EMISSIONS ESTIMATES

LENZ ENTERPRISES COMPOST FACILITY UPGRADE 2019 – Potential to Emit and Emissions Estimates

Lenz Enterprises Stanwood Facility

Submitted To: Puget Sound Clean Air Agency (PSCAA)
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Contents

Introduction

Lenz Enterprises Inc. has submitted an application to the Puget Sound Clean Air Agency (PSCAA) to expand their commercial compost facility in Stanwood WA. As a result emissions and Potential to Emit must be estimated. Estimates of carbon monoxide (CO), nitrogen oxides (NOx), particulate matter (PM10), sulfur oxides (SOx) and volatile organic compounds (VOC) have been prepared.

This document accompanies the attached report entitled "Lenz Enterprises Compost Facility, Proposed Facility Expansion" prepared by EnviroComp Consulting. No regulatory agency with jurisdiction over the Lenz facility (PSCAA, the Washington State Department of Ecology, Environmental Protection Agency (EPA) has defined emission factors (EF) for commercial composting facilities; or an established method to determine those factors. Therefore a description of applicable methods to determine these emissions is provided for the facility. A description of the method and assumptions to determine PTE is also provided.

Definitions

Potential to emit: WAC 173-400-030 Definitions. (76) "Potential to emit" means the maximum capacity of a source to emit a pollutant under its physical and operational design. Any physical or operational limitation on the capacity of the source to emit a pollutant, including air pollution control equipment and restrictions on hours of operation or on the type or amount of material combusted, stored, or processed, shall be treated as part of its design only if the limitation or the effect it would have on emissions is enforceable. Secondary emissions do not count in determining the potential to emit of a source.

Small quantity emission rate (SQER) means a level of emissions below which dispersion modeling is not required to demonstrate compliance with acceptable source impact levels. SQERs are listed in WAC 173-460-150.

Criteria air pollutant: Air pollutants or classes of pollutants regulated by the EPA for which National Ambient Air Quality Standards (NAAQS) have been established.

Emission factor: A number that shows the relationship between an air emission and a measure of production (e.g., pounds of emissions per pound of material input)

Toxic air pollutant (TAP) means any toxic air pollutant listed in WAC 173-460-150.

EPA guidance on inclusion of physical and operational design components: EPA-456/B-98-003; October 1998. Control measures can qualify as limitations that reduce your maximum capacity only if they are operated and maintained continuously for reasons other than air quality protection. Examples of using controls for purposes other than for air quality include: quality control, product recovery, or operating efficiency. For example, at a dry cleaning facility, a closed loop dry cleaning machine may be used for operating efficiency. As a side effect, emissions of HAPs and VOCs may also be reduced.

Following are descriptions of Lenz physical and operational designs that are used in PTE calculation along with descriptions of operation and maintenance conditions.

Included Design Components for Estimating PTE

Air emissions and PTE were calculated based on the proposed maximum permitted feedstock throughput for the proposed facility (150,000 tpy) and emission factors and control efficiencies derived from testing at the site, consistent with applicable published literature. Calculations are provided in this document along with emissions factors (EF) used and any assumptions made in calculating emissions.

Emission estimates and PTE for the site are identical since all major components of the system meet regulatory criteria to be considered under the system's physical and operational design and are enforceable. The following major physical and operational design components were used for PTE calculations and emission estimates for the Lenz Compost Facility.

