In addition, several areas in the plant will have a water connection for fire-fighting purposes, including the infeed system to the Pyrolysis Reactor.

4.9.4 Compressed Air

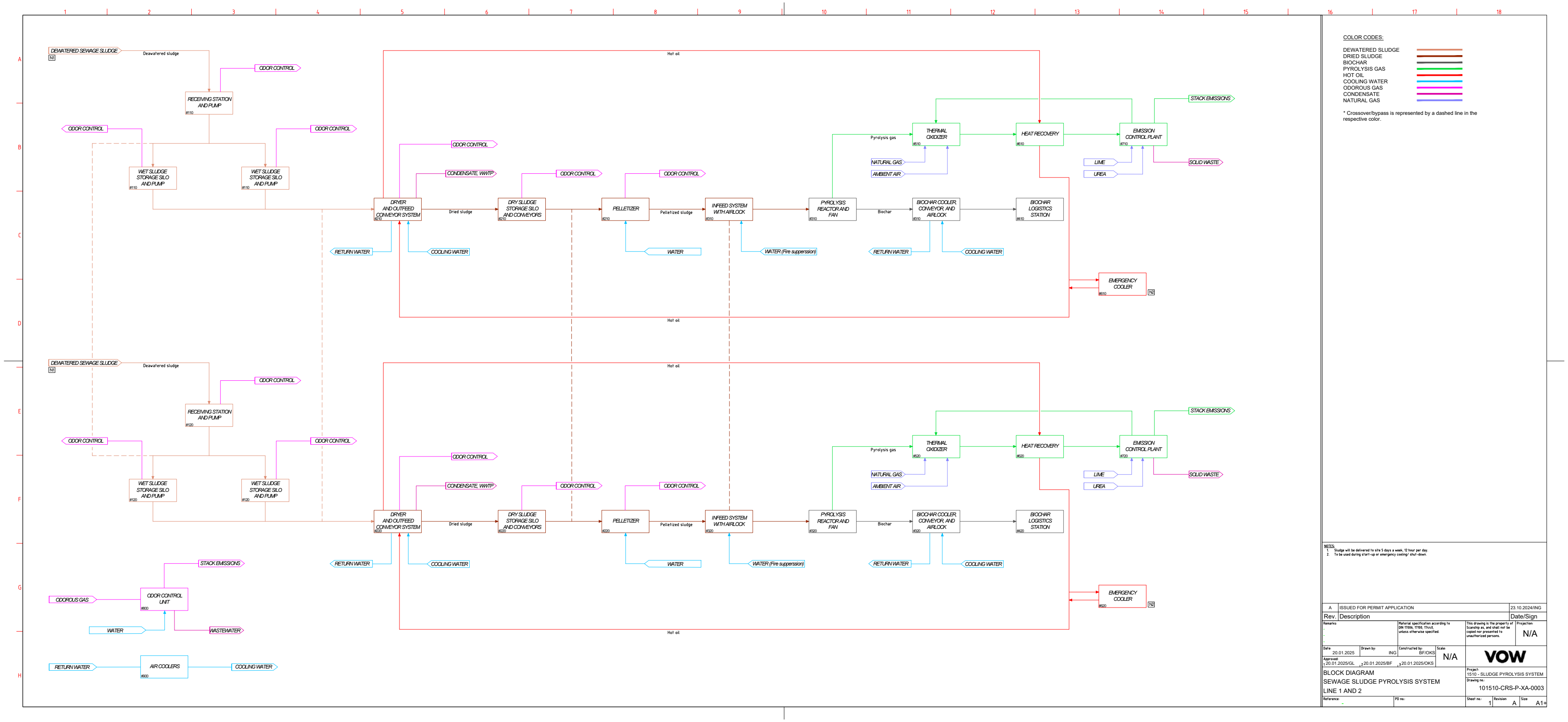
Compressed air is required for operating pneumatic valves, purge cleaning of gas filter, nitrogen production and atomizer (if required) for the thermal oxidizer. Compressors will be installed to deliver compressed air to a buffer vessel. Working
pressure is 8 bar.

4.9.5 Nitrogen

Nitrogen as an inert gas is used to displace oxygen/air from the system. Nitrogen will be produced from the compressed air system at the plant with the use of nitrogen generators. Membrane technology or pressure swing adsorption will be used for production. Nitrogen purity is 96 % (4 % residual O_2).

5 APPENDIX

5.1 Appendix A Block Diagram



COLOR CODES:

DEWATERED SLUDGE
DRIED SLUDGE
BIOCHAR
PYROLYSIS GAS
HOT OIL
COOLING WATER
ODOROUS GAS
CONDENSATE
NATURAL GAS

* Crossover/bypass is represented by a dashed line in the respective color.

NOTES:

1. Sludge will be delivered to site 5 days a week, 12 hour per day.
2. To be used during start-up or emergency cooling/ shut-down.

Rev.	Description	Date/Sign
A	ISSUED FOR PERMIT APPLICATION	23.10.2024/ING

Remarks: - - -

Material specification according to DIN 17006, 17100, 17440, unless otherwise specified.

Projection: N/A

Date: 20.01.2025 | Drawn by: ING | Constructed by: BF/OKS | Scale: N/A

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VOW

BLOCK DIAGRAM
SEWAGE SLUDGE PYROLYSIS SYSTEM
LINE 1 AND 2

Project: 1510 - SLUDGE PYROLYSIS SYSTEM

Drawing no.: 101510-CRS-P-XA-0003

Reference: - | PD no.: | Sheet no.: 1 | Revision: A | Size: A1+

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Document Title

IMPACT OF AIR INGRESS TO PYROLYSIS REACTORS

Originator

Originator Details

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1 ABBREVIATIONS

CO	Carbon Monoxide
CO_2	Carbon Dioxide
H_2	Hydrogen gas
H_2O	Water/Water vapor
Kg	Kilo
O_2	Oxygen gas
N_2	Nitrogen gas
VOCs	Volatile Organic Compounds

2 PYROLYSIS PROCESS

Pyrolysis is the thermo-chemical conversion of biomass in a low-oxygen environment. It converts organic residues into pyrolysis gas and a stable form of carbon, biochar. In the Pyrolysis Process the biomass undergoes thermal decomposition, where organic materials break down into solid, carbon-rich biochar, with the release of volatile gases that can be utilized for energy recovery.

Biochar is a porous, carbonaceous material with a broad range of applications where the contained carbon remains stored as a long-term carbon sink. While the natural degradation of organic carbon leads to the release of greenhouse gases like CO_2 or CH_4 into the atmosphere, the stable carbon fraction in biochar is extremely durable. Unless it is burned, it can resist weathering/degradation with a stability similar to inertinite, a highly stable form of carbon. The temperature and conditions of pyrolysis determine the characteristics of the final biochar product. The biochar has several uses such as soil amendment in agriculture, in materials for the construction industry or as sorbents in contaminated soils.

Pyrolysis Gas refers to the gaseous products produced during the process of pyrolysis. During pyrolysis, volatile matter is decomposed into energy rich gas which can be used to generate renewable industrial heat. This heat can be used to dry incoming biomass and excess heat can be used to offset natural gas consumption or generate electricity. The Pyrolysis Gas contains typically VOCs, CO_2, CO, H_2, N_2 and H_2O.

3 THE DIFFERENCE BETWEEN PYROLYSIS, GASIFICATION, AND INCINERATION

The primary differences between pyrolysis, gasification and incineration lies in the presence of oxygen, temperature conditions, and the types of products generated. Pyrolysis and gasification focus more on converting waste into energy or chemical products, while incineration primarily burns waste to reduce its volume and generate heat.

The different treatment methods are generally described as by the following definitions:

- Pyrolysis: thermal degradation of organic material in the absence of oxygen
- Gasification: partial oxidation
- Incineration: full oxidative combustion

The reaction conditions for these thermal treatments vary but may be differentiated approximately as illustrated in Figure 1.

	Combustion	**Pyrolysis**	**Gasification**
Reaction temperature (ºC)	800–1 450	250–700	500–1 600
Pressure (bar)	1	1	1–45
Atmosphere	Air	Inert/Nitrogen	Gasification agent: O_2, H_2O
Stoichiometric ratio	> 1	0	< 1
Products from the process in the			
• **gas phase:**	CO_2, H_2O, O_2, N_2	H_2, CO, hydrocarbons, H_2O, N_2	H_2, CO, CO_2, CH_4, H_2O, N_2
• **solid phase:**	Ash, slag	Ash, coke	Slag, ash
• **liquid phase:**		Pyrolysis oil and water	

Figure 1 Typical reaction conditions and products from pyrolysis, gasification and incineration processes. From Neuwahl, F., Cusano, G., GÓMEZ, B. J., Holbrook, S., & Roudier, S. (2019). Best available techniques (BAT) reference document for waste incineration: industrial emissions directive 2010/75/EU (Integrated Pollution Prevention and Control).

4 AIR AND OXYGEN IN THE PYROLYSIS PROCESS

There are two main sources of oxygen into the pyrolysis process:
1. Air in feedstock
2. Air ingress through seals on the equipment

The amount of oxygen and air that could enter the pyrolysis process has been estimated and is presented in Table 1.

Table 1 Estimated values for Oxygen and Air into the Pyrolysis Process

	ESTIMATED VALUE	UNIT
Oxygen following the feedstock	2	kg O_2/hour
Oxygen through seals on the equipment	28	kg O_2/hour
Total Oxygen ingress to pyrolysis process	30	kg O_2/hour
Total air ingress to pyrolysis process	119	kg air/hour
Stoichiometric ratio	0.005	

*Elemental oxygen in the feedstock is not considered in these calculations.

4.1 Air ingress mitigation techniques

The pyrolysis reactor and upstream & downstream process have several design elements to minimize air ingress into the system to achieve the low air ingress stated above.

- The equipment in the reactor section is in general manufactured air-tight and is leak-tested during commissioning and prior to start-up.
- **Infeed airlock** – material is fed into the pyrolysis reactor in such a way that air from the storage and conveyance system is generally not pulled into the reactor. This is achieved via a feedstock airlock. VOW employs several different airlock systems for different feedstocks and equipment configurations, including rotary valves, sluice gates, feedstock plugs, etc. For this system, VOW is proposing the use of a sluice arrangement (Figure 2).
- **Equipment seals** – the reactor itself is designed with seals on the cold side of the metal to prevent unwanted air from entering either the heat shell or the pyrolysis tube.
- **Under-pressure control** – the pyrolysis tube is kept under slight negative pressure to evacuate pyrolysis gas during operation. The pressure differential with respect to ambient is small (-1 to -3 mbar) to reduce the risk of air ingress. Pressure is monitored and regulated via fan speed.
- **Outfeed airlock** – hot biochar is extracted from the reactor after pyrolysis has been completed. The hot biochar is fed directly into a cooling screw and cooled down before discharge through a sluice arrangement downstream of the cooler (Figure 2).
- **Inert gas purging** – as a precaution, inert gas (e.g., Nitrogen) connections exist to allow a purge of gas spaces if required.

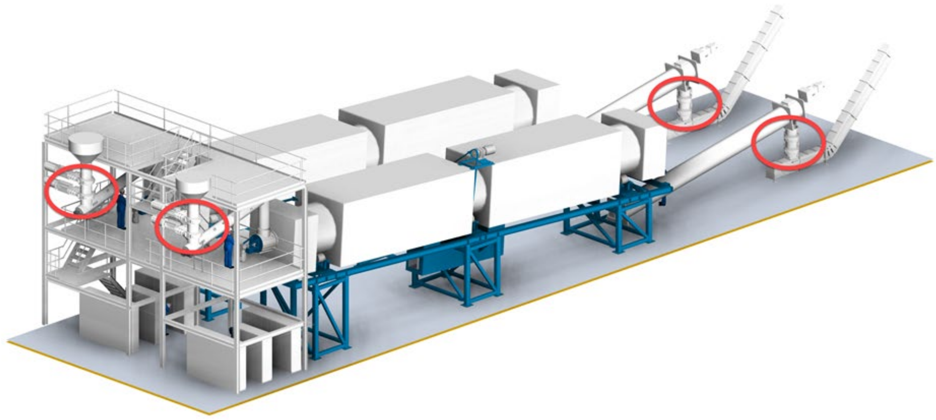


Figure 2 Illustration of feedstock infeed system, pyrolysis reactors and biochar outfeed system. Airlocks indicated by red circles

5 SUMMARY

Several air ingress mitigation techniques are implemented as described in Chapter 4.1 to reduce air ingress to the pyrolysis process. With the estimated levels of air ingress to the pyrolysis process (Table 1), the stoichiometric ratio is close to zero, at 0.005. To qualify as incineration the stoichiometric ratio must be above 1 (Figure 1). The impact of the air ingress is hence assumed to be negligible and does not qualify as incineration.

ATTACHMENT B

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

September 9, 2021

Mr. Dale G. Mullen
McQuireWoods LLP
Gateway Plaza
800 East Canal Street
Richmond, Virginia 23219

Email via dmullen@wtplaw.com

Dear Mr. Mullen:

This letter is in response to your letter of September 2, 2020, requesting an applicability determination by the U.S. Environmental Protection Agency (EPA) for a biosolids gasification unit designed by Ecoremedy, LLC (Ecoremedy) and proposed for construction at the wastewater treatment facility of the City of Edmonds, Snohomish County, Washington. Specifically, your letter requested that EPA make a determination regarding applicability of 40 CFR Part 60, Subpart LLLL – Standards of Performance for New Sewage Sludge Incineration Units (SSI NSPS) – to the gasifier system proposed by the City of Edmonds, Washington. You assert that the SSI NSPS does not apply to this facility because it uses gasification, rather than incineration, to treat sewage sludge.

In relevant part, the SSI NSPS apply to sewage sludge incineration units, as defined in Subpart LLLL. 40 CFR 60.4770(b). As discussed in more detail later in this letter, sewage sludge incineration units are units "combusting sewage sludge." Based on the information provided in connection with your request and as discussed later, EPA concludes that the Ecoremedy gasifier unit as proposed would not combust sewage sludge as defined in the pertinent regulations and that the SSI NSPS would not apply to the biosolids gasification unit that is proposed for construction at the wastewater treatment facility of the City of Edmonds, Snohomish County, Washington because the unit would not be an SSI unit as defined in 40 CFR 60.4930. *See* 40 CFR 60.4770(b). This determination is based on the technical information Ecoremedy provided to show the specific gasification unit is not currently covered under the SSI rules.[1] If any changes are made to the unit or the manner by which is operated, it may require a new determination of applicability.

The Ecoremedy Biosolids Gasification Unit

In your September 2, 2020, letter, you assert that SSI units, as defined by Subpart LLLL, must combust sewage sludge. You further assert, again as defined by Subpart LLLL, that sewage sludge does not include gases of any kind. Accordingly, you submit that units that only combust gases do not combust sewage sludge and, therefore, are not SSI units.

With respect to Ecoremedy's gasifier unit, you generally contend that the unit combusts only syngas and that the unit is designed so that no combustion or burning of any solid, semi-solid, or liquid can occur. You emphasize that "only syngas . . . is combusted – not biosolids." You also state that the sludge is converted to syngas in an "oxygen-deficient environment." More specifically describing the gasifier unit you state, in part:

> Ecoremedy's proprietary gasification technology converts biosolids to renewable thermal energy and recycled beneficial products suitable for land application as a stand-alone fertilizer, fertilizer blending agent, soil conditioner, and/or a renewable fuel product. The gasification process begins with a process of converting biosolids into feedstock through a mixing and drying process. The feedstock is entered into the gasifier and brought to a high temperature in an oxygen deficient environment. This causes the feedstock to break down into synthetic gas ("syngas") while ensuring that combustion cannot occur. The gasification process is flameless; the point of gasification is to prevent, not achieve, combustion. Next, residual solids such as ash and char are removed. The syngas is then sent to an oxidizer where air is introduced, combusting the syngas and creating thermal energy. The gases then move through a drum dryer, where they dry incoming biosolids. It then enters a cyclone, which removes particulate matter, before being sent to a wet scrubber for sulfur dioxide and odor treatment.

On September 30, 2020, in response to your request for an applicability determination, EPA requested additional information from Ecoremedy. You sent another letter dated November 17, 2020 (via email), which substantially reiterated your September 2, 2020, description of the gasifier unit. Also, Ecoremedy provided additional information on November 17, 2020, January 19, 2021, February 2, 2021, May 20, 2021, June 9, 2021, June 10, 2021, June 11, 2021, and August 3, 2021.

[1] As you note in your letter to us, EPA has issued other applicability determinations for similar gasification and/or pyrolysis sources. Importantly, such EPA determinations are specific to the existing SSI NSPS regulations addressing sewage sludge combustion units and do not rule out the applicability of regulations for gasification units issued by EPA in the future. We have limited information on the emissions from gasification and/or pyrolysis sources. For that reason, we have begun a process to request additional information about these processes and their associated emissions. Please refer to https://www.govinfo.gov/content/pkg/FR-2021-09-08/pdf/2021-19390.pdf. This may result in a future standard that could apply to and require additional controls for the facility owned by the City of Edmonds. The information gathering, and potential rulemaking process will likely take some time to complete, and we do not currently have enough information to predict the outcome.

According to information provided by Ecoremedy, the gasification process proposed is a continuously moving, horizontally configured, updraft gasification technology that mimics mini-updraft gasifiers in succession as the fuel bed travels over zones provided with limited air from under the grate. From the supporting information depiction, the gasification system proposed is comprised of a lower and upper chamber correspondingly referred to as the gasifier and oxidizer. There is also a rotary drum dryer physically and operationally connected to the oxidizer and gasifier.

Based on information provided by Ecoremedy on the proposed emission units, we have summarized our understanding of the process as follows.

Sludge is put in the rotary drum dryer. Initially, a natural gas burner is used to provide heated air to the dryer containing the sludge. Dried sludge from the dryer is mixed with wet sludge and fed to the gasifier, where, at least initially, another natural gas burner is used to preheat the gasifier prior to introducing the sludge mix to the chamber. Once heated, the sludge mixture breaks down in the gasifier, which creates its own heat through exothermic reactions and, at this point, the natural gas burner initially used for the gasifier chamber is no longer needed. Along with heat, syngas is also created in the gasifier and the heat and syngas are drawn into the oxidizer. As the heat and syngas from the gasifier enters the oxidizer, enough air is added ("overfire") to combust the syngas to maintain the temperature of the oxidizer chamber without the need for natural gas. Heat is generated in the oxidizer from the combustion of the syngas and the heat is drawn into the dryer to dry the incoming sludge, thereby eliminating the need for the further use of natural gas to externally heat the dryer. Once the process reaches this stage, combustion of the syngas in the oxidizer is self-sustaining and provides the high temperature heat necessary for the gasifier and oxidizer and the rotary drum dryer, without any supplemental heat inputs from natural gas burners.

We understand that, in its initial startup, the rotary drum dryer may be operated independent of the gasifier and oxidizer for several days to produce the needed dried sludge to create the fuel necessary for startup of the gasifier. In addition, the dryer will be operated by itself when the gasifier and oxidizer are down for maintenance. When the dryer is operated by itself, a natural gas burner is used continuously to provide all the heat necessary to dry the incoming sewage sludge.

The additional information provided by Ecoremedy included information relating to your assertion that the gasifier is an "oxygen-deficient environment." The controls on the amount of air in the gasifier include the fan design which limits the total amount of preheated air available for the gasification process and the air distribution system which apportions air by zones according to the processing stage of the organic matter in the sludge. The additional information provided by Ecoremedy also indicated that no overfire air is added to the gasifier. However, overfire air is added to the thermal oxidizer to ensure complete combustion of the syngas in the thermal oxidizer.

Subpart LLLL Applicability Criteria and Determination

Subpart LLLL applies to new “SSI units” that are not otherwise exempt. 40 CFR §60.4770. The request contends that the Ecoremedy gasification unit does not meet the definition of an SSI unit.[2]

"Sewage sludge incineration (SSI) unit" is defined in 40 CFR §60.4930 as:

> an incineration unit combusting sewage sludge for the purpose of reducing the volume of the sewage sludge by removing combustible matter. Sewage sludge incineration unit designs include fluidized bed and multiple hearth. A SSI unit also includes, but is not limited to, the sewage sludge feed system, auxiliary fuel feed system, grate system, flue gas system, waste heat recovery equipment, if any, and bottom ash system. The SSI unit includes all ash handling systems connected to the bottom ash handling system. The combustion unit bottom ash system ends at the truck loading station or similar equipment that transfers the ash to final disposal. The SSI unit does not include air pollution control equipment or the stack.

“Sewage sludge” is defined as:

> solid, semi-solid, or liquid residue generated during the treatment of domestic sewage in a treatment works. Sewage sludge includes, but is not limited to, domestic septage; scum or solids removed in primary, secondary, or advanced wastewater treatment processes; and a material derived from sewage sludge. Sewage sludge does not include ash generated during the firing of sewage sludge in a sewage sludge incineration unit or grit and screenings generated during preliminary treatment of domestic sewage in a treatment works.

In addition, in publishing the final Subpart LLLL, EPA described an SSI unit as "an enclosed device or devices using controlled flame combustion that burns sewage sludge for the purpose of reducing the volume of sewage sludge by removing combustible matter." 76 FR 15372, 15376 (March 21, 2011).

Based on all the information provided in connection with your request for an applicability determination, we conclude that Subpart LLLL does not apply to the proposed Ecoremedy gasification unit for the City of Edmonds because the unit is not an “SSI unit.” It is not an SSI unit, as defined in 40 CFR §60.4930, because it does not combust sewage, also as defined in section 60.4930.

A key part of the definition of sewage sludge describes the state of the material as “solid, semi-solid, or liquid residue.” A key part of the definition of an SSI unit, is an incineration unit “combusting sewage sludge.” There appears to be no question that the Ecoremedy gasification unit receives sewage sludge. As detailed in your September 2, 2020, letter which states that the unit

[2] The request does not question or dispute that the gasification unit is or would be a new unit. The request also does not make any question or raise any claim about the application of any of the exemptions in 40 CFR § 60.4789. Accordingly, those issues are not addressed here and it is assumed that the gasification unit in question is or would be a new unit and that it is not otherwise exempt.

will be constructed at a wastewater treatment facility in Edmonds, Washington and further explains that "biosolids," after some drying and mixing, are fed into the gasifier. We are satisfied from the information provided that the biosolids to be fed into the gasifier are sewage sludge.

You further describe that the sewage sludge that is fed into the gasifier is not combusted, and, indeed, that "combustion cannot occur." As previously described, an SSI unit is an incineration unit "combusting sewage sludge." Accordingly, if the gasification unit does not combust the sewage sludge that is fed into it, it is not an SSI unit. In general, there are two main phases to the processes that occur after the sewage sludge is fed into the gasifier: first, the sewage sludge in the gasifier is subjected to heat (and also generates heat through an exothermic reaction), where the solid, semi-solid or liquid sludge material is reduced and where gases, including syngas, are generated and second, the syngas is fed from the gasifier into the oxidizer, where it is, as you concede, combusted.

Addressing, first, the second phase of the process—the admitted combustion of the syngas derived from the sewage sludge, we conclude that this phase is not "combusting sewage sludge." Although there is combustion, the syngas derived from the sewage sludge is not, itself, sewage sludge nor a "material derived from sewage sludge." As previously described, sewage sludge is "solid, semi-solid, or liquid residue." The syngas, although derived from sewage sludge, is gaseous, not solid, semi-solid, or liquid. The initial, primary definition of sewage sludge does not mention gases, but only solids, semi-solids or liquids. "Material" derived from solids, semi-solids, and liquids, in our view was intended, here, only to include solids, semi-solids, and liquids, not gases.[3]

As to the first phase of the process the sewage sludge is converted to feedstock through mixing and drying and fed into the gasifier where an oxygen-deficient environment is maintained to prevent combustion. Inside the gasifier, under high-temperature, feedstock decomposes and produces syngas. Ecoremedy has confirmed that the gasification process is flameless, and the gasifier prevents combustion by limiting the airflow into the gasifier.[4] Therefore, we believe the gasifier does not use controlled flame combustion of sewage sludge, and is not an SSI.

