Guide to Recovering and Composting Organics in Maine

Pre-consumer food scraps ready for composting.

Photo by Mike Burden, University of Missouri College of Agriculture

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I. Introduction

Since the early 1990's, Maine has been steadily working toward a goal of annually recycling 50 percent of the solid waste it generates. With the assistance of residents, businesses, municipalities, and the state, numerous programs and efforts have been instituted and have been successful in capturing inorganic waste products (i.e., newspaper, corrugated cardboard, plastics and similar materials) from the waste stream and shipping those materials to be used in manufacturing. Little attention has been paid, however, to the organic fraction of the municipal solid waste stream. Food scraps and discards, along with lawn clippings and similar vegetative materials, account for over twenty-five percent of the solid waste stream and offer the possibility of reaching, and surpassing, the fifty percent recycling goal if these organics can be collected and recovered through composting programs or as a feedstock in an anaerobic digester. In July 2012, many of the waste management functions of the previous Maine State Planning Office were merged into the Department of Environmental Protection (MEDEP). During August 2012, the MEDEP created the Division of Sustainability with the mission of providing technical assistance and outreach to public, municipal and private entities regarding recycling initiatives and composting. One of the Division's goals is to assist municipalities, institutions and businesses in recognizing the value of organics and assist in the growing need for focused organics recovery and management.

This document recognizes that organics management includes vegetative discards, such as grass clippings, leaves, weeds and similar landscape materials, and includes food scraps as well. Handling farm animal wastes such as manure is not addressed per se, but reference to the use of manures and bedding materials is made in the sections on composting, since these products have value when utilized in a composting operation. Pet wastes, from dogs and cats, is not encouraged to be included with composting of landscaping materials or food scraps, due to potential health issues with the resulting compost.

The purpose of this document is to provide basic information for those interested in capturing unwanted organics from the waste stream and aiding in turning them into a beneficial product or use. Within this document the reader will find ways and methods of diverting organics from trash, learn the fundamentals of the biology of composting and various composting systems, the regulations that will help guide a program, as well as numerous resources available to assist in the effort.

II. Identification - Separation – Transportation - Issues and Concerns

There are two significant challenges that must first be overcome before we will see successful utilization of the organic portion of the waste stream. The first is informing residents and businesses of the value of diverting organics from the waste stream, and gaining their support in separating organics from trash. The second is securing support from haulers and receiving facilities to accept and manage these organics. But the first step to gaining support is the better identification and understanding of the various components of the organic discards stream, and sharing that information with residents and businesses that generate these materials.

Leaf and yard trimmings and similar landscape organics are widely understood and often are diverted from disposal, and used 'on-site' as mulch or in a backyard compost pile. Food scraps from the family dinner table may be added to these compost piles; but, there are many opportunities to expand the separation, collection and composting of food scraps generated from restaurants and institutions. Many of these practices are covered within this document.

Organic food scraps fall into one of two sub-categories: pre-consumer residuals and post-consumer residuals. Note: both categories may also include various types of paper products, such as napkins, wipes and towels. Pre-consumer food residuals are food residuals left over from meal preparation and grocery stores' 'pick overs' or unsold items. Generally, pre-consumer products have not been cooked or processed except for any initial packaging prior to sale. Post-consumer food residuals are any leftover, uneaten food that has already been served.

In general, pre-consumer food residuals are more easily composted because these scraps are generated within the kitchen or at a designated area within a retail store, and contamination can be easily minimized. Training of staff is also fairly easily done and monitored. Reducing the level of 'non-organics' within the collected organics is critical from a compost management perspective; for example, keeping plastic wrap out of the separated organics is critical, as plastic is an unwanted item at the compost facility.

Post-consumer food separation and temporary storage may require additional monitoring by trained staff to reduce the risk of contamination.

Before starting a food separation program, it is critical to identify potential storage space within the generating facility, secure transportation services for the food scraps to be delivered to an approved facility (composting, anaerobic digestion, other) and establish a relationship with that facility. It may be that the hauler will not

have an arrangement with the receiving facility and it will be up to you to develop that, or perhaps the hauler already has a working relationship with an acceptable facility and your business becomes part of the service route for the hauler.

It is recommended that you start with pre-consumer food separation, which is the easier step to undertake in recovery food scraps and allows for the establishment of a successful collection system. This provides an opportunity to refine the collection/transportation aspect of organics management. Once that system is in place and working well, the post-consumer food residuals can be added to the system.

Continuous employee/consumer education, getting employees/consumers to "buy into the system", and monitoring will help reduce the need to devote to the separation of materials, as will the use of color coded bins and appropriate signage. Once employees have been trained to the system, there will be only a minimal need for extra time to separate materials as it becomes part of the normal work routine.

Part of the initial program set-up is to identify the types and volumes of food residuals the facility will be generating. A fairly simple way to accomplish this estimation is to measure all of the residuals produced in each area during a typical operation week and project this amount over time.

For example, to undertake this measurement effort, measure one typical container of food residuals and multiply this amount by the number of containers that are filled during that week. Keep employees informed of the process to ensure containers contain food residuals only. Typically, disposal costs are billed by the cubic yard (a volume measurement). To convert weight into volume, here are some standard container sizes their volume capacities: 5 gallon container = 0.025 cubic yards; 30 gallon container = 0.15 cubic yards; 55 gallon container = 0.27 cubic yards (National Solid Waste Management Association, 1985).

