

CS-235 Planning and Engineering Services
SEP Biosolids Digester Facilities Project

Odor Control

Prepared for: SFPUC Biosolids Digester Facilities Project
Prepared by: Biosolids Digester Facilities Project Consultant Team
Date: December 2014

Introduction

This fact sheet documents design parameters and characteristics of the on-site Southeast Water Pollution Control Plant (SEP) odor control system at the Biosolids Digester Facilities Project (BDFP), including proposed odor sources to be controlled, ventilation needs, and number of stages of treatment.

Unit Process Basis/Design Criteria

The representative odor control systems are configured to achieve the SEP odor goal at the future plant fence line of 5 dilutions to threshold (D/T) and 99 percent compliance based on a 1-hour average in 2022, while allocating room on site to achieve a future goal of 1 D/T.

Two primary odor control systems are proposed: a pre-digestion odor control system and a post-digestion odor control system. Other secondary standalone odor control systems are also described herein. A description of each primary odor control system is as follows:

- **Pre-digestion odor control system:** This technology approach is long-life engineered media or seashell media biofilter followed by activated carbon or potassium permanganate polishing. Expected odor removal performance is 99 percent and 85 percent removal of hydrogen sulfide (H₂S) and general odor (D/T), respectively, for the first-stage biofilter. Expected odor removal performance is 98 percent and 90 percent removal of H₂S and general odor (D/T), respectively, for the polishing adsorption unit. These performance values are dependent upon inlet odor levels and constituents but are considered representative for odor levels expected for BDFP. Overall removal performance is 99.98 percent and 98.5 percent removal of H₂S and general odor (D/T), respectively. This level of performance, along with dispersion from stacks, is expected to meet the required off-site odor criterion of 5 D/T.
- **Post-digestion odor control system:** This technology approach is a water-only ammonia scrubber, followed by long-life engineered media or seashell media biofilter, followed by activated carbon or potassium permanganate polishing. Ammonia scrubber can be a water-only scrubber due to expected low ammonia levels. However, the system will be provided with features to allow for retrofitting in the future with sulfuric acid dosing, depending on actual ammonia levels. Expected odor removal performance for the biofilter is 99 percent and 85 percent removal of H₂S and general odor (D/T), respectively. Expected odor removal performance for the polishing adsorption unit is 98 percent and 90 percent removal of H₂S and general odor (D/T), respectively. These performance values are dependent upon inlet odor levels and constituents but are considered representative for odor levels expected for BDFP. Overall removal performance is 99.98 percent and 98.5 percent removal of H₂S and general odor (D/T), respectively. Ammonia removal via ammonia scrubber will be 50 percent for water-only scrubbing and > 90 percent for sulfuric acid scrubbing (if deemed

necessary in the future). This level of performance, along with dispersion from stacks, is expected to meet the required off-site odor criterion of 5 D/T.

Odor Emission Sources and Ventilation Criteria

The expected range of odors for the blended air streams to each odor control system is 2-10 ppmV H₂S, 2000 – 10,000 D/T, and 10-50 ppmV ammonia (specific to post-digestion only). The following is a list of odor emission sources that will be ventilated and treated for each odor control system.