This response was coordinated with the Office of General Counsel and the Office of Enforcement and Compliance Assurance and is based on the information provided by Ecoremedy and its counsel. EPA may alter this determination in accordance with applicable regulations, new

---

[3] *See*, e.g., applicability determination for Max West Environmental Systems, dated December 19, 2013, which explains EPA's view that "[t]he definition of sewage sludge is expressly limited to the "solid, semisolid, or liquid residue generated during the treatment of domestic sludge in a treatment works.' Since syngas is a gas, and not a solid, semisolid, or liquid, it does not meet the definition of sewage sludge in the SSI EG rule (even though it is derived from sewage sludge)."
https://cfpub.epa.gov/adi/index.cfm?fuseaction=home.dsp_show_file_contents&CFID=126652990&CFTOKEN=98981573&id=FP00004

[4] *See*, preamble to March 21, 2011, final rule which describes an SSI unit as "an enclosed device or devices using controlled flame combustion that burns sewage sludge for the purpose of reducing the volume of sewage sludge by removing combustible matter." *See* 76 FR 15372.

information, or other good cause. If you have any additional questions, please contact Nabanita Modak of my staff, at (919) 541-5572 or by email at: *Modak.Nabanita@epa.gov*..

Sincerely,

Michael Koerber for

Peter Tsirigotis
Director

cc: Dave Mooney, President, Ecoremedy, LLC via email dmooney@ecoremedyllc.com
John Dawson, Engineering Manager, Puget Sound Clean Air Agency via email JohnD@pscleanair.gov

ATTACHMENT C

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

JUL 2 5 2016

Dario Presezzi
CEO, BIOFORCETECH Corporation
1400 Radio Road
Redwood City, California 94065

Dear Mr. Presezzi:

The BIOFORCETECH Corporation (BFT) has developed a pyrolysis system ("PYREG") to be used at a biosolids to energy facility inside a municipal wastewater treatment plant designed to treat domestic sewage sludge operated by Silicon Valley Clean Water and located in Redwood City, California. According to BFT, the PYREG includes (1) a pyrolysis reactor, where the biosolids are heated to 550-650°C without the addition or presence of air or oxygen, to produce syn-gas; (2) a "flameless" oxidation burner (FLOX®) where the syn-gas is combusted and (3) a heat exchanger and exhaust cleaning system for the gases leaving the annular space between the central tube and the outer shell of the reactor and which are then discharged to the atmosphere. BFT submitted a letter to EPA on January 8, 2016 regarding the applicability of 40 C.F.R. Part 60 Subpart LLLL Standards of Performance for New Sewage Sludge Incineration Units, (SSI NSPS), to the BFT pyrolysis system. BFT sent a revised version of the letter with additional details and a formal request for applicability on March 16, 2016. BFT provided additional information to EPA in an email dated March 2, 2016. For the reasons discussed below, we do not believe that the BFT PYREG system is a sewage sludge incineration unit subject to the SSI NSPS.

The SSI NSPS establishes new source performance standards for sewage sludge incineration (SSI) units at §60.4760 and includes the following definitions and requirements:

> *Your SSI unit is an affected source if it meets all the criteria specified in paragraphs (a) through (c) of this section.*
>
> > *(a) Your SSI unit is a SSI unit for which construction commenced after October 14, 2010 or for which modification commenced after September 21, 2011.*
> > *(b) Your SSI unit is a SSI unit as defined in §60.4930.*
> > *(c) Your SSI unit is not exempt under §60.4780.*

The SSI NSPS also includes the following definitions at § 60.4930:

> <u>*Sewage sludge incineration (SSI) unit*</u> *means an incineration unit combusting sewage sludge for the purpose of reducing the volume of the sewage sludge by removing combustible matter. Sewage sludge incineration unit designs include fluidized bed and multiple hearth. A SSI unit also includes, but is not limited to, the sewage sludge feed system, auxiliary fuel feed system, grate system, flue gas system, waste heat recovery equipment, if any, and bottom ash system. The SSI unit includes all ash handling systems connected to the bottom ash handling system. The combustion unit bottom ash system ends at the truck loading station or similar equipment that transfers the ash to final disposal. The SSI unit does not include air pollution control equipment or the stack.*

<u>Sewage sludge</u> means solid, semi-solid, or liquid residue generated during the treatment of domestic sewage in a treatment works. Sewage sludge includes, but is not limited to, domestic septage; scum or solids removed in primary, secondary, or advanced wastewater treatment processes; and a material derived from sewage sludge. Sewage sludge does not include ash generated during the firing of sewage sludge in a sewage sludge incineration unit or grit and screenings generated during preliminary treatment of domestic sewage in a treatment works.

The SSI NSPS does not include definitions for incineration or combustion. The preamble to the March 21, 2011 final NSPS rule, at 76 Federal Register 15,376, provides a further description as to what constitutes an SSI unit:
"[a] SSI unit is an enclosed device or devices using controlled flame combustion that burns sewage sludge for the purpose of reducing the volume of the sewage sludge by removing combustible matter."

BFT describes that during startup, before sewage sludge is introduced, the temperature raises gradually from ambient temperature to the process temperature using the exhaust gas from the FLOX that flows on the outside wall of the reactor. The temperature profile provided by BFT in the March 16, 2016 revised letter confirms this and also shows that the temperature drops when the sewage sludge is fed to the reactor (at the 45 minute mark) and does not recover to startup levels. BFT further state that, "no flame is present, applied to or propagated into the pyrolysis unit, and the absence of Oxygen prevents combustion inside the pyrolysis unit." BFT also confirmed that two air-tight valves are used to transfer biosolids into the pyrolysis unit, ensuring that no air is able to enter the reactor. The syn-gas is forced from the pyrolysis reactor through a section of insulated pipe, into an insulated cyclone and then a second section of insulated pipe before it is introduced into the combustion chamber.

EPA determines, based on the information provided and statements made by BFT, that:

1. The pyrolysis reactor in the BFT process is not a SSI unit as that term is defined in the SSI NSPS, because there is no flame in the pyrolysis reactor; and
2. The syn-gas is a gas and is not a solid, semi-solid or liquid. Therefore the syn-gas is not sewage sludge (even though it is derived from sewage sludge) as that term is defined in the SSI NSPS; therefore the FLOX® chamber is not combusting sewage sludge and therefore also not an SSI unit.

Consequently, the BFT pyrolysis system is not subject to the requirements in the SSI NSPS.

This response has been coordinated with EPA Region 9, Office of Compliance and Office of Air Quality Planning and Standards. Please contact Charles Aldred at 415.972.3986 or aldred.charles@epa.gov with any questions about this determination.

Sincerely,

Matt Salazar, P.E.
Manager, Air & TRI Section
Enforcement Division

cc: Alfonso Borja, Bay Area AQMD (pdf)

Engineering Evaluation
BioForceTech Corporation
1400 Radio Road, Redwood City, California 94065
Silicon Valley Clean Water Wastewater Treatment Facility
Plant No. 23278
Application No. 27704
Project Description: New Biosolids Process and Handling Operation and Pyrolysis Reactor with Synthetic Gas Process Heater

BACKGROUND

BioForceTech Corporation (BFT) has applied to obtain an Authority to Construct (A/C) and/or Permit to Operate (P/O) for the following equipment:

S-11 Pyreg GmbH Pyrolysis Reactor with Receiving Bin and Process Heater
0.15 Ton Biosolid Reactor Capacity; 1.76 Ton Biosolid Receiving Bin Storage Capacity; 0.25 Ton/Hr Maximum Biosolid Feed Rate; Pyreg Model FLOX Process Heater; 0.99 MMBtu/Hr Maximum Input Heat Rating; 564 SCFM @ 11% O_2 Maximum Exhaust Flowrate

S-12 Biosolid Process and Handling
Enclosed Conveyor Belt System; 8.75 Ton Capacity Storage Bin; 2,000 Ton Maximum Annual Biosolid Throughput

In addition, BFT is proposing to control emissions from permitted sources using the following abatement devices:

A-11 Wet Scrubber; Manufacturer: Pyreg; Maximum Flowrate: 620 CFM
Abating Sulfur Dioxide (SO_2) from Source S-11

A-12 Activated Carbon Vessel; Manufacturer: Pyreg
Maximum Flowrate: 620 cfm; 1500 lb (700 kg) Capacity
Dimensions: 55 in (1400 mm) Diameter, 78 in (1970 mm) Height
Abating Particulate Matter (PM), Mercury (Hg), and Heavy Metals from Source S-11

The pyrolysis reactor with receiving bin and process heater (S-11) will operate besides a wastewater treatment facility owned and operated by Silicon Valley Clean Water (SVCW), Plant #1534, which is located on 1400 Radio Road in Redwood City, California. S-11 is part of an operation intended to provide waste diversion services to SVCW.

Silicon Valley Clean Water

SVCW operates a series of sources, which implement the use of physical, biological, and chemical processes, which reduce the amount of nutrients within influent wastewater prior to discharge into the San Francisco Bay or reuse within Redwood City. SVCW collects and treats influent wastewater from Belmont, Redwood City, San Carlos, Menlo Park, Portola Valley, Woodside, and portions of San Mateo County.

Biological treatment at SVCW, which consist of secondary treatment basins and clarifiers, use microorganisms (bugs) to consume organics within the influent wastewater. When the bugs are unable to treat influent wastewater, the bugs settle out and are collected as waste activated sludge (biosolids).

Collected biosolids are then processed within anaerobic digesters to reduce the overall biosolid mass which is transported to a landfill. In addition to the reduction in biosolid mass, the anaerobic digestion process generates digester gas, which is used as fuel at combustion sources.

BioForceTech Corporation

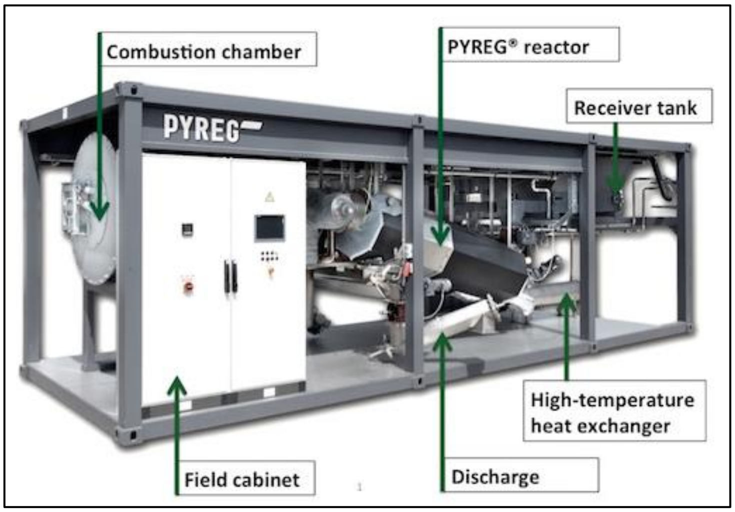
BFT intends to further reduce the biosolid mass which is transported to a landfill, by performing the proposed following actions:

1. Collect the biosolids from SVCW, with a moisture content of 80% by weight, and dry the biosolids to a moisture content of 20% by weight. This process will be performed within a biosolids dryer (S-10). BFT submitted New Source Review (NSR) Permit Application #27509 for the review of S-10 abated by a biofilter (A-10). The proposed project was granted an A/C on May 2, 2016.

2. Feed the dried biosolids into S-11 via enclosed conveyor belt system and storage bin (S-12), which will reduce the biosolid mass that is transported to a landfill and generate synthetic gas to reduce the quantity of public utilities gas needed in order to operate the built-in process heater of S-11. The built-in process heater can be fired on both natural gas and/or synthetic gas, to provide indirect heat to both the inner pyrolysis chamber of the reactor and drying compartments of S-10.

Pyrolysis Reactor with Receiving Bin and Process Heater, S-11

S-11 consists of a biosolids receiving bin, a pyrolysis reactor, and a process heater. The following diagram provides a depiction of S-11. Please note that the manufacturer refers to the biosolids receiving bin as a receiver tank, the pyrolysis reactor as a PYREG reactor, and the process heater as a combustion chamber.



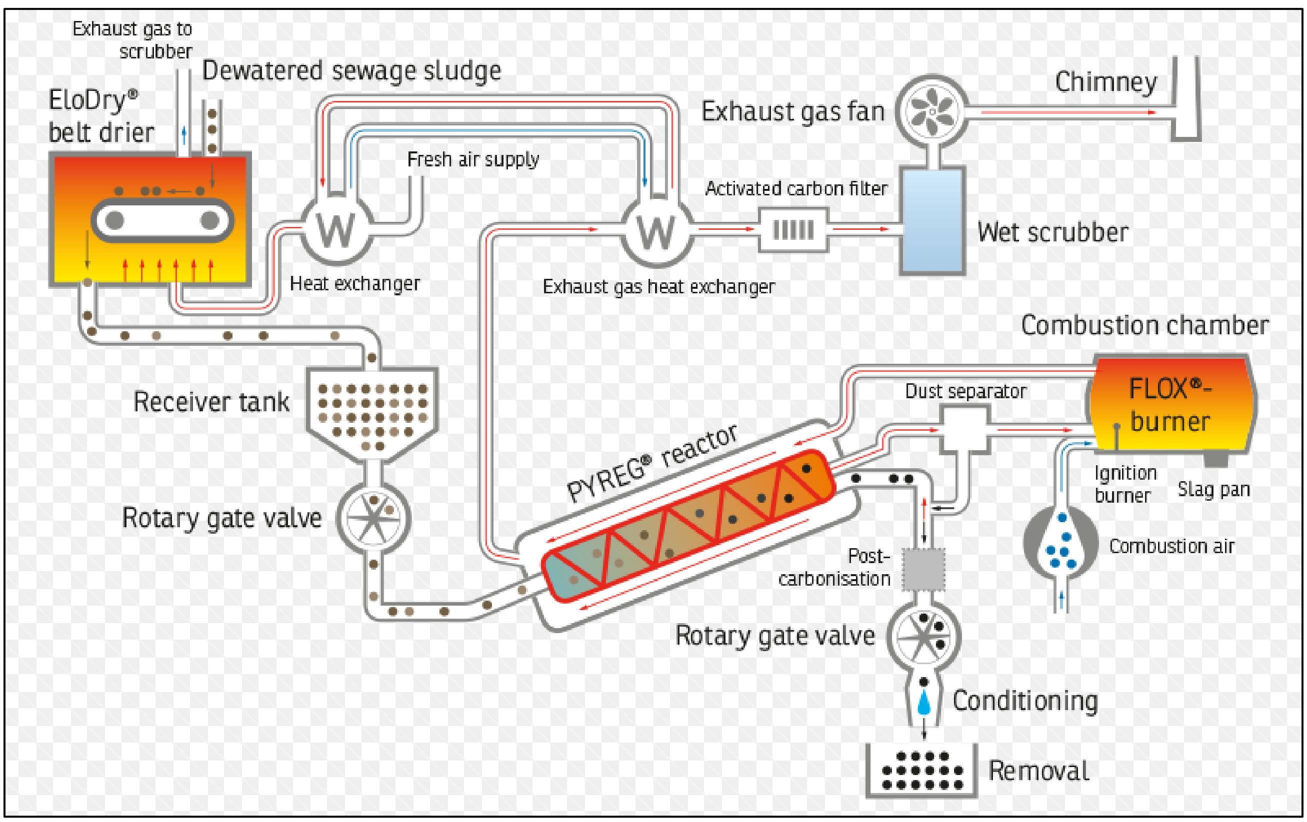
PYREG GmbH. Individual Component of a PYREG -500-Module. http://www.pyreg.de/machinery-en/system-components-en.html. 20 September 2016.

At the start of the process, the biosolids from SVCW, will begin with a moisture content of 80% by weight. The biosolids will then be dried within the compartments of S-10 to a moisture content of 20% by weight. Once the biosolids have been dried, the biosolids are transferred by S-12 and are fed into S-11 at a maximum rate of 0.25 tons of biosolids per hour.

During the initial use of the equipment, the process heater of S-11 will be fired solely on natural gas. The exhaust gas from the process heater will pass through an outer chamber of the S-11 reactor. The exhaust gas will transfer heat to the primary inner chamber of the S-11 reactor, which houses the input biosolids. The primary chamber of the reactor is designed to reach an operating temperature of 1,202°F. At this temperature, the biosolids will be heat treated resulting in the production of synthetic gas. The synthetic gas will then be introduced into the process heater, providing the process heater fuel to operate and ceasing the need for natural gas.

In addition to providing heat to the inner primary chamber of the S-11 reactor, the process heater exhaust gas will also be ducted to S-10 providing heat for the initial biosolids drying process. BFT intends for the project to be energy self-sufficient, alleviating the use of utility gas and energy, while providing waste diversion services to SVCW.

The following diagram provides a general process flow of the project.



Sewage Sludge Mineralization with PYREG. *ELIQUO STULZ GmbH. PYREG – Minimize The Cost of Your Sludge Disposal*. http://www.eliquostulz.com/en/pyreg.html. 20 September 2016.

Lastly, the processing of the dried biosolids will result in biochar. BFT is proposing to recondition the biochar by introducing water and collecting the biochar within portable totes. BFT plans to control dust by adding adequate moisture and loading the biochar into a truck, with the intention of selling the biochar as a top soil.

Background Summary
The emissions associated with this project include criteria pollutants from combustion and material process and handling operations. The expected criteria pollutants include precursor organic compounds (POC), nitrogen oxides (NO_X), carbon monoxide (CO), sulfur dioxide (SO_2), and particulate matter (PM).

EMISSIONS CALCULATIONS

BFT is proposing to operate the pyrolysis reactor with receiving bin and process heater and an enclosed conveyor belt system and storage bin. BFT is limiting the maximum throughput of sludge through the pyrolysis reactor with receiving bin and process heater, S-11, and an enclosed conveyor belt system and storage bin, S-12, to 2,000 tons of sludge per year. The following provides an emissions review of the sources proposed within this application.

Emissions Based on the Pyrolysis Reactor with Receiving Bin and Process Heater, S-11
The manufacturer of S-11 has guaranteed the following pollutant concentrations after abatement.

Table 1. Manufacturer Pollutant Concentrations (@11% O_2)	
Pollutant	**Maximum Concentration (mg/m^3)**
POC	10
NO_X	160
CO	20
PM_{10}[1]	10
SO_2	50

[1]Assume that all PM is in the form of PM 10 microns in size (PM_{10}).

In addition, BFT has obtained the following information from the manufacturer and has also provided calculated design values.

Table 2. Manufacturer/Applicant Process Heater Specifications	
Maximum Input Heat Rating, MMBtu/Hr	0.9895
Exhaust Flowrate @11% O_2, dscfm	564

Using the aforementioned information, the following emission rates were calculated.

Table 3. Criteria Pollutant Emission Rate Calculations					
Pollutant	**Maximum Pollutant Conc. @11% O_2 (mg/m^3)**	**Maximum Pollutant Conc.[1] @11% O_2 (lb/ft^3)**	**Maximum Exhaust Flowrate @11% O_2 (cfm)**	**Maximum Exhaust Flowrate @11% O_2 (cfh)**	**Maximum Hourly Emission Rate (lb/hr)**
POC	10	6.24E-07	564	33,840	0.02
NO_X	160	9.98E-06	564	33,840	0.34
CO	20	1.25E-06	564	33,840	0.04
PM_{10}	10	6.24E-07	564	33,840	0.02
SO_2	50	3.12E-06	564	33,840	0.11

[1]The following are the conversion rates used. 1 g = 1,000 mg; 1 lb = 454 g; 1 m^3 = 35.3147 ft^3.

The following table provides a summary of the potential to emit (PTE) emission rates of all associated criteria pollutants from S-11. The PTE emissions profile for S-11 incorporates the proposed maximum pollutant concentrations, the maximum calculated exhaust flowrate, and the assumption that S-11 will be able to operate 8,760 hours per year.

Table 4. Criteria Pollutant Emission Rates				
Pollutant	**Maximum Hourly Emission Rate (lb/hr)**	**Maximum Daily Emission Rate (lb/day)**	**Maximum Annual Emission Rate (lb/yr)**	**Maximum Annual Emission Rate (ton/yr)**
POC	0.02	0.48	175.20	0.088
NO_X	0.34	8.16	2,978.40	1.489
CO	0.04	0.96	350.40	0.175
PM_{10}	0.02	0.48	175.20	0.088
SO_2	0.11	2.64	963.60	0.482

In addition, S-11 is expected to produce biochar, which will be loaded onto a truck via screw conveyor. However, adequate moisture (approximately 30% water content by weight) will be added resulting in no expected PM emissions from the handling of biochar.

Emissions Based on the Enclosed Conveyor Belt System and Storage Bin, S-12
The dried biosolids from the biosolids dryer, S-10, will be transferred to S-11 through a series of enclosed conveyor belts and will be kept within a storage bin, which will be directly connected to the receiving bin of S-11. The dried biosolids are proposed to be kept at a moisture content of 20% by weight. PM emissions from S-12 are not expected due to the high moisture content of the material handled and the use of an enclosed system.

Total Source Emission Summary
The PTE emissions profile for all the proposed sources within this application incorporates the highest daily and annual emission rates of each source. The following table provides a summary of the PTE emission rates of all associated criteria pollutants from sources proposed within this application.

Table 5. Total Application Emission Rate Summary					
Pollutant	**S-11 Daily Emission Rate (lb/day)**	**S-12 Daily Emission Rate (lb/day)**	**Total Daily Emission Rate (lb/day)**	**Total Annual Emission Rate (lb/yr)**	**Total Annual Emission Rate (ton/yr)**
POC	0.48	--	0.48	175.20	0.088
NO_X	8.16	--	8.16	2,978.40	1.489
CO	0.96	--	0.96	350.40	0.175
PM_{10}	0.48	0.00	0.48	175.20	0.088
SO_2	2.64	--	2.64	963.60	0.482

TOXIC RISK SCREENING ANALYSIS

Regulation 2-5 requires that the cumulative impacts from all related projects permitted within the last two years be included in the risk screening analysis. The facility submitted New Source Review Application 27509 on October 7, 2015, which was deemed complete on March 10, 2016. The cumulative impacts from New Source Review Application 27509 will be included with this project.

Since the operation is implementing uncommon technology, toxic air contaminant (TAC) emissions data is either nonexistent or unreliable. BFT has requested to limit the project below the trigger levels of Regulation 2-5. BFT has agreed to perform source testing to determine detectable TACs and to demonstrate compliance with the trigger level limits. If the source test results show that the operation exceeds any of the TAC trigger levels, BFT has agreed to cease operation and submit an application to perform a Health Risk Screening Analysis (HRSA).

PLANT CUMULATIVE EMISSIONS

BFT will operate at an existing facility undergoing construction. The following table provides a summary of the cumulative increase of each criteria pollutant that will result from the operation of the new sources at this facility.

Table 6. Facility Cumulative Increase Review			
Pollutant	**Existing (ton/yr)**	**New (ton/yr)**	**Total (ton/yr)**
POC	1.872	0.088	1.960
NO_X	0.287	1.489	1.776
SO_2	0.005	0.482	0.487
PM_{10}	0.059	0.088	0.147
CO	2.326	0.175	2.501

Regulation 2-1-242 defines a "support facility" as a facility that conveys, stores, or otherwise significantly assists in the production of the principal product of another facility. BFT is located on a contiguous property owned by SVCW. BFT will convey, store, and assist in the biosolid reduction operation of SVCW. As a result, BFT is defined as a support facility to SVCW.

Pursuant to Regulations 2-1-213 and 2-1-242, for permitting purposes under Regulation 2, a support facility is considered part of the principal facility that it supports regardless of designation under the Standards Industrial Classification Manual. The emissions from BFT and SVCW will be combined for Regulation 2 purposes due to the support facility designation of BFT. The following table summarizes the cumulative increase of criteria pollutants that will result from the operation of the new sources at the support facility.