1. CASP: The Covered Aerated Static Pile (CASP) system is the primary system for Phase I composting at the Lenz Compost Facility (LCF). The system is operated continuously for quality control (meeting regulatory time and temperature requirements, and vector attraction reduction); product recovery (finished product introduction into the CASP is an integral part of material flow) and operating efficiency (CASP's provide the highest level of operating efficiency in the composting industry). CASP are considered BACT by many organizations (California Air Resources Board (CARB), State of Colorado). The Engineered Compost System (ECS) design at the LCF utilizes temperature control to create an enhanced homogenous environment for microbes. This enhanced environment reduces VOCs and other emissions by creating a more efficient and dense population of microbes. The operating times of both positive and negative aeration can be varied, as well as the flow rate of air. These controls can help to create an operating environment that reduces emissions.
2. <u>CASP Positive Air Biofilter</u>: Lenz employs a biofilter layer on top of each CASP zone for quality control, operating efficiency, and product recovery. This biofilter insulates the pile and maintains time/temperature/moisture near the surface of the pile. Without this cover the top several inches of the pile might not meet time and temperature regulatory requirements. The biofilter cover is also a vector attraction reduction method for quality control and provides for product recovery of compost overs into the process providing initial inoculation of the pile.
3. <u>Engineered biofilter</u>. The engineered biofilter, in addition to acting as an emissions control device, is an integral part of the ECS ASP system and provides quality control, product recovery, and operating efficiency. Leachate is delivered to the engineered biofilters daily to maintain moisture and microbial populations (quality control) and to balance site water use (product recovery). Leachate is consumed and used for optimum biofilter function which is an integral part of the site water balance providing quality and quantity control of leachate, product recovery and operating efficiency.

Each of these operational design features is enforceable because they are, or can be, contained within a permit issued pursuant to an EPA-approved permitting program; and they are enforceable as a practical matter (as evidenced by similar permit inclusions).

Sources of Air Pollutants

Sources of air pollution emissions from the proposed operation include:

1. Commercial green waste and food waste composting operations using Covered Aerated Static Pile with integral engineered biofilters and Windrow composting technologies
2. Portable screening and grinding operations
3. Transportation of feedstocks
4. Stationary reciprocating internal combustion engines (RICE)

Source no. 1 is proposed to increase from 75,000 tons of wet feedstock per year to 150,000 tons of wet feedstock per year and is included in this analysis. Source No. 2 may increase gradually over time but no new equipment will be added so it is not included in this analysis per direction from PSCAA. Source no. 3 will not increase due to a displacement of small packer trucks (2-5 tons) with larger live floor loads (28-30 tons) and is therefore not included in this analysis per direction from PSCAA. Source no. 4 will increase due to increased operating time and is included in this analysis.

Criteria Pollutant Emission Estimates

Background for PTE and emission estimates

VOCs, ammonia and other gaseous compounds are emitted to the atmosphere as a by-product of the composting process. The types and quantities of emissions emitted at any particular facility are primarily a function of the following factors:

1. **Feedstock composition**
2. **Duration and types** of composting process
3. **Moisture** This includes initial moisture content and moisture content over time of composting.
4. **C:N ratio**
5. **Initial pH**
6. **Use (or not) of bulking agents**
7. **Degree of aeration** in the pile and distribution throughout the pile
8. **pH profile** throughout the composting process
9. **Heat level/profile**
10. **Porosity/Surface area** – controls concentration and amount of microbial population
11. **Composting particle size range/homogeneity**
12. **Pile Turning** regime (frequency and type of turning)
13. **Environmental controls –** where and how they are used
14. **Environmental conditions**
15. **Pile Geometry**
16. **Compost handling equipment and its use**
17. **Control of process parameters**

While this is not an exhaustive list of factors it provides a good basis for understanding the wide-range of reported emissions from compost in published literature. The California Air Resources board (CARB) has provided information on this subject; while acknowledging the limitations of the data provided. Many other studies and research papers are available on environmental controls and composting processes as well.

In reality, site specific emission testing is the only way to accurately assess a commercial composting facilities PTE or emissions. Emissions' testing was performed at the site twice; once in 2013 and once in 2018. Site testing was performed by Washington State Department of Ecology Environmental Engineers as part of Ecology research in 2013 and in conjunction with WSU in 2018. These tests provide site specific data on actual emissions from the facility. Since the 2013 testing, Lenz has improved many of its processes including CASP, biofilter and other operational efficiencies. Therefore results from testing indicate a worse-case scenario of emissions from the facility.

