INFORMATION NOTICE

July 2016 Ministry of Environment

Summary of General Composting Best Management Practices

Purpose

The ***Organic Matter Recycling Regulation (OMRR)*** applies in British Columbia to the construction and operation of composting facilities, and the production, distribution, storage, sale and use or land application of biosolids and compost (B.C. 2002).

A guideline entitled Compost Facility Requirements Guideline: How to Comply with Part 5 of the Organic Matter Recycling Regulation (the Guideline) was developed to assist proponents with Part 5 of OMRR (Forgie, Sasser & Neger 2004). This information notice summarizes some of the information found in the Guideline; focusing on considerations for siting, leachate and odour control, as well as general composting Best Management Practices.

Composting Facility Design

A Qualified Professional (QP) must prepare plans and specifications for the construction and operation of a new composting facility (regardless of capacity) or a modification of an existing facility (with some exceptions). *Nothing can replace good facility designs that control and treat odours and leachate and minimize noise.*

Siting

Selecting a composting site is a very important decision that will affect the overall long-term success of the facility. *Public participation in the site selection process is very important.*

Site Selection Considerations

Composting method	➢ Each composting method, and its accompanying equipment, will have different site requirements.
Topography	➢ Affects site drainage, facility visibility and, potentially, odour movement.
Proximity to land users	➢ Consider the site's proximity to other land users (e.g. residential areas). The facility will potentially impact sensitive individuals due to noise, odour, dust, etc.
Buffer areas	➢ Open fields and treed spaces can help avoid or mitigate environmental impacts.
Vectors	➢ Insects, rodents, etc. may transport diseases, depending on feedstock materials.

Fires	➢ Maintaining a buffer distance to trees can be prudent and a facility fire protection plan is required.
Weather conditions	➢ Rainfall patterns and prevailing winds will affect leachate generation and odour movement.
Wetlands & flood plains	➢ Sites should not be located in or near wetlands due to the higher potential for environmental impacts. ➢ Do not pick a site that is subject to flooding or where the seasonal high groundwater table is < 1 metre from the soil surface.
Site utilities	➢ Consider the need for access to infrastructure utilities including electrical service, phone service, domestic sewage treatment, and water lines.
Space requirements	➢ Consider the space needed for storing raw materials and finished product, curing, and odour and leachate control measures (berms, sediment ponds, etc.).
Vehicular traffic	➢ Access to the facility should be easy and should be over wide, paved roads through non-residential areas.
Travel distance	➢ Travel distances to raw materials and to product purchasers should be minimized.
Local zoning	➢ Some municipalities forbid composting facilities or restrict their location.

Leachate

Leachate is water, either from rainfall, snowmelt or intentional addition, which has come into contact with organic materials within the composting facility. Leachate management should focus on reduction and re-use, leaving treatment as the option of last resort.

Key Factors for Leachate Control:

- *Drainage:* the OMRR requires that leachate be proactively managed through the provision of impervious surfaces, covers, curbing and a collection system.
- *Buffers:* maintain a buffer between the site and surface or groundwater resources. A minimum of a 1 metre vertical buffer and 15 – 30 metre horizontal setbacks are recommended.
- *Site layout:* can influence leachate generation. For example, windrows should run up and down slopes to allow run-off to move between piles, rather than through them.
- *Pile shape:* flat or concave tops retain water and a convex or peaked shape sheds water.
- *Slope:* a 1% or 2-4% land slope is desirable to prevent run-off and leachate.
- *Site grade:* should be designed so that liquid leachate can flow to a centre point for collection.
- *Gutters:* can be used in open compost systems to drain leachate into a collection pond.
- *In-vessel channels or containers:* used in a closed system to drain leachate into a holding tank.
- *Run-off management:* includes soil treatment, filter strips, recirculation, or sediment traps.
- *Leachate treatment:* decisions regarding treatment methods are left to the discretion of a Qualified Professional.

