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Ms. Carol Cenci
Compliance Manager
Puget Sound Clean Air Agency
1904 3rd Ave Suite 105
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April 13, 2017

Subject: Meeting regarding Smoke Test Procedures

Dear Ms. Cenci

Thank you for agreeing to a meeting between Cedar Grove Composting, Inc. (Cedar Grove) and the Puget Sound Clean Air Agency (PSCAA) to discuss (1) the smoke test procedure developed by PSCAA and (2) the establishment of a Reasonably Available/Best Available Control Technology (RACT/BACT) level of 100 percent control on the tipping building ventilation system at Cedar Grove's Maple Valley facility. We would also like to discuss some possible alternatives to the current smoke test procedures.

Cedar Grove has had a number of discussions with Supervising Inspector Rick Hess and Inspector Nina Birnbaum since the new smoke test was developed in July 2015. Cedar Grove believes that engineering input from PSCAA regarding the smoke test procedures would be helpful in evaluating possible alternatives that also meet Agency objectives. Because of your new role as Compliance Manager, Cedar Grove and CH2M HILL have prepared the attached memo as a means of providing the history of the issue in hopes it will aid in the discussion during the meeting.

Regards,

Stacia Dugan

Stacia Dugan

Air Quality Engineer

TECHNICAL MEMORANDUM

Cedar Grove Composting, Inc. Building Ventilation Test Procedures

PREPARED FOR:	Puget Sound Clean Air Agency
COPY TO:	Cedar Grove Composting, Inc.
PREPARED BY:	Stacia Dugan/CH2M
DATE:	April 13, 2017

In 2012, as part of its ongoing efforts to prevent off-site odors, Cedar Grove implemented new approaches to reduce odors from the facility, including: covering the static piles with overs, covering Phase 3 of the GORE system, and the use of misting systems with an odor surfactant. These actions resulted in an overall reduction of odors at the facility.

There are known, on-site emissions from the facility that come from feedstock tipping, mixing and grinding. The tipping building is continuously loaded and unloaded during the course of a normal day of operation. The building is square (100 ft by 100 ft) with one open door for truck and wheel loader access. There is a fully enclosed gable at both ends of the building so the roof section serves as a hood, or capture device. Plastic strips hang from the opening to enhance this capture effect. There is an additional canopy: the tipping building extension, (100 ft by 50 ft) that extends beyond the opening to insure all unloading of trucks and storage of materials for processing is under cover. The organic waste has some latent heat and moisture, which tends to be warmer than the ambient air, and can carry odors, if odors are present. This creates a slight lift that causes feedstock pile odors to rise into the roof section of the building.

In 2012, the tipping building had a continuous exhaust ventilation system with the exhaust point located near the peak of the interior south wall. This exhaust airflow was discharged into the tipping biofilter for odor removal prior to discharge to the atmosphere. The grinding building was controlled by the grinding biofilter. Both sorting and grinding was conducted in the building, so the biofilter was also called the sorting biofilter. In 2008, PSCAA and Cedar Grove had developed a smoke test procedure to demonstrate that the ventilation systems were operating. The systems had been passing the smoke tests, so the tipping and grinding/sorting buildings had not been identified by the PSCAA as an issue.

When it came time to replace the media in the existing tipping and grinding biofilters, Cedar Grove made the decision to try to increase the size of the biofilters in order to increase the biofilters' residence times, improve moisture retention, and potentially increase the ventilation rates for the tipping and grinding/sorting buildings. Several new design options were evaluated for the tipping and grinding building biofilters; however, all of the options had limitations due to the fact that we were modifying an existing control system on an existing facility and there was limited space available for new or larger biofilters. Eventually, a decision was made to remove the Electric Hammermill Grinder and its conveyor system which was located next to the grinding biofilter. This provided an area that would allow for a new grinding/sorting biofilter (sorting biofilter) that was approximately 3 times the size of the existing biofilter. The tipping biofilter size was also limited due to the stormwater drainage system; however, the new design allowed for increasing the size of the biofilter by about 23 percent.

The larger sorting biofilter (4500 square feet) allowed for a larger exhaust fan (35,300 CFM vs 16,000 CFM). Cedar Grove and PSCAA determined that this additional airflow would be used to draw emissions from both the sorting building and the tipping building extension.