Table 7. Principal/Support Facility Cumulative Increase Review

Pollutant	SVCW (ton/yr)	Existing BFT (ton/yr)	New BFT (ton/yr)	Total (ton/yr)
POC	9.421	1.872	0.088	11.381
NO_X	16.529	0.287	1.489	18.305
SO_2	1.218	0.005	0.482	1.705
PM_{10}	0.460	0.059	0.088	0.607
CO	39.032	2.326	0.175	41.533

BEST AVAILABLE CONTROL TECHNOLOGY (BACT)

Pursuant to Regulation 2-2-301, BACT shall be applied to new sources with a PTE equal to or greater than 10 lb per highest day of any single regulated air pollutant. The emissions from the new sources are not expected to exceed 10 lb per highest day of any regulated air pollutant. Therefore, S-11 and S-12 are not subject to BACT.

OFFSETS

Pursuant to Regulation 2-2-302, offsets must be provided for any new or modified source at a facility that emits, or is permitted to emit, more than 10 tons per year of POC or NO_X. In addition, pursuant to Regulation 2-2-303, offsets must be provided for any new or modified source at a major facility with a cumulative increase, minus any contemporaneous emission reduction credits, which exceeds 1.0 ton per year of PM_{10} or SO_2.

Furthermore, according to Regulations 2-1-213 and 2-1-242, for permitting purposes under Regulation 2, a support facility is considered part of the principal facility that it supports regardless of designation under the Standards Industrial Classification Manual. The PTE emissions from SVCW and BFT will be combined and reviewed as a single facility.

The facility will have a POC and NO_X PTE that is greater than 10 tons per year, but less than 35 tons per year. The facility will be provided credits from the small facility banking account for the un-offset emissions, unless the small facility banking account is exhausted. If the small facility banking account is exhausted, the applicant will then be responsible for emission credits for the un-offset emissions. Lastly, the combined PTE will not result in emissions that would define the facility as a major facility. Therefore, the requirements of Regulation 2-2-303 do not apply.

NEW SOURCE PERFORMANCE STANDARDS (NSPS)

The following sections provide a review of the applicability of all related New Source Performance Standards (NSPS) that may apply to the operation proposed by BFT.

Part 60, Subpart LLLL – Standards of Performance for New Sewage Sludge Incineration Units
Pursuant to §60.4770, the Standards of Performance for New Sewage Sludge Incineration Units (Subpart LLLL) apply to sewage sludge incineration (SSI) units that commence construction after October 14, 2010 or for which modification commenced after September 21, 2011. In addition, §60.4930 defines SSI units as an incineration unit combusting sewage sludge for the purpose of reducing the volume of the sewage sludge by removing combustible matter. SSI unit designs include fluidized bed and multiple hearth. A SSI unit also includes, but is not limited to, the sewage sludge feed system, auxiliary fuel feed system, grate system, flue gas system, waste heat recovery equipment, if any, and bottom ash system. The SSI unit includes all ash handling systems connected to the bottom ash handling system. The combustion unit bottom ash system ends at the truck loading station or similar equipment that transfers the ash to final disposal. The SSI unit does not include air pollution control equipment or the stack.

Although S-11 appears to fit the definition of a SSI unit, the United States Environmental Protection Agency (U.S. EPA) provided a determination letter to BFT on July 25, 2016 on clarification of the definition of a SSI unit. The following provides verbatim comments from the letter.

"EPA determines, based on the information provided and the statements made by BFT, that:

1. *The pyrolysis reactor in the BFT process is not a SSI unit as that term is defined in the SSI NSPS, because there is no flame in the pyrolysis reactor; and*

2. *The syn-gas is a gas and is not a solid, semi-solid or liquid. Therefore, the syn-gas is not sewage sludge (even though it is derived from sewage sludge) as that term is defined in the SSI NSPS; therefore, the FLOX® chamber is not combusting sewage sludge and therefore also not an SSI unit.*

Consequently, the BFT pyrolysis system is not subject to the requirements in the SSI NSPS."

U.S. EPA does not believe that S-11 is a SSI unit since the fuel combusted is not sewage sludge, but a derivative of sewage sludge, and the reactor processes sewage sludge without a flame. Since S-11 is not a SSI unit, the requirements of Subpart LLLL are not applicable to the proposed operation.

Part 60, Subpart CCCC – Standards of Performance for Commercial and Industrial Solid Waste Incineration Units
Pursuant to §60.2010, commercial and industrial solid waste incineration (CISWI) units are subject to the requirements of the Standards of Performance for Commercial and Industrial Solid Waste Incineration Units (Subpart CCCC) if the unit commenced construction after June 4, 2010 or commenced reconstruction or modification after August 7, 2013. §60.2265 defines a CISWI unit as the following:

Any distinct operating unit of any commercial or industrial facility that combusts, or has combusted in the preceding 6 months, any solid waste as that term is defined in 40 CFR part 241. If the operating unit burns materials other than traditional fuels as defined in §241.2 that have been discarded, and you do not keep and produce records as required by §60.2175(v), the operating unit is a CISWI unit. While not all CISWI units will include all of the following components, a CISWI unit includes, but is not limited to, the solid waste feed system, grate system, flue gas system, waste heat recovery equipment, if any, and bottom ash system. The CISWI unit does not include air pollution control equipment or the stack. The CISWI unit boundary starts at the solid waste hopper (if applicable) and extends through two areas: The combustion unit flue gas system, which ends immediately after the last combustion chamber or after the waste heat recovery equipment, if any; and the combustion unit bottom ash system, which ends at the truck loading station or similar equipment that transfers the ash to final disposal. The CISWI unit includes all ash handling systems connected to the bottom ash handling system.

The U.S. EPA provided a determination letter, on July 25, 2016, to BFT that provided further clarification of what an incineration unit is for Subpart LLLL. The determination implies that an incineration unit must combust fuel with a flame. In addition, the fuel must be in a solid state. Due to the determination made by the U.S. EPA, the proposed project from BFT will not fit the definition of a CISWI unit in accordance with the guidelines within the determination letter is not subject to the requirements of this subpart.

NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS (NESHAP)

The following sections provide a review of the applicability of all related National Emission Standards for Hazardous Air Pollutants (NESHAP) that may apply to the operation proposed by BFT.

Part 61, Subpart C – National Emission Standards for Beryllium

The following stationary sources are subject to the requirements of the National Emission Standards for Beryllium (Subpart C):

1. Extraction plants, ceramic plants, foundries, incinerators, and propellant plants which process beryllium ore, beryllium, beryllium oxide, beryllium alloys, or beryllium-containing waste.

2. Machine shops which process beryllium, beryllium oxides, or any alloy when such alloy contains more than 5 percent beryllium by weight.

S-11 is neither an extraction plant, ceramic plant, foundry, machine shop, or propellant plant. In addition, due to a determination made by the U.S. EPA in the July 25, 2016 letter, S-11 would most likely not be considered an incinerator. Therefore, the requirements of this subpart are note applicable.

Part 61, Subpart E – National Emission Standards for Mercury

The provisions of the National Emission Standards for Mercury (Subpart E) are applicable to those stationary sources which process mercury ore to recover mercury, use mercury chlor-alkali cells to produce chlorine gas and alkali metal hydroxide, and incinerate or dry wastewater treatment plant sludge. §61.51(l) and (m) define sludge and sludge dryer as the following:

1. Sludge means sludge produced by a treatment plant that processes municipal or industrial waste waters.

2. Sludge dryer means a device used to reduce the moisture content of sludge by heating to temperature above 65°C (150°F) directly with combustion gases.

Although U.S. EPA may not view S-11 as an incinerator, the purpose of S-11 is to provide SVCW with biosolids weight and volume reduction services. The reactor of S-11 will subject biosolids to temperatures greater than 150°F in the hopes of extracting more organics, as vapor for fuel combustion, and driving the remaining moisture out. The reactor of S-11 fits the definition of a sludge dryer and will be subject to the requirements of this subpart.

Pursuant to §61.52(b), emissions to the atmosphere from sludge incineration plants, sludge drying plants, or a combination of these that process wastewater treatment plant sludge shall not exceed 7.1 lb of mercury per 24-hour period. However, since BFT is not certain of the emission rate of mercury from the processing of biosolids from SVCW, BFT has agreed to lower emission standards to stay below the chronic trigger levels for mercury. BFT is to perform initial source testing to determine the maximum emission rate of various TACs. If initial source testing demonstrates that the operation will exceed acute and chronic trigger levels listed within Regulation 2-5, BFT is to cease operation and submit an application to perform a HRSA for each affected TAC.

Also, to determine compliance with this subpart, BFT shall perform stack sampling in accordance with §61.53(d) or sludge sampling pursuant to §61.54 to determine compliance with the emission standard of §61.52(b). Stack and sludge sampling must be performed within 90 days of startup, with notification provided at least 30 days prior to an emission test. Emissions from stack and/or sludge sampling shall be determined within 30 days of completion of the sampling. Each determination shall be reported by a registered letter dispatched within 15 calendar days following the date such a determination is completed. Records should be kept for a minimum of 2 years.

For wastewater treatment plant sludge incineration and drying plants, emissions that exceed 3.5 lb per 24-hour period, demonstrated by stack or sludge sampling, shall monitor mercury emissions at intervals of at least once per year by use of Method 105 of Appendix B of this subpart or the procedures specified in §61.53(d)(2) and (4). The results shall be determined within 30 days of the completion of sampling and reported by a registered letter dispatched within 15 calendar days following the date such a determination is completed. Records should be kept for a minimum of 2 years.

STATEMENT OF COMPLIANCE

Regulation 1

The pyrolysis reactor with receiving bin and process heater, S-11, and enclosed conveyor belt system and storage bin, S-12, will be subject to the public nuisance requirements of Regulation 1-301, which states the following:

No person shall discharge from any source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance or annoyance to any considerable number of persons or the public; or which endangers the comfort, repose, health or safety of any such persons or the public, or which causes, or has a natural tendency to cause, injury or damage to business or property. For purposes of this section, three or more violation notices validly issued in a 30-day period to a facility for public nuisance shall give rise to a rebuttable presumption that the violations resulted from negligent conduct.

The operation of S-11 and S-12 are expected to meet the requirement of Regulation 1-301.

Regulation 2, Rule 1
According to Regulation 2-1-301, prior to the installation of the equipment, an A/C must be obtained. The facility has submitted an application and is expected to be in compliance with Regulation 2-1. Furthermore, the facility has certified that the source will not be located within 1,000 feet of the outer boundary of any K-12 school site. Therefore, the requirements of the California Health & Safety Code §42301.6 are not applicable.

BFT intends to operate a pyrolysis reactor with receiving bin and process heater and an enclosed conveyor belt system with storage bin. Although the process heater is below the 1 MMBtu/hr exemption thresholds for combustion equipment under Regulation 2-1-114.1.1, the process heater is part of an article, machine, equipment, operation, contrivance or related groupings of such which may produce and/or emit air pollutants and is defined as a source pursuant to Regulation 2-1-221. Since there is no exemption within Regulation 2-1 for pyrolysis reactors with receiving bin and process heaters, S-11 is subject to the requirements of this regulation.

In addition, according to Regulation 2-1-115, sources located at biomass recycling, composting, landfill, publically owned treatment works (POTW), or related facilities, including but not limited to, the following are exempt from the permitting requirements of Regulation 2-1:

- Tub grinder powered by a motor with a maximum output rating less than 10 horsepower;
- Hogger, shredder or similar source powered by a motor with a maximum output rating less than 25 horsepower; and,
- Other biomass processing/handling sources at a facility with a total throughput less than 500 tons per year.

BFT intends to operate an enclosed conveyor belt system with storage bin. The enclosed conveyor belt system with storage bin will process and handle biosolids at the facility. BFT has requested for a biosolids throughput of 2,000 tons per year. Since the requested throughput exceeds 500 tons per year, the enclosed conveyor belt system with storage bin is subject to the permitting requirements of Regulation 2-1.

Regulation 2, Rule 2
Pursuant to Regulation 2-2-301, BACT is required for new sources with PTE emission increases that equal 10.0 lb or greater of POC, NPOC, NO_X, SO_2, PM_{10}, or CO. S-11 and S-12 are not expected to exceed any of the BACT thresholds and are not subject to the requirements of Regulation 2-2-301.

Furthermore, according to Regulation 2-2-302, offsets must be provided for any new or modified source at a facility that emits, or is permitted to emit, more than 10 tons per year of POC or NO_X. In addition, Regulation 2-2-303 requires that offsets be provided for any new or modified source at a major facility with a cumulative increase, minus any contemporaneous emission reduction credits, which exceeds 1.0 ton per year of PM_{10} or SO_2. The operation of S-11 and S-12 will result in an emission increase, which will place the facility's POC and NO_X PTE at more than 10 tons per year, but less than 35 tons per year. The increases from S-11 and S-12 will be provided credits from the small facility banking account, unless the small facility banking account is exhausted. If the small facility banking account is exhausted, the applicant will then be responsible for emission credits for the un-offset emission increases.

Regulation 2, Rule 5
Pursuant to Regulation 2-5-110, the provisions of this rule are not subject to projects with an increase in emissions less than the trigger levels listed in Table 2-5-1. BFT does not have reliable data for the operation of S-11 and S-12 and has requested to be subject to a limit below the trigger levels of Table 2-5-1 of Regulation 2-5. BFT will be required to perform source testing to determine the maximum concentrations of each detectable TAC, which will be converted to an hourly emission rate and compared against the acute and chronic trigger levels of Regulation 2-5. If the source testing demonstrates that the operation of the project exceeds any of the trigger levels, BFT will be required to cease operation and submit a permit application immediately to perform a HRSA for each affected TAC.

Regulation 6, Rule 1
Pursuant to Regulations 6-1-301, a person shall not emit from any source for a period or periods aggregating more than three minutes in any hour, a visible emission which is as dark or darker than No. 1 on the Ringelmann Chart, or of such opacity as to obscure an observer's view to an equivalent or greater degree. In addition, pursuant to Regulation 6-1-302, a person shall not emit from any source for a period or periods aggregating more than three minutes in any hour an emission equal to or greater than 20% opacity as perceived by an opacity sensing device, where such device is required by District regulations. The sources are expected to meet the requirements of Regulations 6-1-301 and 6-1-302.

Regulation 7
According to Regulation 7-102, the limitations of this Regulation shall not be applicable until the District receives odor complaints from 10 or more complainants within a 90-day period, alleging that a person has caused odors perceived at or beyond the property line of such person and deemed to be objectionable by the complainants in the normal course of their work, travel, or residence. When the limits of this regulation become effective as a result of citizen complaints described above, the limits shall remain effective until such time as no citizen complaints have been received by the District for 1 year. The limits of this Regulation shall become applicable again when the District receives odor complaints from five or more complainants within a 90-day period.

Regulation 8, Rule 2
Regulation 8-2-301 prohibits a person from discharging into the atmosphere from any miscellaneous operation an emission containing more than 15 lbs of organic compounds per day and containing a concentration of more than 300 ppm total carbon on a dry basis. At a combined emission rate of 0.48 lb of POC per day, the operation of S-11 and S-12 are not expected to exceed an emission rate of 15 lb of organic compounds per day.

Regulation 9, Rule 1
S-11 is subject to the SO_2 limitations of Regulation 9-1-301 (Limitations on Ground Level Concentrations of Sulfur Dioxide), Regulation 9-1-302 (Limitations Sulfur Dioxide Emissions) and 9-1-304 (Burning of Solid and Liquid Sulfur Dioxide Fuel).

Pursuant to Regulation 9-1-301, the ground level concentrations of SO_2 shall not exceed 0.5 ppm continuously for 3 consecutive minutes or 0.25 ppm averaged over 60 consecutive minutes, or 0.05 ppm averaged over 24 hours. Pursuant to Regulation 9-1-302, a person shall not emit from any source, a gas stream containing SO_2 in excess of 300 ppm (dry). Lastly, pursuant to Regulation 9-1-304, a person shall not burn any liquid fuel having a sulfur content in excess of 0.5% by weight.

Based on a maximum SO_2 mass emission rate of 2.64 lb/day, the operating parameters of S-11, and the Ideal Gas Law, the maximum SO_2 volumetric concentration may be calculated.

$$V = \frac{nRT}{P}$$

$$n = \frac{\mathbf{2.64}\ \cancel{lb\ SO_2}}{\mathbf{day}} \times \frac{\mathbf{mol_{lb}\ SO_2}}{\mathbf{64.058}\ \cancel{lb\ SO_2}} = 4.1 \times 10^{-02}\ mol_{lb}\ SO_2/day$$

$$V = \frac{\frac{\mathbf{4.1 \times 10^{-02}}\ \cancel{mol_{lb}}\ \mathbf{SO_2}}{\mathbf{day}} \times \frac{\mathbf{0.730241}\ \cancel{atm} \cdot \mathbf{scf}}{\cancel{°R} \cdot \cancel{mol_{lb}}} \times \mathbf{527.67}\cancel{°R}}{1\ \cancel{atm}} = 1.6 \times 10^{+01}\ scf\ SO_2/day$$

$$\frac{\frac{\mathbf{1.6 \times 10^{+01}\ scf\ SO_2}}{\cancel{day}}}{\frac{\mathbf{564\ scf}}{\cancel{min}} \times \frac{\mathbf{60}\ \cancel{min}}{\cancel{hr}} \times \frac{\mathbf{24}\ \cancel{hr}}{\cancel{day}}} \times \mathbf{10^6} = 19.7\ ppmv\ SO_2 \approx 20\ ppmv\ SO_2$$

Since the SO_2 volumetric concentration from the exhaust is below 300 ppmv, at a volumetric concentration of 20 ppmv, S-11 is expected to meet the emission standards of Regulation 9-1.

California Environmental Quality Act (CEQA) and Regulation 2-1
BFT filed for a Notice of Exemption (NOE) on September 29, 2015, with the lead agency SVCW. On October 1, 2015, SVCW considered the project to be categorically exempt from CEQA pursuant to the following:

<u>*CEQA Guideline §15303*</u>: Class 3 consists of construction and location of limited numbers of new, small facilities or structures; installation of small new equipment and facilities in small structures; and the conversion of existing small structures from one use to another where only minor modifications are made in the exterior of the structure. The numbers of structures described in this section are the maximum allowable on any legal parcel. Examples of this exemption include, but are not limited to:

(a) One single-family residence, or a second dwelling unit in a residential zone. In urbanized areas, up to three single-family residences may be constructed or converted under this exemption.

(b) A duplex or similar multi-family residential structure, totaling no more than four dwelling units. In urbanized areas, this exemption applies to apartments, duplexes and similar structures designed for not more than six dwelling units.

(c) A store, motel, office, restaurant or similar structure not involving the use of significant amounts of hazardous substances, and not exceeding 2500 square feet in floor area. In urbanized areas, the exemption also applies to up to four such commercial buildings not exceeding 10,000 square feet in floor area on sites zoned for such use if not involving the use of significant amounts of hazardous substances where all necessary public services and facilities are available and the surrounding area is not environmentally sensitive.

(d) Water main, sewage, electrical, gas, and other utility extensions, including street improvements, of reasonable length to serve such construction.

(e) Accessory (appurtenant) structures including garages, carports, patios, swimming pools, and fences.

(f) An accessory steam sterilization unit for the treatment of medical waste at a facility occupied by a medical waste generator, provided that the unit is installed and operated in accordance with the Medical Waste Management Act (Section 117600, et seq., of the Health and Safety Code) and accepts no offsite waste.

SVCW had agreed with the following assessment provided by David J. Powers & Associates, Inc. on behalf of BFT.

"The proposed BioForceTech Plant will be installed at the existing SVCW WWTP. The improvement will be minor, less than 0.4 acres and will occur with the existing boundary of the WWTP. The project does not propose any changes in land uses at the WWTP or any increase in overall allowable discharge capacity for the WWTP. An air quality analysis was completed for the proposed project in compliance with the CEQA Guidelines. The air quality analysis determined that the project will not result in significant impacts (Attachment A). Per section 15300.2 of the CEQA Guidelines, it has been determined that the project is not located on a hazardous waste site, and that the project will not result in a significant impact due to unusual circumstances, damage scenic resources, affect a historic resource, or result in a cumulative impact. For these reasons and those stated above, the project is exempt from the provisions of CEQA."

SVCW provided NOE #2015128142, which was signed on October 1, 2015.

BFT is expected to operate on the property of a POTW and provide services that are closely related to sludge handling process listed in the District *"Permit Handbook – Section 8.2 Wastewater Treatment Facilities"* (Permit Handbook). Sludge handling processes include the removal of water from sludge using sand drying beds, vacuum filters, filter presses, and centrifuges.

BFT is proposing for the installation of a pyrolysis reactor with receiving bin and process heater, S-11, and an enclosed conveyor belt system with storage bin, S-12. S-11 will be abated by a wet scrubber, A-11, and activated carbon vessel, A-12. The emissions from S-11 and S-12 are not expected to exceed an emission rate of 10 lb per day. In addition, BFT has agreed to limit TAC emissions below the thresholds of Regulation 2-5 and will be required to perform source testing or sampling to verify compliance with the limit. If at any BFT exceeds the limit, BFT is to cease operation and submit a permit application to review TAC emissions.

According to the 1999 BAAQMD CEQA Guidelines, the project threshold of significance for reactive organic gases (ROG), NO_X, and PM_{10} is 80 lb per day. Assuming POC is equivalent to ROG, the operation is expected to be below the significance thresholds and is not anticipated to have a potential for causing a significant adverse environmental impact.

Since the operation of S-11, S-12, A-11 and A-12 have been provided a NOE, are closely related to operations listed in the Permit Handbook, and are expected to emit less than the significance threshold for ROG, NO_X and PM_{10}, the District will take no further action.

California Health & Safety Code §42301.6 and Regulation 2-1-412
Pursuant to California Health & Safety Code §42301.6(a), prior to approving an application for a permit to construct or modification of a source, which is located within 1,000 feet from the outer boundary of a school site, the District shall prepare a public notice as detailed in §42301.6. §42301.9(a) defines a "school" as any public or private school used for the purposes of the education of more than 12 children in kindergarten or any grades 1 to 12, inclusive, but does not include any private school in which education is primarily conducted in private homes.

BFT has certified that the source will not be located within 1,000 feet of the outer boundary of any K-12 school site. Therefore, the requirements of the California Health & Safety Code §42301.6 are not applicable.

PERMIT CONDITIONS

Permit Condition #****

The following permit condition applies to the pyrolysis reactor with receiving bin and process heater, S11, abated by a wet scrubber, A11, and activated carbon vessel, A12. For the purpose of this condition, the following definitions apply:

Biochar: A solid byproduct of the biosolids pyrolysis process. Biochar may also be referred to as ash.

Biosolids: Dried sludge from the biosolids dryer, S10.

Sludge: Spent sludge from a publically owned treatment works (POTW).

Synthetic Gas: Fuel gas that is derived from flameless combustion within a pyrolysis reactor.

