WSU COMPOSTING - TECHNICAL SUPPORT DOCUMENT
APPROVAL ORDER 17AQ-E034

WSU operates a composting facility at its WSU campus. The facility converts bedding and manure from agricultural research facilities at the university into compost. It also makes compost of yard wastes and of animal carcasses from the ag research facilities and offal from the meat processing facility on campus. The modification proposed to the air quality order regulating this facility is to alter the list of allowable feedstocks so that WSU can do a pilot study of composting human remains in a modified in-vessel composter: the Urban Death Project. The in-vessel composter was a single rotary drum composter 66 ft long and 5 ft in diameter. For this project it will be divided into three 22 foot sections so that the pilot study can be isolated from other composting activity. Air emissions from this composting are not expected to change from those of composting other animal carcasses.

Process Data:

Composting Feedstock Materials: Type I, Type II, Type III, and limited research scale Type IV wastes are allowed to be composted at this facility. In addition, animal carcasses or offal (in either static piles or the IVC) and human remains (in the IVC only) are approved feedstocks upon issuance of 17AQ-E034.

Type 1 Feedstocks are defined as source-separated yard and garden wastes, wood wastes, agricultural crop residues, wax-coated cardboard, pre-consumer vegetative food wastes, other similar source-separated materials that the jurisdictional health department determines to have a comparable low level of risk in hazardous substances, human pathogens, and physical contaminants.

Type 2 Feedstocks are defined as manure and bedding from herbivorous animals that the jurisdictional health department determines to have a comparable low level of risk in hazardous substances and physical contaminants when compared to a type 1 feedstock.

Type 3 Feedstocks are defined as meat and post-consumer source-separated food wastes or other similar source-separated materials that the jurisdictional health department determines to have a comparable low level of risk in hazardous substances and physical contaminants, but are likely to have high levels of human pathogens.

Type 4 Feedstocks are defined as mixed municipal solid wastes, post-collection separated or processed solid wastes, industrial solid wastes, industrial biological treatment sludge, or other similar compostable materials that the jurisdictional health department determines to have a comparable high level of risk in hazardous substances, human pathogens and physical contaminants.

Compost Facility Production Rates: Expected actual compost production: 10,000 tons per year finished compost. Facility maximum production capacity, 18,000 tons finished compost per year.

Aerated Static Pile Composting: The aerated static piles are operated under vacuum year-round. The blower draws air through the pile and forces it into and through the static pile biofilter.

Static Pile Layout and Equipment:

1. Blower: 50 HP Blower with variable speed drive, 14,500 cfm at 10" SP wg.
2. Biofilter: 37 ft long x 52 ft wide (=1924 sq ft), 3 ft bed depth (min) 45 second contact time (min), media mix-1 part finished compost to 3-5 parts wood chips/bark
3. Up to 12-90 ft long piles: 2-peak demand composting piles at 12 cfm/ton or 2640 cfm to biofilter, 10 average demand at 3 cfm/ton or 2640 cfm to biofilter. Total to biofilter 5280 cfm.

In-Vessel Composter (IVC)

1. Horizontal rotating drum, 66 ft long, 5 ft in diameter. To be separated into 3 interconnected sections, each 22 ft long, to pilot composting of human remains.
2. HEPA filter. Gases generated in the IVC will first pass through a HEPA filter and then into a pair of biofilters which are operated singly or in parallel.
3. Blower: 1 HP
4. Biofilters (2)- 8 ft wide x 20 ft long (160 sq ft), maximum loading rate 4 cfm/sf, 3 ft deep bed, with 1 part finished compost to 3-5 parts wood chips and bark

Trommel Screen

All compost at the facility is screened using a trammel screen which is currently powered by a 66 HP John Deere diesel engine. The screen used currently is a 2005 Wildcat 516-Cougar. This screen and diesel engine is to be managed as a non-road engine and will not be subject to new source review if the WSU Compost facility follows all requirements for non-road engines. Those requirements include that it is moved off of the WSU campus for a period each year and that WSU provide notification to Ecology when it is returned to the site and how long it will be there.