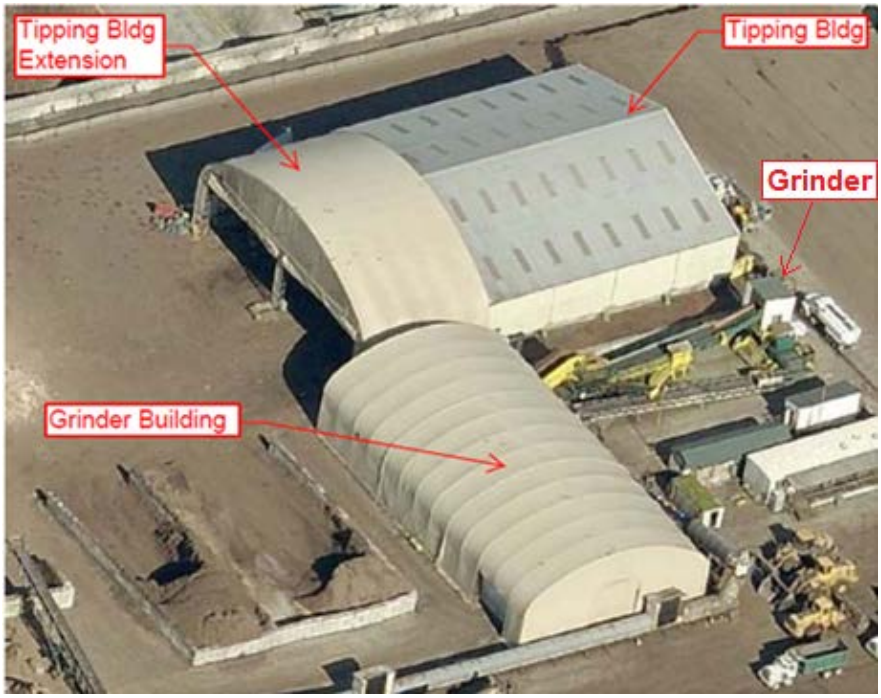

Figure Number. 1
Cedar Grove Composting, Maple Valley, Tipping and Grinding Buildings 2013

PSCAA Regulation 6.03(a) requires that an approval order be obtained before making a "substantial alteration" to control equipment installed on an existing source. There was some discussion as to whether or not a new air permit was required, since the project involved enlarging existing biofilters, which Cedar Grove did not feel was a "substantial alteration" of the control device. In addition, there would be no emission increase associated with the project, since the new biofilters would be able to treat a larger volume of air from the buildings, thereby potentially creating a reduction in emissions. No increase in production was associated with this project. However, in the interests of cooperation it was decided that an NOC application would be submitted to PSCAA so that the agency could review the new design.

NOC 10645 Application Process

In 2008, the tipping building had a design ventilation rate of 24,000 cubic feet per minute. The basic procedure for the 2008 smoke test involved using a smoke candle that released smoke at approximately the same rate as the ventilation system for one minute. The smoke was generated at the centroid of the interior volume that is above the resident feedstock pile. The smoke generation point was generally located 25 – 50 feet from the rear wall and half the distance from the top of pile to the center ridge in the roof section (which is approximately 32 feet high), since warm air from the feedstock will rise to fill this space and the smoke generated was intended to move with the warm air coming off the feedstock. The generation point was later moved to the floor in front of the center of the pile because of fire and other safety issues.

The ventilation design requirement for composting facilities that are not co-composting is four (4) air exchanges per hour. The 2008 smoke test was structured to evaluate whether or not the ventilation system was being operated as designed, so the test was used to demonstrate that the smoke was going to the ventilation system and that all of the smoke was removed from the building within 15 minutes from the time the smoke candle stopped generating smoke. But there was also a permit condition that there be no visible emissions from the tipping building extension door.

It was also stated in the test procedures that high winds were not compatible with this test procedures. Since the procedure is intended to reveal subtle wind eddy currents in low mixing conditions it would be difficult to conduct this test when winds were inducing a vacuum effect on the building shell. Likewise, when high winds were present, atmospheric mixing is more vigorous and odor impacts are less likely. Therefore the smoke test was only conducted if the ambient wind speed was less than approximately 5 miles per hour and no wind gusts were observed.