GENERAL OPERATING REQUIREMENTS

1. The owner/operator shall only process sludge and biosolids that are derived from Silicon Valley Clean Water (SVCW), Plant #1534. [Basis: Regulation 2-1-403]

2. The owner/operator shall only operate the pyrolysis reactor with receiving bin and process heater, S11, only when abated by the wet scrubber, A11, and carbon vessel, A12. [Basis: Regulation 2-1-403]

3. The owner/operator of the wet scrubber, A11, and carbon vessel, A12, shall maintain and properly operate the abatement devices as recommended by the manufacturer. [Basis: Regulation 2-1-403]

4. The owner/operator of the pyrolysis reactor with receiving bin and process heater, S11, abated by a wet scrubber, A11, and activated carbon vessel, A12, shall not exceed 6 tons of biosolids during any calendar day. [Basis: Regulation 2-1-403]

5. The owner/operator of the pyrolysis reactor with receiving bin and process heater, S11, abated by a wet scrubber, A11, and activated carbon vessel, A12, shall not exceed 2,000 tons of biosolids during any 12-month consecutive period. [Basis: Regulation 2-1-403]

6. The owner/operator of the pyrolysis reactor with receiving bin and process heater, S11, abated by a wet scrubber, A11, and activated carbon vessel, A12, shall not exceed an exhaust flowrate of 564 dscfm @ 11% O2. [Basis: Cumulative Increase]

7. The owner/operator of the pyrolysis reactor with receiving bin and process heater, S11, shall add adequate moisture, as necessary, to biochar stockpiles to ensure that no particulate emissions generated. [Basis: Regulation 2-1-403]

EMISSION STANDARDS

8. The owner/operator shall not operate the pyrolysis reactor with receiving bin and process heater, S11, abated by a wet scrubber, A11, and activated carbon vessel, A12, if the following emission limits have been exceeded:

   a. 0.02 lb POC/MMBtu (36 ppmv @ 3% O2 as Carbon 1)
   b. 0.34 lb NOx/MMBtu (150 ppmv @ 3% O2)
   c. 0.04 lb CO/MMBtu (30 ppmv @ 3% O2)
   d. 0.02 lb PM10/MMBtu
   e. 0.11 lb SO2/MMBtu (33 ppmv @ 3% O2)

   [Basis: Cumulative Increase]

9. The owner/operator of the pyrolysis reactor with receiving bin and process heater, S11, abated by a wet scrubber, A11, and activated carbon vessel, A12, shall not be equal to or exceed the following toxic air contaminant (TAC) emission rates:

   Metals
   a. Arsenic and compounds (inorganic): 4.4E-04 lb/hr; 7.2E-03 lb/yr;
   b. Cadmium and compounds: 2.6E-02 lb/yr;
   c. Chromium, (hexavalent, 6+): 7.7E-04 lb/yr;
   d. Lead and compounds (inorganic): 3.2E+00 lb/yr;
   e. Manganese and compounds: 3.5E+00 lb/yr;
   f. Mercury and compounds (inorganic): 1.3E-03 lb/hr; 2.7E-01 lb/yr;
   g. Nickel and compounds: 1.3E-02 lb/hr; 4.3E-01 lb/yr;
   h. Vanadium (fume or dust): 6.6E-02 lb/yr;

   Acids
   i. Hydrochloric acid (hydrogen chloride): 4.6E+00 lb/hr; 3.5E+02 lb/yr;
   j. Hydrogen fluoride (hydrofluoric acid): 5.3E-01 lb/hr; 5.4E+02 lb/yr; and,

   Other
   k. Polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), and dioxin-like polychlorinated biphenyls (PCBs) (as 2,3,7,8-PCDD equivalent): 3.4E-07 lb/yr calculated and summed in accordance with BAAQMD Regulation 2-5, Table 2-5-1.

   If the owner/operator exceeds any of the limits within this part, the owner/operator must cease operation and submit a permit application to perform a Health Risk Screening Analysis (HRSA) in accordance with BAAQMD Regulation 2-5. [Basis: Toxics]

10. The owner/operator of the pyrolysis reactor with receiving bin and process heater, S11, abated by a wet scrubber, A11, and activated carbon vessel, A12, shall not exceed a mercury emission rate of 7.1 lb in any consecutive 24-hour period. If the owner/operator exceeds a mercury emission rate exceeds 3.5 lb in any consecutive 24-hr period, the owner/operator shall perform annual sampling in accordance with 40 CFR Part 61, Subpart E. [Basis: 40 CFR Part 61, Subpart E]

SOURCE TEST/SAMPLING REQUIREMENTS

11. No later than 60 days from the startup of the pyrolysis reactor with receiving bin and process heater, S11, abated by a wet scrubber, A11, and activated carbon vessel, A12, the owner/operator shall conduct District approved source tests to determine initial compliance with the limits in Parts 6, 8, 9, and 10. The owner/operator shall submit the source test results to the District staff no later than 60 days after the source test. [Basis: Cumulative Increase, Toxics, Regulation 2-1-403, and 40 CFR Part 61, Subpart E]

12. The owner/operator shall obtain approval for all source test procedures from the District's Source Test Section prior to conducting any tests. The owner/operator shall comply with all applicable testing requirements as specified in Volume V of the District's Manual of Procedures. The owner/operator shall notify the District's Source Test Section, in writing, of the source test protocols and projected test dates at least 7 days prior to testing. [Basis: Cumulative Increase, Toxics, Regulation 2-1-403, and 40 CFR Part 61, Subpart E]

RECORD KEEPING/REPORTING REQUIREMENTS

13. No later than 30 days after the completion of testing to demonstrate compliance with Part 9, the owner/ operator shall compile and submit a report to the District's Engineering Division, which reviews source test emissions data with the limitations of Part 9. If the owner/operator determines that a limit of Part 9 has been exceeded, the owner/operator must cease operation of the pyrolysis reactor with receiving bin and process heater, S11, abated by a wet scrubber, A11, and activated carbon vessel, A12, and submit a permit application to perform a HRSA in accordance with BAAQMD Regulation 2-5. [Basis: Toxics]

14. The owner/operator of the pyrolysis reactor with receiving bin and process heater, S11, abated by a wet scrubber, A11, and activated carbon vessel, A12, shall report to the Compliance and Enforcement Division any exceedance of conditions at the time that it is first discovered. The submittal shall detail the corrective action taken and shall include the data showing the exceedance as well as the time of occurrence. [Basis: Regulation 2-1-403]

15. The operator/operator of the pyrolysis reactor with receiving bin and process heater, S11, abated by a wet scrubber, A11, and activated carbon vessel, A12, shall maintain a log of the following records for each month of operation:

    a. Daily amount of biosolids processed (tons);
    b. Monthly amount of biosolids processed (tons);
    c. Source test(s); and,
    d. Maintenance records.

    All measurements, records, calculations, and data required to be maintained by the owner/operator shall be retained and made available for inspection by the District for at least two years following the date the data is recorded. [Basis: Recordkeeping and Regulation 2-1-403]

End of Conditions

Permit Condition #****

The following permit condition applies to the enclosed conveyor belt system with storage bin, S12. For the purpose of this condition, the following definitions apply:

Biosolids: Dried sludge from the biosolids dryer, S10.

Sludge: Spent sludge from a publically owned treatment works (POTW).

1. The owner/operator shall only process sludge and biosolids that are derived from Silicon Valley Clean Water (SVCW), Plant #1534. [Basis: Regulation 2-1-403]

2. The owner/operator of the enclosed conveyor belt system with storage bin, S12, shall not exceed 2,000 tons of biosolids during any 12-month consecutive period. [Basis: Regulation 2-1-403]

3. The owner/operator of the enclosed conveyor belt system with storage bin, S12, shall report to the Compliance and Enforcement Division any exceedance of conditions at the time that it is first discovered. The submittal shall detail the corrective action taken and shall include the data showing the exceedance as well as the time of occurrence. [Basis: Regulation 2-1-403]

4. The operator/operator of the enclosed conveyor belt system with storage bin, S12, shall maintain a log of the following records for each month of operation:

   a. Monthly amount of biosolids processed (tons);
   b. Annual amount of biosolids processed (tons); and,
   c. Reports submitted in accordance with Part 3 of this condition.

   All records and data required to be maintained by the owner/operator shall be retained and made available for inspection by the District for at least two years following the date the data is recorded. [Basis: Recordkeeping and Regulation 2-1-403]

End of Conditions

RECOMMENDATION

Issue an Authority to Construct and/or Permit to Operate to BioForceTech Corporation for the following equipment:

S-11 Pyreg GmbH Pyrolysis Reactor with Receiving Bin and Process Heater
0.15 Ton Biosolid Reactor Capacity; 1.76 Ton Biosolid Receiving Bin Storage Capacity; 0.25 Ton/Hr Maximum Biosolid Feed Rate; Pyreg Model FLOX Process Heater; 0.99 MMBtu/Hr Maximum Input Heat Rating; 564 SCFM @ 11% O_2 Maximum Exhaust Flowrate

S-12 Biosolid Process and Handling
Enclosed Conveyor Belt System; 8.75 Ton Capacity Storage Bin; 2,000 Ton Maximum Annual Biosolid Throughput

A-11 Wet Scrubber; Manufacturer: Pyreg; Maximum Flowrate: 620 CFM
Abating Sulfur Dioxide (SO_2) from Source S-11

A-12 Activated Carbon Vessel; Manufacturer: Pyreg
Maximum Flowrate: 620 cfm; 1500 lb (700 kg) Capacity
Dimensions: 55 in (1400 mm) Diameter, 78 in (1970 mm) Height
Abating Particulate Matter (PM), Mercury (Hg), and Heavy Metals from Source S-11

By: ____________________________ Date: _____________

Alfonso Borja
Air Quality Engineer

ATTACHMENT D

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

MAR 0 2 2017

Dr. Judi Krzyzanowski
Krzyzanowski Consulting
1967 Moira Road
Roslin Ontario, Canada K0K 2Y0

Dear Dr. Krzyzanowski:

We have received your July 5, 2016, letter ("July letter") requesting a determination regarding the applicability of 40 CFR Part 60 Subpart CCCC – "Standards of Performance for Commercial and Industrial Solid Waste Incineration (CISWI) Units" for your client, the Carbon Black Global LLC (CBG) facility in Dunlap, Tennessee. The request relates to a pilot "scaled-down" unit that will be used to optimize and research the gasification of a variety of carbon-based waste feedstocks for clients. Based on our review of the July letter and the additional information provided by CBG on August 23, 2016, September 16, 2016, and December 12, 2016, we have determined the proposed operation of the pilot unit is not a CISWI unit and will not be subject to Subpart CCCC.

In the July letter, you provided the following details about the CBG pilot unit. The process will gasify a variety of carbon-based feedstocks by using downdraft gasification to produce charcoal or activated carbon and synthetic gas (syngas) for energy production. The pilot unit operated by CBG will handle no more than 100 pounds of feedstock at a time, and no more than one batch of any feedstock will be processed in any given day. Municipal Solid Waste (MSW) will be tested in the pilot unit as a feedstock no more than twice each quarter, for a maximum of eight batches of MSW per calendar year, and at no time in excess of 30 percent of the load by weight (estimates are that it will remain below 12 percent).

The process in the CBG pilot unit begins by loading the reactor vessel with a 10-inch layer of charcoal on top of a perforated base. The feedstock is loaded on top of the charcoal. The reactor vessel is then placed into an autoclave where gasification occurs. Temperature, pressure, and air/oxygen levels in the autoclave will be regulated, partially through the use of steam injection, and will be optimized for each individual feedstock. The syngas produced in the process will then be passed through a set of two packed-tower wet scrubbers followed by a fabric-filter before being diverted to a flare. In real-world client applications the syngas will be used to produce energy, but due to the research and development nature of the CBG pilot unit the syngas will be flared off. The results from waste feedstock test batches will be used to optimize the process for each waste feedstock in order to increase efficiency and reduce emissions. The July letter describes that at no time does combustion of the waste feedstock occur, and both temperature and air content within the autoclave are highly regulated to ensure this.

In an email to the U.S. Environmental Protection Agency on August 23, 2016, you provided a temperature profile showing four different time and temperature profiles associated with different test conditions (minimum temperature/minimum time, minimum temperature/maximum time, maximum temperature/minimum time, and maximum temperature /maximum time). On September16, 2016, you provided a document to elucidate the temperature profile. Our understanding of the temperature profile and documentation is that it depicts, for the first five minutes, the ignition of the charcoal using non-solid waste fuel (i.e., natural gas or light fuel oil) with the addition of five percent (volume) compressed air for combustion.

In a follow-up letter of December 12, 2016, ("December letter") you provided additional detail about the startup of the process and described that the flame used on cold-start is underneath the charcoal base and never comes into contact with the charcoal (and as stated in the July letter, never comes in contact with the waste feedstock). You also state that not all of the charcoal will be ignited before the ignition (intake) valve is closed to eliminate air intake, but that there is sufficient heat within the system to continue the heating of the charcoal base, and to initiate the gasification process. The EPA is able to discern this from the temperature profile; the temperature reaches 700 to 800°C due to the fuel-based flame and ignition of charcoal during the first five minutes of operation.

You also provided additional detail in the December letter regarding the operation of the ignition (intake) valve to ensure that oxygen levels are kept below those needed to sustain combustion. The process valves are solenoid valves with modulating valve controls (MVCs). The ignition MVC is able to regulate air intake to the fraction of a percent, and is responsible for the supply of five percent air into the system to initiate combustion of the lower charcoal layer, during the first five minutes. The MVC closely regulates the amount of air in the autoclave throughout the gasification process, allowing just enough oxygen to stimulate and maintain certain chemical processes, but not enough to initiate combustion. Steam acts as the primary supply of chemical oxygen in gasification reactions, but at no time during the process would there be enough oxygen in the system to allow for the combustion of waste feedstock.

Our understanding is that after the initial five-minute period, the fuel source and air/oxygen source are cut off and the unit is sealed, with the exception of holes at the top of the vessel that draw all gases upwards, out through the holes, down through the shield and into the scrubber via pressure differentiation. At this time, the gasification process begins, as there is no longer sufficient air/oxygen to support combustion. The EPA can see from the temperature curves that the gasification temperature, depending on the four different profiles, can range from 300 to 800°C. The temperature profile also shows a hot steam activation during the 45 to 180 minute time range causing the temperature to rise to 850°C, and which you state is done to improve the quality of the syngas. The temperature diagram indicates a cool steam quench is performed to bring the vessel temperature back down to between 70 and 100°C the intention of which, by your description, is to reduce the possible formation of secondary products such as dioxins and furans.

As indicated in §60.2010, Subpart CCCC applies to a new incineration unit that is a CISWI unit and that is not one of the types of units excluded under §60.2020. A *CISWI unit* is defined in §60.2265 as "any distinct operating unit of any commercial or industrial facility that combusts, or has combusted in the preceding 6 months, any solid waste as that term is defined in 40 CFR part 241. If the operating unit burns materials other than traditional fuels as defined in §241.2 that have been discarded, and you do not keep and produce records as required by §60.2175(v), the operating unit is a CISWI unit."

The EPA recognizes that gasification, by itself, is not combustion. According to your description, while there is combustion of the charcoal and external fuel (i.e., natural gas or light fuel oil) in the first five minutes of operation, the external fuel source and air are cut off, transitioning the process to gasification before combustion of the waste feedstock will occur. This also initiates the gasification process of the waste feedstock, which is required to produce the carbon black product and ultimately, the syngas. From your description, we believe that the MVC is able to regulate the presence of oxygen in the system and to preclude combustion of the waste feedstock from occurring. Therefore, we do not believe that the unit meets the criteria that the unit is "any distinct operating unit of any commercial or industrial facility *that combusts, or has combusted* in the preceding 6 months, any solid waste as that term is defined in 40 CFR part 241" and, for this reason, Subpart CCCC does not apply to the gasification process described by CBG.

We note that for the CBG process, the resultant syngas will be flared. Subpart CCCC applies to the combustion of waste gases that are in a container when combusted (see §60.2265). Since the resultant syngas will not be in a container when combusted in the flare, Subpart CCCC will not apply to the flare.

While operation of the pilot unit by CBG will not be subject to Subpart CCCC, combustion of syngas produced by the gasification of other wastes, by CBG clients, should be evaluated by the appropriate delegated permitting agency for potential applicability under section 129 or section 112 (in the case of hazardous waste rules). For example, 40 CFR Part 60 Subpart EEEE applies to *other solid waste incineration units*, which include very small municipal waste combustion units and institutional waste incineration units. A *very small municipal waste combustion unit* is defined in Subpart EEEE as "any municipal waste combustion unit that has the capacity to combust less than 35 tons per day of MSW or refuse-derived fuel, as determined by the calculations in §60.2975." A very small municipal waste combustion unit may be exempt from Subpart EEEE if the criteria in §60.2887(b) are met. The criteria for being exempt include a requirement that a very small municipal waste combustion unit have a federally enforceable permit limiting the combustion of MSW to 30 percent of the total fuel input by weight. Subpart EEEE applies, in part, to the combustion of gasified MSW (i.e., syngas) produced by pyrolysis/combustion units. This applicability is similar to 40 CFR Part 60 Subpart AAAA – "Standards of Performance for Small Municipal Waste Combustion Units" which applies to municipal waste combustion units that have the capacity to combust at least 35 tons per day but no more than 250 tons per day of MSW or refuse-derived fuel.

This determination was coordinated with the EPA's Office of Enforcement and Compliance Assurance, the Office of General Counsel, the Office of Land and Emergency Management, and the Office of Air Quality Planning and Standards. If you have any questions concerning the determination provided in this letter, please contact Todd Russo at (404) 562-9194.

Sincerely,

Beverly H. Banister
Director
Air, Pesticides and Toxics Management Division

cc: Sara Ayres, OECA
Marcia Mia, OECA
Nabanita Modak, OAQPS
George Faison, OLEM
Paul Versace, OGC

ATTACHMENT E

Notice of Construction (NOC) Worksheet

Applicant: City of Edmonds Wastewater Treatment Plant	NOC Number: 12135
Project Location: 200 2nd Ave S, Edmonds WA 98020	Registration Number: 14063
Applicant Name and Phone: Pamela Randolph	NAICS: 22130 Sewage Treatment Facilities
Engineer: Madeline McFerran/Ralph Munoz	Inspector: Melissa McAfee

A. DESCRIPTION

For the Order of Approval:
Sewage sludge gasification and syngas oxidation system. Sludge rotary drum dryer. Exhaust from gasification/oxidation and sludge dryer controlled by product separator cyclone, venturi scrubber, granulated activated carbon adsorption. Dry sludge handling bins, conveyors, hoppers controlled by one baghouse.

Additional Information (if needed):

Facility

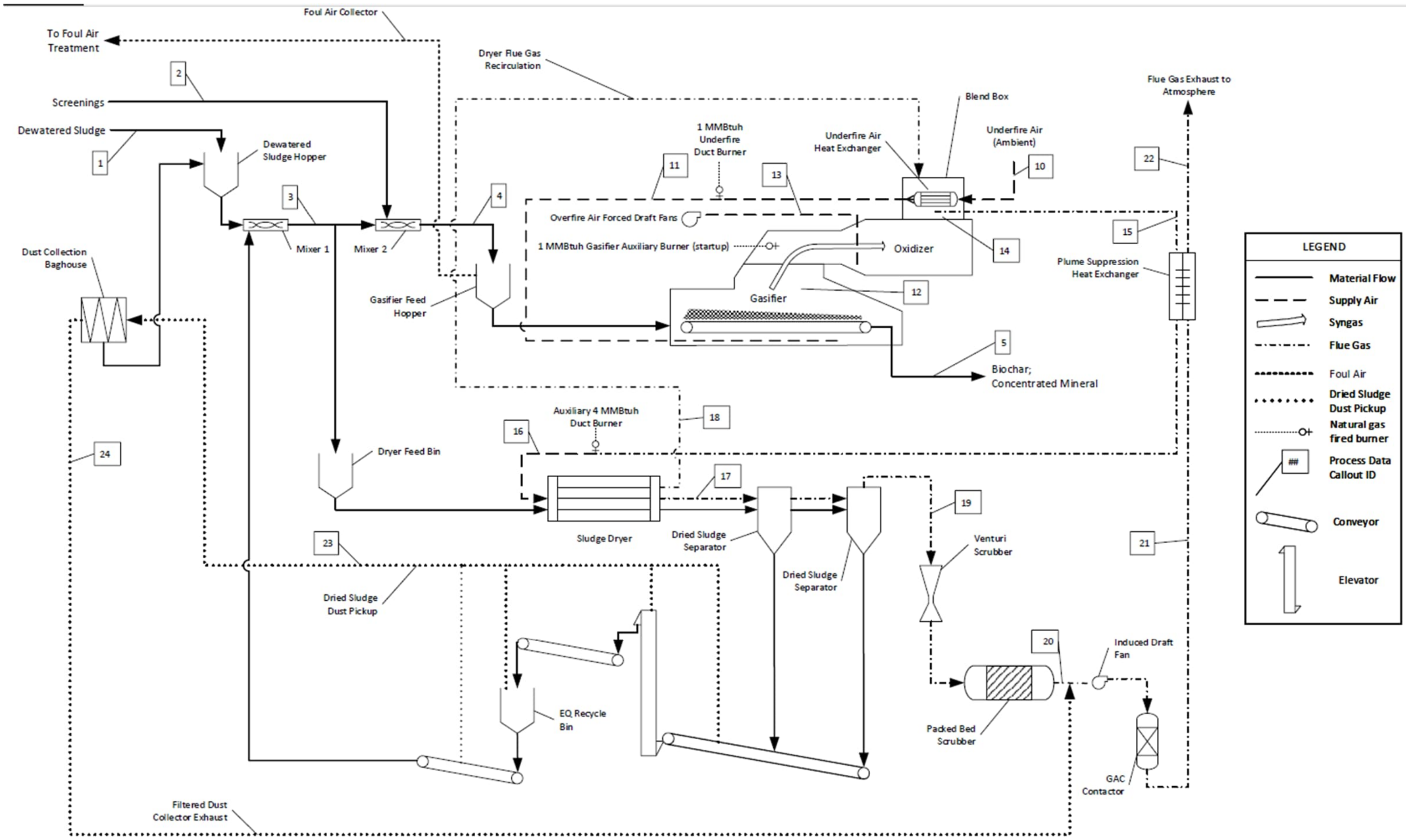
City of Edmonds Wastewater Treatment Plant is a primary and secondary treatment municipal wastewater treatment plant. Primary treatment consists of removal of suspended solids through mechanical settling, and secondary treatment utilizes activated sludge to oxidize carbonaceous waste. This Notice of Construction application reviews a proposed change to the waste sludge treatment: replacement of sewage sludge incineration with sewage sludge gasification and oxidation of the syngas produced by the gasification.

Proposed Equipment/Activities

The project is for replacement of the existing sewage sludge incinerator at the facility with a gasifier/oxidizer system to produce syngas and residual product. The sewage sludge incinerator was decommissioned July 1, 2021 as noted in the facility's semiannual 40 CFR 60 Subpart O report.

Gasification is a phased carbon conversion process conducted in an oxygen starved environment to convert solid organic materials into volatile gases and ash residuals. The proposed unit may be operated to produce residuals with variable carbon content; the applicant specifies that biochar is one end of the operating spectrum with highest carbon content and concentrated mineral (CM) is the other end of the operating spectrum with lowest carbon content. Production of CM generates more heat than production of biochar. The syngas produced by gasification is combusted in the oxidizer portion of the chamber and the resulting heated exhaust is used to dry sludge in a rotary drum dryer.

The proposed project flow diagram was supplied with the permit application:



A written summary of the project flow for the gasification/oxidizer system is described below:

<u>Material Flow</u> (dewatered sludge, concentrated mineral product, biochar, screenings)

Upstream of the portion of this facility under review for NOC 12135, the wastewater treatment plant generates primary sludge, which is the sludge that settles to the bottom of the primary clarifiers, and waste activated sludge (WAS), which is excess sludge produced by the activated sludge secondary treatment process. Activated sludge tanks contain microorganisms that consume carbonaceous waste and produce more sludge as the organisms grow and multiply. Primary sludge and WAS are commingled and then dewatered.

The activities that are part of this project will occur after the sludge is dewatered. The dewatered sludge will enter a sludge hopper and will be pumped to a mixer which will combine the dewatered sludge with solids collected from the dryer. The dewatered sludge mixture will then be split and routed as follows:

A) About 80% of the sludge mixture will go to the rotary drum dryer where flue gas from the gasifier/oxidizer unit will heat and dry the sludge. After the sludge is dried, the sludge will pass through a product separator where the dried product will be separated from the flue gas. A high efficiency cyclone will remove coarse PM particles from the flue gas stream. The dried sludge captured in the product separator and the cyclone will be returned to the sludge mixer to be mixed with the dewatered sludge.