Emissions estimates for the proposed facility

Site specific results from emission testing at the site have been evaluated and emission factors have been developed for VOCs, NH3 and HAPs and TAPs. In the report "Lenz Enterprises Compost Facility Air Quality Technical Report" prepared by ENVIRON International August 2013, data from the Ecology report was used to estimate VOC emissions at the LCF. The report states "*The VOC emission estimate based on the third party testing is 11.6 tons per year, based on toluene as the base species which would correspond to approximately 0.6 pounds of VOC per ton of organics processed*." However, during this testing neither the engineered nor the CASP biofilter caps were operationally optimized. These units were allowed to dry out during the test to facilitate emission testing. To factor for this condition, the EF of 0.6 pounds of VOC per ton of organics process must be reduced. Research shows that engineered biofilters that are not optimally maintained typically result in approximate 25-35% efficiency for reducing emissions; whereas well-maintained biofilters can reduce emissions up to 98%.

In the most recent emission report for the site entitled "Lenz Enterprises Compost Facility Proposed Expansion" prepared by EnviroComp Consulting, the same source data was used to estimate emissions however with a slightly modified method to refine the process (see attached report for more detail). This report calculates a VOC emission factor of 0.57 pounds of VOC per ton of organics processed. Because this was a technical report based on the same data the report, once again, did not factor in the diminished functionality of the biofilters because there was no data to support this claim.

Compost systems using technologies and operational plans similar to the LCF have also been tested and evaluated and emission factors have been estimated by industry experts. In the project Memo 272-038-4 (Appendix A) Engineered Compost Systems (ECS) estimated VOC and ammonia emissions from the planned expansion, based on similar systems that are in operation and have been tested. This Memo states "Conclusion: An estimate of primary composting in a reversing CASP can be made as the average of the emission factor from the positive CASP and negative CASP data from above (0.05 lbs VOC as CH4 per wet ton feedstock)."

In early 2018, the department of Ecology and researchers from Washington State University (WSU) tested emissions at the site once again. Results from this testing were examined by Thomas Jobson, Ph.D, a professor of Civil and Environmental Engineering at WSU. Dr. Jobson's preliminary results indicate a VOC emission factor of 0.3 lbs/wet ton of feedstock processed. An email from Dr. Jobson is included in Appendix A.

The California Air Resources Board (CARB) has developed an Emissions Inventory Methodology for Composting Facilities that are partially applicable to the LCF. This method could be used to estimate VOCs and ammonia at the existing and proposed LCF however many of the assumptions formed and conclusions reached in the document are based on process that are engineered, designed and constructed significantly different than the LCF. The methodology states it is applicable to both ASP processes and windrow composting. Emission inventory methodology addresses composting facilities with feedstocks that include Greenwaste, co-composting (Greenwaste combined with other feedstocks) and food waste mixed with Greenwaste. The methodology applies to composting mixtures with up to 15% by weight Foodwaste. Acknowledged method limitations are addressed in the following discussion as they relate to use of this method for estimating emissions at the Lenz Composting Facility.

The method assumes that material is stockpiled prior to composting for up to 14 days before the active phase is initiated. Lenz Enterprises does not stockpile material. In contrast Lenz processes feedstocks as they are delivered resulting in de minimus stockpiling emissions. Therefore stockpiling emission factors are not included in this analysis.

The method assumes that air is directed through CASP systems in one direction only. The Lenz system uses a "reversing air system" that allows air to flow up through or down through the pile, or to be turned off, as required by the process. This process has been shown to be much more efficient and effective in composting material and reducing emissions (see California recommendation for CASP as BACT in composting). This functionality is acknowledged in the CARB EF methodology described in the following paragraph:

> "*These VOCs are biogenic in origin; thus, they are biodegradable. Since these are biogenic and biodegradable compounds, any measure that would promote active biological processes will decrease their emissions. The key factors that need to be controlled to optimize the biological process of composting are oxygen content, moisture content, pH, and carbon:nitrogen (C:N) ratio*."