During the design review phase for the new biofilters, PSCAA visited Cedar Grove's Maple Valley facility to observe a smoke test. The tipping building passed the existing smoke tests, but Rick Hess decided that the test was not rigorous enough. PSCAA modified the existing smoke test procedures on July 15, 2013.

The 2013 smoke test procedures use two Superior Smoke candles #3WC (or Agency approved equivalent) in line with wicks attached together so the first, once spent, ignites the second to assure a minimum three minute burn time. Each candle produces 40,000 cubic feet of white smoke over a 3 to 4 minute period resulting in 6 to 7 minutes of smoke. The smoke candles are placed at ground level at a location where waste material is not extending and will not extend beyond and will not be handled beyond following the test. Handling includes the loading of material into a grinder for processing. This location tends to be in line with the edge of the grinder in the tipping extension building and in the middle of the open door. The distance from the smoke candles to the open door is about 25 feet, but can vary a little based on the placement of the grinder. The test must proceed regardless of climatic conditions unless there are safety concerns or Cedar Grove would not process (receive or handle) waste due to existing climatic conditions.

The 2013 smoke test procedures were developed by PSCAA with the instructions to use the procedures as provided, but modifications could be suggested. Cedar Grove had a meeting with PSCAA on June 23, 2014 to discuss a few aspects of the procedures, which included:

1. What was the regulatory basis for no visible emission which is equivalent to 100 percent capture by the tipping and grinding buildings? We were unable to find any BACT determinations establishing 100 percent capture for tipping buildings at composting facilities that were not composting biosolids. South Coast Air Quality Management District (SCAQMD) has established a requirement for 80 percent capture and control of VOCs from the active composting phase. In the SCAQMD rule the feedstock storage and grinding phase do not have specified control efficiencies, but do have requirements for how long the material can sit on site before being processed.
2. If the smoke candle is rated for the proper amount of airflow and specified to last for the required length of time of 3 minutes, instances where the smoke bomb last less than 3 minutes should not automatically result in a fail and two smoke bombs should not be required.
3. There should be some consideration for the effect of wind speed and direction on the outcome of a smoke test.

The discussions on the new smoke test procedures occurred before the new tipping and sorting biofilters were installed. Cedar Grove and CH2M pointed out that "no visible smoke" indicated 100 percent capture for the tipping building. The building and the process was an existing process that was never designed for that level of control. The building was designed for four air exchanges per hour which also results in the building being under negative air. PSCAA's position has been that the building is not under negative air if 100 percent of the smoke is not captured.

PSCAA proposed the current smoke test procedures during the permitting process for the new sorting biofilter. At the time, PSCAA indicated that they wanted Cedar Grove to use the test as a learning tool, and specifically requested that they use it to try new things to optimize the system. However, Cedar Grove needed to report all test results in the smoke test report whether or not they passed or failed. Since the new tipping and sorting biofilters had not yet been installed, Cedar Grove had no experience with how the ventilation system would perform under the new test procedures. Cedar Grove agreed to

use the new test procedures on the new ventilation system once it was installed as long as discussions could continue about the procedure. These continuing discussions would be necessary if it was determined that the ventilation system was working as designed, but still couldn't meet the 100 percent capture.

Ventilation System Performance

The tipping building biofilter was redesigned and new media was added to it in June 2014. The sorting building biofilter was redesigned and went into operation March 10, 2015. PSCAA issued Notice of Construction, Order of Approval No. 10645 for the new biofilters. The permit contains Condition No. 14.

> *Condition No. 14 - Emissions from the tipping building, and the pre-processing, sorting, and grinding building, shall be captured and passed through the biofilter. Compliance with this requirement shall be determined by the observation of no visible emissions from any open building face during the release of test smoke or other methods specified in an Agency approved test plan. Compliance with this requirement shall be determined by the observation of no visible emissions from any open building face during the release of test smoke or other methods specified in an Agency approved test plan.*

In general, smoke tests on the new tipping building ventilation system have demonstrated a strong draw along the floor away from the doorway and into the building. A portion of the smoke is immediately removed by both intakes while some of the smoke remains in the building moving in a swirling pattern. After approximately 5 to 8 minutes into the test, a light haze may exit from the top right hand side of the doorway. Most of the smoke will turn and re-enter the building. However, because the air inside the building is warmer than the air outside, some of the smoke may rise above the door and exit from the top of the doorway. Alternatively, because of wind conditions outside, some of the smoke may escape the pull of the ventilation system and not re-enter the building. The proportion of smoke leaving the building is less than 5 percent based on observation and, generally, there is no smoke observed more than 6 feet from the door of the building. The entire building and the area in front of the doorway and on the sides of the building are usually clear of smoke before the 15 minute test is over but that can be dependent on how long the candles produces smoke which can be from 5 to 7 minutes.