ESTIMATED EMISSIONS:

For the change to compost human remains using the repurposed IVC, there will be no change to the emissions estimated for the 2008 Approval Order. Actual and maximum compost production, 10,000 and 18,000 tons per year, are not changing. Adjusting the 2008 emission estimates for changes to WAC 173-460, results in the following:

Estimates of emissions for total criteria pollutants and fugitive air pollutants from composting at expected annual compost production (10,000 tons produced) and maximum potential annual production (18,000 tons produced) are given below. The estimates for all pollutants including NOx are based on information compiled by Tom Clark from the Olds College Composting Technology Centre and do not include any NOx removal at the biofilter. Mr. Clark's NOx emission estimates are extremely conservative. Composting operations that maintain 30:1 carbon to nitrogen ratio are more likely to emit ~5% of the maximum potential NOx emissions. Robert

Koster adjusted these to 10% of the total estimated by Tom Clark to account for the careful maintenance of C:N ratios at the WSU facility.VOCs are based upon a 90% capture of compost gases and 90% removal at the biofilter.

Criteria Pollutants	Actual Emissions (tons/yr)	Maximum Emissions (tons/yr)
NOx	1.17	2.10
VOC	1.06	1.91

Fugitive Air Pollutant	Actual Emissions (lb/yr)	Maximum Emissions (lb/yr)
Particulate Matter	0.45	0.82

The potential total toxic air pollutant emissions from composting were estimated by assuming the worst case conditions for aerobic composting at a maximum annual production of 18,000 tons finished compost. The estimates are based upon 90% capture of compost gases and 90% removal of the toxic air pollutants at the biofilter except for NO2 which is assumed to be released without reduction by the biofilter.

Toxic Air Pollutant	Maximum Emissions (lb/yr)	ASIL (ug/m3)	SQER (lb/avg period)	Modeling Needed?
Ammonia	1034.7	70.8	9.31/24 hr	no
Hydrogen Sulfide	10	2	0.263/24 hr	no
Carbon Disulfide	17.4	800	105/24 hr	no
Nitrogen Dioxide	4200	470	1.03/ hr	no

BACT, T-BACT: There is no change to these determinations from those of the 2008 approval: Composting shall be aerobic, no odors or visible emissions shall cross the facility boundary, and composting shall be performed as prescribed in the facility permits and SOPs administered by the Health Department

PERMITTING HISTORY

On June 6, 2017, WSU submitted an NOC application to separate the IVC into 3 interconnected, batch-operated rotary composters, and to pilot composting of human remains (the “Urban Death Project”). Approval Order 17AQ-E034 incorporates the IVC modifications, cleans up the approval order to remove technical support information inserted into approval conditions in 12AQ-E471, and revises emission estimates to remove reference to toxics requirements that are no longer in or have changed in WAC 173-460.

On June 11, 2012, WSU submitted a Notice of Construction (NOC) application for modifications to its composting operations to allow for use of an in-vessel-composter (IVC) developed by ECO Drum at the WSU Compost facility. Approval Order No. 12AQ-E471 was issued to approve the IVC. The IVC was designed as a continuous rotary composter, 5 feet in diameter and 66 feet long. Originally, the plan was to use 2 of these IVCs, but by 2017, it was determined by WSU that the systems did not work as well as WSU required and the single IVC installed by that date was divided into three pieces, still interconnected, but to be operated in batch mode and to be

used as a pilot project for the composting of human remains (the "Urban Death Project"). Approval Order 17AQ-E034 incorporates the changes to the IVC into the compost facility (NOC) approval order, and once again, removes technical support information from the approval conditions section of the approval order.

The original composting facility utilized windrow composting of animal manure, soiled animal bedding, coal ash from the Power Plant, Dining Center food wastes, and yard waste collected from campus facilities. The compost facility design is intended to keep the compost materials aerobic during the composting process, as outlined in the Standard Operating Procedures manual. Finished compost is land applied for agronomic use by crops and pasture on WSU property, and re-used as bedding at various animal husbandry facilities at WSU.

