Rural and Suburban Composting: Practices and Tools

Many municipalities are leading the call for more composting to reach their zero-waste goals. Success means achieving both biological and economic sustainability, and getting there means developing a process with appropriate technology for that unique site and opportunity.

By Steve Diddy

Appropriate technology has a local definition. What is appropriate technology at one composting facility is likely inappropriate at another facility with a different location, size, feedstock, environment, etc. For more than 15 years ECS has developed a Tool Kit of mature technologies to address these site specific challenges. Our Tool Kit approach enables us to be responsive to both the process requirements of a facility and the constraints of its business plan.

There are several factors that need to be investigated before deciding on which process technology is appropriate for a compost facility. All of these factors have an effect on CAPEX and OPEX. A few of the key factors are:

- Location and odor sensitivity of the site (proximity to neighbors)
- Annual tip tonnage
- Type of feedstocks
- Climate and topography
- Cost of labor and of capital
- Revenue from tip fees and product market
- Storage requirements
- Regulatory environment

Location and Odor Sensitivity of the Site and Throughput Annual Tonnage

Based on the 100+ facilities we've had some involvement with, we've developed a qualitative chart to help visualize the risk of odors in relationship to tons per year of throughput (tpy) and proximity to neighbors (**see Chart 1**). Bear in mind that this chart assumes the facility is operating per Best Management Practices (BMP's) at all stages of the compost process to minimize the production of, and to capture and control, odors at the site.

When you are first considering a new site, take a moment to measure the distances from the facility to the nearest odor receptors (this is quickly done on Google maps) and see what category it falls in on Chart 1. If by good fortune your neighbors are one mile away and you planned to process less than 40,000 tpy, you could reasonably assume that modest technology (with modest CAPEX) and operated per BMPs, could be successful. If, on the other hand, you are planning a facility at the same location with more than 120,000 tpy throughput the additional odor capture and control required to remain a good neighbor will rapidly drive up CAPEX. Through comprehensive process design, fully enclosing the facility, BMP operations and thoroughly scrubbing all exhaust air streams, it is possible to locate a large facility near to odor receptors. However, the economics in most markets do not yet support this approach. The majority of commercial scale facilities will fall somewhere in between these two examples.

Type of Feedstocks

The types of feedstocks also help determine what technology is appropriate for capture and control of odors and the overall odor risk of the site. Feedstocks, the individual components that you are wanting to compost, are not created equally. Nor do they have the same potential to create odors. Feedstocks are typically found in the categories such as yard waste, food waste, manure and other. Yard waste from the Pacific Northwest has more potential to create odors because it contain a larger percentage of wet green materials than does the comparatively drier browner yard waste from southern California. Food waste can be anything from 90 percent moisture and looking like bad soup to 30 percent moisture and looking like a bunch of napkins. (Food waste can also contain a high degree of contamination that can also lead to facility odors). And with manure, for example, there is a huge difference in the amount of odor potential between poultry manure and horse manure.

Climate

Besides the differences between Urban and Rural there are many aspects of climate that can make a difference not only to the technology choices but also to the facilities infrastructure. Local wind and topography play a strong role in impact of odor plumes on neighbors. Typically, the more extreme the weather the greater effect on CAPEX:

- Rain: For example, the Pacific Northwest, Atlantic, and Southern states both receive considerable annual rainfall. The dramatic difference is that the Northwest gets a little rain almost every day (at least it feels that way),

Chart 1: Odor sensitivity of site based on tons per year and proximity of receptors. Green – low; Yellow – moderate; Orange – considerable; Red – high; Black – extreme. Images courtesy of ECS.

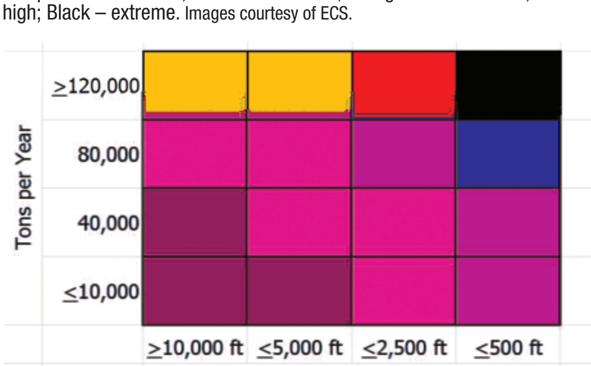

Chart 2: Commercial composting system types.