Volume-to-weight conversions for food waste can vary considerably, depending on the type of food and its moisture content. If trash disposal at your facility is measured and billed by the ton, a standard container filled with representative samples of your facility's food residuals should be filled, and then weighed for an approximate conversion between volume and weight.

If an on-site composting program is planned (where the proper mix of feedstocks is important) measuring the food residuals will be critical in developing the recipe for the composting process. Food residuals are typically wet, heavy and provide a source of nitrogen for the composting operation, which will need to be balanced with a material(s) that provides a source of carbon and can 'lighten' the food scraps. Before developing an on-site composting program, it is critical to determine whether food residual composting is right for the business. That review requires a thorough assessment of the facility's waste generation and disposal practices, and assistance is available for that review. Most successful composting programs are individually

structured to meet the financial and operational opportunities and constraints of a given operation.

Currently, there are approximately 20 Department licensed composting facilities, about 10 'on-farm' operations that compost food residuals, and several 'on-site' composting operations for restaurants or institutions.

It is fairly standard that a composting facility charge a 'tipping fee' when accepting organics from generators. Tipping fees may range from $30 to $40 dollars per ton on average, as opposed to most of Maine's disposal facilities which currently charge $55 or more per ton. Even with the cost of trucking added, composting can make economic sense for most organics generators.

A. Why do it?

1. Lower Costs

Composting can be a relatively inexpensive management method as compared to the cost of disposing the same materials at either landfills or incinerators. In addition, managing organic residuals through composting or anaerobic digestion provides benefits by extending the landfill capacity.

2. Environmental Benefits

Diverting organic residuals to composting sites reduces the potential for water and air pollution from landfills, and reduces air emissions and residues from waste to energy facilities. Compost can be used to improve soil quality, reduce water consumption needs of landscape plants and reduce non-point source pollution from the use of chemical fertilizers. Recovering food scraps and utilizing them through a composting process or directed to an anaerobic digester reduces the carbon footprint of your facility.

3. Enhance Public Relations Through Educational Outreach

Organics have value, and by informing and educating residents, businesses, and institutions to the benefits of a properly managed and promoted community compost program, an opportunity to promote environmental stewardship through sustainability is created. People can support the recovery of food scraps, receive positive reinforcement for their efforts and may be able to use the finished compost for their own use.

4. Produce a Useful and Desirable Commodity

Because composting turns discarded, organic materials and residues into a valuable end product, citizens, local businesses and public works departments can be both the suppliers of additional carbon and nitrogen feed stocks, and the end users of the compost.

B. Why now?

1. Composting has proven a track record throughout the State

As stated previously, municipalities and businesses have been accepting lawn clippings and similar organics for composting for more than two decades. Some of these operations also accept small amounts of food residuals. Due to increased interest in capturing food residuals for composting and for use in anaerobic digesters, there are increasing opportunities for food scrap generators to divert their organics from landfills and waste to energy facilities to composting or anaerobic digester facilities.

2. Current Regulations Encourage Composting Efforts

In February 2010, the MEDEP published the new Composting Regulations, Chapter 410 (see Section 3 of this manual for the complete rule). This revised rule provides a clear and consistent framework for environmentally sound compost operations.

3. Technical Assistance and Educational Outreach Opportunities

In addition to knowledgeable staff at the MEDEP, Maine is home to two nationally known resources on composting: the **Compost Team** and the **Compost School**. Both programs are cooperative efforts by the MEDEP, Department of Agriculture, and the University of Maine Cooperative Extension.

Another source of assistance information is available through the Northeast Recycling Council's website; www.NERC.org. Through the blog on their website, numerous discussions on organics recycling are posted. One post that relates directly to this document may be found at http://www.nerc.org/news-and-updates/blog/nerc-blog/2013/07/30/opportunities-and-action-in-commercial-organics-recycling. This blog post provides a thorough summary overview of separating and recovering food scraps from generators, and possible scenarios for planning and implementing food scrap programs, including discussion on transportation and facility options.

Additionally, MEDEP staff can direct interested individuals to other sources of information as well.

III. The Composting Process

Composting is a biological process in which microorganisms consume organic materials (carbon and nitrogen compounds) and convert them into a nutrient-rich, soil amendment material, commonly referred to humus. All of the composting processes presented in this guide focus on aerobic activity (with oxygen) of the microorganisms, which is when the activity of the microorganisms takes place in the presence of oxygen, and where the by-products are water vapor and carbon dioxide (CO^2). Examples would be someone's backyard compost pile of leaves, grass clippings and food scraps, where the pile is flipped on a regular basis. Composting can also without oxygen (anaerobic), although the microbes perform poorly and the by-products may be odorous volatile organic acids which may create "nuisance" conditions. In addition to oxygen, microorganisms also require suitable amounts of carbon, nitrogen, and moisture, to help them thrive and multiply within the compost pile. The moisture serves as the medium in which the microorganisms live; the carbon provides the energy/food source to fuel them; and the nitrogen provides the building blocks for their reproduction, which leads to further composting activity. The composting process begins when the appropriate ratios of materials (feedstocks) have been mixed together to form a "recipe". The physical process of mixing the feedstocks usually provides enough oxygen to initiate the composting process.