In July 2007 WSU installed an aerated static pile composting system that operates under both positive and negative pressure and biofilter at their existing composting operation. On September 14, 2007 Ecology received the semi-annual monitoring report required by AOP No. 02AQER-4553, 3rd Revision. In it, WSU reported initiation of a pilot study on composting animal carcasses and slaughter offal at their composting facility. On October 10, 2007, WSU submitted updates to the standard operating procedures (SOP) for the compost facility to Ecology. Changes to the SOP included both aerated static pile composting with a biofilter and changes to compost feedstock materials to include composting of slaughter offal from WSU Meats Lab and livestock carcasses. At the time Ecology learned of them, the changes to composting operations had already been made without modifications to the compost facility approval order.

As part of the Notice of Construction modification process, WSU indicated that they were planning to increase the amount of finished compost produced over the next year at the facilities' design capacity of up to 18,000 tpy finished compost. To achieve compost production at this level, WSU plans to add two more aerated static piles or add two aerated compost vessels. The aeration system collection equipment and biofilter installed on campus in 2007 were designed to treat composting emissions from operation at full capacity (18,000 tpy).

The 2008 NOC process is intended to update the types of feedstock accepted for composting at WSU and review adequacy of the biofilter to control composting emissions from the aerated static pile composting system, at current levels of operation (10,000 tpy finished compost) and at full design capacity (18,000 tpy finished compost).

Process Data

Composting Feedstock Material:	Type I, Type II, Type III and limited (research project scale) Type IV, as defined in WAC 173-350-100
Aerated Static Pile Composting	
Expected Annual Production:	10,000 tons finished compost
Maximum Production @ Capacity:	18,000 tons finished compost
Positive vs Negative Pressure Operation:	Anticipate positive pressure from December – March Anticipate negative pressure from April - November
Blower Type:	50 hp Supply blower w/ VFD
Blower CFM:	14,500 cfm at 10" SP (w.g.), positive or negative
Aeration Zones:	(10) total aerated static pile zones, at 5280 cfm to biofilter: (2) "peak" demand compost (12 cfm/ton or 2640 cfm) and (8) "average" demand compost (3 cfm/ton or 2640 cfm)

Aeration Zones @ Capacity:	(12) total aerated static pile zones, at 5940 cfm to biofilter: (2) "peak" demand compost (12 cfm/ton or 2640 cfm) (10) "average" demand compost (3 cfm/ton or 3300cfm),or Combination aerated static piles plus vessels, at 5480 cfm to biofilter: (10) aerated static pile zones (5280 cfm), and (2) 30 yd^3 vessels (~5 tons material per vessel) w/ onboard mixers to prevent pathogen contamination (20 cfm/ton peak aeration or 200 cfm total)

Biofilter

<u>w/ negative pressure aeration</u>	
Dimensions:	37' L x 52' W (rectangular) = 1924 ft^2
Biofilter Loading Rate:	4cfm/sf (maximum)
Contact Time at operational flow rate:	45 seconds (minimum)
Bed Depth:	3' (minimum)
Media Mix:	1 part finished compost to 3-5 parts wood chips/bark
Biofilter Target Temperature:	< 100°F
Biofilter Target Moisture:	40 – 60%
Biofilter Expected Porosity:	75 -90%
Biofilter Expected pH Range:	6.5 – 8.5
<u>w/ positive pressure aeration</u>	
Thickness/Type of biofilter on pile:	12 - 18" finished compost
Expected Control Efficiencies:	based on 90% capture of compost emissions, 90% removal of ammonia and VOC at Biofilter 95% removal of hydrogen sulfide at Biofilter 98% removal of mercaptans/sulfides at Biofilter

2. ESTIMATED EMISSIONS

2.1 The estimated emissions are based upon producing a maximum of 18,000 tons per year from aerated static pile (or vessel) composting on ~4.4 acres.

2.2 The raw feedstocks accepted to produce finished compost are Type I, Type II, Type III and limited (research project only) Type IV feedstocks, as defined in WAC 173-350-100 Solid Waste Handling Standards, approved for composting in the Whitman County Department of Public Health permit, and described in the WSU Compost Facility Standard Operating Procedures (SOP). Increasing composting acreage or changing the types of materials may require that another Notice of Construction be submitted.

