Considerations when designing and operating a large composting facility

Feedstocks & Health and Safety

Compost Method & Pad Design

Location & Infrastructure

Water Management

Odor Management

Monitoring & Testing of finished Compost

Helpful Tips

Feedstock

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Health and Safety

Feedstock Considerations

- Consider your ideal C:N ratio.
  - Range of 20:1 to 40:1 - (optimal is 30:1)
  - How will you gauge C:N ratio? Will depend on type of feedstock accepted.
- Estimate amount of feedstock per day/wk/mo, that facility can handle.
- Bulking agents, Is there a limited supply?
- How to manage/calculate bulk density and porosity?
- Is the feedstock high risk? (i.e. food waste, livestock mortality) incorporate immediately, do not stockpile

Feedstock

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Health and Safety

Health and Safety

- Address pathogens, dust, heat, fires, fumes, Volatile Organic Compounds (VOC’s), infectious agents (Prions, allergenic microorganisms, Dust, Toxins, Noise and PPE
- Assure operational flow is done in a manner to prevent accidents.
- Is there a plan to respond to equipment spills and fluid leaks?
- Are safety guards properly installed on equipment? Is there a safety plan to address equipment blockages?
- Are employees trained on the safety plan and procedures?

Compost Method

Compost Method

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Pad Design

- Static Piles - slower process, air supply, how to avoid going anaerobic?
- Turned windrow - Odors & isle space considerations. Evenly shaped windrows have fewer dry spots and process more evenly.
- Aerated Static pile - usually placed on perforated piping, providing air circulation for controlled aeration.
- In Vessel - air flow and temperature can be controlled, using the principles of a bioreactor.
- Method choice may dictate row width and may limit space/capacity at the facility.

Compost Method

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Pad Design

Pad Design

- Concrete, asphalt, lime stabilized, compacted clay, etc.
- Impermeable pads do not prevent leachate generation, but they can allow you to collect, store and sue this liquid appropriately or treat.
- Pads do not last forever. Incorporate price of pad upkeep or new pads in facility design phase.
- Fact sheet on Pad design - http://www.manuremanagement.cornell.edu/Pages/General_Docs/Fact_Sheets/compostfs6.pdf

Location

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Infrastructure

Location

- Buffers – Use distance, trees and existing buildings as buffers to keep noise, dust and odors form neighboring properties.
- Zoning – does the city or county require a conditional use permit?
- Meteorological data – look at the 5 yr data showing prevailing wind speed and direction. Can be helpful in odor management.
- Is location close to Materials and Markets? Are roads and utilities available?
- Is there room for future expansion?

Location

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Infrastructure

Infrastructure

- Is site operational seasonally or year round? Storage issues?
- Is the site firm enough to support heavy equipment during periods of high rain?
- Layout of the facility:
  - Will the finished compost be store on the higher side of the site to avoid being contaminated by materials with higher pathogen content?
  - What is the process flow? Create a layout that allows smooth, safe movement of the material and equipment through the site and minimizes leachate generation and extra steps.

Location

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Infrastructure

Infrastructure, continued

- Allow enough space between areas to manage the compost and maintain the site.
- Will there be berms placed to divert water away from the pile?
- Reserve uncovered storage space for building agents and very stable feedstock.
- Sod in alleyways may improve traction and reduce runoff. Mow the grass periodically during the growing season and incorporate into your compost piles.

Water Management

Water Management

- Run-on, leachate, roof drains, wash-water management.
- Avoid compost sitting in water as it may cause odors and rotting issues.
- Grass lined storm water ditch to prevent run-on and capture run-off.
- Possibly place mulch chips on perimeter to catch liquids
- Moderate slopes reduce pooling (1%-2%), excessive slopes accelerate the rate at which water leaves the site and may promote erosion.

Water Management

Water Management

- Covers may prevent storm water from coming into contact with high-risk feedstock and can prevent leachate generation.
- Orient piles parallel to the slope to minimize leachate production during high rainfall.
- A freshly turned pile is optimum time to add moisture if needed as it is accepted well.
- Water added to finished compost may make compost unsellable.
- Dome shape of compost pile will help with water runoff, flat tops allow it to soak in and may cause issues.

Odor Management

Odor Management

- Description of meteorological conditions. Obtain 5yr. history, use windsock etc.
- Develop a complaint response protocol. Be proactive!
- Have a detailed plan for where odors come from:
  - Feedstock receipt
  - Odors from preparation of feedstock for composting
  - Odors from active composting (will there be compost cover, hoop building, bio filters etc.?
  - Odors in the curing process
- Common odors include ammonia, urea, hydrogen sulfide, mercaptans.

Monitoring

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Testing of finished compost

Monitoring

- How often will you monitor temperature? What is optimum temperature and for how long? What equipment will be used?
- How will oxygen be monitored, and at what frequency?
- How will moisture be monitored? What is optimum, how will it be tested and who will issues be addressed?
- Are there Standard Operations Procedures (SOP's) in place for monitoring each parameter?