Odours

Odour is perhaps the most common problem associated with composting. Although a well-constructed and well-operated compost system will not be odour-free, it should not produce offensive odours. Odours from the compost system typically arise if process conditions (mix composition, moisture content, aeration conditions, temperature, etc.) are not optimal.

Key Factors Relating to Odour

Feedstock degradability	➢ Understanding the amount and type of food available to the degrading organisms in each feedstock is important. ➢ For odour control, the composting process should be directed to aerobic degradation. The greater the percentage of aerobic degradation, the less potential for undesirable odour emission.
Aeration	➢ Odour problems are often the result of anaerobic (low to no oxygen) conditions. The compost pile or windrow must be aerated or turned during active composting to promote oxygen transfer and aerobic conditions.
Microorganisms	➢ If you do not have the right microorganisms in the compost to complete oxidation, some metabolic processes end with odorous compounds even if oxygen is present.
Temperature	➢ High temperatures may result in the generation and release of more odorous gases. ➢ Higher temperatures typically only cause odours if there is not enough oxygen.
Moisture content	➢ Moisture maintains temperatures (through evaporation). ➢ Excessive moisture reduces porosity and increases compaction, thereby limiting the movement of air into the mass. Strong, musty odours may be a sign that the mix is too moist. ➢ Moisture content should be 45-65%. However, 50-60% is the most successful range.
pH levels	➢ For odour control, compost material should have a pH at or slightly below neutral (pH = 7). Where odours do not present a problem, a pH of 8 or 9 is acceptable.
Good housekeeping	➢ Eliminating sources of odour like wet feedstocks and stagnant water is an inexpensive and effective way to prevent odour production.
Dust control	➢ Minimize dusty conditions, which tend to carry odours off-site. Spraying water on dirt or gravel roads can reduce dust.
Visual buffers	➢ Visual buffers such as trees and shrubs around composting areas may help reduce odorous air streams and also the number of complaints.

Every composting facility operator should have an Odour Source Control Strategy. This would include the types of odours, conditions which lead to odour release, practices that reduce odour potential and the potential for impact to neighbouring land uses.

It is highly recommended for a discharger to document odour complaints in a record book.

Figure 1. An aerated static pile system with a fabric cover for moisture and odour control.

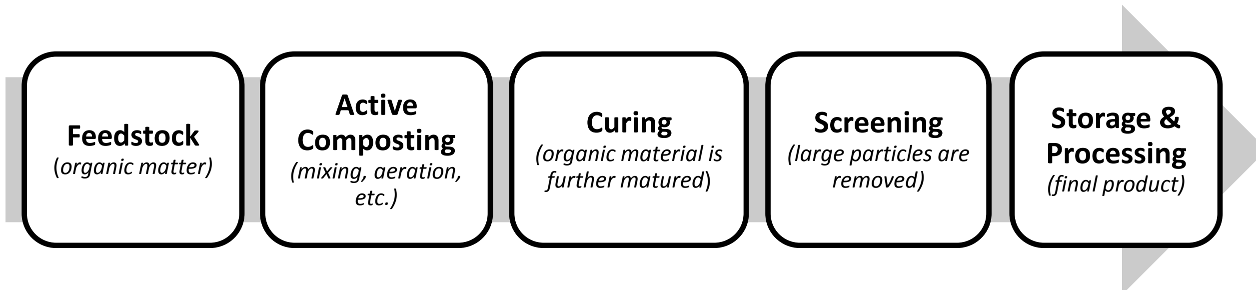
Tools for Identifying Potential Odour Problems

Experience at similar facilities	➢ The exchange of verified technical information on emissions before and after process modifications is valuable in identifying and selecting process/facility odour control adjustments.
Laboratory analysis & field measurement of air volumes	➢ The analysis of specific compounds is useful when known compounds are the primary sources of odour. ➢ Analysis using an odour panel is normally the most effective method because of the complex mix of compounds that contribute to odours. ➢ The emission of odour can be calculated if the odorant concentration and air volume is known. The rate of emission is a critical factor in determining the potential for off-site odour impacts.
Odour modeling	➢ Odour modelling uses the odour emissions from all sources, historical weather data and local topography to estimate the off-site odour levels that would be experienced over a historical period of 3-5 years. ➢ It provides the technical basis for the need to make process modifications and it can be used to evaluate alternative improvements with minimal cost.
Source monitoring	➢ Source monitoring involves the measurement of odours at off-site receptors (often on neighbouring properties) or the facility property line. ➢ It provides the needed input for a model analysis, which will provide the long-term impact of the measured odour emissions. ➢ Source modelling can also relate odour generation to specific site activities such as turning piles or windrows, and accepting certain types of feedstock materials.