The first six to eight weeks of the compost process are referred to as the "active composting phase." During this time, microorganisms consume a great deal of oxygen as they feed on the available organic matter. At the same time, they are producing heat, water vapor, and carbon dioxide as they consume and reduce the original volume and mass of the raw ingredients and begin the process of converting the feedstocks to a more stable material, humus.

After the initial active composting period, the pile enters a **"**curing phase**"** where the microorganisms still feed, but at a slower pace, giving off lower amounts of heat, water vapor, and carbon dioxide. Left undisturbed, the microorganisms will continue to feed until all the organic matter has been consumed. The final product is a nutrient rich soil amendment that provides many benefits including**:** increased organic matter, enhanced soil structure, drainage and porosity, and water holding capacity. Because of these qualities, compost is a valuable end product for the local home gardener and landscape companies.

A. Four common composting techniques used in Maine

Over the years, many composting systems have been developed and employed in Maine to facilitate the composting process. Today, though, there are four fundamental

composting systems in use: the static pile, the aerated static pile, the turned windrow and the in - vessel system.

1. The Static Pile The static pile method involves mixing the compost ingredients together and constructing a pile from the blended material. Subsequent turnings may not be required but are encouraged.

Advantages:

- The least labor/equipment intensive method.
- The preferred method for composting leaves.
- The only equipment needed is a tractor with a bucket or a front end loader (or a very strong back!)
- The pile may be turned up to four times a year but will usually compost without any further management.

Disadvantages:

- The composting usually happens very slowly due to the steady reduction in the amount of oxygen available throughout the pile.
- When this method is used with materials that are wetter and/or contain more nitrogen, such as food scraps, a lack of sufficient available oxygen may cause the process to go anaerobic and unpleasant odors may result.

Sandy River Recycling Association (Farmington)-Static Pile (Photo by Mark King)

2. Aerated Static Pile This system involves building a static pile on top of an aeration system, either passive (usually pipes with holes drilled in along their length) or forced air, and then leaving the material without subsequent turning until the active phase of the compost process is completed. However, during this phase, air is passively drawn down through or forced upwards through the pile with fans or blowers attached to the pipes.

Advantages:

- This 'low-tech' approach requires very little capital investment or accessory equipment, and as a result, has been widely used for manure and municipal sewage residual composting efforts.

Disadvantages:

- Because there can be no mechanical turning of the pile once it is placed on the aeration system, a thorough mix of all materials must be achieved at the outset of the pile formation. Care must be taken to achieve a homogenous blend.
- The building of the pile over the pipe requires careful equipment handling.
- The pipe needs to be 'pulled out' prior to removing the compost once the active composting phase is complete; again here, special care needs to be used to minimize potential damage to the aeration pipe.
- Care must be taken in the layout of the aeration system to allow for the free exchange of air or else odors may occur.
- There must be careful monitoring of the airflow, temperature, and moisture content of these piles as they are prone to excessive drying, that can result in a decrease in the microbial activity.

Little River Compost Facility (Lisbon)-Aerated Static Piles (photo by Mark King)

3. Turned Windrow System This is the preferred method for most on-farm and seafood composting activities. It would work equally well for municipal operations with sufficient space and resources. Typically, leaves and yard trimmings are placed down in layers in long piles (windrows) and mixed using a mechanical windrow turner. Windrows are then turned as needed with the same windrow turner. A front end loader can be substituted to mix and turn the windrows though care must be

taken to achieve a good level of mixing. A front end loader will require more time than a windrow turner.

Advantages:

- The windrow system requires the least amount of time for the composting to occur and allows for a large volume of material to be turned in a short length of time.
- Each subsequent turn further blends the compost ingredients, releases trapped carbon dioxide and water vapor, redistributes air spaces within the row, and also aides in the physical breakdown of the materials. This results in a very uniform product.

Disadvantages:

- This method requires more intensive management and more space (for equipment maneuvering) than the static pile/ aerated pile methods.
- Pile temperature must be carefully monitored so that the row will be turned at the appropriate time to ensure successful composting.
- Windrow turning machines can be costly investments.

Rainbow Valley Farms (Sidney)-Turned Windrow Composting (photo by Mark King)

4. In-Vessel System As the name denotes, in-vessel composting occurs within a closed system. Usually this means within a building or a container. All of the receiving, mixing and composting activities are enclosed, and exhaust gases are collected and processed through a filter**.** Any leachate generated during composting is collected and recirculated back into the process. Most in-vessel systems combine forced air and a form of mechanical mixing or agitation.

Advantages:

- The immediate benefit of in-vessel systems is the rapid production of a well decomposed product without any concern for odors or leachate generation.

Disadvantages:

- The initial capital investment can be prohibitive.
- Such systems use complex machinery which requires a high level of technical expertise to operate and maintain.

Green Mountain Technology™ "Earth Tub" (Carrabassett Valley)-In-Vessel Compost Units (photos by Mark King)

B. Organic Residuals Management Challenges

The process of siting, developing and managing a compost facility can be challenging. Organic residual generators and compost facility operators have different needs and requirements that must be considered prior to setting up a compost site. Additionally, many generators operate on a limited budget and may have little or no on-site storage capacity. This creates an immediate problem, as organic residuals by nature, tend to be highly putrescible and odorous due to a low carbon to nitrogen ratio (<15:1) and low solids content (10% to 30%). As a result, residuals tend to decompose quickly, creating odor and leachate issues, necessitating the need for regular removal.