Monitoring

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Testing of finished compost

Testing of finished Compost

- How long is the curing process? Will it change with each feedstock?
- What is the sampling method used for testing?
- Is there a Standard Operation Procedure (SOP) in place for the testing of *finished* compost?
- Is the market for the compost ongoing? Avoid stockpiling
- If offered for sale as a soil conditioner or fertilizer, is it registered with the Department of Agriculture and Land Stewardship?

Helpful Tips

Helpful tips

- The amount of reduction depends on the type of feedstock. Plant materials recue more than manure, which reduces more than wood products or soil. A rough guide to reduction might be that curing piles are about 55% of the original feedstock volume and finished compost is about 45%.
- Allow room for alleyways and pile edges. You do not want to drive over compost and need to avoid compactions. Windrow turners require about 25 to 45 feet to turn at the end of each row. Front end loaders require at least that, if not more.
- Make sure the compost is protected from contamination from fueling stations or pesticide mixing areas.

Helpful Tips

Helpful tips, continued

- The practices that protect water quality also contribute to the production of high quality compost. Composting proceeds efficiently where there is adequate moisture and porosity, and a good carbon-to-nitrogen ratio.
- Correct moisture content is an important variable in compost management. Water holds five times as much heat per gram as compost. Generally, a moisture content of 60-65 percent is ideal during the first 2 to 3 weeks of composting. Moisture content below 40 percent by weight severally limits composting. When the weather is very hot, actively composting piles can lose as much as 2-3 percent of their moisture per day.

Helpful Tips

Helpful tips, continued

- The molecular form of carbon-rich material influences its susceptibility to decomposition. Fresh, soft, green leaves, fruits, and processed grains contain carbon in the form of simple sugars. Bacteria readily digest these materials, often within 2 to 10 days. This form of carbon is called available carbon.
- Straw stems, hulls, bark and wood are made of cellulose, hemi-cellulose and lignin. These complex carbons are more resistant to decomposition. In active compost piles, many of these materials will decompose fairly quickly, but larger wood particles do not.

Helpful Tips

Helpful tips, continued

RELATIVE WATER QUALITY RISK OF CONTRASTING FEEDSTOCK

**based on procession experience and judgement of OSU Extension.

Feedstock	Nutrient content	Pathogen Content	Relative risk to water quality
Ground wood or bark	Low	Low	Low
Fallen deciduous leaves	Low	Low	Low
Ground woody yard debris	Low	Low	Low
Ground leafy yard debris	Medium	Low	Medium
Wood shavings with some horse manure	Low	High	Medium
Separated dairy solids	Low	High	Medium
Vegetable packing waste	Medium	Low	Medium
Vegetative food waste	Medium	Low	Medium
Mixed food waste	High	Medium	High
Bedding and manure	Medium	High	High
Concentrated manure	High	High	High
Livestock mortalities and slaughterhouse waste	High	High	High

Helpful Tips

Helpful tips, continued

COMPOSTING METHODS: OVERALL PERFORMANCE			
Method	**Cost**	**PFRP**	**Time to finished compost**
Windrow – Front-end loader	Minimal added investment	May not consistently meet PFRP with infrequent turning	6-12 months
Windrow – Windrow turner	Specialty equipment	Routinely meets PFRP in 15 days with 5+ turns	2-6 months
Aerated Static Pile (ASP)	Engineering design consultation advisable	Routinely meets PFRP in 3 days.	2-4 months. Usually ASP for 2+weeks, until temperature drops. The, curing for 1-3 months.
****PFRP is a composting process that meets prescribed conditions for human pathogen control**			

Helpful Tips

Helpful tips, continued

COMPOSTING METHODS: SPACE REQUIREMENTS				
Method	**Space**	**Height**	**Width**	**Distance between piles**
Windrow – Front-end loader	Largest site	5-8 feet	Base: 12-18 feet	Aisles wide enough for bucket loader and other equipment
Windrow – Windrow turner	Intermediate	Dictated by turner height	Dictated by turner width	Depends on turner. Self-propelled units allow narrow alleyways. Wider aisles for tractor-mounted units. Aisle cleanup may be hand labor.
Aerated Static Pile (ASP)	Smallest site for active (hot) composting. Same are needed for curing as with other methods.	8-12 feet	Dictated by pipe and blower capacity.	Saves space because PFRP is rapidly met and active composting area is reused more often. Compost can be put into larger curing piles after about a month.

Helpful Tips

Helpful tips, continued

COMPOSTING METHODS: MANAGEMENT TASK COMPAIRISON			
Method	**Feedstock mixing**	**Turning frequency**	**Adding water**
Windrow – Front-end loader	Materials must be well mixed prior to forming windrows	Usually turned two or three times	Hard to do with turning
Windrow – Windrow turner	Turning provides additional mixing. Turning usually reduces particle size and porosity.	Usually turned more than four times during active composing and several times during curing.	Most turners can be equipped with a water supply hose to wet feedstock during turning.
Aerated Static Pile (ASP)	Feedstock must be well mixed and raised to the proper moisture level before ADP is formed.	Mix when ASP is taken down and moved to curing site.	Cannot add water after ASP is formed. Can add water when moving compost to curing site. Forced air movement through ASP increases rate of water loss.