



THE COMPOSTING PROCESS: Feedstock Management

Defining the Issue

Feedstocks are the materials coming onto a composting site that will serve as the main ingredients in the compost recipe. Effective feedstock management needs to be a critical part of any composting facility's operational plan. Improperly managed, feedstocks can be a significant source of odour concerns and can negatively affect the quality of your finished product. A proactive materials management plan that extends to feedstocks, however, will help the operator to capitalize on the potential benefits each feedstock can contribute to the final compost mix.

Key Concepts

Effective feedstock management strategies fall into two categories:

- **Odour control, and**
- **Pre-processing to optimize the composting process.**

Odour Control

Organic feedstock material being brought onto a composting site is biologically active and populated with a variety of microorganisms. These microbes have already begun the process of breaking down the material. As in actively-composting mixtures, microorganisms that require oxygen to function (called aerobic microorganisms) will break down organic material to produce odourless carbon dioxide and water vapour. If a feedstock is wet and heavy or compacted so that air cannot infiltrate into the mass, microorganisms that do not require oxygen to function (anaerobic microorganisms) will become the dominant decomposers. These microbes use processes that generate strong, objectionable-smelling gases. In order to avoid the production of these gases, material needs to be maintained in an aerobic state from the time it enters your facility.

Feedstocks with a characteristically high moisture content and low carbon/nitrogen ratio (C:N ratio) may smell strongly even when fresh (e.g. fish or slaughterhouse processing waste, raw manure, some sludges). In general, these materials are highly bioactive and prone to become anaerobic very quickly. Since they will likely emit odour from the time they enter your site, decisive management can help to minimize the potential for complaints from neighbours.

Plan to incorporate such material as soon as possible into your composting mix. This may include having sufficient amounts of other dry, coarse-textured, high carbon materials ready to mix with the volatile feedstock. Some examples being used with success by Canadian operators include wood products (shavings, sawdust, chips, or hog fuel), straw, and dry leaves. These amendments act to reduce odour emission in several ways:

- the coarse texture makes the mixture porous so that air can be drawn into the mass to supply oxygen
- dry material can absorb excess moisture in the volatile feedstock, which increases the available air space between particles in the mixture
- the C:N ratio rises, preventing the release of nitrogen as ammonia gas

[See *Odour Reduction Techniques* in Useful Tools].

Preprocessing to Optimize the Composting Process

Preprocessing operations fall into three main categories:

- Separation
- Size Reduction
- Mixing

SEPARATION

The ideal compost feedstock is a clean, homogeneous organic material. Since few waste streams produce such material, it is usually necessary to separate the incoming

mixture in compostable, recyclable, and disposable fractions. From a compost production perspective, effective separation is important in order to reduce or eliminate:

- visible non-compostable materials in the finished compost (e.g. plastics, glass)
- chemical contaminants (such as those from hazardous household waste and batteries).

Material such as aluminum, ferrous metal, and other locally valuable recyclables can be removed, not only to produce a cleaner final compost, but as a source of cost recovery.

The actual separation processes chosen will vary with each individual facility.

Factors to consider when choosing separation technology include:

- The characteristics of the expected feedstocks you will be working with
- The target quality for the finished product—compost to be used as landfill cover need not be as clean as that headed to retail markets.
- Market options for separated materials—the cost of the machinery must be offset by the expected return on sale of the separated material, (both recovered recyclable fractions and cleaner finished compost).

For example, in considering the purchase of an eddy current separator to capture aluminum in your feedstock, you need to consider whether aluminum is a significant portion of the incoming stream—in areas where a deposit system is in place for consumer beverage cans, this may not be the case. Second, whether the aluminum presents a significant source of contamination for the finished product you are aiming for, and finally whether there is sufficient volume in your feedstock stream, and an adequate resale market, to justify the expense of installing the separator.