The Lenz CASP system promotes active biological processes through its continual monitoring and feedback mechanisms of air control; which in turn optimizes oxygen and moisture content and pH. Optimum carbon to nitrogen ratios are addressed in the site operations plan.

Numerous studies have shown that up to 90% of VOCs are emitted during the initial two weeks of composting. The Lenz CASP system reduces this timeframe significantly due to optimum environmental control of the process. Therefore this analysis assumes 10% of VOCs are still available to be emitted during the Windrow phase of composting at the Lenz facility.

The CARB method includes technologies other than CASP systems.

The CARB method provides the following recommended emission factors for Greenwaste and Foodwaste based on available test data and the configuration of the facilities tested:

Table 1 Recommended Emission Factors for Greenwaste and Foodwaste

Pollutant	Stockpile (lbs/wet tons-day)	Composting Process (lbs/wet ton)
VOC	0.20	3.58
NH3	N/A	0.78

Not all of the available emission test data that supports these numbers are relevant to the Lenz site due to technological and operational differences. Therefore the starting EF must be modified to accurately reflect those differences.

Biofiltration

The removal of odorous compounds within a biofilter starts with the transfer of contaminants from the air to the water phase, followed by adsorption to the medium or absorption into a water film, and finally biodegradation of contaminants within the biofilm. The overall effectiveness of a biofilter is largely determined by the properties and characteristics of the support medium, which includes porosity, degree of compaction, water retention capacity, and the ability to host microbial populations

The ARB EF document provides guidance for efficiency of environmental controls. Unfortunately, efficiencies documented in the guidance do not reflect efficiencies of well-maintained environmental controls. The ARB document identifies "Negative ASP with Biofilter" with forced negative air as being 25% efficient for VOC control and 53% efficient for NH3 control. While these numbers may be representative of a biofilter that is constructed and not maintained, they are not representative of a biofilter that is well-engineered, constructed of optimum materials and well-maintained on a daily basis such as is the case at the LCF. Onsite testing of Lenz engineered biofilters and ASP biofilter caps has coincided with research which indicates efficiency up to 98% for VOCs and NH3 control.

To accurately assess emission and PTE for the LCF, starting from the ARB documented emission factors, the following conditions need to be considered and adjustments made:

1. Feedstocks accepted at the LCF contain between 5-10% Foodwaste; not up to 15%
2. No stockpiling occurs at the LCF
3. The LCF has more efficient integral environmental controls than those identified
4. The LCF CASP system incorporates aeration downtime to optimize conditions and reduce energy consumption and emissions
5. LCF uses an optimized C:N ratio

Condition 1: Feedstocks delivered to the Lenz facility contain between 5-10 percent Foodwaste, averaging about 6 percent. Foodwaste contributes significantly to VOCs and NH3. Therefore a reduction factor of 25 percent has been used to approximate conditions at the LCF.

Condition 2: No stockpiling occurs at the Lenz site therefore no EF is used for this activity.

Condition 3: Biofilters used at the LCF include engineered biofilters that treat emissions from downward airflow through the ASP and constructed biofilter caps that treat emissions from upward air through the ASP. The engineered biofilter is constructed of an optimum mixture of woody material, maintained at adequate moisture content, and is tested on a monthly basis. Biofilter caps on the ASP are an average of 12" in depth, constructed of an optimum mixture of woody material, and maintained at adequate moisture content. Site testing has shown the engineered biofilter to reduce emissions by up to 98 percent and biofilter caps to reduce emissions up to 95 percent. These percentages are used in this emission estimate comparison.