B) About 20% of the sludge mixture will be routed to a mixer where screenings may be added to the dewatered sludge material. Screenings are coarse materials removed by the bar screens at the plant headworks, e.g. rags, rope, cardboard, and paper and wipes which are dewatered and ground for disposal. When the system is producing biochar the screenings will not be added and will be disposed off-site. When the system is producing CM the screenings will be added. The mixture will then be conveyed to the gasifier feedbin and into the gasifier unit to be converted into syngas and end product. The gasifier will operate between 1200°F - 1600°F in a reducing environment. The biochar or CM produced will pumped out of the gasifier unit and then conveyed to a dumpster for solid waste collection.

Exhaust Flow (foul air, syngas, dust/particulate from dry sludge handling)

Foul Air

The initial sludge handling will include emission points for foul air (the sludge itself will be a source of emissions). Potential emission points for volatile organic compounds (VOCs) and odor will include:

- The dewatered sludge hopper.
- Mixer 1 (where dewatered sludge and dried sludge will be mixed).
- Conveyor 005 which will split the mixture between the Dryer Feed bin or Mixer 2 (where the sludge mixture can be blended with screenings).
- The screenings conveyor in the gasifier room
- The Dryer Feed Bin.
- Mixer 2

These emission points will each be routed to the plant odor control system under review under NOC 12123.

Syngas

Syngas will be produced in the gasifier portion of the gasifier/oxidizer (1200°F – 1600°F reducing environment in the gasifier portion of the process unit) and then be oxidized in the oxidizer by adding ambient air to the syngas which will result in the spontaneous combustion of the syngas at temperatures of 2000°F-2300°F to produce process heat. The oxidized syngas will then flow to a blend box, where flue gas from the sludge dryer will be blended with the oxidized syngas. The blend box will also include a heat exchanger to preheat the gasifier underfire air supply.

The blend box is last stage in the oxidation process, and the blend box exhaust will be the process flue gas. After leaving the blend box, the flue gas will pass through a stack gas vapor plume suppression heat exchanger, which will heat stack gas above dewpoint to mitigate formation of a visible vapor plume when the stack gas is released into the atmosphere. The flue gas will then flow to the drum dryer, where the flue gas will provide direct heat for sludge drying.

A portion of the exhaust from the dryer will be returned to the blend box. The remainder of the dryer exhaust will be conveyed through the product separator and cyclone. The exhaust gas will then be treated by a Venturi scrubber to remove particulate, then a packed bed scrubber to remove acid gases, and then an activated carbon contactor to treat exhaust organics and mercury vapor. (See discussion in Section F). After this treatment train, the exhaust will pass through the vapor plume suppression heat exchanger (where heat from the blend box exhaust will be recovered and transferred to the exhaust stack gas). The flue gas leaving the heat exchanger will then be emitted into ambient air through a stack 20 foot high (measured above building grade) and 1.67 foot diameter.

Dry Sludge Handling Dust

Following the sludge dryer, the dried sludge will be transferred to dried sludge separators and the dry material will be transferred by two conveyors to an EQ Recycle Bin. The dried sludge will be recirculated back into mixer 1 where the dried sludge will be mixed with dewatered sludge to condition the dried sludge prior to gasification. The dried sludge dust pickup system will convey dust to an induced draft 3,000 cfm pulse jet dust collector with air to cloth ratio of 5.19:1.

System capacity (pasted from page 15 of application):

The system is sized to process 14,500 wet tons per year of dewatered biosolids cake averaging 20% solid content, equivalent to 2,875 Dry TPY, and process 840 wet tons per year of screenings averaging 50% solid content, equivalent to 420 Dry TPY. The screenings provide a portion of fuel for the gasifier and are completely separated from the biosolids. The project will be installed within the confines of the existing incinerator building.

The gasifier technology is described as "quiescent fluidized bed" technology, P100EM1Q PDF describes in Table 1 two kinds of fluidized beds, both are high in particulate and are "bubbling" and "recirculating." Bubbling removes ash after the fluidized bed via cyclone and recirculating returns the ash to the fluidized bed. The process flow diagram for the application indicates that the residual product (biochar or CM) will not be recirculated. The manufacturer shows their process as what they call "fluid lift" where the feedstock itself is the fluidized bed rather than a separate medium as with conventional fluidized beds and may be closest approximated by the bubbling fluidized bed technology in P100EM1Q. The "fluid lift" is also similar to a traveling grate system supplied with underfire air. The system uses plenums to vary the flow rate, fluid type, temperature and pressure to dry, pyrolyze and gasify the feedstock. Given that there is not an additional medium added and the absence of full fluidization reduces interparticle contact and abrasion in the gasifier, particulate emissions are expected to be overall lower than for bubbling fluidized beds.

Permit History

The facility's wastewater treatment plant (clarifiers, activated sludge and chlorine contact chambers) and fluidized bed sludge incinerator have been permitted since 1989 with four revisions made for changes to the controls on the incinerator and the sludge basins as detailed below. This NOC proposal would replace the sewage sludge incineration at the facility with gasification and production of biochar and mineral product. The permitting history for the facility is outlined below:

NOC 3097 issued 10/9/1989 (superseded by NOC 6466) for one fluidized bed sludge incinerator with a 2,600 cfm venturi/impingement tray scrubber and solids handling odor control using a packed tower scrubber at 20,000 cfm, 3 activated sludge diffused air aeration basins with 12,000 cfm air filter, two secondary clarifiers and chlorine contact chambers.

NOC 6466 issued 7/3/1996 (superseded by NOC 8959) modification of NOC 3097 to remove a requirement that the incinerator and its control system meet article 12 of regulation I.

NOC 8959 issued 6/10/2004 (superseded by NOC 11115) modification to remove pleated filters on activated sludge aeration basins.

NOC 11115 issued 4/11/2016 (superseded by NOC 11212) addition of four module fixed mercury sorption unit to the existing scrubber serving the sludge incinerator

NOC 11212 issued 7/26/2016 administrative update to NOC 11115, this NOC will be cancelled and superseded by NOC 12135.

NOC 12123 issued 12/17/2021 for replacement of the Foul Air (FA) control system: replace an existing 2-stage FA packed bed scrubber with a biotrickling filter odor control system. The application for NOC 12135 details 500 acfm air flow from the dewatered sludge hopper, Mixer 1, Conveyor 005, the dryer feed bin, Mixer 2, Screener 601 being routed to the Foul Air System. NOC 12123 describes a 20,000 cfm biofilter (the previous 2 stage biofilter covered under NOC 11115 also was for 20,000 cfm). From NOC 12123: "Existing equipment that feeds dewatered sludge and ground screenings to the SSI will be removed and replaced with new equipment to feed dewatered sludge to the gasifier and sludge dryer units in the CRP. This will require replacement of the existing FA collection system facilities associated with dewatered sludge handling".

As part of the permitting process and determination that 40 CFR 60 Subpart LLLL is not applicable to the project, the applicant made the following process modifications for supplemental natural gas firing during start-up and shutdown.

- A 1 MMBtu/h burner that provides supplemental heat to the gasifier during cold start-up has been relocated to the underfire air supply duct upstream of the gasifier.
- A 4 MMBtu/h NG finish burner has been added to the flue gas stream upstream of the sludge dryer. This burner will operate once during initial system charge and thereafter only to burn-off residual syngas in the system during shutdown.

All NG burners are less than 10 MMBtuh capacity, and accordingly are exempt from permit to construct review per PSCAA Regulation 1, Section 6.03(c). With these burners being used only during start-up and shutdown, the burners will not operate more than 50 hours per year. Once the system initial charge is complete, the finish burner will operate only during shutdown; the finish burner will not operate at the same time as the 1 MMBtu/h burners supporting start-up of the gasifier and oxidizer.

B. DATABASE INFORMATION

Reg: 14063 - Edmonds, City of, Wastewater Treatment Plant
Item #: 6
Code: 39 - miscellaneous
Year Installed: Units Installed: 1 Rated Capacity: 768 Units: Lb/Hr
Primary Fuel: 7 - Other Fuel Standby Fuel:
NC/Notification #: 12135 NOC Not Required? (b)(10) Exemption?
Removed?
Operating Requirements:
Comments: Ecoremedy gasification and oxidation unit for sewage sludge, gasifier (model ECR-542) generates syngas from sewage sludge which is then oxidized in oxidizer

Reg: 14063 - Edmonds, City of, Wastewater Treatment Plant
Item #: 7
Code: 22 - dryer (moisture removal only)
Year Installed: Units Installed: 1 Rated Capacity: 7200 Units: Lb/Hr
Primary Fuel: 7 - Other Fuel Standby Fuel:
NC/Notification #: 12135 NOC Not Required? (b)(10) Exemption?
Removed?
Operating Requirements:
Comments: sewage sludge direct rotary drum dryer utilizing syngas to dry sludge, 72,000 lb/hr at 65% solids input and 5,2000 lb/hr output at 90% solids, inlet temp 600-900 F, outlet temp 190-210 F 6,000 ACFM flow

Reg: 14063 - Edmonds, City of, Wastewater Treatment Plant
Item #: 11
Code: 75 - Single cyclone
Year Installed: Units Installed: 1 Rated Capacity: 6557 Units: Acfm
Rated Exhaust Flowrate: 6557 CFM
NC/Notification #: 12135 NOC Not Required?
Removed?
Operating Requirements:
Comments:

Reg: 14063 - Edmonds, City of, Wastewater Treatment Plant
Item #: 12
Code: 53 - Venturi scrubber
Year Installed: Units Installed: 1 Rated Capacity: 4557 Units: Acfm
Rated Exhaust Flowrate: 4557 CFM
NC/Notification #: 12135 NOC Not Required?
Removed?
Operating Requirements:
Comments: 99% particle removal of 5 micron and above particulate

Reg: 14063 - Edmonds, City of, Wastewater Treatment Plant
Item #: 13
Code: 141 - Wet scrubber
Year Installed: Units Installed: 1 Rated Capacity: 3350 Units: Acfm
Rated Exhaust Flowrate: 3350 CFM
NC/Notification #: NOC Not Required?
Removed?
Operating Requirements:
Comments: packed bed scrubber, NaOH and NaOCl scrubber estimated 95% SO2 and H2S removal efficiency

Reg: 14063 - Edmonds, City of, Wastewater Treatment Plant | Item #: 14
Code: 48 - Activated carbon adsorption
Year Installed: | Units Installed: 1 | Rated Capacity: 450 | Units: Cu Ft
Rated Exhaust Flowrate: 6350 CFM
NC/Notification #: 12135 | NOC Not Required?
Removed?
Operating Requirements:
Comments: carbon adsorber bed

New NSPS due to this NOCOA?	No	Applicable NSPS: NA	Delegated? NA
New NESHAP due to this NOCOA?	No	Applicable NESHAP: NA	Delegated? NA
New Synthetic Minor due to this NOCOA?	No		

Prior to this permitting action, the City of Edmonds Wastewater Treatment Plant has been subject to 40 CFR 60 Subpart O, 40 CFR 61 Subpart C and 40 CFR 61 Subpart E.

See federal rule applicability discussion in the "Federal Rule" section of this worksheet.

C. NOC FEES AND ANNUAL REGISTRATION FEES

NOC Fees:

Fees have been assessed in accordance with the fee schedule in Regulation I, Section 6.04. All fees must be paid prior to issuance of the final Order of Approval.

Fee Description	Cost	Amount Received (Date)
Filing Fee	$ 1,150	
Refuse burning equipment ≤12 ton/day (control equipment included)	$5,000	
Equipment: rotary drum dryer, sludge handling particulate control	$1,200	
Refined dispersion modeling review	$1,000	
NSPS or NESHAP Review (40 CFR 60 Subparts O, 40 CFR 61 E)	$2,000	
Public Notice (additional publication fees invoiced through finance department)	$700	
Filing received		$ 1,150 (4/15/2021)
Additional fee received		$9,900
Total		$12,050

Invoice sent 11/29/22 –additional fees paid 2/13/23

Registration Fees:
Registration fees are assessed to the facility on an annual basis. Fees are assessed in accordance with Regulation I, Section 5.07.

This source was previously subject to PSCAA Regulation I Article 7, as the previous SSI was subject to 40 CFR 60 Subpart O. This new sludge treatment system is not subject to federal regulations affecting Title V applicability; the source is no longer a Title V source. The previous fees are listed below:

Invoice for Year 2021 Operating Permit Fees

Bill To:
Edmonds, City of, Wastewater Treatment Plant
200 2nd Ave S
Edmonds, WA 98020

Attention: Accounts Payable

Invoice Date:	Invoice #:
November 20, 2020	20210026
Due Date:	**Terms:**
January 04, 2021	Net 45 Days
Facility ID (Permit #):	
14063	

Site Address: ***Edmonds, City of, Wastewater Treatment Plant***
200 2nd Ave S, Edmonds, WA 98020

The annual operating permit fee is required by Washington State law and Puget Sound Clean Air Agency's Regulation I.
Your fees are based on your NAICS code and your actual emissions during 2019.

Facility Fees and Applicable Regulations	Charges
Facility Fee for Operating Permit Sources. Reg I, 7.07(b)(1)(iii) NAICS 221320 -- Sewage Treatment Facilities	**$ 28,600.00**
Fee Totals	
Operating Permit Fee (After February 18, 2021, the fee is $35,100.00). *The Total Fee is due by January 04, 2021. If unpaid after February 18, 2021, an additional delinquent fee of $6,500.00 will be applied. The delinquent fee is equal to 25% of the Operating Permit Fee, not to exceed $6,500 (Reg I, 7.07(b)).*	**$ 28,600.00**
WA State Department of Ecology surcharge, Reg I, 7.07(d) *For further information regarding the WDOE surcharge, please call 1-360-407-7530.*	**$ 652.15**
TOTAL FEE	**$ 29,252.15**

Fees moving forward are summarized below:

Applicability		
Regulation I	Description	Note
5.03(a)(1)(B)	Source subject to federal emission standard under 40 CFR 61	40 CFR 61 Subpart E
5.03(a)(8)(L)	Sewage treatment with odor control	Biofilter system for odor control at wastewater treatment plant
5.03(a)(5)(A),(D)	Sources with gas/odor control equipment >200 cfm	Carbon adsorption, biofilter
5.03(a)(6)(A),(K)	Sources with particulate control equipment >200 cfm	Venturi scrubber, dust collector
Annual Registration Fee		
Regulation I	Description	Fee
5.07(c)	General registration fee	$1,150
5.07(c)(1)	Sources subject to federal emission standard	$2,100
	Total =	$3,250

D. STATE ENVIRONMENTAL POLICY ACT (SEPA) REVIEW

State Environmental Policy Act (SEPA) review was conducted in accordance with Regulation I, Article 2. The SEPA review is undertaken to identify and help government decision-makers, applicants, and the public to understand how a project will affect the environment. A review under SEPA is required for projects that are not categorically exempt in WAC 197-11-800 through WAC 197-11-890. A new source review action which requires a NOC application submittal to the Agency is not categorically exempt.

The City of Edmonds is the SEPA lead agency for this project and issued the associated DNS on March 15, 2019. A copy of this DNS is included in the NOC file. This NOC is being issued after the date that the DNS became final.

E. TRIBAL CONSULTATION

On November 21, 2019, the Agency's Interim Tribal Consultation Policy was adopted by the Board. Criteria requiring tribal consultation are listed in Section II.A of the policy and include establishment of a new air operating permit source, establishment of a new emission reporting source, modification of an existing emission reporting source to increase production capacity, or establishment or modification of certain equipment or activities. In addition, if the Agency receives an NOC application that does not meet the criteria in Section II.A but may represent similar types and quantities of emissions, the Agency has the discretion to provide additional consultation opportunities.

The Agency identified that this NOC application meets one of the criteria in the Agency's Interim Tribal Consultation Policy, adopted by the Board on November 21, 2019. Criterion 5 of Resolution 1410 includes projects that modify an existing sewage treatment plant with odor control equipment to replace the primary production equipment for the existing sewage treatment plant. The gasifier/oxidizer and drum dryer under review for this NOC are replacing the sewage sludge incinerator. The gasifier/oxidizer produces syngas for drying of sludge and biochar and CM. The primary production equipment producing activated sludge (the activated sludge reactor units) are not being modified under this review. This application meets Criterion 5 because the gasifier/oxidizer unit produces syngas used for the gasification process and sludge drying as well as ash residuals which would constitute part of the plant's primary production equipment.

In accordance with the policy, the Agency notified each Tribe within the Agency's jurisdiction on May 17, 2021 of the intent to hold a consultation.

Based on no response, the Agency notified each tribe that the Agency would be proceeding with the final steps to issue the conditional approval of this Notice of Construction application.

F. BEST AVAILABLE CONTROL TECHNOLOGY (BACT) REVIEW

Best Available Control Technology (BACT)

New stationary sources of air pollution are required to use BACT to control all pollutants not previously emitted, or those for which emissions would increase as a result of the new source or modification. BACT is defined in WAC 173-400-030 as, "an emission limitation based on the maximum degree of reduction for each air pollutant subject to regulation under Chapter 70.94 RCW emitted from or which results from any new or modified stationary source, which the permitting authority, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such source or modification through application of production processes and available methods, systems, and techniques, including fuel cleaning, clean fuels, or treatment or innovative fuel combustion techniques for control of each pollutant."

An emissions standard or emissions limitation means "a requirement established under the Federal Clean Air Act or Chapter 70.94 RCW which limits the quantity, rate, or concentration of emissions of air contaminants on a continuous basis, including any requirement relating to the operation or maintenance of a source to assure continuous emission reduction and any design, equipment, work practice, or operational standard adopted under the Federal Clean Air Act or Chapter 70.94 RCW."

Best Available Control Technology for Toxics (tBACT)

New or modified sources are required to use tBACT for emissions control for TAP. Best available control technology for toxics (tBACT) is defined in WAC 173-460-020 as, "the term defined in WAC 173-400-030, as applied to TAP."

The system controls are designed as follows: (1) combustion controls for the oxidizer (2) auxiliary 4 MMBtuh duct burner (3) venturi scrubber for exhaust stream particulate removal (4) caustic packed bed scrubber for acid gas/inorganic gas removal (5) granulated activated carbon contactor for removal of residual metals, trace toxics (dioxins, furans, PAHs, PCBs). The dried sludge handling system controls proposed consist of a dust collector.

The equipment under review as well as the associated emissions subject to BACT and tBACT review are summarized below. The final column summarizes the applicant's proposed controls for BACT.

Emission Unit	Associated Emissions	Proposed Control(s)
Gasifier and Oxidizer 6mmBtu/hr (combusting syngas)	NOx	Excess air control, upper temperature of 2300°F to minimize thermal NOx
	CO	Combustion controls
	PM	No discussion, design proposed utilizes cyclone and dust collector then venturi scrubber
	SO2	No discussion, design proposed utilizes packed bed scrubber acid gas removal
	VOC	No discussion, design proposed utilizes oxidizer Activated carbon for residuals
	HAP: arsenic, cadmium, mercury vapors	No discussion, design proposed utilizes activated carbon
	TAP: arsenic, cadmium, mercury vapors, PAHs, PCBs, dioxins furans,	No discussion, design proposed utilizes Oxidizer 2300°F combustion
Natural gas duct burners 2mmBtu/hr	NOx	Applicant proposes that the natural gas combustion in the duct burner is below thresholds for permitting i.e. not subject to BACT
Sludge dryer (about 200°F)	PM (including metallic HAP as particulate)	No discussion, design proposed utilizes cyclone and dust collector then venturi scrubber for PM, exhaust gas stream from dryer is the same as the exhaust gas stream from the oxidizer
	VOC	No discussion, design proposed utilizes Packed bed scrubber for acid gases, Activated Carbon adsorption for TAP and mercury removal
Sludge handling system	PM	No discussion, design proposed utilizes Dust collector with grain loading of 0.01 gr/dscf

<u>Similar Permits</u>

PSCAA has not permitted any sewage sludge gasification or pyrolysis projects prior to this review for NOC 12135. PSCAA has reviewed some projects utilizing acid gas control and metal controls. The PSCAA projects with some carryover to the pollutants under review are tabulated below:

NOC (date issued)	Description	Pollutant	BACT/tBACT
11075 (3/9/16)	Replacement venturi scrubber w/ mercury sorption module at existing WWTP SSI	Mercury, PM	(RACT) venturi scrubber with mercury modules (additional requirements of 40

			CFR 60 Subpart MMMM monitoring)
11579	Replacement of chemical wet scrubber at waste sorting and recycling facility	Sulfur-containing emissions, NMOC	(RACT) packed bed caustic scrubber with 98% NMOC reduction (or outlet 10 ppmv @ 3% O2, H_2S removal 99.7% or ≤1.0 ppmv H_2S at outlet

PSCAA has permitted dry material handling similar to the sludge handling system in several cases:

NOC (date issued)	Description	Pollutant	BACT/tBACT
11838 (2/13/2020)	Virgin abrasive blast media handling	PM & silica	0.002 gr/dscf, achieved with MERV 15 filtration
11650 (5/6/2020)	Lime dust collection system	PM	0.002 gr/dscf grain loading limit
11801 (2019)	Cocoa bean winnowing controlled by baghouse	PM	0.003 gr/dscf grain loading limit No visible emissions nor fallout from baghouse
11606 (2018)	Starch silo controlled by bin vent	PM	0.003 gr/dscf grain loading limit No visible emissions nor fallout from baghouse

<u>Other Regulatory Agencies BACT</u>

The applicant identified two operational facilities in the country utilizing similar technologies: (1) the Silicon Valley Clean Water Plant (permitted by BAAQMD Application No. 27704) and (2) an Ecoremedy location in Morrisville PA which was reviewed by PADEP.

Both facilities can provide information about what control devices have been achieved in practice for similar sources though neither facility was subject to BACT review (neither project triggered BACT thresholds for the state/local agencies reviewing the projects).

Three projects involving gasification of sewage sludge are also under review by New Jersey Department of Environmental Protection (one of the three projects under review, Aries Linden, has been permitted once already and the open review is for a modification to increase throughput). As there is an issued Aries Linden permit, that project is included along with the Silicon Valley Clean Water Plant and the Morrisville PA facility information below:

Project	Description	Limits, (Basis)	Summary of Technology to Achieve Limits, Conditions for Compliance
Silicon Valley Clean Water Plant (BAAQMD)	Pyrolysis system processing 500 lb/hr sludge, 2,000 ton annual sludge throughput	0.02 lb/hr POC (VOC) (cumulative increase) 0.42 lb/hr CO (cumulative increase) 0.42 lb/hr NOx (cumulative increase) 0.02 lb/hr PM10 (cumulative increase) 0.02 lb/hr PM2.5 (cumulative increase) 0.11 lb/hr SO2 (cumulative increase) TAP/HAP emission limits post control device (air toxics requirements)	Packed bed scrubber, activated carbon adsorption Measuring mercury from carbon beds to determine carbon change-out: monthly then once/3 months changeout required @ control efficiency below 90% and/or 0.0013 ppmv outlet mercury, limiting carbon bed temperature below 167°F, hourly parametric monitoring pH range (6-8) and temperature range (≤167°F) for removal of SO_2 materials, minimum flow for caustics in wet scrubber, hourly parametric monitoring Emission testing and associated operational limitations (one time testing)
Morrisville PA WWTP (PADEP)* (Determination issued 3/4/2021)	Wastewater gasification (~1100 lb/hr biosolids processed)	PADEP R&D limits: 20 TPY CO 10 TPY NOx 8 TPY SOx (SO2) 3 TPY PM10 8 TPY VOC 1 TPY single HAP 2.5 TPY total HAPs (basis for exemption)	Parameter monitoring once every 4 hours of: (1) fan amperage, (2) pressure drop across scrubber (3) temperatures at dropout box, dryer inlet, scrubber inlet, oxidizer (4) scrubber exhaust air flowrate (5) liquid flowrate to scrubber (6) scrubber liquid pH Parameter monitoring daily of: (1) total sludge processed (2) amount of sludge fed to gasifier Stack testing requirement for informational purposes
Aries Linden (NJDEP) (issued 10/16/2020, expires 2024)	Wastewater gasification and oxidation (gasifier capacity is 85 ton/day)	99.5% VOC removal efficiency (SOTA) 95% NOx removal (SOTA) 96% SO2 removal (SOTA)	Cyclone for large particulate and ash removal Tri-mer emission control system consisting of dry sorbent injection, ammonia injection and ceramic filter with embedded SCR catalyst unit to remove PM, spent sorbent and NOx

		99% total suspended particulate removal (SOTA) 90% Cyclone particulate up to 5 micron removal	Cyclone pressure drop monitoring on DAS continuously Oxidizer continuous monitoring of temperature (1500°F minimum) Tri-mer control system continuous monitoring of ammonia slip, pressure drop, lime injection rate, ammonia injection rate Initial stack testing (VOC, NOx, SO2, TSP)

*The Morrisville PA WWTP review indicated a "Plan Approval" was not required on 3/4/2021 but did require that the facility meet with PADEP after 1 year of operation to prepare a plan approval for the process.