The smoke tests seem to indicate that there is an area, located between the door to the sorting building and the open door of the tipping building, where the pull of the ventilation system is not as strong as the rest of the building. We believe this is due to the air flow pattern created by the ventilation system. Cedar Grove has made adjustments to the position of the tipping extension intake; however, the changes have not demonstrated any significant change in the air flow pattern.

The flow pattern is similar, but also more complex, than the pattern indicated in Figure 1, a pattern created by PSCAA. The area outlined in red is area where it appears that the ventilation system has less pull. The excavator is frequently located in this area and no feedstock material is stored there.

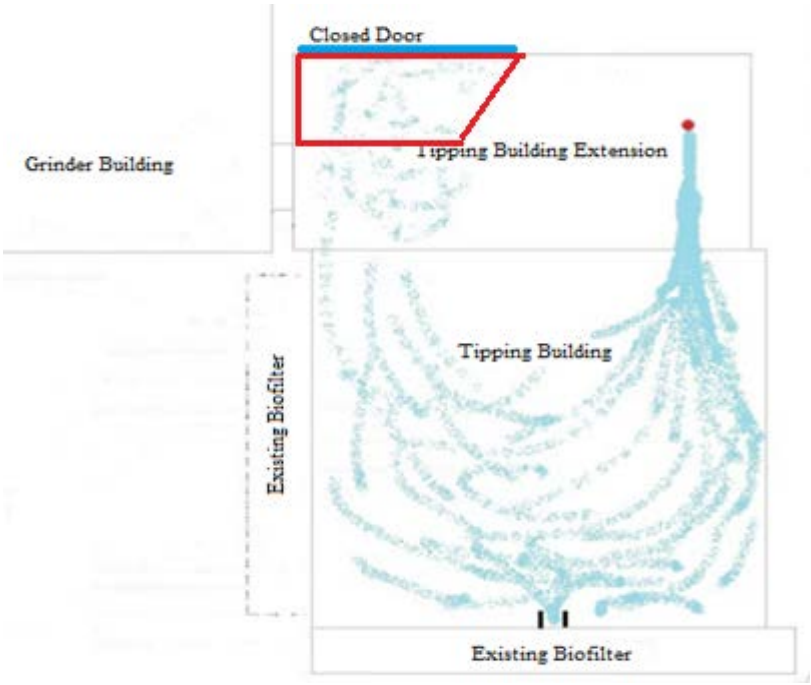

Figure 2.
Smoke Flow Pattern in Tipping Building

It is important to understand that the intake behaves much like a vacuum. If you put your hand right in front of the vacuum the pull is strong, but as you move your hand further away the pull diminishes. However, air that is not in the direct pull of the vacuum moves toward the intake to fill the "void" or low pressure area created by the vacuum. Because the intake is near the ceiling, the air flow is not necessarily straight into the intake. It appears that air moves across the floor and then up the walls to the ceiling area in a vertical swirly pattern as well as the horizontal swirling pattern shown in the drawing. The smoke tends to concentrate in the main tipping building where the feedstock material is located, but a lighter concentration of smoke is present in the tipping building extension. There appears to be less pull by the ventilation system on the area between the grinding building doorway and the closed tipping building door which is probably caused by the fact that it is easier for the system to pull air in through the door to the sorting building and over the grinding area, than it is to pull the air on the other side of the grinding building doorway.

Buildings that have 100 percent capture are generally fully enclosed with no open door. The potential for installing an intake over the entire door has been discussed but is not technically feasible for this existing process. There are several issues associated with installing an intake: 1) It would require more airflow than available and might actually draw air from further in the building to the door, 2) the extra ducting would add back pressure to the system and reduce the amount of air the fan could pull from the building, and 3) the building was not designed to support a ventilation system over the doorway and does not have enough available space for the equipment. Additionally, there is no evidence that this type of control has ever been used at a composting facility or that it has demonstrated its effectiveness in practice.