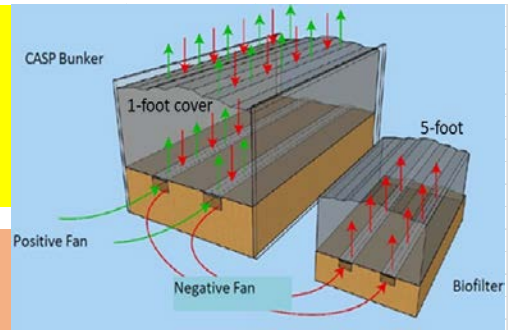
Condition 4: The ECS ASP system used at the LCF utilizes a constant feedback mechanism to optimize environmental conditions while maintaining airflow at minimum levels. This system includes a minimum 20 percent downtime (air is not flowing either up or down through the pile). This downtime reduces emissions by reducing air flow from the system. The minimum 20 percent downtime is used for this emissions estimate comparison.

Condition 5: Optimized C:N ratios can significantly reduce emissions from composting. The majority of data from the ARB Emissions Factor Inventory Methodology came from sites using low C:N ratio. LCF uses optimum C:N ratios. A conservative added reduction of 5% is included for this purpose.

Using the described values and adjustments and specific onsite data, Lenz has determined the following PTE and emissions for VOCs and NH3 for the proposed facility using the CARB EF method as a basis:

Input values		
Assumptions	**Value**	**Units**
Uncontrolled VOC EF	3.580	lb/wet ton
Reduction due to less food waste, optimzed C:N ratio, no stockpiling	98	%
Control efficiency negative flow (biofilter 5-foot)	95	%
Control efficiency positive flow (biofilter cover 1-foot)	0	%
Fraction of time with negative flow	0.4	
Fraction of time with positive flow	0.4	
Amount of VOC emission in the CASP (remaindcer in windrows)	90	%

Output		
Calculations	**Value**	**Units**
Reduced VOC EF due to difference in food waste	0.0716	lb/wet ton
CASP VOCEF after control	0.072	lb/wet ton
Biofilter VOC EF after control	0.004	lb/wet ton
CASP+Biofilter VOC EF after control	0.030	lb/wet ton
Windrow VOC EF	0.003	lb/wet ton



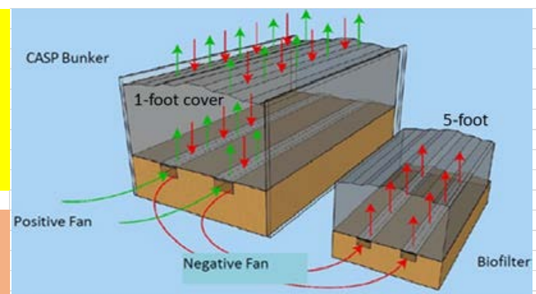
1 ton =	2000	lb				
		CASP+Biofilter	**Windrow**	**Total**		
	tpy waste	**lb/wet ton VOC**	**lb/wet ton VOC**	**lb/we ton VOC**	**t/y VOC**	**PTE**
Current scenario	75,000	2,255	251	2,506	1.3	1.3
Future scenario	150,000	4,511	501	5,012	2.5	2.5

Using this established methodology; VOC PTE and emissions for the proposed facility is 2.5 tons VOC per year.

A similar calculation has been performed for NH3 using the same reference for emission factors:

Input values		
Assumptions	**Value**	**Units**
Uncontrolled NH3 EF	0.780	lb/wet ton
Reduction due to less food waste, optimzed C:N ratio, no stockpiling	25	%
Control efficiency negative flow (biofilter 5-foot)	95	%
Control efficiency positive flow (biofilter cover 1-foot)	90	%
Fraction of time with negative flow	0.4	
Fraction of time with positive flow	0.4	
Amount of NH3 emission in the CASP (remaining in windrows)	90	%

Output		
Calculations	**Value**	**Units**
Reduced NH3 EF due to difference in food waste	0.585	lb/wet ton
CASP NH3 EF after control	0.059	lb/wet ton
Biofilter NH3 EF after control	0.029	lb/wet ton
CASP+Biofilter NH3 EF after control	0.035	lb/wet ton
Windrow NH3 EF	0.004	lb/wet ton



1 ton =	2000	lb				
		CASP+Biofilter	**Windrow**	**Total**		
	Feedstocks (TPY)	**lb/wet ton NH3**	**lb/y NH3**	**lb/y NH3**	**t/y NH3**	**PTEA**
Current scenario	75,000	2,633	293	2,925	1.5	1.5
Future scenario	150,000	5,265	585	5,850	2.9	2.9

Using this established methodology; NH3 PTE for the proposed facility is 2.9 tons VOC per year.