The compost site should be relatively close to the residual generating facility, as trucking these residuals long distances can be cost prohibitive. Additionally, generators may not be able to guarantee predictable residual volumes to compost facilities, due to sales variations and other factors.

Therefore it is critical that compost facilities and anaerobic digesters must be adequately sized to handle incoming organic streams and properly designed to facilitate flow of materials throughout their process. A compost facility must also have adequate amounts of carbon amendment on site to mix with incoming loads of organic residuals, to accomplish an initial mixing to help control leachate, prevent odors and initialize the compost process.

Note: Most of Maine's organic compost facilities depend on tipping fees to help establish and maintain their sites. This arrangement works well provided that compost facility operators accept only the volume of organic residuals that the facility can handle. However, facility operators often accept more product than they can process in the hopes of expanding their sites with the added revenue. Invariably, this "short circuits" the compost process leading to numerous nuisance problems including: odors, leachate, and animal (vector) attraction.

Once a facility begins this action, it is often difficult (but not impossible) to recover. Additionally, compost facilities need to establish operating hours and access control to prevent unauthorized deliveries, especially on weekends when facility personnel are not available to properly process incoming loads. Dust, noise, and traffic can also add to volatile nuisance problems. Nuisance issues are discussed more thoroughly in Section VI, "Trouble Shooting the Compost Process".

IV. Regulations

In Maine, organic composting activities are regulated under the provisions of Maine Solid Waste Regulations, 06-096, CMR 410, "Composting Facilities". The Department provides for a *Reduced Procedure For Select Compost Facilities (effective December 11, 2011)* which follows below. Any compost activity that does not meet the exemptions outlined in 06-096 CMR 410, Section 1 (b), below, requires a permit which may be obtained through any MEDEP Regional offices (a complete reference list of Department Solid Waste licensing staff phone numbers and regional office locations appears at the end of this document in the Appendix).

Note: *this section is designed for informational purposes only. Where applicable, you will still need to contact the appropriate Department Solid Waste Staff for information and complete rule reference (see Appendix for staff contact information).*

1. **Applicability.** This Chapter applies to solid waste composting facilities including certain Agricultural Composting Operations. A solid waste composting facility license under the *Maine Solid Waste Management Rules: General Provisions*, 06-096 CMR 400 and this Chapter is required to locate, establish, construct or operate any new composting facility or to alter an existing composting facility, unless that facility is exempt from licensing under these rules. Agricultural Composting Operations which are not exempt from licensing under the provisions of section 1(B) of this Chapter are subject to the requirements of sections 2 through 4 or section 6 of this Chapter.

A. **Facilities Not Subject to the Requirements of this Chapter.** In addition to the facilities listed in the 06-096 CMR 400(2), the following facilities conducting only the specified activities listed are exempt from the requirements of this Chapter:

NOTE: See 06-096 CMR 400(1) for a full definition of residual types. Type IA residuals are leaf, vegetative and other residuals with a C:N ratio of greater than 25:1. Type IB residuals are food and other residuals with a C:N ratio of between 25:1 to 15:1. Type IC residuals are fish and other residuals with a C:N ratio of less than 15:1. C:N refers to the ratio of available carbon to nitrogen of the raw residual prior to composting. See Appendix B of this Chapter for a list of typical C:N ratios for various residuals. The lower the initial C:N the higher the potential for generation of nuisance odors and leachate generation. Type II residuals are sewage sludge, septage, and other residuals that may contain human pathogens. Type III residuals are petroleum contaminated soils and other residuals that may contain hazardous substances above risk based standards in 06-096 CMR 418, Appendix A.

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(1) Facilities that, in any thirty (30) consecutive day period, receive for composting less than:

(a) Ten (10) cubic yards of Type IA residuals;

(b) Five (5) cubic yards of Type IB residuals; or

(c) Five (5) cubic yards of Type IC residuals;

(2) Facilities that compost domestic animal and poultry carcasses from routine events pursuant to the Maine Department of Agriculture, Food and Rural Resources *Rules and Regulations Relating to Disease Control of Domestic Animals and Poultry*, 01-001 CMR 211;

(3) Facilities that compost 10,000 cubic yards or less of animal manure per year;

NOTE: The facilities listed in section 1(B)(1) through (3) above should comply with the Department of Agriculture, Food and Rural Resources' Best Management Practices.

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(4) Agricultural Composting Operations that, in any thirty (30) consecutive day period, compost a total of between five (5) and sixty (60) cubic yards of Type IB and IC residuals, and is operated in accordance with a Compost Management Plan approved by the Maine Department of Agriculture, Food and Rural Resources;

(5) Agricultural Composting Operations that compost any volume of Type IA, Type IB or Type IC waste provided that at least 70% of the finished compost product is used at appropriate agronomic rates on the farm that produced the compost within two (2) years after it is produced, and provided that the facility is operated in accordance with a Compost Management Plan approved by the Maine Department of Agriculture, Food and Rural Resources;

(6) Agricultural Composting Operations that use leaves as an amendment to compost manure provided that the facility is operated in accordance a Compost Management Plan approved by the Maine Department of Agriculture, Food and Rural Resources;

(7) Agricultural Composting Operations that compost offal provided that the facility is operated in accordance with a Compost Management Plan approved by the Maine Department of Agriculture, Food and Rural Resources;

(8) The composting of solid waste during a Department-supervised remediation, emergency response, or research project; and

(9) Composting toilets as defined in the *Maine Subsurface Wastewater Disposal Rules,* 10-144 CMR 241 (1004)(0).