The three current applications under review with NJDEP for similar processes to the Linden plant (one modification to increase production of the Linden plant, one new plant proposed for Newark, and one new plant proposed for Kearny, each by the same company) have a similarly designed fluidized bed gasification system and tri-mer emission control system. The NJEDP proposed projects are summarized below for informational purposes though the projects are still under review:

- Aries Linden New Jersey (application for increase in production from 430 ton/day to 450 ton/day)
  - Fluidized bed gasifier using quartz sand as inert bed material produces a syngas of typically 120-150 Btu/scf and solid biochar. Proposed monitoring parameters: bed temperature profile, average temperature at feed level, pressure drop across bed, gasifier outlet pressure, has capacity of 85 ton/day
  - Gasifier routed to thermal oxidizer (99.5% DRE for VOC) which would measure outlet exhaust gas VOC concentration, combustion chamber temperature, CO2 concentration and CO concentration
  - Emissions controlled with cyclone to remove most large particulate and ash (90% DRE up to 5 micron particulate), Tri-mer Emissions Control System for NOx SOx and PM removal (95% NOx removal, 96% SOx removal, 99% DRE for PM)
  - CEMS for NOx, CO2, O2 and NH3 monitoring
  - Parameter monitoring (injection of ammonia and of sorbent, pressure drop)
  - One-time testing of NOx, SO2, PM, CO, CO2, also to include toxic metals arsenic, cadmium, HCl, nickel

- Aries Kearny (450 tons/day wet)
  - Same design as the Linden facility with the gasifier, thermal oxidizer and tri-mer emission control system for NOx, SO2 and PM removal

- Aries Newark New Jersey (proposed 430 tons/day wet)

- Same design as the Linden facility with the gasifier, thermal oxidizer and tri-mer emission control system for NOx, SO2 and PM removal

As discussed in Section B, 40 CFR 60 Subparts O and LLLL do not apply to this facility as the gasification unit does not meet the definition of a sewage sludge incinerator. While Subparts O and LLLL do not apply, the initial feedstock of sludge is common between an SSI unit and the proposed gasification system, and many of the same pollutants are anticipated from combustion of sewage sludge directly, as in an incinerator as the combustion of syngas. Due to the differing technology, the emissions from these two processes will likely have different emission factors as a result. The limits, testing and monitoring requirements of Subparts O and LLLL fluidized bed SSI are broadly summarized below for informational purposes only, they do not apply to the facility:

Subpart	Limits	Method of Compliance
O	1.30 lb/ton dry sludge PM limit 20% opacity limit	EPA Method 5 testing EPA Method 9 testing (one-time) Parameter monitoring specific to control device employed
LLLL	9.6 mg/dscm @ 7% O_2 PM limit (applies at all times during operation)	Method 5 performance test (initial and annual), reduced frequency to once per 3 yrs if results of two consecutive tests are 75% of emission limit or less)
	0.24 ppmv @ 7% O_2 HCl limit (applies at all times during operation)	Method 26A performance test (initial and annual, reduced frequency to once per 3 yrs if results of two consecutive tests are 75% of emission limit or less))
	27 ppmv @ 7% O_2 CO limit (applies at all times during operation)	CEMs meeting PS 4B
	0.013 ng/dscm @ 7% O_2 dioxin/furan limit (mass basis) or 0.0044 @ 7% O_2 ng/dscm (toxic equivalency basis) (applies at all times during operation)	Method 23 performance test (initial and annual, reduced frequency to once per 3 yrs if results of two consecutive tests are 75% of emission limit or less)
	30 ppmv @ 7% O_2 NOx limit (applies at all times during operation)	Method 7 or 7E performance test (initial and annual, reduced frequency to once per 3 yrs if results of two consecutive tests are 75% of emission limit or less))
	5.3 ppmv @ 7% O_2 SO_2 limit (applies at all times during operation)	Method 6 or 6C performance test (initial and annual, reduced frequency to once per 3 yrs if results of two consecutive tests are 75% of emission limit or less))
	0.0011 mg/dscm @ 7% O_2 Cd limit (applies at all times during operation)	Method 29 performance test (initial and annual, reduced frequency to once per 3 yrs if results of two consecutive tests are 75% of emission limit or less))

	0.0010 @ 7% O_2 mg/dscm mercury limit (applies at all times during operation)	Method 29 performance test (initial and annual, reduced frequency to once per 3 yrs if results of two consecutive tests are 75% of emission limit or less))
	0.00062 mg/dscm @ 7% O_2 lead limit (applies at all times during operation)	Method 29 performance test (initial and annual, reduced frequency to once per 3 yrs if results of two consecutive tests are 75% of emission limit or less))
	Operational limits for combustion chamber temperature, control device specific parameter monitoring, sludge feed rate	Operating limits established during initial performance testing/most recent performance test*: minimum pressure drop for wet scrubbers, scrubber liquid flow rate, scrubber pH, minimum combustion chamber operating temperature

*Selected control devices similar to those proposed for this application are listed from LLLL; list not exhaustive.

Analysis

The Silicon Valley Clean Water Plant permit and the Morrisville PA WWTP plants share some similarities with the proposed project: relative size of the operation, system design and the control technologies employed. NJDEP's Aries Linden review includes a State of the Art (SOTA) analysis, which, of the analyses completed is closest to PSCAA BACT analysis. The Aries Linden project is at a larger scale than the proposed Edmonds project (more than nine times the throughput of Edmonds) and utilizes different control technologies.

The Agency originally looked at each piece of equipment within the facility, but later realized the entire system is closed with only one exit point at the end of the process. This will make it easier to test for pollutants at one single stack.

NOx BACT
The NOx controls proposed across each of the facilities are ranked from most to least stringent. The control devices employed for projects voluntarily are also included given that the controls are technically feasible.

1. 95% removal (use of SCR)
2. Operational limits (limited throughput to keep NOx emissions below certain thresholds)

The applicant described available technologies for NOx control including flue gas recirculation and catalytic conversion. The applicant specified "Flue gas recirculation reduces NOx formation by suppressing combustion temperature. However, sufficient oxidizer temperature is needed to provide effective destruction of toxic organics in the syngas during oxidation." PSCAA concurs that flue gas recirculation would potentially decrease NOx emissions at the expense of potentially higher toxic air emissions from less effective destruction efficiency.

The applicant specified that "catalytic NOx reduction is economically unfeasible for a project of this size" but did not include any data to support this assertion. The NJDEP Linden facility utilizes a system including sorbent injection and a ceramic filter system with an SCR catalyst. The NJDEP Linden facility has an 85 ton sludge processing/day capacity in the gasifier with pre-control NOx emissions of 87.6 lb/hr. Linden's production corresponds to uncontrolled PTE of >300 ton/yr operating 8760 hours per year. In comparison, the Edmonds WWTP gasifier has design daily capacity of 9 ton sludge processed/day and pre-control NOx emissions calculated at 0.26 lb/hr (on CM mode) or 0.42 lb/hr (on Biochar mode) with NOx PTE annually below 2 tons/year for both modes of operation. Assuming a similar control efficiency to Linden (95%) the emission reduction associated with SCR for this project is expected to be about 1.9 tons of NOx per year while also introducing the potential for ammonia emissions associated the ammonia injection utilized for SCR. In this case, while an economic analysis is not presented, the additional environmental considerations associated with NOx reduction (including ammonia slip) and the magnitude of emission reduction support that BACT will be best management practices.

The applicant does discuss setting a maximum oxidizer temperature of 2500°F with the intention of limiting thermal NOx formation. The actual operating maximum temperature was reported to be around 2300°F but with capabilities up to 2500°F. Equilibrium constants for the formation of nitrogen oxide ($N_2 + O_2 \leftrightarrow 2NO$) increase from 2.7×10^{-18} at 440°F to 7.5×10^{-9} at 1340°F further increasing to 1.1×10^{-5} at 2240°F[1] (formation of NO is favored increasingly with temperature). Equilibrium constants for the formation of nitrogen dioxide ($NO + \frac{1}{2}O_2 \leftrightarrow NO_2$) favor nitrogen oxide formation over nitrogen dioxide formation as temperature increases above 1340°F[1]. The proposed upper limit of operation (2500°F) allows for complete combustion while minimizing NO formation.

Initial testing of NOx will be required for verification of emission factors utilized during permitting. Parametric monitoring of the oxidizer temperature will be used to demonstrate compliance with the oxidizer temperature limits associated with NOx BACT.

CO BACT

Across the different pyrolysis/gasification units permitted, CO emission limits were not set based on SOTA or BACT. CO emission limits were set based on the applicant's specification of CO emissions in the NJDEP permit.

The applicant does not explicitly discuss CO emission controls in the BACT discussion for the oxidizer flue gas at Edmonds although CO is discussed along with NO_x in the applicant's discussion of oxidizer operating temperature. The oxidizer minimum temperature of 1800°F is expected to allow for complete combustion needed to limit CO formation.

CO emission testing will be required for initial testing and parametric monitoring of the oxidizer temperature will be used to demonstrate compliance with the oxidizer temperature limits associated with CO BACT.

[1] Cooper, David C. and Alley, F.C. Air Pollution Control a Design Approach. 4th ed. Table 16.3 Equilibrium Constants for the Formation of NO and NO_2 (page 527).

VOC BACT

Across the three permitted gasification/pyrolysis units outlined above, VOC control is achieved consistently through efficient syngas combustion/oxidation, as is proposed with the Edmonds gasifier and oxidizer combined unit. In addition, the heat generated by the combustion of syngas in the proposed system is routed directly to the sludge rotary drum dryer. The NJDEP SOTA determination for VOC destruction efficiency was 99.5% control. The oxidizer for the proposed system does not include any manufacturer specifications for control efficiency.

For the Edmonds oxidizer, the applicant reported an operating range from 1800°F – 2500°F with a destruction efficiency of 99.5% or an alternate outlet concentration limit of 13.9 ppmvd @ 3% O_2 as methane will constitute BACT for both biochar and CM modes. The basis for the alternate limit is from available test data from pyrolysis and gasification units tabulated below:

Test, Location, Date	VOC emissions (as methane)	Process Info
Chicken Litter Gasification Unit, Morrisville PA, May 2011	7.5 ppmvd*, 0.0029 lb/hr Measured w/ EPA Method 25 Run 1: 7.0 Run 2: 8.1	Not provided
Pyrolysis Unit, Redwood City CA, October 2017	10 ppmvd @ 3% O_2 Measured w/ EPA Method 25A Run 1: 8 @ 3% O_2 Run 2: 9 @ 3% O_2 Run 3: 12 @ 3% O_2	219 lb/hr sludge processing

*Morrisville PA VOC test data did not include oxygen correction factor nor did the test data included specify the O_2 concentration during the May 2011 testing.

As the Morrisville PA VOC test data utilized Method 25 rather than Method 25A and did not include process info and oxygen correction, each of the three runs from the October 2017 Redwood City test were utilized to calculate a standard deviation and the alternate limit for VOC at the outlet consists of the average plus two standard deviations: 10.8 ppmvd @ 7% O_2. Annual testing to be conducted utilizing EPA Method 25A.

Additional VOC control is provided by the scrubber system (which will provide removal of soluble organics) and the GAC contactor.

SO_2 and Sulfur Compound BACT, HCl tBACT

The gasification of the sludge releases sulfur in multiple compounds which are combusted in the oxidizer to primarily SO_2 although residual sulfur compounds including: hydrogen sulfide, dimethyl disulfide, methyl mercaptan, dimethyl sulfide, carbon disulfide, and carbonyl disulfide could be present in the exhaust stream. As with the Silicon Valley Clean Water Plant and the Morrisville PA facility, a packed bed scrubber and GAC contactor is proposed for inorganic gas removal.

The emission limits and control efficiencies specified for SO_2 or sulfur compound removal in similar permits sometimes applied to different subcategories of sulfur containing compounds and were often in different formats. An estimated ranking from most to least stringent is listed below:

1. 99.7% H_2S removal (NOC 11579 RACT)
2. 96% SO_2 removal (NJDEP Linden SOTA)
3. 5.3 ppmv @ 7% O_2 (40 CFR 60 Subpart LLLL limit)
4. 0.11 lb/hr SO_2 (33 ppmv @ 3% O_2/ 25.6 ppmv @7% O_2) (BAAQMD production limit)
5. 8 TPY SO_2 (PADEP research exemption annual emission threshold)

The applicant does not discuss sulfur compound or SO_2 BACT in the application but proposes use of a wet scrubber utilizing bleach and caustic soda (with wastewater from the system reintroduced into the WWTP processing).

The NJDEP SOTA analysis for the Linden plant required a 96% removal of SO_2 with the tri-mer control system (includes dry sorbent injection) as compared to the applicant's proposed 95% removal of inorganic gas using the packed bed scrubber (95% SO_2 and H_2S removal based on maximum inlet concentrations of 50 ppmv H_2S and 4 lb/hr SO_2). The 99.7% H_2S RACT removal from NOC 11579 was primarily focused on odor control at a facility with exhaust gas stream consisting primarily of H_2S and is not considered a required removal efficiency as BACT for this project. The Silicon Valley Clean Water Plant packed bed scrubber is more similar in design and sizing to the proposed system at Edmonds although the SO_2 limit from BAAQMD was not set based on BACT but as a cumulative increase limit and the BAAQMD limit would not be appropriate for this project. Test results from the 2017 Silicon Valley Clean Water Plant results indicated that outlet SO_2 emissions were 1.3 ppm @ 3% O_2 (1.03 ppmv @7% O_2). For the proposed packed bed scrubber, the manufacturer's 95% control, maximum emissions at the outlet of the scrubber would be expected to be 0.2 lb/hr SO_2 (estimated to be about 10.8 ppm @ 7% O_2 based on the design flows specified in the application for the scrubber exhaust and an assumption of 3% O_2 in the exhaust downstream of the oxidizer and 4 MMBtu/hr exempt duct burner). At high loading 95% SO_2 control will constitute BACT, with an alternate limit of 5.3 ppmv @ 7% O_2 based on the 40 CFR 60 Subpart LLLL limit for sulfur removal from sewage sludge incineration for low loading.

Compliance with the emission limits to be demonstrated through annual compliance testing using EPA method 6C. SO_2 removal efficiency will be utilized as a proxy for removal of all sulfur compounds.

The caustic scrubber is also anticipated to control hydrochloric acid that may form from the combustion of syngas halogens when combusted in the oxidizer. The manufacturer specifications do not address HCl control, but a limit from NSPS LLL was used as a BACT limit and required testing was placed into the permit.

PM BACT

The proposed system is anticipated to generate particulate during the gasification of the syngas with particulate carried in the exhaust stream through the oxidizer, with potential for generation of more particulate when the hot exhaust gas is used to directly heat sludge in the rotary drum dryer. The combined exhaust stream of the dryer and the gasifier/oxidizer is proposed to be controlled with a venturi scrubber. Particulate collected from the venturi scrubber will be routed to a dust collector.

Particulate controls and limits for similar gasification/pyrolysis systems have some variable formats and ranking is estimated from most to least stringent as follows, depending on inlet loading).

1. 99% TSP removal (NJ Linden SOTA)
2. 9.6 mg/dscm @ 7% O_2 (40 CFR 60 Subpart LLLL)
3. 0.02 lb/hr (BAAQMD production limit)
4. 3 tpy PM_{10} (PADEP research exemption threshold)
5. 1.3 lb/ton dry sludge (40 CFR 60 Subpart O)
6. 20% opacity (40 CFR 60 Subpart O)

For particulate, the Ecoremedy Morrisville facility processing chicken litter can provide an expectation of inlet loading for the proposed Edmonds facility. While the feedstock differs from the sludge under review for Edmonds, the design of the system where the feedstock is itself the transfer media for the fluidized bed is anticipated to be lower in particulate generation as compared to a traditional fluidized bed gasification system. The chicken litter facility is considered as the most representative particulate data for the proposed facility. The May 2011 Morrisville testing for PM found inlet particulate loading to be 1.95 lb/hr total (1,378 mg/dscm with unspecified dilution air). Anticipating similar inlet loading and the manufacturer's guaranteed 99% PM removal efficiency from the venturi scrubber would yield 13.78 mg/dscm at the anticipated O_2 dilution in the system.

The proposed system is closed between the oxidizer and the stack; no air is admitted to the system and all side streams (such as flue gas recirculation and dust pick-up streams) reconnect with the oxidizer flue gas. Thus, there is no oxygen dilution downstream of the oxidizer; and on a dry basis the oxygen content in the dryer exhaust is the same as the oxygen content in the flue gas from the oxidizer. The oxygen content of the oxidizer exhaust is proposed by the applicant to be about 13% on a dry basis, demonstrating that the oxidizer operates under significant lean-burn conditions. Note that the elevated levels of excess oxygen aid in providing complete combustion of the syngas.

The applicant proposes use of 99% PM removal efficiency from the venturi scrubber which is consistent with the 99% TSP removal found to the SOTA for NJ Linden. 99% PM removal will constitute BACT for PM generated from the dryer and the gasifier/oxidizer. An alternate limit for low loading of 9.6 mg/dscm @ 7% O_2 based on the limits of 40 CFR 60 Subpart LLLL for combustion of sewage sludge is also specified for BACT. Compliance with this limit will be using EPA method 5 instead of PSCAA method 5 since the 9.6 mg/dscm was taken from NSPS LLLL which calls for using EPA Method 5.

The sludge handling system (3,000 acfm) dust collector proposed would meet a grain loading of 0.01 gr/dscf which is higher than typically seen for material handling where there may be metallic TAP present. Similar permits issued for material handling for cement and spent abrasive blast media have been required to meet a grain loading of 0.002 gr/dscf and this grain loading is considered BACT in this case, to be demonstrated through manufacturer specifications or equivalent.

Metallic TAPs tBACT

The gasification of the sewage sludge is anticipated to occur at high enough temperature to volatilize some metals present in the sludge such that the syngas being combusted in the oxidizer may contain metals. Design temperature of exhaust from the oxidizer will typically range from 1,930°F-1,969°F (actual operating temperatures may be somewhat higher or lower) dropping to 180°F-230°F between the dryer and the and the venturi scrubber. The drop in temperature is anticipated to condense many of the metals present in the oxidized syngas for removal as particulate as discussed in the PM BACT section. As discussed in the application, during gasification, temperatures will exceed the sublimation or boiling points of arsenic, cadmium, and mercury, but once the exhaust air is routed to the venturi scrubber the exhaust temperature will be below the boiling points of arsenic (1,135°F), cadmium (1,412°F) and mercury (675°F). Thus the metal vapors will condense and may be collected as particulate from the venturi scrubber. Conditions will be added to the permit that ensure proper abatement of metals based on inlet gas temperatures.

In addition to the particulate removal from the venturi discussed in the PM BACT section, the system also includes an activated carbon adsorption bed intended to capture additional compounds including metals which may not be controlled by the venturi and packed-bed scrubbers. Similar technologies are utilized at Silicon Valley Clean Water Plant where the carbon system is monitored for mercury break-through to achieve an outlet mercury concentration at or below 0.0013 ppmv. The Silicon Valley Clean Water Plant permit also limits carbon bed temperature to at or below 167°F.

40 CFR 60 Subpart LLLL imposes limits on and requires testing for certain metallic toxics: lead, mercury, and cadmium utilizing EPA Method 29. Given the similar feedstocks and expectation of metals present in the exhaust system, initial and ongoing metals testing will be required to show compliance with our local TAP regulations along with tBACT. Due to the nature of the emerging technology, an initial performance test will be required to determine the presence and amount of TAPs and other criteria pollutants.

Volatile TAPs tBACT

Among the volatile and organic toxics anticipated to be generated in the gasification process are dioxins and furans, PCBs and PAHs which are expected to thermally decompose in the oxidizer, with the carbon adsorption bed as a secondary control for volatile TAPs that are not destroyed in the oxidizer. Testing for VOC destruction efficiency using Method 25A does provide the ability to determine destruction efficiency of specific compounds; however doing a method 25A on the gasifier and associated afterburner would be difficult as it is part of an entire process and does not directly vent to the atmosphere. Given the toxicity of dioxins and furans, and the basis of ongoing testing of dioxins and furans at SSI combustion facilities per 40 CFR 60 Subpart LLLL, The permittee will be required to test for dioxins and furans as part of the original testing. The testing limits will be compared to emission factors used during original permitting to ensure they were accurate. tBACT for these pollutants will be the use of the carbon adsorption bed.

<u>Recommendations</u>

Due to the emerging technology of the gasifier, and the way the system is set up with multiple control devices being used before finally being emitted to the atmosphere, BACT and tBACT will be a summary of control devices and monitoring. The permittee will be required to conduct an initial performance test where the results will be used to set emission limitations for pollutants and compare the results to emission factors used during this permitting action. There will be some restrictions on the amount of TAPs that can be emitted which will have to be set prior to permit issuance to protect the toxics program (SQERs/ASILs/etc).

Summary tBACT determination

Pollutant	Available Method That Meets BACT	Implementation of Method
Mercury	Venturi scrubber and carbon adsorption bed Compliance with initial performance test limit	Mercury break-through monitoring of carbon adsorption bed, Testing per EPA Method 29 or Method 30B,
Lead and Cadmium	Venturi scrubber and carbon adsorption bed: Compliance with initial performance test limit	Testing per EPA Method 29,
Dioxins, Furans	Compliance with initial performance test limit in ng/dscm	Oxidizer and activated carbon, testing per EPA Method 23,
HCl	Compliance with initial performance test limit	Packed bed scrubber, testing per EPA Method 26A, initial and annual testing with reduced frequency if emissions at or below 75% of emission limit

Summary BACT determination

Pollutant	Available Method That Meets BACT	Implementation of Method
NO_x	Good combustion practices, oxidizer temperature not to exceed 2500°F Compliance with initial performance test limit	Parameter monitoring Method 7E
SO_2	Packed bed Scrubber Compliance with initial performance test limit	Method 6C

Pollutant	Available Method That Meets BACT	Implementation of Method
		Continuous monitoring of packed bed scrubber parameters
CO	Good combustion practices, minimum oxidizer temperature of 1800°F Compliance with initial performance test limit	Parameter monitoring Method 10
Total VOCs	Compliance with initial performance test limit	EPA Test Method 25 or 25A EPA Test Method 18 to quantify exempt compounds.
PM	Compliance with initial performance test limit	EPA Test Method 5, Method 26A or Method 29

G. EMISSION ESTIMATES

Proposed Project Emissions

Emission units associated with the project include the gasifier/oxidizer, the drum dryer, and materials handling of dried product.

Emissions from this project are based on a maximum dewatered sludge feed rate of 768 lb/hr as dry solids for biochar production, and a maximum sludge and screenings mixture feed rate when operating

in concentrated mineral mode of 864 lb/hr (screenings feed adding 96 lb/hr as dry solids to the dewatered sludge feed rate) (see page 8 of application 12135 for full project details).