System Type	Range tons/day	Process Phase	Feedstock	Weather Considerations	Relative Cost
Stationary In-vessel	5 to no upper limit	Primary	All Organics	Excellent all weather operations.	High
Containerized In-vessel	1 to 50	Primary	All Organics	Excellent all weather operations. Deep snow could hinder operations.	High
TAP	5 to no upper limit	Primary & Secondary	All Organics	Excellent all weather operations.	Moderate to High
ASP	5 to no upper limit	Primary & Secondary	All Organics	Excellent all weather operations.	Low to Moderate
Fabric Covered ASP	5 to no upper limit	Primary & Secondary	All Organics	Not recommended for high wind or extreme cold	Moderate

sometimes just a drizzle, and rarely with high winds driving it; whereas the Atlantic states receive the bulk of their rain during the summer/fall months and it can be driven by high-wind storms and hurricanes.

- Snow: A little snow is nothing to design around; however, if there is deep snow that lasts for months at a time then the site configuration (mass-bed, bunkers, individual rows or piles) becomes more important as does an intelligent aeration control system that will monitor pile temperatures and not overcool piles that are struggling to maintain temperatures.
- Cold: The same for snow is true for cold. Freezing temperatures are not necessarily a design consideration until the temperatures fall to or below -20-30C and remain there for extended periods of time. Ice becomes an operational issue, process access is another and certainly an intelligent control system is warranted.
- Hot: Hot climates bring their own unique set of challenges and typically they include managing moisture in the compost piles to maintain BMP conditions and ensuring the capture and control features (especially for condensate/leachate) are operating within their design specifications.

Cost of Labor and Cost of Equipment

It's often the case that our municipal clients are willing to spend more CAPEX on equipment and site efficiencies in an effort to reduce a facility's demand for labor. Whereas our private clients may prefer to limit CAPEX expenditures in favor of spending more on OPEX.

Tipping Fee and Project Budget

A sustainable facility is one that is in regulatory compliance (including odors) and also operates at a profit. If the tipping fee is too low to build a facility in an Urban environment, then a reasonable option is to seek a more Rural site and hope the additional cost of transportation won't sink the Pro Forma.

Hands-On Approach

As mentioned above, the Tool Kit offers a variety of systems and components that are assembled for each unique project. They include Aerated Static Pile (ASP) systems with and without fabric covers, in-vessel systems (stationary

Location	Rural	Urban
Inception	2011	1998
TPY	60,000	60,000
Feedstocks	YW, FW, Biosolids	YW
Market	Agricultural	Wholesale
Total Footprint (acres)	40	8
Enclosed Area (ft2)	0	95,000
Roof only Area (ft2)	0	55,000
Pond/Tank Capacity (gal)	1,000,000	26,000
Rainfall (in/yr)	13	44
Min. Days on Air	30	30
Aeration Horsepower	60	300
Typical Time on Site	6 months	35 - 45 days

Chart 3: Rural and Urban composting examples.

	Rural	Urban
Min. Days On Air	15	50 or until shipped
Max Aeration Rate	Low - Moderate	High
Typical Time on Site	6 months	As few as 30 days
Typical Tip Fees ($/ton)	$25 - $40	$45 - $80

Chart 4: Guidelines for Rural and Urban facilities.

Best Management Practices (BMP's) for all composting processes

Property	BMP Range
% moisture by weight	55-60%
Density (settled)	900 lbs/yd3
Porosity	>30% free air space
Carbon/Nitrogen (a significant portion of carbon must be bio-available)	25-35:1 (ratio)
Mixing	Near Homogenous

Figure 1: ‰ • •…

Figure 2: CASP System Barr-Tech.

and mobile), Turned Aerated Pile (TAP) systems (combining the advantages of windrow turners and aeration), and system components including: aeration systems, aeration floors, a flexible control and monitoring system, a range temperature and airflow sensors, biofilter designs and feed stock mixers. These tools are mutually compatible and are used in various combinations to meet a client's process goals, odor control requirements and project budget. **Chart 2, page 27** gives an overview of the various the process system types and how they are most commonly employed.