What follows is an excerpt from these rules: 06-096, CMR 410 Section 6 - "Reduced Procedure For Select Compost Facilities":

A. **Applicability.** This section applies to compost facilities that choose to follow the siting, design and operational standards in this section and compost the following residuals:

(1) Any amount of Type IA residuals; and/or

(2) Up to 400 cubic yards monthly of Type IB residuals; and/or

(3) Up to 200 cubic yards monthly of Type IC residuals or up to 200 cubic yards monthly of Type II residuals.

If the conditions of this section will not be met, or if the applicant chooses to site, design or operate the facility in a manner that would not meet the standards of this section, then the applicant must submit an application to the Department for a license to develop and operate the compost facility under sections 2 through 4 of this Chapter. Facilities licensed under this section are subject to the operating standards in section 4 of this Chapter.

B. **Reduced Procedure Siting and Design Standards.** In addition to the general siting and design standards contained in section 2 of this Chapter, a compost facility licensed under this section must comply with the following standards:

(1) Working surface: Mixing, composting, curing, storing or otherwise handing residuals, and compost at the facility must be on surfaces meeting one of the following standards:

(a) On soils that a Maine Certified Soil Scientist has determined are moderately well-drained to well-drained, as classified by the Natural Resources Conservation Service, and that are at least 24 inches above the seasonal high water table, bedrock, and sand or gravel deposits.

(b) On a pad that is constructed a minimum of two (2) feet above the seasonal high water table and is either composed of:

(i) a minimum of eighteen (18) inches of soil material having between 15 and 35% fines, covered with a minimal six (6)- inch drainage layer of compacted gravel; or

(ii) soil covered with asphalt or concrete.

(c) Alternative surface: On a surface determined by a Maine Certified Soil Scientist, soil engineer or other qualified individual as being suitable for the proposed activity, taking into account the other aspects of the facility design, such as a roofed structure or in-vessel system. An applicant must arrange a pre-application meeting with the Department if proposing an alternative surface under this section.

(2) Pad: At a facility handling Type IC residuals, the receiving and mixing pad must be constructed with asphalt, concrete, or other similar material. At a facility handling any amount of Type II residuals, or more than 750 cubic yards of Type IC residuals annually, the entire waste handling area must consist of a pad constructed of asphalt, concrete, or other similar material for the entire waste handling area, excluding the storage area for compost meeting the requirements of section 6(C)(5) of this Chapter.

(3) Runoff, Storm Water, and Leachate Control: Surface water drainage must be diverted away from receiving, processing, composting, curing, and storage areas. The facility must also be designed to manage runoff and collect all leachate to prevent contamination of groundwater or surface water. Water falling on the facility during a storm of an intensity up to a 25-year, 24-hour storm event must infiltrate or be detained such that the storm water rate of flow from the facility after construction does not exceed the rate prior to construction. The facility design must include provisions to contain, collect and treat any leachate and contaminated stormwater or runoff generated at the facility.

(4) Slopes: Surfaces on which composting takes place must slope between 2% and 6%, and where necessary, be graded to prevent ponding of water.

C. Operating Requirements. In addition to the operating requirements of section 4 of this Chapter, a compost facility licensed under this section is subject to the following additional operating requirements. Facilities licensed pursuant to 06-096 CMR 409(9) are subject to the operating requirements of section 4 of this Chapter, and the following additional operating requirements:

(1) Pad Inspection: All soil surfaces used for residuals mixing and composting must annually be graded clean and re-compacted. All concrete and asphalt pads must annually be scraped clean and inspected for cracks or other deformities, and repaired as needed. The operator must maintain the minimum two (2)-foot separation to bedrock, groundwater and sand or gravel deposits.

(2) Odor Control: The facility must be operated to prevent nuisance odors. The facility must:

(a) Operate and maintain the odor control system approved by the Department;

(b) Receive incoming putrescible residuals on a pile of sawdust or other sorbent, high carbon compost amendment;

(c) Contain and treat process air or cover odorous piles with a layer of finished compost or other suitable compost amendment;

(d) Properly aerate piles such that composting is aerobic throughout the pile;

(e) Blend materials to achieve a homogenous mix throughout the pile; and

(f) Alter the compost recipe as needed to alleviate odorous emissions.

(3) Pathogen treatment and vector attraction reduction: Type IC residuals with the potential to contain human pathogens and Type II residuals must be composted to achieve a Class A Pathogen Reduction and Class A Vector Attraction Reduction in accordance with 06-096 CMR 419, Appendix B, unless otherwise approved in the facility's utilization license issued under 06-096 CMR 419. To attain these standards by composting, all of the following standards must be met:

(a) Pathogen Reduction: Each particle of residual is maintained at 55 degrees Celsius or higher for at least three (3) consecutive days. For windrow systems, this standard is presumed to be met if the residual is maintained at operating conditions of 55 degrees Celsius or higher for 15 days or longer, and during the period when the compost is maintained at 55 degrees or higher, there is a minimum of five turnings of the compost pile.

(b) Vector Attraction Reduction: Residual must be treated by an aerobic composting process for 14 days or longer. During that time, the temperature of the residual must be higher than 40 degrees Celsius and the average temperature of the residual must be higher than 45 degrees Celsius.

