The Composting Council of Canada
Le Conseil canadien du compostage

Action on WASTE

The Composting Process: Odour Management

Defining the Issue

Odour control is a primary concern for any facility operator whose property is within range of residential or business areas. When the natural breakdown of organic materials is happening under optimum conditions it produces primarily carbon dioxide, water vapour, and heat. When the process is unbalanced in some way, other gases begin to be produced, some of which have objectionable odours. Odour management, then, is one of the primary motivators for optimizing our composting process.

Key Concepts

Unlike a mechanical process, the breakdown of organic materials is very difficult to stop. When the necessary components for a particular biological process are not present in adequate amounts, the microbial population will shift to favour microorganisms capable of capitalizing on the existing conditions. For example, when adequate oxygen is available, aerobic microorganisms will dominate the population, but a lack of oxygen will cause organisms that do not require oxygen (anaerobic microorganisms) to take over as the dominant group. These different microorganisms use alternative processes to degrade organic material. This diversity of options is very healthy for our planet as it ensures that most nutrients will be returned to the soil through one biological pathway or another.

From a facility operator's point of view, however, some of these processes are definitely preferable to others because of the associated odours. Microbes utilizing odour-producing processes commonly take over when conditions are:

- **Anaerobic:** processes occurring without adequate oxygen often release strong-smelling gases that many people find objectionable. Many of these odourous compounds are pervasive and likely to be noticed off-site.

- **Low carbon/nitrogen ratio (C:N):** a composting mixture that has a low C:N ratio will often release ammonia as part of the degradation process. Ammonia is not a pervasive odour and disperses easily, and so is more likely to be noticed on-site than by neighbours. It is, however, a signal that nitrogen is being lost from your mixture, which will lower the nutritive value of the final composted product.

There are two main stages at which material in a composting facility may to exposed to these odour-producing conditions: before entering the facility, and when in the active composting phase.

Managing Incoming Feedstock for Odour Control

Causes of Odour

Material coming onto your site may already have developed a strong odour due either to the nature of the material itself or to the way it has been stored. This can include:

- Material stored under anaerobic conditions: fresh organic material stored in plastic bags or insufficiently ventilated carts. The potential for odour increases if the material has a high moisture content, has been kept in an anaerobic state for a number of days, and/or has been subjected to high temperature and direct sunlight. (E.g. grass clippings, fresh plant material, wet leaves).
- Material that has a low C:N ratio: this can be a particular problem if the material also has a high moisture content. (E.g. biosolid or other high-nitrogen sludges, fish processing or slaughterhouse residuals, raw manure).

Management Strategies

Such feedstocks are often invaluable because of the nitrogen and moisture they provide to the composting recipe. Proactive management strategies can help you to

capitalize on the benefits they offer while minimizing the potential for offensive odour release:

I. KNOW your organics delivery schedule or pattern! If you know when a potentially odorous load is likely to arrive you can be ready to deal with the material immediately, minimizing the potential for odours to spread off-site.

II. Have a plan in place for dealing with materials you know are likely to be offensive. This can include the following:

- Incorporate the material quickly. Have a stock of porous, high-carbon material on hand which can be mixed immediately with the incoming material. Examples being used with success by Canadian operators include wood chips, shavings, or sawdust, dry leaves, and straw. This helps to balance the C:N ratio, absorb the moisture in wet materials, and add porosity so that the mixture can remain aerobic.
- If possible, work with loads of potentially offensive feedstock inside an enclosed work area ventilated to the outside through a biofilter. Be sure to close the outside doors so that air circulation systems operate effectively.
- If the material must be stored before blending, add a blanket of finished compost to the outside of the pile to act as a built-in biofilter.
- Control your pick-up schedule. Homeowners are most likely to mow lawns on weekends. Organics pickups on Monday, therefore, will be much less odorous than those on Thursday, when wet grass clippings have been sitting in carts or bags in the sun for three extra days.
- Plan your staffing availability so that sufficient people and equipment are available to deal quickly and efficiently with planned load drop-offs.

Managing the Composting Process for Odour Control

During active composting, effective odour control is best achieved by optimizing your process, ensuring that the microbes have ideal conditions to break down the material [See *Optimizing the Composting Process*, Useful Tools]. Practical strategies to consider

fall into two basic categories: Optimizing the Process and Minimizing Possible Odour Effects.