Most commercial composting facilities refer to three phases of the compost process: they are primary composting (the most active phase and with the highest potential for odor generation); secondary composting (a less active phase however still has a potential for generating odors); and Curing (the least active phase assuming primary and secondary were well accomplished). The curing phase is often done without forced mechanical aeration and secondary composting and curing are often lumped into the same category.

Let's have a look how this information can work together to quickly determine a possible technology solution at two very different facilities. Barr-Tech and The Compost Factory are both located in the State of Washington. Barr-Tech is in a rural area and the Compost Factory is in a urban area. The rural facility is located where neighbors are sparse and therefore their need for odor capture and control is less imperative (and the opposite is true for urban facility). **Chart 3** shows a quick overview and comparison of the two facilities. Now let's take a closer look at each one.

Barr-Tech

The Rural facility is located on a 40-acre plot **(see Figure 1)** outside of Spokane, WA. They use an ECS AC Composter™—a fabric covered ASP system coupled with negative only aeration with all process air scrubbed by onsite biofilters. **Figure 2, page 29**, is a view of the facility layout. The term Covered Aerated Static Pile (CASP) system often refers to two different types of top-covered capture and control technologies: fabric and organic. The Barr-Tech facility uses both types. For primary composting they use a fabric covered system and for secondary composting they use ~12" of finished product on top of the ASP in-place of the biofilter. **Figure 3** shows the Rural Facility Material Flow/Compost Process.

Figure 3: Rural facility material flow compost flow.

The primary and secondary compost process takes about 30 days on aeration. The material is turned only once (at 15 days) and more moisture is added during this step to maintain BMPs. The curing time following primary and secondary composting is done without forced aeration and takes ~4 to 8 months. The large land plot occupied by the facility allows for the less expensive approach and longer curing times of the compost. The Barr-Tech facility makes a mature compost product and sells it in bulk and retail from this facility.

The Compost Factory

The urban facility is located in Puyallup WA with an airport, hospital and homes located nearby. Because of the urban environment, the process goals include a very high level of capture and control of odors, a fast processing and a small footprint. To achieve those goals the process technology selected is a Turned Aerated Pile System (TAP) inside an enclosed building. The on-air process time is longer than at the example Rural facility however the overall processing time is much shorter. And since the facility's footprint is much smaller the resulting layout in **Figure** 4 is more compact than at the rural facility. Note the green roof in **Figure 5** is the Compost Factory.

In total, the compost is aerated for 24 to 36 days and is turned eight times. Primary composting in TAP ranges from 18 to 24 days **(see Figure 6)**. This intensive turned, watered, and highly aerated process more rapidly stabilizes the product than most any other method. It also has a relatively high CAPEX. After the TAP it is moved outside to Secondary composting in a positively aerated ASP under a roof for 6 to12 days. The compost is then screened and shipped to customers that can accept a modestly stable product thus avoiding the creation of on-site stock piles.

Figure 4: TAP System Urban Compost Factory aerial diagram.

The keys to odor control at the Compost Factory are: keeping the compost constantly aerated (to keep Oxygen levels high and odor production low) from tipping to load-out, enclosing the primary composting process, scrubbing all of the exhaust air in a biofilter, having no stock piles, and having an operation that adheres to BMPs.

Selecting an Appropriate Technology

The facility design processes should start with thorough understanding the specific process and financial requirements of your site and business plan. Only then should you begin the analysis of the costs and benefits of various process technologies. This analysis sets up a tug-of-war between the desire for a highly controlled (lower risk) process and the need to control costs. Make sure your analysis includes the life-cycle costs (costs to own, operate, and maintain) and an odor risk analysis. Ask how you are going to maintain BMP's and good housekeeping at every step of the way. Then combine technologies and components that are appropriate for your site.

Figure 5: Compost Factory aerial.

Unfortunate there are too many examples of composting facilities being forced to close—typically because of odors. Some of these facilities have been quite recent, well publicized, and have included both low and high technology solutions. Poor planning, an over-reliance on a single technology or component, and not following BMP guidelines are common causes of failure.

Everyone in the compost industry is affected by each facility closure, and yet at the same time many municipalities are leading the call for more composting to reach their zero-waste goals. We believe success means achieving both biological and economic sustainability, getting there means studying all the variables listed above, and developing a process with appropriate technology for that unique site and opportunity. | WA

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Figure 6: Suburban facility material flow compost process.