(c) Analytical Standard: The density of *Salmonella sp*. bacteria in the finished compost must be less than three (3) Most Probable Number per four (4) grams of total solids (dry weight basis) or the density of fecal coliform in the finished compost is shown to be less than 1000

Most Probable Number per gram of total solids (dry weight basis). This analytical standard must be met at the time the compost is distributed for utilization.

(4) Static Pile Composting: The following additional standards apply to composting Type IC or Type II residuals using the static pile method:

(a) The static piles must be aerated during the active composting stage;

(b) Detention time in the static aerated pile must be at least 21 days;

(c) If an auger, tub grinder hammer mill, or other Department-approved mixer is not used to mix the initial ingredients for the pile, the pile must be broken down half way through the active composting process and re-formed.

(d) To maintain temperatures throughout the pile and control odors, the pile must be fully covered with an insulating blanket of at least 12 inches of finished compost, sawdust, or other material as approved by the Department during the active compost phase.

(5) Stability/Maturity: Residuals that have completed the active composting phase and are only destined for bulk distribution for direct agricultural uses or blending with other residuals must also be cured until the equivalent of a Dewar's stability class of III or greater is achieved and the final C:N ratio of the finished compost is less than 25:1. Additionally, compost that is destined for bagging or high-end horticultural purposes must be cured until the equivalent of a Dewar's stability class of IV or greater is achieved, the final C:N ratio is less than 25:1 and the total NH_3-N is less than 800 parts per million.

NOTE: Compost facility operators may opt to use other industry standard tests to achieve this standard, provided that they receive written approval from the Department.

(6) An operations log must be kept at the facility and made available for Department review during normal business hours. The operations log must contain the following:

(a) Source and volume of residual received on a daily basis;

(b) Date of individual pile construction and breakdown;

(c) Pile composition (mixture recipe);

(d) Date and time of turning or otherwise aerating;

(e) Process monitoring data;

(f) Date the pile is put into curing and the date it is taken out of curing;

(g) Date, time, volume, and type of samples obtained from the facility;

(h) Name of the person collecting samples at the facility.

(7) The facility may not receive more than the volumes in section 6(A) of this Chapter.

(8) Residuals must be handled on approved surfaces. Type IC and Type II residuals must be offloaded and mixed on a receiving pad meeting the standards in section 6(B)(2) of this Chapter.

D. Application Requirements. The applicant shall submit to the Department, on forms developed by the Department, information sufficient to meet the standards and submissions requirements of 06-096 CMR 400(4) and the application requirements of section 3 of this Chapter. For outdoor compost facilities, instead of the site investigation information required by section 3(H) of this Chapter, the applicant may submit a report from a Maine Certified Soil Scientist or other qualified individual that either:

(1) Verifies that the waste handling areas for the proposed facility are on soils that are moderately well-drained to well-drained, as classified by the Natural Resources Conservation Service, and are at least 24 inches above the water table, bedrock, and sand or gravel deposits; or

(2) Identifies all major limitations to the proposed development presented by the soil characteristics and describes the techniques to be used to overcome the soil limitations identified in the soil survey.

V. Making Compost

A. Setting Up the Composting Site

Once the site has passed initial inspection by MEDEP, it is time to begin setting it up. The first consideration involves determining how large a footprint you will need to handle the volumes that you project. Remember, it is much easier to fill vacant space than it is to create more space at an already cramped site!

Determining the footprint is generally accomplished by developing a site-layout plan. The "On-Farm Composting Manual", published by the Northeast Regional Agricultural Engineering Service (NRAES- Bulletin 54), includes a very helpful chapter on site design and layout. A complete reference citation for this publication is included in the Appendix.

A site-layout plan should include sub-dividing the compost area into designated handling areas, listing facility design features and achieve/facilitate a logical flow of materials through the process at the facility. This plan will identify how many times the same material will have to be handled and how long it will occupy space in the different management areas on the site.

The following section describes a typical compost site-layout plan: (an illustration depicting this site-layout immediately follows):

1. Receiving and Handling Area: This dedicated area allows for the coordinated delivery and handling of in-coming feedstocks. Problem residuals may be isolated here. Provides operators with their first chance to control odors through good residual management (i.e., receiving putrescible materials, such as manure, on a bed of sawdust or leaves to help absorb leachate) and immediate mixing of seafood processing residuals with carbonaceous amendment.

2. Amendment Storage Area: This area allows for the delivery and stockpiling of carbonaceous amendment, free from contamination with other feedstock.

3. Mixing Area: This area allows for pre-determined, measured amounts of feedstocks to be accurately and thoroughly mixed, while also providing for odor and leachate control. This results in a thorough, heterogeneous mixture, which facilitates initiation of the active compost phase.

4. Composting Area: This is the area where the active composting begins. This is generally the largest portion of the site and should be located central to the receiving/handling and mixing areas.

5. Curing Area: This area is designed for the aging and final maturation of compost piles or windrows that have completed the active compost phase.

Curing is an essential step in the completion of the compost process, allowing natural progression and die-off of microbial populations.

6. Waste Bypass Area: This designated location provides a centralized area for collection and storage of "non-compostables" for later disposal. Rejected loads of residuals may be staged here while waiting for pick-up. Common contaminants may include:

- Road grit and sand;
- Litter, coffee cups and lunch bags;
- Rocks, roots, and dirt;
- Large branches, and waste wood;
- Plastic bags, plant containers, and flower pots.