The order in which separation activities are performed can have a significant effect on the cleanness of the resulting feedstock. The exact configuration of a plant's processing set-up may vary to suit specific needs, but operators have found a few general principles for increasing effectiveness:

- **Screening:** can be done at various stages of the feedstock preparation process in order to sort the material by size to facilitate further separation.
- **Manual separation:** still the most effective way to separate materials that are not differentiated by size, density, or electromagnetic characteristics. Manual separation can occur at a variety of points, from removing obviously hazardous or non-compostable materials on the tip floor to doing a final check for inerts before the feedstock is added to the compost mix. If workers are sorting material on a moving belt, stations may be most effective following a screening or size-reduction operation so that small articles are not buried under large ones.

Worker comfort and safety are paramount: sorting stations should be designed to minimize physical strain, and workers should wear appropriate safety equipment (such as gloves, safety glasses, protective clothing, hearing and respiratory protection).

- **Magnetic separation:** effectiveness is influenced by depth of material, and can be enhanced by shredding or screening material before the magnet. One of the most effective and inexpensive sorting technologies, magnetic separation is often used at several points in the feedstock preparation process.
- **Eddy-current machines:** should be placed after the magnetic separator to remove non-ferrous metal.
- **Air classifiers:** separate by weight, and so are best placed after material has been size-reduced (ground, shredded, etc.)
- Other separation options, such wet or ballistic technologies, can be incorporated.

Please see *MSW Physical Processing* in Useful Tools for a brief, concise description of various separation technologies.

SIZE REDUCTION

Size reduction processes are usually performed after all recoverable non-compostables have been removed, since allowing plastics, glass, hazardous materials such as batteries to pass through a grinder may make it impossible to retrieve all of the fragments, seriously affecting the quality of your finished product. Some separation activities, such as air classification and magnetic separation, are more effective *after* size reduction, so proper sequencing of preprocessing operations is critical to the system's overall performance.

Particle size reduction is important to the composting process because it increases the amount of surface area the microorganisms have available to act on. This enhances the decomposition rate, facilitates effective mixing, and helps produce a more uniform end product. If particles are too small, however, the material may become too dense, excluding necessary airflow. Compost facility operators and researchers have found that a range of particle sizes, from 0.5-2.5" (1.3-5 cm) provides the best balance.

Please see *MSW Physical Processing* in Useful Tools for a brief, concise description of various size reduction technologies.

MIXING

Mixing is usually the final pre-preprocessing step before the material enters the active composting stage. Depending on the volume and content of your material, and the mixing precision required for your final product specifications, a variety of mixing options are available, including:

- layering material and then turning it with a windrow turner
- feeding all mix components through the final size reduction process together
- utilizing a specialized mixer

An evenly blended organic mixture promotes uniform decomposition and a homogeneous end product. Please see *MSW Physical Processing* in Useful Tools for a brief, concise description of various mixing options and technologies.

Useful Tools:

Odour Reduction Techniques: <http://www.jgpress.com/BCArticles/2002/010229.html>

MSW Physical Processing:

<http://www.epa.gov/epaoswer/non-hw/compost/> USEPA, Composting, Yard Trimmings

and Municipal Solid Waste, “Processing Methods, Technologies, and odor Control”, (p. 41-50) and Appendix B (p. 136-143).

<http://www.cfe.cornell.edu/compost/MSW.FactSheets/msw.fs1.html>

Additional Informational Links:

US Composting Council: <http://compostingcouncil.org/index.cfm>

Cornell Composting: http://www.cfe.cornell.edu/compost/Composting_homepage.html

US Environmental Protection Agency Composting: <http://www.epa.gov/compost/>

The Composting Association of the UK: http://www.compost.org.uk/dsp_home.cfm

Washington State University Compost Connection: <http://csanr.wsu.edu/compost/>

Compost Education and Resources for Western Agriculture:

<http://www2.aste.usu.edu/compost/>

Recycling and Composting Online: <http://www.recycle.cc/>

Feedback:

Are you an operator who has had experiences—faced particular challenges, solved specific problems—that would be of help to other operators? To share tips or solutions your facility has developed with regards to the subjects in this fact sheet, please click on the button below. Thanks for sharing your practical ingenuity! [%%%]