Odour Control Technology

- Biofilters.
- Wet-chemical scrubbers.
- Chemical odour suppression or counteractants.
- Thermal catalytic destruction.
- Ultra-violet irradiation (a new technology).
- Odour dilution techniques: discharge stacks or agricultural air mixing fans.

General Composting Best Management Practices



Feedstock

Feedstock is the organic matter/raw material used for the production of compost (i.e. food wastes, plant matter, yard waste). Raw materials should be kept dry and be composed as soon as possible to minimize odours.

Composting Processes

In general, the more passive the composting process, the longer it takes to complete the active composting period. If odour control is required, it is easier to facilitate in closed systems.

Figure 2. Windrow composting and windrow turner.

Typically Successful Composting Processes

Passive composting	➢ Essentially just a piling technique, no mechanical turning or aeration.
Turned windrows or piles	➢ Involves mechanical turning of some form.
Passively aerated windrows	➢ No turning, but aeration is provided through convection and open-ended perforated pipes.
Open aerated static piles	➢ No turning, but spaces are left between piles, with forced air aeration.
Aerated static piles with fabric covers	➢ Fabric covers control moisture and odours.
Extended aerated static piles	➢ No turning, no spaces between the piles, with forced air aeration.
Aerated turned extended bed	➢ Similar to extended aerated static piles but with additional periodic mechanical turning of the piles.
In-vessel systems	➢ Totally enclosed systems with forced aeration.
Rectangular agitated beds	➢ Similar to turned windrows except the compost material is in concrete channels. Uses mechanical turning and may also have forced air aeration through the channel floor.

Carbon to Nitrogen Ratio (C:N Ratio)

Nutrient balance is determined primarily by the C:N ratio in the compost mix. A typically successful ratio is 25 to 30:1 (25 to 30 parts carbon to 1 part nitrogen). Mixing wet nitrogen-rich materials with coarse, dry bulking agents provides an extra carbon source to increase the C:N ratio. It also increases porosity, enhances air circulation, and reduces moisture; thereby, reducing the potential for odour issues. If woodchips are added as a bulking agent then the recommended ratio is 35 to 40:1. Going above 40:1 increases the likelihood that the mix will not heat up.

Mixing

Select a good mix of raw materials to use in the compost mix and avoid overly wet mixes. Strong smelling materials can be mixed with bulking agents to get a more porous mixture. Thorough mixing during the active composting phase creates a homogenous mix with consistent results.

Typically Successful Mixing Equipment

Rubber-tired front-end loader or tracked excavator	⇨	The cheapest and least effective option.
Mechanical mixing bucket on a front-end loader or tracked excavator	⇨	The next level up in cost and effectiveness.
Mechanical "mix box"	⇨	The most expensive and most effective option.

Typical mix time is often only approximately 5-7 minutes.

Moisture Content

$$Moisture\ Content = \frac{(Weight\ of\ Wet\ Sample\ - Weight\ of\ Dry\ Sample)}{(Weight\ of\ Wet\ Sample)} \times 100$$

Moisture content should be in the 45-65% range; in most cases, 50-60% is the most successful range. Dry compost may need to be re-moistened. The most effective re-moistening strategy is to physically mix water with the composting material. With windrows, the external material can be moistened with surface spray and then mixed in with turning machines. Injection and surface spray of static piles may be helpful, but it will likely cause uneven moisture. Moisture addition techniques that allow for the direct addition of water to thin layers of material are the most effective (e.g. using a conveyor belt and a spray bar).