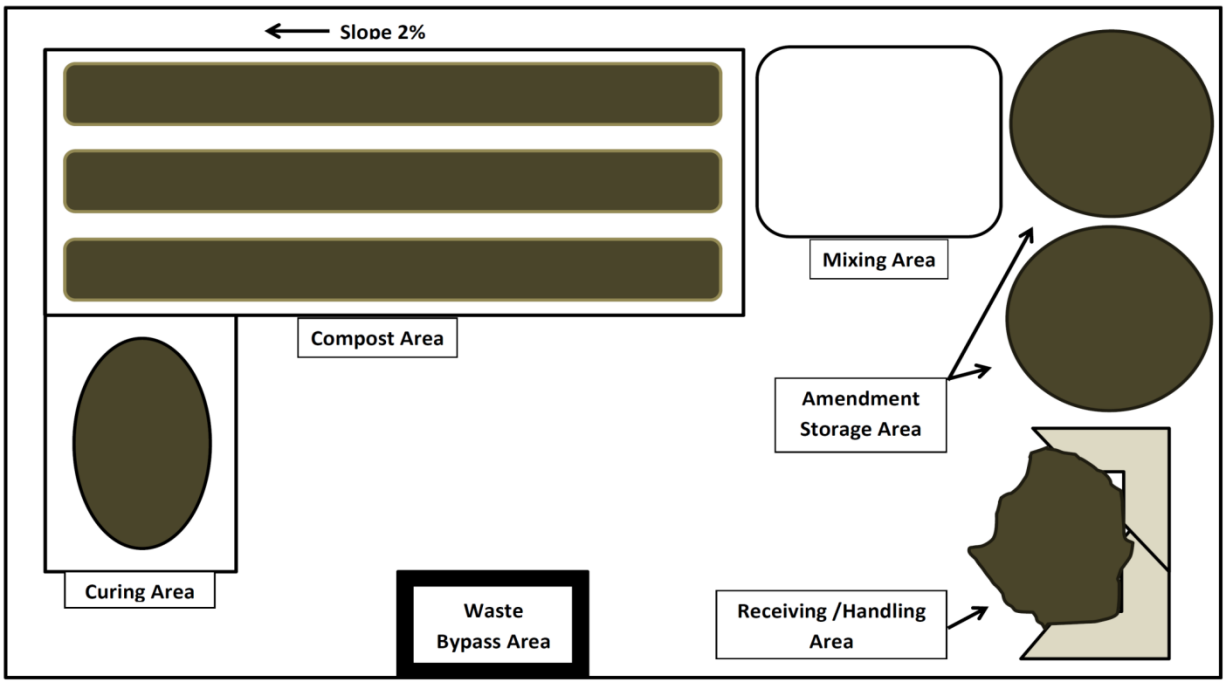


Illustration of the layout of a well-planned compost site

B. The Working Surface

Upon determining the footprint of the compost area, you will need to develop a suitable work surface. A flat surface with a 2 to 4% grade (pitch) allows surface precipitation to quickly move off the pad, which prevents ponding. There has been much discussion regarding the benefits/need of an asphalt or concrete pad over a

traditional compact gravel or soil-based pad. Proponents of the asphalt pad claim that it provides an impervious barrier, preventing leachate movement to groundwater. In addition, asphalt and concrete pads are very durable and can withstand years of use with very little maintenance. Soil and gravel pads, on the other hand, are prone to leachate infiltration and associated rutting, needing to be scraped and resurfaced on a yearly basis. For leaf and yard trimming composting, a compacted gravel pad is adequate, as very little leachate is usually generated as a result of composting these feedstocks. However, if you are considering co-composting your leaf and yard trimmings with manure or food discards, you may wish to consider investing in an asphalt or concrete pad to avoid future leachate issues.

Compost facility design should include provisions for site drainage. Every attempt should be made to divert surface run-on (clean water) away from the compost area. This can usually be accomplished using upslope diversion ditches or berms. In areas where surrounding water sheds are significant, stone-lined waterways, and catch basins may be employed to intercept and channel surface water. Compost piles may be protected from precipitation by using pile coverings such as polar fleece to help shed excess water. Roofing over the compost operation is an option if the very high cost can be justified by the scale and goals of the program.

Runoff from the compost pad may be intercepted and treated by placing a vegetated "level lip spreader" on the downslope edge of the composting surface. County Soil and Water Conservation Districts can provide advice on design and placement of level lip spreaders, or refer to the technical assistance list in the Appendix.

Facility access roads should also be designed and constructed with site drainage considerations in mind. Run-on from surrounding slopes can be diverted from the compost site simply by constructing a perimeter road perpendicular to the surrounding slopes.

C. Site Operations and Management

The general operations of a compost facility can be broken down into six separate steps:

- recipe development
- feedstock preparation
- mixing and pile formation
- turning
- curing

1. Recipe Development

The first step to beginning any compost effort is to determine what feedstocks are available for use and at what ratios they should be blended together. The easiest way to accomplish this is to develop a compost recipe. As a general rule, for leaf and yard trimmings, a recipe of three parts leaves to one part grass clippings will yield satisfactory results. If manure is added to the mixture, at least two additional parts leaves should be added for each part manure.