Summary of VOC and NH3 Estimates

Using a modified CARB method for estimating site emissions, values of 2.5 tpy and 2.9 tpy of VOCs and NH3 are calculated respectively. Industry expert opinion (See ECS Memo) of emissions from the proposed system estimates 3.3 tpy of VOCs annually (NH3 was not assessed) based on testing at similar sites. Using site specific data, and without adjusting for environmental control inefficiencies, (see EnviroComp report for baseline) 43.0 tpy VOC and 2.925 tpy of NH3 have been estimated. All these values are compared in Table 1.

Table 1. Comparison of VOC and NH_3 tpy based on different methods

Method	VOC tpy	NH3 tpy
Modified CARB method	2.5	2.9
Similar systems test data (ECS)	3.3	NT
EnviroComp	43.0	2.925

Because the EnviroComp analysis did not include reductions for inefficiencies of the biofiltration units, this estimate is significantly different than the other two. Applying expected biofilter efficiencies would result in similar results.

If the PSCAA accepts emissions estimates provided in this submission, Lenz is willing to acknowledge worst-case scenario emissions and move forward with the permitting process using this data. If PSCAA does not accept these estimates then Lenz will be requesting additional PSCAA authorized testing at the site to confirm existing testing data.

Particulate Matter (PM), Sulfur dioxide (SOx) Nitrous oxides (NOx) and Carbon dioxide (CO)

PM, SOx, NOx, and CO are primarily emitted due to the operation of stationary reciprocating internal combustion engines (RICE) used on site. The following table estimates emission of these sources based on engine type and size and estimated hours operated per year.

Table 2 PM, SOx, NOx, and CO estimated emissions

			RICE Engines Estimated emissions (tons/yr)						
Manufacturer	BHP	Hrs/yr	PM	PM10	PM2.5	SOx	NOx	VOC	CO
2017 Komptech Nemus 2700 Trommel	97	2400	0.17	0.17	0.17	0.16	2.44	0.2	0.53
2017 Screenpod Airvac 1600 Dual	68	2400	0.08	0	0.08	0.08	1.20	0.1	0.26
6" Pioneer Trailer mounted diesel pump	75	50	0	-	0	-	0.03	0	0.01
6" Pioneer trailer mounted pump #2	75	20	0	-	0	-	0.01	0	0
Airbo Light Plant	15	20	0	-	0	-	0	0	0
CEC 36X80 Stacker Conveyor	45	2400	0.04	0	0.04	0.03	0.53	0.04	0.11
CEC Screener 6' X 16'	97	1500	0.11	0	0.11	0.10	1.52	0.12	0.33
Edge MS 8036 Conveyor / Stacker	37	2400	0.050	0	0.05	0.05	0.72	0.06	0.16
Finaly Screener	37	20	0.000	-	0	-	0	0	0
Kohler GenSet	134	1032	0.14	0	0.14	0.13	2	0.16	0.43
Komptech Hurrikan S	96	1032	0.07	0	0.07	0.07	1.03	0.08	0.22
Komptech Screener Multistar L3 #1	85	1032	0.06	0	0.06	0.05	0.81	0.07	0.17
Komptech Screener Multistar L3 #2	85	516	0.03	0	0.03	0.03	0.4	0.03	0.09
Komptech Screener Multistar L3 #3	85	516	0.03	0	0.03	0.03	0.4	0.03	0.09
McCLusky Green Stacker / Conveyor	120	1032	0.11	0	0.11	0.11	1.61	0.13	0.35
MultiQuip Gen Set	65	1032	0.03	0	0.03	0.03	0.47	0.04	0.1
Onan 125 KW Gen-Set	86	1032	0.06	0	0.06	0.05	0.82	0.07	0.18
MGL Picking Station	20	1720	0.01	0	0.01	-	0.07	0.01	0.02
Powerscreen Phoenix 2100 Trommel	129	1032	0.13	0	0.13	0.12	1.86	0.15	0.4
Powerscreen Phoenix 3300 Trommel	139	1032	0.13	0	0.13	0.12	1.86	0.15	0.4
		TOTAL	1.25	1.25	1.25	1.16	17.78	1.44	3.85