- Pre-digestion odor control system:
 - Degritting (upper level): Foul air is to be extracted directly off of equipment. In addition, equipment space is to be ventilated at 8 air changes per hour (ACH).
 - Degritting (load-out level): Space ventilated at 15 ACH.
 - GBT Thickening Building: Space ventilated at 15 ACH.
 - Thickening Feed Wetwell: Headspace ventilated at 12 ACH.
 - Sludge screens (upper level): Foul air is to be extracted directly off of equipment. In addition, equipment space is to be ventilated at 8 ACH.
 - Sludge screens (load-out level): Space ventilated at 15 ACH.
 - Pre-dewatering centrifuges: Space ventilated at 6 ACH.
 - Screw conveyors: Ventilated at 10 cubic feet per minute (cfm) per lineal foot.
 - Pre-dewatering cake hoppers: Headspace ventilated at 6 ACH.
 - Anaerobic digester and thermal hydrolysis process (THP) pressure/vacuum relief doghouses: To prevent off-gassing due to valve leakage, each space is to be ventilated at 12 ACH. Due to classification issues, airflows from these sources may be routed to a separate treatment train.
- Post-digestion odor control system:
 - Dewatering belt filter press (BFP): Space ventilated at 15 ACH. Glass enclosures provided to improve working space and limit ventilation airflows.
 - Belt conveyors located within glass enclosures and ventilated to odor control.
 - Dewatered cake storage: Headspace ventilated at 6 ACH.
 - Cake load-out: Space ventilated at 10 ACH.

Air change rates indicated herein will be further optimized during the forthcoming CER. In some cases, a better criteria may be odor containment (maintaining of negative pressure) versus air change rate.

In addition, odor control will be provided for high-strength waste, yellow grease, and sidestream treatment. Depending on site layout configuration, some or all of these sources may be treated at the post-digestion odor control system. Otherwise, individual standalone systems would be provided for treating these sources as described herein.

Reliability and Redundancy Criteria

Odor control systems will be provided with a reasonable level of reliability and redundancy to consistently meet the project-specific off-site odor goals.

The biofilter, which is expected to require infrequent media replacement, is split into three modules or cells. This will allow uninterrupted ventilation and treatment when one cell is down for media replacement or maintenance for meeting off-site odor limits.

Exhaust fans will be provided with a single standby unit such that if one exhaust fan fails or must be removed for maintenance, the standby unit will provide uninterrupted operation.

The adsorption polishing units, which are expected to require media replacement every 5 to 6 years, will be provided with a redundant unit. This will allow uninterrupted ventilation and treatment when one unit is down for media replacement or maintenance.

Placement of fans between biofilters and adsorption vessels will ensure that some energy is imparted to the saturated air stream to prevent condensation from occurring in adsorption vessels. Space will be provided for addition of a future in-duct heater if deemed necessary.

Fan and ductwork will be slightly oversized to account for any future increases in odorous airflows.

Space has been provided adjacent to the odor control system to account for future biosolids expansion.

Basis for Technology Selection

The selected primary odor control systems have been developed based on their capability to achieve the fenceline odor goal. In addition, technologies were selected in consideration of capital expenditure (CAPEX) and operating expenditure (OPEX) comparisons and also the following key non-financial criteria:

- Safety/health: Biofilter + Adsorption requires less handling of hazardous materials and greater safety than other technologies.
- Risk of odor break-through: Biofilter + Adsorption can handle varying inlet odor levels while meeting required performance levels.
- Technology maturity and reliability: Biofilter + Adsorption will continue to perform well after a shutdown, system disruption, or re-acclimation mainly due to the second-stage adsorption system.
- Adaptability of future regulatory changes: Biofilter + Adsorption is considered more resilient to future regulatory changes (specifically chlorinated by-products emissions) than other technologies.
- Level of maintenance Required: Biofilter + Adsorption requires less frequent and intense maintenance activities than other technologies.

Follow-on Evaluations Required

- Select specific biofilter media (long-life engineered media or seashell media) and adsorption media (carbon or potassium permanganate) for odor control systems that are best suited to THP+ mesophilic anaerobic digestion (MAD) and represent best net present value (NPV).
- Determine the most efficient means to treat odorous air from the mesophilic pressure/vacuum relief valves.
- Refine odorous air volumes to be treated by confirming design criteria for rooms, tanks, and equipment. Enclosures for gravity belt thickeners (GBTs) and BFPs will also be confirmed.

Costing Basis

Table 1 summarizes the major equipment associated with the representative odor control system serving THP+MAD.

Figure 1 and Figure 2 provide process flow diagrams (PFDs) for pre-digestion odor control and post-digestion odor control, respectively.