The applicant supplied emission calculations that were analyzed and verified by the Agency during this review. Table 1 provides emissions calculations for the biochar production scenario. Table 2 provides similar information for the concentrated minerals operating mode. Information in these tables includes basic operating data, development of emission factors, and emissions calculations. The format of both tables is identical; the only differences are changes in operating rates associated with each mode.

Parameter	Value	Units	Comments/Basis
Sytem Operating Parameters			
dewatered sludge feed	768	lb dry solids/hr	
dewatered screenings feed	0	lb dry solids/hr	
Total dry solids feed	768	lb dry solids/hr	
dryer operating rate	3,197	lb dry solids/hr	
Gasifier exhaust			
temperature	1993	° F	
moisture content	10.3%	weight percent	
	16.4%	volume percent	
gasifier flue gas rate, actual	6,974	wacfm	
Flue gas rate, standard wet	1500	wscfm	
Flue gas rate, standard dry	1,254	dscfm	
West Scrubber exhaust			
temperature	114	°F	
flow rate, actual	2,552	acfm	
Flow rate, standard	2,347	wscfm	
Exhaust stack			
flow rate, actual	7,122	acfm	
Flow rate, standard	5,740	wscfm	
stack temp	195	°F	
moisture content			
Stack diameter	1.67	feet	assumed - sized to attain ~ 50 fps stack gas velocity at standard conditions
stack velocity	54	fps	
Combustion gases			
CO			
Concentration	93	ppmvw	after wet scrubber
	6.76	lb/MMwscf	
Emission Rate	0.95	lb/hr	
NOx concentration actual			
Concentration	25	ppmvw	after wet scrubber
	2.99	lb/MMscf	
Emission Rate	0.42	lb/hr	
NO2			
Emission Rate	0.21	lb/hr	In-stack NO2:NOx ratio = 0.5 (EPA default)
VOC			
Concentration – gasifier exhaust	7.42	ppmvd	NMTHC as methane

PUGET SOUND
Clean Air Agency

Parameter	Value	Units	Comments/Basis
Concentration - gasifier exhaust	0.31	lb/MMscf as methane	
VOC emission rate	0.03	lb/hr	.
Process Emissions			
PM/PM10/PM2.5			
Gasifier PM			Based on results of PM measurements from stack testing of similar gasification/oxidation unit using chicken litter. PM data normalized to gasifier output in dscfm. Assume all PM is PM2.5
chicken litter gasifier PM			
air flow during stack test	387	lb/hr	average for five runs across two feed conditions
PM emission rate	1.95	lb/hr	average for five runs across two feed conditions
	83.95	lb/MMdscf	
Gasifier PM - biochar mode			
gasifier PM, bichar mode	6.32	lb PM/hr	
Dryer PM			
Emission factor	5.8	lb PM10/ton dry solids	
Dryer sludge feed rate - BC	3197	lb dry solids/hr	Process Flow Diagram (G-7) 10 Feb 2021
Dryer PM	9.27	lb PM/hr	uncontrolled emissions
Gasifier + Dryer PM			
Uncontrolled PM emissions	15.59	lb PM/hr	
Control efficiency	99%		
PM emissions, gasifier + dryer	0.156	lb/hr	controlled emissions. Measured downstream of packed bed scrubber.
Dust System PM			
Air flow rate	3000	acfm	
Temperature	120	°F	
Baghouse performance	0.01	gr/dscf	controlled emissions.
PM emission dust system	0.23	lb/hr	
Total controlled PM emissions	0.39		
SO2			
Concentration	0.5	ppmvw	controlled emissions. Measured downstream of packed bed scrubber.
	0.08	lb/MMscf	
Emission Rate	0.03	lb/hr	
DXF (mass)			
Emission Factor	5.27E-11	lb/ton dry solids	Based on source tesing of similar pyrolysis unit.
Emission Rate	2.02E-11	lb/hr	calculation based on total solids loading to carbon recovery process
PCB			
Emission Factor	1.05E-09	lb/ton dry solids	Based on source tesing of similar pyrolysis unit.

Parameter	Value	Units	Comments/Basis
Emission Rate	4.03E-10	lb/hr	
Total PCDD/PCDF			
Emission Factor	<5.3E-11	lb/ton dry solids	Based on source tesing of similar pyrolysis unit.
Emission Rate	2.02E-11	lb/hr	
HCl			
Emission Factor	6.39E-04	lb/ton dry solids	Based on source tesing of similar pyrolysis unit.
Emission Rate	2.45E-04	lb/hr	
HF			
Emission Factor	7.31E-04	lb/ton dry solids	Based on source tesing of similar pyrolysis unit.
Emission Rate	2.81E-04	lb/hr	
Arsenic			
Emission Factor	2.90E-05	lb/ton dry solids	Based on source tesing of similar pyrolysis unit. Emission factor adjusted based on differences in As content in sludge cake.
Emission Rate	1.11E-05	lb/hr	
Cadmium			
Emission Factor	6.33E-08	lb/ton dry solids	Based on source tesing of similar pyrolysis unit. Emission factor adjusted based on differences in Cd content in sludge cake.
Emission Rate	2.43E-08	lb/hr	
Chromium			
Emission Factor	1.18E-06	lb/ton dry solids	Based on source tesing of similar pyrolysis unit. Emission factor adjusted based on differences in Cr content in sludge cake.
Emission Rate	4.54E-07	lb/hr	
Chromium VI)			
Emission Factor	7.50E-07	lb/ton dry solids	Based on source tesing of similar pyrolysis unit. Emission factor adjusted based on differences in Cr content in sludge cake.
Emission Rate	2.88E-07	lb/hr	
Lead			
Emission Factor	4.41E-06	lb/ton dry solids	Based on source tesing of similar pyrolysis unit. Emission factor adjusted based on differences in Pb content in sludge cake.
Emission Rate	1.69E-06	lb/hr	
Manganese			
Emission Factor	5.42E-06	lb/ton dry solids	Based on source testing of similar pyrolysis unit.
Emission Rate	2.08E-06	lb/hr	
Mercury			
Emission Factor	9.54E-06	lb/ton dry solids	Based on source tesing of similar pyrolysis unit. Emission factor adjusted based on differences in Hg content in sludge cake.
Emission Rate	3.66E-06	lb/hr	

Parameter	Value	Units	Comments/Basis
Nickel			
Emission Factor	5.65E-07	lb/ton dry solids	Based on source tesing of similar pyrolysis unit. Emission factor adjusted based on differences in Ni content in sludge cake.
Emission Rate	2.17E-07	lb/hr	
Vanadium			
Emission Factor	1.12E-06	lb/ton dry solids	Based on source tesing of similar pyrolysis unit. Emission factor adjusted based on differences in V content in sludge cake.
Emission Rate	4.29E-07	lb/hr	

The tables below are presented for Concentrated Minerals scenario:

Parameter	Value	Units	Comments/Basis
Sytem Operating Parameters			
dewatered sludge feed	768	lb dry solids/hr	
dewatered screenings feed	96	lb dry solids/hr	
Total dry solids feed	864	lb dry solids/hr	
dryer operating rate	2,911	lb dry solids/hr	
Gasifier exhaust			
temperature	1993	° F	
moisture content	10.3%	weight percent	
	16.4%	volume percent	
gasifier flue gas rate, actual	11,248	wacfm	
Flue gas rate, standard wet	2420	wscfm	
Flue gas rate, standard dry	2,023	dscfm	
West Scrubber exhaust			
temperature	120	°F	
flow rate, actual	1,572	acfm	
Flow rate, standard	1,431	wscfm	
Exhaust stack			
flow rate, actual	8,666	acfm	
Flow rate, standard	5,094	wscfm	
stack temp	438	°F	
moisture content			
Stack diameter	1.67	feet	assumed - sized to attain ~ 50 fps stack gas velocity at standard conditions
stack velocity	66.2	fps	
Combustion gases			
CO			
Concentration	93	ppmvw	after wet scrubber
	6.76	lb/MMwscf	
Emission Rate	0.58	lb/hr	
NOx concentration actual			
Concentration	25	ppmvw	after wet scrubber
	2.99	lb/MMscf	
Emission Rate	0.26	lb/hr	
NO2			
Emission Rate	0.13	lb/hr	In-stack NO2:NOx ratio = 0.5 (EPA default)
VOC			
Concentration - gasifier exhaust	7.42	ppmvd	NMTHC as methane

Parameter	Value	Units	Comments/Basis
Concentration - gasifier exhaust	0.31	lb/MMscf as methane	
VOC emission rate	0.04	lb/hr	.
Process Emissions			
PM/PM10/PM2.5			
Gasifier PM			Based on results of PM measurements from stack testing of similar gasification/oxidation unit using chicken litter. PM data normalized to gasifier output in dscfm. Assume all PM is PM2.5
chicken litter gasifier PM			
air flow during stack test	387	lb/hr	average for five runs across two feed conditions
PM emission rate	1.95	lb/hr	average for five runs across two feed conditions
	83.95	lb/MMdscf	
Gasifier PM - CM mode			
gasifier PM, CM mode	10.19	lb PM/hr	
Dryer PM			
Emission factor	5.8	lb PM10/ton dry solids	
Dryer sludge feed rate - BC	2911	lb dry solids/hr	Process Flow Diagram (G-7) 10 Feb 2021
Dryer PM	8.44	lb PM/hr	uncontrolled emissions
Gasifier + Dryer PM			
Uncontrolled PM emissions	18.63	lb PM/hr	
Control efficiency	99%		
PM emissions, gasifier + dryer	0.186	lb/hr	controlled emissions. Measured downstream of packed bed scrubber.
Dust System PM			
Air flow rate	3000	acfm	
Temperature	120	°F	
Baghouse performance	0.01	gr/dscf	controlled emissions.
PM emission dust system	0.23	lb/hr	
Total controlled PM emissions	0.42		
SO2			
Concentration	0.5	ppmvw	controlled emissions. Measured downstream of packed bed scrubber.
	0.08	lb/MMscf	
Emission Rate	0.03	lb/hr	
DXF (mass)			
Emission Factor	5.27E-11	lb/ton dry solids	Based on source tesing of similar pyrolysis unit.
Emission Rate	2.28E-11	lb/hr	calculation based on total solids loading to carbon recovery process
PCB			
Emission Factor	1.05E-09	lb/ton dry solids	Based on source tesing of similar pyrolysis unit.

Parameter	Value	Units	Comments/Basis
Emission Rate	4.54E-10	lb/hr	
Total PCDD/PCDF			
Emission Factor	<5.3E-11	lb/ton dry solids	Based on source tesing of similar pyrolysis unit.
Emission Rate	2.28E-11	lb/hr	
HCl			
Emission Factor	6.39E-04	lb/ton dry solids	Based on source tesing of similar pyrolysis unit.
Emission Rate	2.76E-04	lb/hr	
HF			
Emission Factor	7.31E-04	lb/ton dry solids	Based on source tesing of similar pyrolysis unit.
Emission Rate	3.16E-04	lb/hr	
Arsenic			
Emission Factor	2.98E-05	lb/ton dry solids	Based on source tesing of similar pyrolysis unit. Emission factor adjusted based on differences in As content in sludge cake.
Emission Rate	1.29E-05	lb/hr	
Cadmium			
Emission Factor	6.33E-08	lb/ton dry solids	Based on source tesing of similar pyrolysis unit. Emission factor adjusted based on differences in Cd content in sludge cake.
Emission Rate	2.73E-08	lb/hr	
Chromium			
Emission Factor	1.26E-06	lb/ton dry solids	Based on source tesing of similar pyrolysis unit. Emission factor adjusted based on differences in Cr content in sludge cake.
Emission Rate	5.42E-07	lb/hr	
Chromium VI)			
Emission Factor	7.96E-07	lb/ton dry solids	Based on source tesing of similar pyrolysis unit. Emission factor adjusted based on differences in Cr content in sludge cake.
Emission Rate	3.44E-07	lb/hr	
Lead			
Emission Factor	4.87E-06	lb/ton dry solids	Based on source tesing of similar pyrolysis unit. Emission factor adjusted based on differences in Pb content in sludge cake.
Emission Rate	2.10E-06	lb/hr	
Manganese			
Emission Factor	5.42E-06	lb/ton dry solids	Based on source testing of similar pyrolysis unit.
Emission Rate	2.34E-06	lb/hr	
Mercury			
Emission Factor	9.54E-06	lb/ton dry solids	Based on source tesing of similar pyrolysis unit. Emission factor adjusted based on differences in Hg content in sludge cake.
Emission Rate	4.12E-06	lb/hr	

Parameter	Value	Units	Comments/Basis
Nickel			
Emission Factor	6.10E-07	lb/ton dry solids	Based on source tesing of similar pyrolysis unit. Emission factor adjusted based on differences in Ni content in sludge cake.
Emission Rate	2.63E-07	lb/hr	
Vanadium			
Emission Factor	2.44E-06	lb/ton dry solids	Based on source tesing of similar pyrolysis unit. Emission factor adjusted based on differences in V content in sludge cake.
Emission Rate	1.05E-06	lb/hr	

The project emission summary total for criteria pollutants is outlined below:

Pollutant	Biochar		Emissions Summary Concentrated Mineral		Maximum Emissions		Comparison with Exemption Thresholds	
	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	Threshold, tpy	Percent of Threshold
PM2.5	0.39	1.71	0.39	1.71	0.39	1.71	0.5	342%
PM10	0.39	1.71	0.39	1.71	0.39	1.71	0.8	228%
Nitrogen Oxides	0.42	1.84	0.26	1.12	0.42	1.84	2.0	92%
Sulfur Dioxide	0.03	0.13	0.03	0.11	0.03	0.13	2.0	6%
Carbon Monoxide	0.95	4.17	0.58	2.54	0.95	4.17	5.0	83%
Volatile Organics	0.03	0.12	0.04	0.20	0.04	0.20	2.0	10%
Lead	1.69E-06	7.42E-06	2.10E-06	9.21E-06	2.10E-06	9.21E-06	5.00E-03	0%

Note: The emission limits were compared to WAC 173-400-110(5) which the Agency does not use for exemption thresholds, and was only presented here for informational purposes.

Toxic Air Pollution emissions are presented below and discussed in more detail in the toxics review section below:

Project Toxic Air Pollutant Emissions

Toxic Air Pollutant	CAS #	SQER Averaging Period	SQER, lb/averaging period	De Minimis (lb/averaging period)	Toxic Air Pollutant Emissions Summary* lb/hr	lb/day	lb/yr	lb/Averaging Period	% of SQER
Arsenic & Inorganic Arsenic Compounds	---	year	0.0581	0.00291	1.29E-05	3.09E-04	1.13E-01	1.13E-01	194%
Cadmium & Compounds	7440-43-9	year	0.0457	0.00228	2.73E-08	6.56E-07	2.39E-04	2.39E-04	1%
Chromium(III), insoluble particulates, NOS¥	---	24-hr	0.370	0.019	1.98E-07	4.76E-06	1.74E-03	4.76E-06	0%
Chromium(VI)¥	18540-29-9	year	0.00128	0.000064	3.44E-07	8.26E-06	3.01E-03	3.01E-03	235%
Lead and compounds (NOS)	——	year	16	10	2.10E-06	5.05E-05	1.84E-02	1.84E-02	0%
Manganese & Compounds	---	24-hr	0.00526	0.000263	2.34E-06	5.62E-05	2.05E-02	5.62E-05	1%
Mercury, Elemental	7439-97-6	24-hr	0.0118	0.000591	4.12E-06	9.89E-05	3.61E-02	9.89E-05	1%
Nitrogen dioxide†	10102-44-0	1-hr	1.03	0.457	2.28E-11	5.46E-10	1.99E-07	2.28E-11	0%
Polychlorinated Biphenyls, NOS	1336-36-3	year	0.336	0.0168	4.54E-10	1.09E-08	3.97E-06	3.97E-06	0%
2,3,7,8-Tetrachlorodibenzo-p-dioxin & Related Compounds, NOS	---	year	5.05E-06	2.52E-07	2.28E-11	5.46E-10	1.99E-07	1.99E-07	<4%
Vanadium	7440-62-2	24-hr	0.0263	0.00131	1.05E-06	2.53E-05	9.22E-03	2.53E-05	0%
Hydrogen chloride	7647-01-0	24-hr	1.18	0.0591	2.76E-04	6.63E-03	2.42E+00	6.63E-03	1%
Hydrogen Fluoride	7664-39-3	24-hr	1.84	0.092	3.16E-04	7.57E-03	2.76E+00	7.57E-03	0%
Sulfur dioxide‡	7446-09-05	1-hr	1.45	0.457	2.86E-02	6.87E-01	2.51E+02	2.86E-02	2%

Notes:
*Maximum emissions occur in concentrated mineral mode.
¥ All chromium that is not chromium(VI) assumed to be chromium(III).
† assume 50% of NOx (default EPA in-stack NO2:NOx ratio)
‡ Same as criteria pollutant emissions

A copy of the emission calculations spreadsheet submitted by the applicant can be found here:

120902.44 CRP NOC
Applications calcs - Dr

H. OPERATING PERMIT OR PSD

The Title V Air Operating Permit (AOP) program applicability for the entire source has been reviewed.

The facility is not a Title V air operating permit source because post project PTE remains below Title V applicability thresholds and criteria. The source is considered a "natural minor". The facility was previously a Title V facility due to presence of a sewage sludge incinerator on-site (subject to 40 CFR 62, Subpart LLL (see 40 CFR § 62.16035)). On-site inspection has confirmed removal of the SSI unit.

I. AMBIENT TOXICS IMPACT ANALYSIS

The estimated potential toxic air pollutant (TAP) emissions at 100% rated capacity and 8760 hour per year for each new or modified emission unit (*or based on limit in permit*). The table below includes estimated potential emissions of all TAP and compares those to the Small Quantity Emission Rates (SQER) in WAC 173-460-150.

Emission offsets may be considered during First Tier review per WAC 173-460-080(3). "The reductions in TAP emissions authorized by this subsection must be included in the approval order as enforceable emission limits and must meet all the requirements of WAC 173-460-071 [public comment requirements]"

The September 2010 WA Department of Ecology Guidance Document for First, Second and Third Tier Review of Toxic Air Pollution Sources specifies that the emission reductions must be actual reductions, the reductions must be modeled against all affected receptors and when the emission increase and reductions are modeled together at the receptor the modeling must demonstrate that the off-set proposal results in emission values lower than the ASIL.

Arsenic and hexavalent chromium emissions from the project exceeded the SQER even when using offset values from the existing equipment (SSI) being removed with this project. See Table 6 of the permit application for those initial offset emission values.

Arsenic and hexavalent chromium emissions were calculated based on source testing of a similar pyrolysis unit done in Redwood City, CA from October 2-6, 2017. The emission factors used for this emission calculations of Chromium and Arsenic will be placed into the permit for verification since they were above the SQER and relied upon emissions data from another pyrolysis unit. Cr(VI) emissions were based on 10% of the total Chrome emissions, this conversion was based on the chrome speciation measurements in the sewage sludge incinerator exhausts found in the document titled: "Emissions of Metals, Chromium and Nickel Species, and Organics from Municipal Wastewater Sludge Incinerators. Project Summary", EPA/600/SR-92/003. May 1992. DeWees, William G., Robin R. Segall, Laurie Cone, and F. Michael Lewis.

Modeling was conducted by the source using AERMOD version 21112 and was done subtracting the offset values from the emissions (presented in Table 6 of the application). The results were verified for accuracy and the parameters used were verified as most representative. These files are available for download with the agency by request.

Project Toxic Air Pollutant Emissions

Toxic Air Pollutant	CAS #	SQER Averaging Period	SQER, lb/averaging period	De Minimis (lb/averaging period)	Toxic Air Pollutant Emissions Summary* lb/hr	lb/day	lb/yr	lb/Averaging Period	% of SQER
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Chromium(VI)¥	18540-29-9	year	0.00128	0.000064	3.44E-07	8.26E-06	3.01E-03	3.01E-03	235%
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Mercury, Elemental	7439-97-6	24-hr	0.0118	0.000591	4.12E-06	9.89E-05	3.61E-02	9.89E-05	1%
Nitrogen dioxide†	10102-44-0	1-hr	1.03	0.457	2.28E-11	5.46E-10	1.99E-07	2.28E-11	0%
Polychlorinated Biphenyls, NOS	1336-36-3	year	0.336	0.0168	4.54E-10	1.09E-08	3.97E-06	3.97E-06	0%
2,3,7,8-Tetrachlorodibenzo-p-dioxin & Related Compounds, NOS	---	year	5.05E-06	2.52E-07	2.28E-11	5.46E-10	1.99E-07	1.99E-07	<4%
Vanadium	7440-62-2	24-hr	0.0263	0.00131	1.05E-06	2.53E-05	9.22E-03	2.53E-05	0%
Hydrogen chloride	7647-01-0	24-hr	1.18	0.0591	2.76E-04	6.63E-03	2.42E+00	6.63E-03	1%
Hydrogen Fluoride	7664-39-3	24-hr	1.84	0.092	3.16E-04	7.57E-03	2.76E+00	7.57E-03	0%
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Notes:
*Maximum emissions occur in concentrated mineral mode.
¥ All chromium that is not chromium(VI) assumed to be chromium(III).
† assume 50% of NOx (default EPA in-stack NO2:NOx ratio)
‡ Same as criteria pollutant emissions

Modeling parameters:

Table F-1
Emission Source Parameters

Source Description	Stack ID	Stack Release Type	UTM Easting (m)	UTM Northing (m)	Base Elevation (m)	Stack Height (ft)	Temperature (°F)	Exit Velocity (fps)	Stack Diameter (ft)
Carbon Recovery Project – Biochar Mode	GOX_BC	DEFAULT	546210.2	5295212	5.54	20	195	54.4	1.67
Carbon Recovery Project – Biochar Mode	GOX_CM	DEFAULT	546210.2	5295212	5.54	20	438	66.2	1.67
Existing Sewage Sludge Incinerator	SSI	DEFAULT	546210.2	5295212	5.54	20	90	24.0	1.58

Table F-2
Stack Emission Rates for Arsenic and Cr(VI)

Air Pollutant	Stack Emission Rates, lb/hr GOX_BC	GOX_CM	SSI
Arsenic	1.11E-05	1.29E-05	-1.88E-05
Cr(VI)	2.88E-07	3.44E-07	-2.67E-07

Table F-4
Comparison of Modeled Impact for Arsenic and CR(VI) with ASILs

Air Pollutant	Averaging Time	ASIL µg/m³	Modeled Impact µg/m³	Modeled Impact % of Threshold
Arsenic	Annual	3.03E-04‡	0.00	0%
Cr(VI)	Annual	6.67E-06‡	0.00	0%

Notes:
* Cause or Contribute Threshold Value (WAC 173-400-113, Table 4a) for criteria air pollutants.
† US EPA Significant Impact Level for 1-hour NO2
‡ Acceptable Source Impact Level" (WAC 173-460)

ASILs were found to be below the thresholds found in WAC 173-460. No further analysis was conducted. As can be seen in the table above, modeled impacts are 0.00 due to the fact that offset modeling values were used from taking the SSI offline which is allowed under the Toxics review regulation.

J. APPLICABLE RULES & REGULATIONS

Puget Sound Clean Air Agency Regulations

SECTION 5.05 (c): The owner or operator of a registered source shall develop and implement an operation and maintenance plan to ensure continuous compliance with Regulations I, II, and III. A copy of the plan shall be filed with the Control Officer upon request. The plan shall reflect good industrial practice and shall include, but not be limited to, the following:
(1) Periodic inspection of all equipment and control equipment;
(2) Monitoring and recording of equipment and control equipment performance;
(3) Prompt repair of any defective equipment or control equipment;
(4) Procedures for startup, shut down, and normal operation;
(5) The control measures to be employed to ensure compliance with Section 9.15 of this regulation; and
(6) A record of all actions required by the plan.
The plan shall be reviewed by the source owner or operator at least annually and updated to reflect any changes in good industrial practice.