Operating hours for engines are based on actual hours operated during previous year with increases added to hours for extended operations based on the proposed scenario. Emission factors and calculations were prepared using the Minnesota Pollution Control Agency Internal combustion engines air emission calculator "p-sbap5-25 – 4/8/19". These calculations are based on EPA standards.

Summary of Total Emission and PTE

Criteria pollutants emissions and Potential to Emit (PTE) levels have been calculated for the proposed Lenz Enterprises compost facility based on best available data, site specific testing, and actual operations as conducted at the Lenz facility. Baseline uncontrolled emissions for VOC and NH3 emissions were taken from the California Air Resources Board (CARB) Emission Inventory Methodology for Composting Facilities. Applicable reductions for emission controls were applied and tons per year were calculated for the facility. Table 3 summarizes results from this calculation.

Table 3 Estimated VOC and NH3 Emissions from the proposed Lenz Compost Facility

Pollutant	Tons/year
VOC	44.44
NH3	2.925
CO	3.85
NOx	17.78
PM10	4.45*
SOx	1.16
HAP	2.39 **

* PM results include Road Dust Emission Factors (see Environ 2013 report for details)
** See emissions report for details.

References

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16. Report on Revision to 5th Edition AP-42 Section 3.4 Large Stationary Diesel and All Stationary Dual-fuel Engines.
17. Understanding biofilter performance and determining emission concentrations under operational conditions. ER36 Final Report June 2014.
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19. Phase II SBIR Grant Final Technical Report: The development of a low cost, environmentally compliant on-site animal manure management composting technology. 2008.

APPENDIX A: Supporting Documentation

RE: Lenz compost emission factor

Jobson, B Thomas tjobson@wsu.edu

Sent: Tue 7/16/2019 10:52 AM

To: Edward Wheeler

Hi Ed,

I was out on a bit of a break so haven't been thinking about compost emissions lately.

Returning to your pile and using the new dimensional data.

I'm assuming a total VOC emission rate of 237.9 g / m^2 from the measured compounds over the ASP lifetime of 30 days. We are missing ethanol and methanol data so this value is an underestimate of total VOC emissions. The total VOC was simply found by summing up concentrations of VOCs identified in our GC-MS analysis.

Assuming a wet compost density of 1000 lbs / yd^3 the VOC emission factor would be:

VOC emission factor = (237.9 g /m^2)(195 m^2) / (778 yd^3)(1000 lbs/yd^3)

VOC emissions factor = 0.3 lbs / wet-ton

So this is a pretty rough estimates. I would bet your emission are no greater than 1 lbs total VOC / wet-ton. The missing methanol and ethanol and other stuff (like acids) that didn't get measured or quantified might double this value.

Cheers

Tom

Project Memo
272-038-4

engineered COMPOST systems

DATE:	5/29/19	ECS PROJ. NO.:	P272-038
BY:	Tim O'Neill, Geoff Hill	PROJECT NAME:	Lenz Phase II
TO:	Edward Wheeler	COPY TO:	Jason Lenz
SUBJECT:	VOC emissions from ECS Negative CASP and generic Positive CASP		

RESPONSE REQUESTED

Yes	X	No		Hard Copy		E-Mail	X	Phone Call	

Overview

ECS has been tasked with providing an estimate of VOC emissions that could be expected from a negative CASP passing through a wood chip biofilter and a positive CASP passing through a moist bio-cover layer. Together these estimates could be used to estimate the VOC emission associated with a reversing CASP system as is planned for the Lenz Phase II expansion (and currently operating). We have also included recent emission results from food waste piles at Napa, CA.