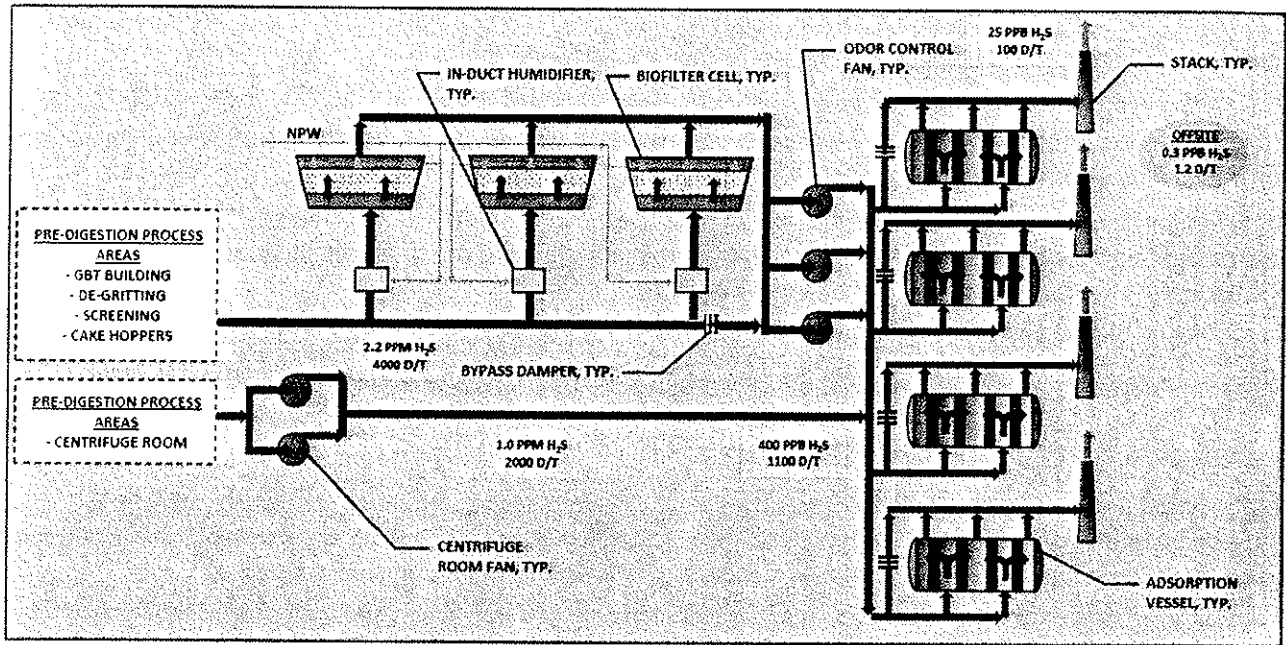


Figure 1. Pre-digestion odor control PFD

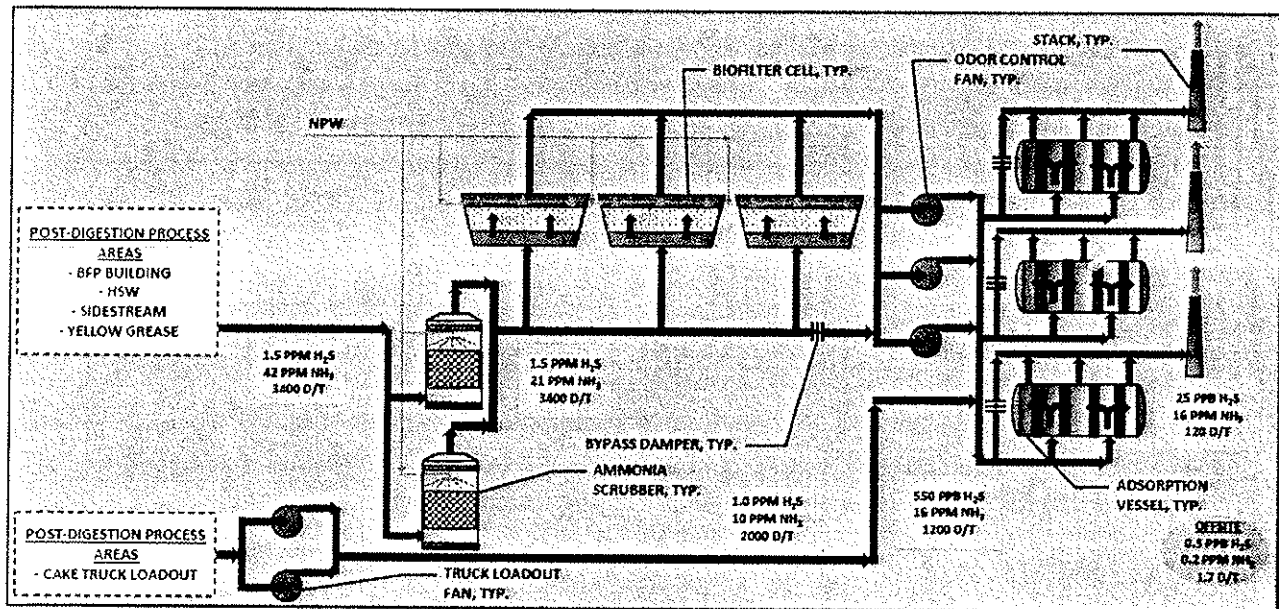


Figure 2. Post-digestion odor control PFD

Table 4. Odor Control Major Equipment		
Pre-Digestion Odor Control System	Unit	Value
Odor control exhaust fan		
Units	Number	3 (2 duty, 1 standby)
Size	cfm	43,375 @ 15.7 inches WC; 200 hp
Biofilter		
Cells	Number	3
Media volume (total)	yd ³	2,566
Minimum empty-bed gas residence time	Seconds	45
Carbon vessels		
Units		4 (3 duty, 1 standby)
Type	-	4-bed
Centrifuge Building Odor Fans		
Units	Number	2 (1 duty, 1 standby)
Size	cfm	47,500 @ 8.8 inches WC; 100 Hp
Post-digestion Odor Control System		
Odor control exhaust fan		
Units	Number	3 (2 duty, 1 standby)
Size	cfm	22,420 @ 17.7 inches WC; 150 hp
Biofilter		
Cells	Number	3
Media volume (total)	yd ³	1557
Minimum empty-bed gas residence time	Seconds	45
Carbon vessels		
Units	Number	3 (2 duty, 1 standby)
Type	-	4-bed
Truck Load-out Odor Fans		
Units	Number	2 (1 duty, 1 standby)
Size	cfm	43,800 @ 9.1 inches WC; 100 Hp
High-strength Waste Odor Control System (if standalone)		
Odor control exhaust fan		
Units	Number	1
Size	cfm	5,000 @ 13 inches WC; 25 hp
Biofilter		
Cells	Number	1 (25 ft x 30 ft)
Carbon vessels		
Units	Number	1 (single-bed)

Table 1. Odor Control Major Equipment		
Pre-Digestion Odor Control System	Unit	Value
Yellow Grease Odor Control System (if standalone)		
Odor control exhaust fan		
Units	Number	1
Size	cfm	12,000 @ 8 inches WC; 25 hp
Biofilter		
Cells	Number	1 (50 ft x 30 ft)
Sidestream Treatment Odor Control System (if stand-alone)		
Odor control exhaust fan		
Units	Number	1
Size	cfm	2,700 @ 8 inches WC; 5 hp
Packaged biofilter	Number	1 (20 ft x 20 ft footprint)

cfm = cubic feet per minute.

ft = feet.

hp = horsepower.

WC = water column.

yd³ = cubic yards.