OPTIMIZING THE PROCESS

- Check your carbon to nitrogen ratio (C:N) when preparing your mix: recipes with a C:N ratio of less than 25 are likely to lose nitrogen in the form of ammonia. A ratio of 25-40 is better, with 30 being considered ideal for most materials. [See *Carbon/Nitrogen Ratio, Recipe formulation* in Useful Tools]
- Check the moisture content of your recipe: while too little moisture will slow the composting process, too much moisture will cause anaerobic conditions—as all of the small spaces in the material fill with water, not enough space is left for the air that the aerobic microorganisms also need. A moisture content between 40 and 60% is considered to provide a good air/moisture balance to support aerobic processes. [See *Moisture Content Calculations* in Useful Tools].
- Know the pH of your recipe. Basic mixtures above pH8.5 will release nitrogen as ammonia.
- Consider porosity in formulating your mix: a mixture consisting of nothing but fine-textured materials will likely become compacted as it settles, preventing air from penetrating the pile. To maintain porosity when composting such feedstocks, include some coarser material (such as wood shavings or chips) so that air can continue to move freely through the material as it breaks down. This is particularly important in systems where the material will not be turned during active composting. [See *Porosity* in Useful Tools].
- Be sure that material is turned or aerated often enough to maintain aerobic conditions. Whether you are monitoring oxygen or temperature in deciding the timing of your management activities [see Sheet #1, *The Composting Process*], ensuring adequate oxygen will result in more efficient composting as well as control of odourous gases.
- Ensure that the pile size is not too large: air will not be able to infiltrate to the centre of a large mass. Temperatures may be very high in center.

MINIMIZING POSSIBLE ODOUR EFFECTS:

Even in a facility being managed for optimum composting conditions, equipment problems, unexpectedly wet weather, or unfamiliar feedstocks can result in odours that need to be carefully managed. North American facility operators rely on a variety of helpful practices, including the following:

- Check local weather conditions before turning or moving compost. Consider the wind direction relative to the location of your neighbours, and aim to handle potentially odourous or dusty material only when they will not be affected. Depending on your geography, the barometric pressure may also play a role in the "behaviour" of odourous gases: low pressure may allow gases to flow at ground level while high pressure can allow them to disperse.
- Keep external doors closed if handling material inside a building vented through a biofilter. This allows the air circulation system to operate properly. If heavy machinery passes through large roll-up doors many times in a day, consider automatic door openers to minimize the length of time the doors are open and to support operator efficiency.
- Check your biofilter on a regular basis. Process air being passed through a well-constructed biofilter can be cleaned of a high percentage of odourous compounds. Because a biofilter is an organic system, it must be adequately maintained in order to continue functioning at an effective level.
- Use blankets of finished compost to cover static windrows or piles outdoors. Canadian operators managing unturned biosolids composting operations have found that a 30 cm/12" layer of compost applied to the outside of a newly-constructed windrow serves as a built-in biofilter, trapping any odourous gases. This layer can also serve as insulation to help the material reach the required processing temperature, particularly in winter. If an insulation effect is desired, a deeper layer may be required in cold weather.

- Ensure good site drainage. Standing water can result in waterlogged, anaerobic material.

Useful Tools:

Optimizing the Composting Process:

THE COMPOSTING PROCESS: *Fundamental Principles*

http://www.recycle.com/compost/odor.html (*On-Farm Composting Handbook* on odor control)

Carbon/Nitrogen Ratios, Recipe formulation:

http://www.cfe.cornell.edu/compost/OnFarmHandbook/apa.taba1.html (*On-Farm Composting Handbook*'s tables of average C:N values:

http://www.cfe.cornell.edu/compost/calc/cn_ratio.html

http://www.cfe.cornell.edu/compost/calc/simultaneous.html [contains spreadsheets]

Moisture Content Calculations:

http://www.cfe.cornell.edu/compost/odors/excess.moisture.html

http://www.cfe.cornell.edu/compost/calc/moisture_content.html

Porosity:

http://www.cfe.cornell.edu/compost/odors/inadeq.porosity.html

Site Design Problems (*On-Farm Composting Handbook)*:

http://www.recycle.com/compost/sitedesign.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! [%%%]