Negative CASP Emissions

A private client in Southern California installed an ECS system two years ago and has conducted third party source testing, with the approval from the South Coast Air Quality Management District (SCAQMD), of the air emissions. Emissions were measured using the full EPA (South Coast) 25.3 methodology. Given the negative aeration, the SCAQMD was not concerned with emissions from the pile surfaces; only the emissions from the biofilter were sampled and analyzed. The system is not a LFT aeration floor like Lenz, but a pipe on grade aeration floor which is likely to deliver less uniform air distribution and thus have the potential for hot spots with higher emissions. Also this facility processes as high as 40% food waste combined with green waste in a rough mix. All in all, this facility provides a fairly conservative comparison for emissions from a negative CASP with LFT aeration floor and lower amount of food waste in the mix.

The source testing results were as follows:

Emission	**Post biofiltration (lb/wet ton)**
VOC (as CH4)	0.0018
NH3	0.00073

Positive CASP Emissions

CalRecycle conducted a full-scale research project in the spring of 2013 at an composting facility in Tulare California which included extensive side-by-side source testing on a positively aerated bio-layer Covered ASP and unaerated turned windrows. All side-by-side test were conducted using the same feedstock mix of green waste and food waste. Emissions were measured using the full EPA 25.3 methodology. The positive CASP's were shown to reduce VOC emissions by 98.8% over the unaerated windrows, despite having very poorly design aeration systems. To suppress VOC emissions the CASP surfaces were consistently irrigated with sprinklers with application rates averaging 3" per day. This kept the surfaces cool and moist to readily absorb and bio-oxidize the VOCs. It was noted that water penetrated two feet deep in some places. Based on reasonable assumptions we calculate that 1.3x the mass of wet mix was added in mass of water over the 22 day retention period. From ECS experience, as much as 0.5x the weight of compost mix is needed to mitigate moisture loss through to a well stabilized compost in an aerated turned system. The water use during the trial was excessive yet achieved very high VOC reduction control despite a poorly designed aeration system. A reversing CASP system with top cover irrigation control could be expected to perform similarly if the surface of the CASP is cool and moist.

Emission	Post wet cover-layer (lb/wet ton)
VOC (as CH4)	0.099
NH3	0.017

The results are published here:

Summary: https://www.calrecycle.ca.gov/organics/air

Full report: http://www.valleyair.org/Grant_Programs/TAP/documents/C-15636-ACP/C-15636_ACP_FinalReport.pdf

Fresh Tipped Food & Green Waste Piles at Napa CA

An ECS client hired ECS and a fully approved source testing company to measure the fluxes from their raw feedstock piles. The following are surface emission flux rates (lbs VOC (as CH4) per wet ton of feedstock contributing to the emission surface per day of retention time) measured using the 25.3 methodology.

Emissions (lb/wet ton/day)	Coffee	Food 2	Food 3	Green 1	Green 2
VOC (as CH4)	0.01	0.1	0.2	0.03	0.04
NH3	0.00026	0.00035	0.0004	0.0002	0.00021

VOC sources not covered, but usually low compared to feedstock piles and primary composting:

- Curing (usually 10% of active processes)
- Storage piles (minimal contribution especially if stabilized material dominates the pile)
- Screener (hard to measure)
- Windrow turning (hard to measure)

Conclusion

An estimate of primary composting in a reversing CASP can be made as the average of the emission factor from the positive CASP and negative CASP data from above (0.05 lbs VOC as CH4 per wet ton feedstock). In order to achieve this emission factor, the full planned retention time would need to be followed, a BMP mix would need to be the norm, the facility would need to be maintained in optimal condition as per our O&M manual, and the biofilter and biocover layer would need to be kept moist (perhaps quite moist).