Aeration

Aeration allows for proper airflow and makes oxygen available to the microorganisms. This helps maintain appropriate levels of moisture and temperature. Aeration depends on the size and shape of the particles in the compost mix; larger particles and loosely packaged materials make the compost more porous, increasing airflow and reducing moisture accumulation; small particles will be more compacted, making air flow more difficult. To avoid odour problems and complaints, try to mix, turn and move the compost during conditions or a period of time that is least bothersome to neighbours such as windy conditions and early mornings.

Figure 3. Aerated static pile.

Typically Successful Aeration Equipment

Front end loaders	➢ Front end loaders are used in a windrow composting application. ➢ This is the least costly and likely the least effective option. An excavator could serve the same purpose.
Purpose-built windrow turners	➢ These come in a variety of designs including straddle-types (that go completely over the windrow) and rising-face types (that operate more like conveyors).
Aerated static piles (ASP)	➢ ASPs are similar to windows but they are not turned. The aeration is supplied from beneath the piles (usually by perforated pipe).
Extended aerated static piles (EASP)	➢ EASPs are similar to ASPs except that the piles are continuous, i.e. one week's pile lies up against the previous week's pile, etc. ➢ EASPs are more likely to have permanent aeration floor systems than ASP.
Bin-type composting systems	➢ Bin-type systems are similar to EASP except there is a wall between each week's piles. ➢ They are often used in permanent buildings; therefore, permanent in-floor aeration systems are common.
Agitated bed or channel systems	➢ These are similar to windows in that mixing and aeration is done with a straddle-type roto-tiller-like machine with compost materials in concrete channels rather than open windows. ➢ Also, the compost turner runs on rails on the top of the channel walls rather than on tracks or rubber tires like a windrow turner.
Aerated and turned extended bed system	➢ Uses aeration and frequent turning. Similar to EASP, this approach uses an extended pile and an aerated floor. ➢ However, it also includes periodic turning using a rising-face conveyor/sidecast-type turning machine.

Temperature

Compost temperature should be regularly monitored. The optimum temperature to promote microbial growth ranges from 40-60°C. High temperatures ensure that most microbes of pathogenic significance cannot survive. However, microorganism activity, and the degradation process, dramatically slows down at temperatures higher than 65-70°C.

Temperature Monitoring and Control Equipment

Long tube-type thermometer probes	➢ Likely the least effective. These are temporarily inserted into the compost pile or left in the pile during the composting process, and physically read. ➢ Only suitable for small-scale systems.
Thermocouples mounted on aluminium rods	➢ A slight improvement over long tube-type probes. Read-outs can be done physically or remotely through wires and a system control and data acquisition system. ➢ This is cheaper and more effective where multiple readings are needed.
Wireless remote temperature sensors	➢ These are a recent innovation that eliminate the need for hardwire connections.

Curing

The curing process takes place when the organic matter that has undergone the rapid initial stage of composting is further matured into a humus-like material. A well-stabilized material may only need time to cure. Material that is not fully stable may require aeration, turning and temperature monitoring.

Figure 4. An aerated curing system under cover on a paved road.

Screening

A retail grade product should have less than 1% by weight foreign matter. Consequently, screening is done to remove oversize materials such as bulking agents, stones, metals, etc.

Figure 5. Screening finished compost under cover on a paved road.

Typically Successful Screening Equipment

Internally fed rotary trammel	➢ Most likely to be negatively affected by pre- or post-curing compost that is too wet. However, newer screen and brush designs eliminate some of these problems.
Externally fed "star" screen	➢ Good for wetter products; however, bulking agents can fall through the spaces between the "stars". ➢ They do not remove plastic film very well.

References

Forgie, D.J.L., Sasser, L.W., and Neger, M.K. 2004. Compost facility requirements guideline: How to comply with part 5 of the Organic Matter Recycling Regulation. Government of British Columbia. Accessed on-line at http://www2.gov.bc.ca/assets/gov/environment/waste management/recycling/compost.pdf

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