According to Cedar Grove's operation and maintenance plan, for the control of potential odors, the tipping building has the following criteria:

1. The building needs to be under negative air, and
2. The building shall have an air exchange rate of four air exchanges per hour.

Based on the foregoing, Cedar Grove's position is that the system is meeting these requirements. However, the smoke tests have repeatedly been declared a fail by PSCAA because some smoke left

through the open door, even when almost all of the smoke re-entered the building. PSCAA believes that even a small amount of smoke leaving the building is an indication that the building is not under negative air. Cedar Grove's position is that emissions of visible smoke are not the same as the building not being under negative air, since the videos show that there is good pull on the smoke into the building.

The tipping building had two instances when the wind speeds were significant and it did not pass the zero visible emissions requirement for the smoke test. The exact wind speed that is required to overcome the pull at the door is not known, since it is also dependent on wind direction and temperature. In the two test conducted where wind speeds were an issue, the wind gusts were over 15 mph. The pull inside the building appeared to still be good, but some of smoke in the area near the door was pulled out by the vacuum created by the wind. It is worth noting, when high winds are present, atmospheric mixing is more vigorous and odors impacts are less likely.

The building ventilation system was designed to provide four air exchanges per hour, which means that the ventilation system should be able to remove all the smoke from the building within 15 minutes from the end of smoke generation. The smoke tests have repeatedly demonstrated that the smoke is removed from the building well within 15 minutes from the time the smoke candles stops generating smoke, which indicates the building has an air exchange rate higher than 4 air exchanges per hour.

Additional Issues

South Coast Air Quality Management District (SCAQMD) Rule 1133.3 states that "any active phase of composting containing more than 10 percent food waste, by weight, shall be conducted using an emission control device designed and operated with an overall system control efficiency of at least 80 percent, by weight, each for VOC and ammonia emissions". This is generally considered to be Best Available Control Technology (BACT) for the active phase of composting operations. The tipping and grinding building are not part of the active phase of the composting process, however past emission tests conducted on Cedar Grove's biofilters have demonstrated well over 90 percent removal of VOCs and ammonia. Therefore, a ventilation system operating at over 90 percent capture should be considered BACT when operated effectively and as designed.

Cedar Grove requested information on the smoke test requirements for the other composting facilities in PSCAA's region. PSCAA provided information on two facilities: Lenz Enterprises, Inc. (Lenz) in Stanwood, WA and EMU Topsoil (EMU) in Poulsbo, WA.

Lenz Enterprises, Inc.

Notice of Construction (NOC) permit 9386 includes the following requirements related to the operation of the tipping building ventilation system at Lenz:

- Conditions 5a, b and c require daily inspections of the property to ensure that all tipping building activities and aerated static piles are operating in good working order and corrective action is taken if necessary;
- Condition 6a, b and c discuss the location and handling of composting feedstock in the tipping building;
- Condition 11a indicates where material can be stored in the tipping building;
- Condition 11b requires monthly measurement of the tipping building exhaust flow rate;
- Condition 11c requires Lenz to conduct a smoke test on the tipping building ventilation system once each quarter or when requested by the agency; and
- Condition 12 requires Lenz to have the tipping building and biofilter operations reviewed by a third party annually.

Notice of Construction (NOC) permit 10494 includes the same requirements listed above for NOC permit 9386.

PSCAA also provided a couple of examples of Lenz's tipping building inspection reports. The reports appear to include the ventilation airflow measurement and confirmation that the measured flowrate was above the design flow rate. The reports also include observations during the smoke tests that a large percentage of the smoke moved into the blower intake during the tests verifying operation of the blower.

The smoke test procedure at Lenz appears to involve holding a smoke generator on the end of a 20 foot piece of pipe somewhere in front of the blower intake to confirm the intake is working.