SECTION 6.09: Within 30 days of completion of the installation or modification of a stationary source subject to the provisions of Article 6 of this regulation, the owner or operator or applicant shall file a Notice of Completion with the Agency. Each Notice of Completion shall be submitted on a form provided by the Agency, and shall specify the date upon which operation of the stationary source has commenced or will commence.

SECTION 9.03: (a) It shall be unlawful for any person to cause or allow the emission of any air contaminant for a period or periods aggregating more than 3 minutes in any 1 hour, which is:
(1) Darker in shade than that designated as No. 1 (20% density) on the Ringelmann Chart, as published by the United States Bureau of Mines; or
(2) Of such opacity as to obscure an observer's view to a degree equal to or greater than does smoke described in Section 9.03(a)(1).

(b) The density or opacity of an air contaminant shall be measured at the point of its emission, except when the point of emission cannot be readily observed, it may be measured at an observable point of the plume nearest the point of emission.
(c) This section shall not apply when the presence of uncombined water is the only reason for the failure of the emission to meet the requirements of this section.

SECTION 9.07: Sulfur Dioxide Emission Standard. It shall be unlawful for any person to cause or allow the emission of sulfur dioxide from any source in excess of 1,000 parts per million by volume on a dry basis, 1- hour average (corrected to 7% oxygen for fuel burning equipment and refuse burning equipment).

SECTION 9.09: General Particulate Matter (PM) Standard. It shall be unlawful for any person to cause or allow the emission of particulate matter in excess of the following concentrations:
Refuse Burning Equipment: Rated at 12 tons per day or less with heat recovery 0.02 gr/dscf @7% O_2

SECTION 9.10: Emission of Hydrochloric Acid. (a) It shall be unlawful for any person to cause or allow the emission of hydrochloric acid from any equipment in excess of 100 ppm on a dry basis, 1-hour average corrected to 7% oxygen for combustion sources.

SECTION 9.11: It shall be unlawful for any person to cause or allow the emission of any air contaminant in sufficient quantities and of such characteristics and duration as is, or is likely to be, injurious to human health, plant or animal life, or property, or which unreasonably interferes with enjoyment of life and property.

SECTION 9.13: It shall be unlawful for any person to cause or allow the installation or use of any device or use of any means designed to mask the emission of an air contaminant which causes detriment to health, safety or welfare of any person.

SECTION 9.15: It shall be unlawful for any person to cause or allow visible emissions of fugitive dust unless reasonable precautions are employed to minimize the emissions. Reasonable precautions include, but are not limited to, the following:
(1) The use of control equipment, enclosures, and wet (or chemical) suppression techniques, as practical, and curtailment during high winds;
(2) Surfacing roadways and parking areas with asphalt, concrete, or gravel;
(3) Treating temporary, low-traffic areas (e.g., construction sites) with water or chemical stabilizers, reducing vehicle speeds, constructing pavement or rip rap exit aprons, and cleaning vehicle undercarriages before they exit to prevent the track-out of mud or dirt onto paved public roadways; or
(4) Covering or wetting truck loads or allowing adequate freeboard to prevent the escape of dust-bearing materials.

REGULATION I, SECTION 9.20(a): It shall be unlawful for any person to cause or allow the operation of any features, machines or devices constituting parts of or called for by plans, specifications, or other information submitted pursuant to Article 6 of Regulation I unless such features, machines or devices are maintained in good working order.

Washington State Administrative Code

WAC 173-400-040(3): Fallout. No person shall cause or allow the emission of particulate matter from any source to be deposited beyond the property under direct control of the owner or operator of the source in sufficient quantity to interfere unreasonably with the use and enjoyment of the property upon which the material is deposited.

WAC 173-400-040(4): Fugitive emissions. The owner or operator of any emissions unit engaging in materials handling, construction, demolition or other operation which is a source of fugitive emission:

(a) If located in an attainment area and not impacting any nonattainment area, shall take reasonable precautions to prevent the release of air contaminants from the operation.

WAC173-400-111(7): Construction limitations.

(a) Approval to construct or modify a stationary source becomes invalid if construction is not commenced within eighteen months after receipt of the approval, if construction is discontinued for a period of eighteen months or more, or if construction is not completed within a reasonable time. The permitting authority may extend the eighteen-month period upon a satisfactory showing by the permittee that an extension is justified.

Federal

Prior to this permitting action, the City of Edmonds Wastewater Treatment Plant was already subject to the requirements found in 40 CFR 60 Subpart O, 40 CFR 61 Subpart C and 40 CFR 61 Subpart E.

Section 129 of the Clean Air Act ("Solid Waste Combustion") requires EPA to develop regulations under Section 111 of the Clean Air Act ("Standards of Performance for New Stationary Sources") for each category of solid waste incineration unit. EPA has developed the following New Source Performance Standards (NSPS) and emission guidelines (EG) for solid waste incineration units as required by Section 129 for sewage sludge incinerators:

- Sewage Sludge Incinerators - Subparts LLLL/MMMM

Section 129 states that the term "solid waste" shall have the meaning established by the Administrator pursuant to the Solid Waste Disposal Act [42 U.S.C. 6901 et seq.]. Solid waste is defined in 40 CFR 258.2 as "any garbage, or refuse, sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities, but does not include solid or dissolved materials in domestic sewage, or solid or dissolved materials in irrigation return flows or industrial discharges that are point sources subject to permit under 33 U.S.C. 1342, or source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954, as amended (68 Stat. 923)."

The feedstock first entering the gasifier is solid waste per 40 CFR 258.2 as the material is sludge from a wastewater treatment plant. When the sludge was incinerated, 40 CFR 60 Subpart O and 40 CFR 61

Subpart C and 40 CFR 61 Subpart E applied. As the treatment of the wastewater sludge is proposed to be modified under this NOC, the federal rule applicability for gasification of wastewater sludge and oxidation of syngas is reviewed below:

40 CFR 60 Subpart O – Standards of Performance for Sewage Treatment Plants

40 CFR 60 Subpart O applies to facilities with an incinerator that combusts wastes containing 10% or more sewage sludge on a dry basis, or charges more than 2205 lb/day constructed after June 11, 1973. 40 CFR 60 Subpart O and 40 CFR 60 Subpart A do not define *incinerator* or *sewage sludge incinerator*, although Applicability Determination O006 specified "In the June 11, 1973, Federal Register sewage sludge is defined… Sewage is defined in the same Federal Register… While these definitions were removed when the regulations were promulgated, it is our feeling that these definitions supply the intent of the final promulgation."
EPA cites Applicability Determination (AD) O006 in AD 9900008 and adds "Although Subpart O specific definitions were not contained in the promulgated rule, this was not characterized as a major, substantive or substantial change from what had been proposed." Based on the EPA determinations from the Applicability Determination Index, the sewage sludge incinerator definition from the proposed rule is used in evaluation of 40 CFR 60 Subpart O applicability for this application.

Federal Register 38:111 (Monday June 11, 1973) published the proposed rule for 40 CFR 60 Subpart O and included the following definition for sewage sludge incinerator which was not included in the final rule:
"Sewage Sludge Incinerator" means any combustion device used in the processes of burning sewage sludge for the primary purpose of solids sterilization and to reduce the volume of waste by removing combustible matter, but does not include portable facilities or facilities used solely for burning scum or other floatable materials, recalcining lime, or regenerating activated carbon.

Utilizing the sewage sludge incinerator definition from the Federal Register for determination of 40 CFR 60 Subpart O applicability, indicates that for 40 CFR 60 Subpart O to apply the unit must be a combustion device used to burn sewage sludge.

PSCAA reviewed published applicability determinations for 40 CFR 60 Subpart O in the EPA Applicability Determination Index, as well as the materials provided by the applicant. PSCAA review did not yield any applicability determinations for specifically gasifier/oxidizer units and 40 CFR 60 Subpart O, however several applicability determinations (both for 40 CFR 60 Subpart LLLL and for the SSI Emission Guideline rule 40 CFR 60 Subpart MMMM) provide a framework for review of applicability which was utilized to determine that 40 CFR 60 Subpart O does not apply.

EPA Region 4 worked with OAQPS in the 40 CFR 60 Subpart MMMM determination made December 19, 2013 for a fixed bed downdraft gasifer processing biosolids, and EPA Region 9 made the 40 CFR 60 Subpart LLLL determination discussed below on July 25, 2016. In both letters, systems with pyrolysis/gasification to produce syngas from sewage sludge were found to not meet the definition of a sewage sludge incinerator. Both determinations considered the sewage sludge incinerator definitions of the federal rule under review. Both the SSI unit defined in 40 CFR 60.520 and 40 CFR 60.4930 specify that that the SSI is a combustion unit combusting sewage sludge. As discussed above, the SSI definition from Federal Register 38:111 (Monday June 11, 1973) published the proposed rule for 40 CFR 60

Subpart O is also a combustion device for burning sewage sludge. Sewage sludge is also defined in both 40 CFR 60.5250 and 40 CFR 60.4930 as "a solid, semi-solid, or liquid residue generated during the treatment of domestic sewage", and the Subpart O proposed rule published in the Federal Register 38:111 (Monday June 11, 1973) as "the solid waste byproduct of municipal sewage treatment processes…".

Given that the SSI and sewage sludge definitions are similar between 40 CFR 60 Subparts O, MMMM, and LLLL, the 40 CFR 60 Subpart O applicability determination is based on the same criteria as the 40 CFR 60 Subpart MMMM and LLLL determinations. For 40 CFR 60 Subpart O to apply, the unit proposed would need to meet the SSI definition and the material combusted would need to meet the definition of sewage sludge. The proposed unit's gasification unit does not combust sewage sludge; no flame is applied and oxygen levels in the gasifier are limited to below the combustion threshold. The proposed unit's oxidizer system is where combustion occurs, however the fuel combusted is syngas which is a gas and not solid, which does not meet the definition of sewage sludge. Given that neither the gasifier nor the oxidizer components of the proposed units are SSIs, 40 CFR 60 Subpart O does not apply.

40 CFR 60 Subpart LLLL – Standards of Performance for New Sewage Sludge Incineration Units

The manufacturer of the gasifier/oxidizer system proposed under this NOC 12135 requested an applicability determination from EPA. EPA issued an applicability determination September 9, 2021 finding that 40 CFR 63 Subpart LLLL does not apply. The applicability determination is embedded below:

Signed 9-9-21 Final
Clean Ecoremedy Re

40 CFR 61 Subpart E- National Emission Standard for Mercury

40 CFR 61 Subpart E applies to "stationary sources which… incinerate or dry wastewater treatment plant sludge." The rotary drum dryer for sludge in this case is directly dried by the flow of combusted syngas through the dryer such that the dryer proposed meets the requirements of a sludge dryer per 40 CFR 61.51(m): "Sludge dryer means a device used to reduce the moisture content of sludge by heating to temperatures above 65°C (ca. 150°F) directly with combustion gases." 40 CFR 61 Subpart E applies in this case as the facility dries wastewater treatment plant sludge.

40 CFR 61 Subpart C – National Emission Standard for Beryllium

In contrast to 40 CFR 60 Subparts O and LLLL, the 40 CFR 61 Subpart C defines incinerator as "any furnace used in the process of burning waste for the primary purpose of reducing the volume of the waste by removing combustible matter" such that for the purposes of 40 CFR 61 Subpart C, the gasification and oxidation unit, which removes combustible material as syngas would meet the definition of an incinerator under 40 CFR 61 Subpart C.

40 CFR 61 Subpart C applicability includes incinerators processing beryllium containing waste, defined in 40 CFR 61.31(g) as “material contaminated with beryllium and/or beryllium compounds used or generated during any process or operation performed by a source subject to this subpart.” The sources subject to Subpart C from 40 CFR 61.30 are “(a) Extraction plants, ceramic plants, foundries, incinerators, and propellant plants which process beryllium ore, beryllium, beryllium oxide, beryllium alloys, or beryllium-containing waste” and “(b) Machine shops which process beryllium, beryllium oxides, or any alloy when such alloy contains more than 5 percent beryllium by weight.”

The applicant identified ADI Z980002 for 40 CFR 61 Subpart C applicability which reviewed waste sludge from a pulp and paper mill. EPA Region 4 determined that since the waste containing beryllium was not generated from any of the sources subject to 40 CFR 61 Subpart C, the waste was not “beryllium containing waste” as defined in Subpart C and therefore Subpart C did not apply. Based on ADI Z980002, the applicant noted that Subpart C applicability would be dependent on whether “the Edmonds Wastewater Treatment receives discharges from wastes generated from a foundry, extraction plant, ceramic plant, propellant plant or machine shop which is subject to Subpart C. Given the previous determinations and the 40 CFR 61 definition of “beryllium containing waste” PSCAA concurs that 40 CFR 61 applicability is determined by whether the waste at Edmonds Wastewater Treatment plant meets the definition of beryllium containing waste. The applicant identified the City’s industrial waste discharge control program as a mechanism of ensuring there are no discharges from 40 CFR 61 Subpart C facilities to the wastewater treatment plant. Therefore, 40 CFR 61 Subpart C is not an applicable federal regulation.

K. PUBLIC NOTICE

A notice of application was posted on the Agency’s website for 15 days. No requests or responses were received. A copy of the website posting is below:

New Construction Projects

Company	Address	Project Description	Date Posted	Contact Engineer
Edmonds, City of, Wastewater Treatment Plant	200 2nd Ave S, Edmonds, WA 98020	Application for a carbon recovery unit to replace a sewage sludge incinerator at an existing municipal wastewater treatment plant. The carbon recovery unit puts sewage sludge in contact with air or oxygen at high temperature and pressure to convert the sewage sludge into two products: fuel called syngas and an ash product (either high carbon biochar or low carbon concentrated mineral products). The syngas is burned in the oxidizer portion of the unit to heat the process. Oxidized syngas is proposed to be controlled with a cyclone, a venturi scrubber, packed bed scrubber, and a carbon filter.	5/3/21	Madeline McFerran

This project meets the criteria for mandatory public notice under WAC 173-400-171(3). This project included emission offsets from the replacement of the SSI unit with the gasification unit under WAC 173-460-080(3) which requires mandatory public notice under WAC 173-400-171(3).

A 30-day public comment period will be held from October 27, 2022 through November 28, 2022.

The public comment period yielded one response in favor of the project and it is attached below:

Yes to the Ecoremedy system in Edmonds.m

No other comments were received during the public notice period.

L. RECOMMENDED APPROVAL CONDITIONS

Standard Conditions:

1. Approval is hereby granted as provided in Article 6 of Regulation I of the Puget Sound Clean Air Agency to the applicant to install or establish the equipment, device or process described hereon at the installation address in accordance with the plans and specifications on file in the Engineering Division of the Puget Sound Clean Air Agency.

2. This approval does not relieve the applicant or owner of any requirement of any other governmental agency.

Specific Conditions:

Emissions Limitations and Standards:

3. The owner and/or operator under this order must comply with all applicable requirements established in 40 CFR Part 61 Subparts A and E.
4. The owner and/or operator shall not process more than 864 pounds of dry solids per hour in the sludge handling processes covered under this order of approval. Compliance with this condition can be done using monthly processing records or daily processing records.
5. The owner and/or operator shall ensure that the dewatered sludge is not processed in the gasifier into syngas unless the oxidizer is properly functioning as part of the system.
6. The owner and/or operator shall not operate the sludge dryer unless emissions are routed through a three-stage emissions control system: the Venturi scrubber, followed by a packed bed scrubber, and then an activated carbon contactor.
7. All emissions associated with sludge drying and dried sludge handling shall be routed to either the three-stage emissions control system or the fabric filter dust collection system described above.
8. The gasifier/oxidizer operating temperature shall not exceed a temperature of 2500 degrees F. Compliance with this condition shall be determined using a block one-hour average, determined in accordance with 40 CFR 60.13(h)(2).

9. The flue gas exhaust stack coming from the sludge dryer, after being processed in the three-stage emissions control system, shall be 20 feet above the elevation of the bottom floor of the solids buildings.

10. The owner and/or operator shall not process waste from:

    - Extraction plants, ceramic plants, foundries, incinerators, and propellant plants which process beryllium ore, beryllium, beryllium oxide, beryllium alloys, or beryllium-containing waste.
    - Machine shops which process beryllium, beryllium oxides, or any alloy when such alloy contains more than 5 percent beryllium by weight.

    This condition can be verified according to the facilities waste discharge control program and shall be made available upon request from the agency.

11. The facility shall meet emission limits as described below.

    Upon startup, emissions from the final exhaust stack shall not exceed the following limits.

Pollutant	Emissions Limit	Compliance Demonstration Method
SO2	1000 ppmv @ 7% O_2 dry	EPA Test Method 6C, or an alternative method approved by the Agency
HCl	100 ppmv @ 7% O_2 dry	EPA Test Method 26A, or an alternative method approved by the Agency
Arsenic	0.0000129 lbs/hr	EPA Test Method 29 Or an alternative method approved by the Agency.
Chrome (VI)	0.000000344 lbs/hr	EPA Test Method 29 Or an alternative method approved by the Agency.
PM	0.05 gr/dscf	EPA Test Method 5, Method 26A or Method 29 or an alternative method approved by the Agency.

Within 120 days after completing initial performance testing in accordance with permit condition 12, the owner and/or operator shall submit an engineering report to the agency proposing emission limits for the following constituents based on results of the initial performance test. Emission limits may include a 30% adjustment to allow for operational flexibility as long as this increase does not violate any other regulation. Upon approval by the Agency, the proposed emission limits will become enforceable operating limits and the owner and/or operator shall keep a copy of the table with all current enforceable limits on site and readily available for review.

If the results of the performance test show that using the updated testing emission factors would put the facility above any small quantity emission rates (SQERs) or any National Ambient Air Quality standards (NAAQS) that were previously below based on initial similar equipment estimates, the facility shall submit a permit modification to address these pollutants.

Pollutant	Emission Limit Units[a]	Compliance Demonstration Method[b]
PM	mg/dscm	EPA Test Method 5, Method 26A or Method 29
NOx	ppmv	EPA Test Method 7E
SO_2	ppmv	EPA Test Method 6C
CO	ppmv	EPA Test Method 10
VOC	ppmv	EPA Test Method 25 or 25A EPA Test Method 18 to quantify exempt compounds.
As	lb/ton of dry solids feed OR % removal from dry solids feed	Air: EPA Test Method 29 Solids: SW-846
Cd	lb/ton of dry solids feed OR % removal from dry solids feed	Air: EPA Test Method 29 Solids: SW-846
Hg	lb/ton of dry solids feed OR % removal from dry solids feed	Air: EPA Test Method 29 or 30B Solids: SW-846
Pb	lb/ton of dry solids feed OR % removal from dry solids feed	Air: EPA Test Method 29 Solids: SW-846
Total dioxins and furans	ng/dscm	EPA Test Method 23

Notes:
[a] Gas phase concentrations shall be corrected to 7% oxygen dry.
[b] Or other method approved by the Agency.
[c] Permittee may include methods to address potential ammonium chloride interferences in Method 26

All equipment covered under this order of approval shall not be required to commence initial startup for the sole purpose of conducting a performance test. The owner and/or operator may wait until the unit is needed to commence initial startup and testing.

12. Within 90 days of completing initial startup of the carbon recovery project (Gasifier/Oxidizer system with dry sludge material handling), the owner and/or operator shall conduct a performance test to establish emissions limits in accordance with permit condition 11.

    At least 60 days prior to conducting performance testing, the owner and/or operator shall submit a performance test plan for the sampling that includes the following elements:

    - The data that is to be collected during the testing.
    - The test methods to be used for stack gas measurements.
    - Sample collection procedures and test methods for any other proposed testing (such as sludge or dry solids).
    - The procedures and methods that will be used to develop emissions limits from the results of the source test.

The owner and/or operator shall conduct all testing in accordance with Section 3.07 of Puget Sound Clean Air Agency (PSCAA) Regulation I, including:

- Sampling sites and velocity traverse points shall be selected in accordance with EPA Test Method 1 or 1A.
- The gas volumetric flow rate shall be measured in accordance with EPA Test Method 2, 2A, 2C, 2D, 2F, 2G or 19.
- The dry molecular weight shall be determined in accordance with EPA Test Method 3, 3A or 3B.
- The stack gas moisture shall be determined in accordance with EPA Test Method 4.
- The permittee shall use GFAAS or ICP/MS as needed for the analytical finish on the metals when using EPA Method 29 (Lead, Cadmium, Chrome, Arsenic and Mercury)

The equipment identified in this section is not required to commence initial startup for the sole purpose of conducting a performance test. The owner and/or operator may wait until the unit is needed to commence initial startup and testing.

13. The owner and/or operator shall not exhaust the dried sludge separators unless they are connected to a properly functioning dust collection baghouse. The dust collection baghouse shall have an outlet grain loading standard of 0.002 gr/dscf @ 13% O_2 dry. Compliance with this condition can be met by supplying manufacturers specifications showing the dust collection baghouse is capable of meeting the grain loading standard. The owner and/or operator shall make the document available to the agency upon request.

14. The owner and/or operator shall ensure that the flue gas entering the venturi scrubber unit does not exceed 230 degrees F (one-hour block average). The owner and/or operator must monitor the temperature of the influent gas coming into the venturi scrubber to ensure compliance with this condition.

15. The owner and/or operator shall ensure that the flue gas entering the packed bed carbon adsorption unit does not exceed 200 Degrees F (one-hour block average). The owner and/or operator must monitor the temperature of the influent gas coming into the packed bed carbon adsorption unit to ensure compliance with this condition.

16. The owner/or operator shall develop and maintain an Operation and Maintenance (O&M) plans for the three-stage emission control (the Venturi scrubber, followed by a packed bed scrubber, and then an activated carbon contactor). The O&M plan shall be developed and implemented per Agency's Regulation I.

17. Odor Compliance
    The owner and/or operator shall develop an odor response plan and odor complaint log with the following elements:

a. Instances where the odor is detected and any corrective action taken.
b. Initiate an investigation of all odor complaints received from the public as soon as possible, but no later than 12 hours after receipt of the complaint.
c. Take corrective action to eliminate odors beyond the property line as soon as possible, but within 24 hours after receipt of the complaint. If the odors cannot be eliminated within 24 hours after receipt of the complaint, the owner and/or operator shall explain the reasoning in the odor compliant log and the date that it was corrected.
d. Develop a report for every odor complaint and investigation. The odor complaint and investigation report must include the following:
    i. The date and time of when the complaint was received.
    ii. The date and time of when the investigation was initiated.
    iii. Location of complaint and investigation.
    iv. Weather conditions during the complaint and investigation.
    v. Description of complaint and investigation.
    vi. Actions taken in response to the complaint.
    vii. The date and time odors are no longer detected.

18. The following records shall be kept onsite and up-to-date, and be made readily available to Agency personnel upon request at all times:
    a. Compliance test reports.
    b. Amount of sludge handling processed on a monthly or daily basis to verify compliance with Permit Condition 4.
    c. A copy of the odor complaint log and odor response plan.
    d. A written log showing any instance where sludge handling gasses bypass the oxidizer or the three-stage control system and are released to the atmosphere unabated. Each log entry must include date, time, duration and the estimated amount of sludge handling gasses released to the atmosphere.
    e. The Operation and Maintenance (O&M) plan.
    f. All records required by 40 CFR 61 Subpart E.

19. Records required by this order must be kept by the owner and/or operator for at least 2 years, and made available upon request by the agency.

20. This order of approval hereby cancels and supersedes order of approval 11212 (issued 7/26/2016) upon the installation of the new equipment outlined in this order of approval.

M. REVIEWS

Reviews	Name	Date
Engineer:	Ralph Munoz	2/14/23
Inspector:		
Second Review:	John Dawson	5/31/2022
Applicant Name:	Steve Nelson	