2.3 Estimates of emissions for total criteria pollutants and fugitive air pollutants from composting at expected annual compost production (10,000 tons produced) and maximum potential annual production (18,000 tons produced) are given below. The estimates for NOx are based on information compiled by Tom Clark from the Olds College Composting Technology Centre and do not include any NOx removal at the biofilter. NOx emission estimates are extremely conservative. Composting operations that maintain 30:1 carbon to nitrogen ratio are more likely

to emit ~5% of the maximum potential NOx emissions. VOCs are based upon a 90% capture of compost gases and 90% removal at the biofilter.

Criteria Pollutants	Actual Emissions (tons/yr)	Maximum Emissions (tons/yr)
NOx	11.67	21.0
VOC	1.06	1.91

Fugitive Air Pollutant	Actual Emissions (lb/yr)	Maximum Emissions (lb/yr)
Particulate Matter	0.45	0.82

2.4 The potential total toxic air pollutant emissions from composting were estimated by assuming the worst case conditions for aerobic composting at a maximum annual production of 18,000 tons finished compost. The estimates are based upon 90% capture of compost gases and 90% removal of the toxic air pollutants at the biofilter.

Toxic Air Pollutant	Maximum Emissions (lb/yr)	ASIL (gr/m3, 24 hr avg)	SQER (lb/yr)	Modeling Needed?
Ammonia	1034.7	100	17,500	no
Hydrogen Sulfide	10	0.9	175	no
Methyl Mercaptan	5.6	3.3	175	no
Ethyl Mercaptan	7.3	4.3	175	no
(1,2)-Propyl Mercaptan	8.9	not listed in -460		n/a
Dimethyl Sulfide	7.6	not listed in -460		n/a
Carbon Disulfide	17.4	100	17,500	no
Carbon Oxysulfide	6.9	none given in -460		n/a

Modeling was not performed since controlled maximum (PTE) emissions do not exceed the SQERs for any of the toxic air pollutants. Three of the toxic air pollutants expected from composting were either not listed in WAC 173-460 or no ASIL was identified. No further review was performed for these pollutants. The controlled maximum (PTE) emissions and the SQERs are listed for comparison above.

3. BACT

As required in WAC 173-400-113(2), this project shall use Best Available Control Technology (BACT) to control emissions. As proposed, the facility will utilize the following technologies and procedures to attain BACT.

3.1 NOx and VOC - The facility shall follow the provisions prescribed by the Whitman County Department of Public Health permit. The facility shall follow the procedures described in the WSU Compost Facility SOP for aerobic composting.

3.2 Fugitive emission points – The facility shall follow the fugitive emission control procedures described in the WSU Compost Facility SOP.

4. T-BACT

As required in WAC 173-460-040(4)(b), this project shall use Best Available Control Technology for Toxics (T-BACT) to control emissions. In addition to BACT noted above, the facility will use the following pollution control technologies and procedures to attain T-BACT.

4.1 Toxics – The facility shall compost feedstocks identified in this application in aerated static piles (or vessels) designed to maintain aerobic composting. Composting emissions shall be captured and discharged through a properly designed Biofilter. The facility shall follow the procedures described in the WSU Compost Facility SOP.

On August 16, 1995, Washington State University (WSU) submitted a Notice of Construction application for expansion of the existing compost facility located on Dairy Road at WSU Main Campus in Pullman, Washington in Whitman County to approximately 4 acres. The legal description is the NW ¼ , SE ¼, Section 4, Township 14 North, Range 45 East, of the Willamette Meridian.

The original composting facility utilized windrow composting of animal manure, soiled animal bedding, coal ash from the Power Plant, Dining Center food wastes, and yard waste collected from campus facilities. The compost facility design is intended to keep the compost materials aerobic during the composting process, as outlined in the Standard Operating Procedures manual. Finished compost is land applied for agronomic use by crops and pasture on WSU property, and re-used as bedding at various animal husbandry facilities at WSU.