EMU Topsoil

Notice of Construction (NOC) permit 9727 includes the following requirements related to the operation of the tipping building ventilation system:

- Condition 4a, b and c require daily inspections of the property to ensure that all tipping building activities and aerated static pile are operating in good working order and corrective action is taken if necessary;
- Condition 5a, b and c discuss the location and handling of composting feedstock in the tipping building;
- Condition 10a establishes the requirement to conduct a smoke test and that no visible emissions will be observed from the open face of the tipping building;
- Condition 10b established that the smoke test will be conducted once each calendar quarter;
- Condition 10c requires EMU to establish a smoke test plan for submittal to the agency; **PSCAA did not provide us with a copy of the smoke test plan**;
- Condition 10d and e, established the date for first test and notification of test;
- Condition 10f requires a digital video of the smoke test;
- Condition 10g requires identifying any failed test in a monthly report. Additionally the date and scope of corrective action taken as well as the date of any subsequent test demonstrating compliance shall be identified in the monthly report.
- Condition 11 requires EMU to have the tipping building and biofilter operations reviewed by a third party biannually.

Most of the conditions for EMU were similar to the conditions for Lenz, however EMU does not appear to have the requirement to measure the ventilation flowrate. Lenz did not have the requirement for no smoke to leave the open face of the building or the requirements to submit a test plan and digitally record the smoke test.

The objective of Lenz's smoke test procedures appear to be to confirm the tipping building's ventilation system was operating as designed by confirming the airflow rate was above design and that the blower was in fact in operation. EMU's procedures appear to be closer to Cedar Grove's 2008 procedures; however, that could not be confirmed since the test procedures were not provided by PSCAA. EMU's smoke test procedure may also involve holding a smoke generator on the end of a 20 foot piece of pipe somewhere in front of the blower intake to confirm the intake is working, therefor not distributing the smoke throughout the entire building.

CH2M discussed the current smoke test procedures with the owner of Superior Smoke, who manufactures the smoke candles, and he indicated that we were not using the smoke candles as intended. He indicated that the smoke candles are intended to confirm design criteria. When testing the ventilation of a building, first the testers close all openings and then fill the building with smoke. They use fans or multiple smaller candles to uniformly spread the smoke throughout the building. Once the candles have finished burning, the testers start timing how long it takes for all the smoke to clear the building. The elapsed time is compared to the design air exchange rate requirement.

Meeting Objectives

Cedar Grove and CH2M would like to discuss the implementation of the 100 percent capture for the tipping and sorting buildings, demonstrated by a smoke test. We have not seen the 100 percent capture requirement applied to other facilities, including smaller, fully enclosed composting or co-composting facilities. There does appear to be requirements for minimum airflow speeds at open doorways for co-composting facilities. The smoke test procedures for the other facilities were much less rigorous than Cedar Grove's. We have discussed with Rick Hess the possibility of continuing with the smoke test, but reducing the requirement to greater than 90 percent of the smoke captured. Mr. Hess was opposed to this approach because it required a judgement about how much smoke could be lost and still achieve 90 percent and, therefore, was subjective.

Cedar Grove and CH2M would like to discuss some possible alternatives to the smoke test. We think a test that is designed to show that the ventilation system is working and that it is achieving its design air exchange rate of 4 air exchanges per hour would be more appropriate and more in line with what other facilities are doing.

One option to demonstrate that the ventilation system is working would be to conduct the smoke test as recommended by Superior Smoke. When testing the ventilation of a building, the testers would fill the building with smoke using multiple smaller candles to uniformly spread the smoke throughout the building. Once the candles have finished burning, the testers start timing how long it takes for all the smoke to clear the building. The elapsed time is compared to the design air exchange rate requirement. This type of test would demonstrate that the smoke is going into the ventilation system, and would be more vigorous than holding the candle in front of the intake. The one potential issue with this method is that it can be difficult to determine exactly when all the smoke is gone because there will always be a mist of warm air coming off the feedstock piles that can look like smoke.

The second option would be to use the air flow rates measured during the quarterly inspections to demonstrate that the ventilation system is operating at the required airflow rate. This data could be used to show that the total airflow from the tipping building and sorting building is meeting or exceeding the design flow rate of 49,300 cubic feet per minute, or 4 exchange rates per hour.

With the tipping and sorting building currently operating at or slightly above the 49,300 cfm flow rate, we have demonstrated using the current smoke test, a greater than 90 percent capture on the building. In addition, the tipping and sorting buildings are currently not identified as a significant odor issue.