In a more detailed and comprehensive approach, each compost feedstock is representatively sampled and sent to a testing laboratory to be analyzed for:

- % moisture
- total nitrogen
- ammonia
- total carbon
- volatile solids
- bulk density
- pH

From the laboratory analysis, a final mixture (recipe) of feedstocks, which optimizes the chances for aerobic, thermophilic composting (sustained temperatures greater than 131 degrees Fahrenheit), can be developed.

In order for microbial colonization to occur, a recipe must contain appropriate amounts of carbon (microbial energy source), nitrogen (provides building blocks for microbial replication) and moisture (the medium that the microbes live in). In addition, there must be enough coarseness to the ingredients to promote natural diffusion of air throughout the final mixture. Otherwise, anaerobic conditions producing odors will occur. The following conditions must be met, within the recipe, in order for optimal composting conditions to occur:

- moisture-50 to 60%,
- Carbon to Nitrogen Ratio (C:N)-20:1 to 30:1,
- pH 6.5 to 7.5,
- Bulk Density <1,000 lbs./cubic yard and
- volatile solids >40% dry weight basis**.**

For assistance in developing individual recipes, please refer to the technical assistance reference list that appears in the Appendix.

2. Feedstock Preparation Options

Once the compost recipe has been determined, you should consider preparing the feedstocks for the mixing process. The amount of time invested in initial feedstock preparation directly affects the rate at which materials will compost. The goal is to create a feedstock that can be handled easily but will decompose

quickly. The first processing step usually involves material sizing through grinding. Grinding feedstocks prior to mixing increases available surface area for microbial contact, provides for a better mixture among ingredients, and helps to speed decomposition by initiating the physical breakdown of ingredients. The purchase or lease of a grinder can be a costly investment, but grinding services can be hired in Maine on a per day basis. The charge for this service usually consists of the cost of transportation, set up, and the grinding. Grinding should be considered when making up the facility's operations budget.

Morbark™ 1300 - Commercially available tub grinder (photo by Morbark™)

Once the feedstocks have been properly sized, the next consideration is moisture management. Ideally, a feedstock should contain approximately 50% to 60% water. Adding water to a dry feedstock will help optimize conditions for microbial colonization, whereas adding dry material to a saturated pile helps to create additional air spaces for pile oxygenation. To address this issue, the facility should have a water supply contingency plan, or if possible, have water directly available on site so that feedstocks and compost piles may be irrigated if necessary.

3. Mixing and Pile Formation

a. Mixing Next to recipe development, proper mixing is the single most important step determining success or failure of the compost operation. Obtaining a thorough, homogeneous mixture at the onset of the compost process, will ensure intimate contact between the carbon, nitrogen and moisture components of the pile, thereby reducing the potential for the formation of "dead spots". In addition, proper mixing allows for even air distribution throughout the pile, helping to promote aerobic composting.

Mixing can be accomplished by using: front-end loaders, manure spreaders or other farm equipment, batch or continuous mixers, and windrow turners.

Regardless of the method chosen, the objective is to obtain as thorough a mix as possible to help hasten the onset of the active composting phase.

Mixing Equipment commonly used for composting.
Image on left is of Kuhn Knight™- Reel Auggie 3130 Mixer.
The image on the right is of a typical manure spreader found on nearly any farm.
(photos by Mark King)

b. Pile Formation The objective here is to create a pile large enough to sustain the "self-heating" process that accompanies active, thermophilic (requiring high temperature) composting. As a general rule, piles should be constructed at least five to six feet high by eight to 15 feet in diameter. In areas experiencing long winter seasons, pile dimensions may need to be increased to 10 feet high by 15 to 18 feet in diameter. The size and shape of the compost pile will ultimately be determined by the type of compost system that you choose and the volume of material you will be handling in a given season. In addition to adequate mass, the pile must also contain enough porosity (air spaces) to allow natural movement of air throughout the pile. Creating piles that are too high (in excess of 10 feet) risks compression of the inner core contents due to the excessive weight of the overlying materials.

4. Turning

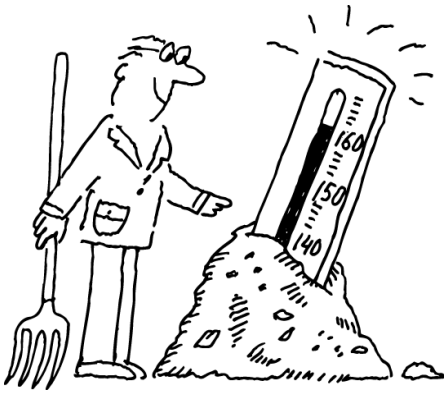
Turning is the physical process by which compost pile ingredients are blended and re-mixed throughout the active compost phase to help sustain thermophilic temperatures. During the turning process, compacted, settled materials are "fluffed-up", creating air spaces. The act of turning accomplishes several things at once, including: re-mixing of pile ingredients, further physical breakdown of resistant ingredients, and redistribution of air spaces within the pile to help promote passive air flow. In addition, the turning process can be used as a

moisture management tool. Piles that are too wet can be turned more often to facilitate drying, whereas piles that are too dry may be turned immediately following precipitation events to help capture and retain moisture. In addition, flattening the top of a pile prior to an anticipated rain event increases the amount of surface area available to absorb moisture. The frequency of turning depends upon the individual needs of each compost pile.

Windrow turner at Rainbow Valley Farms in Sidney—(Photo by Mark King)

Most compost operators prefer to determine pile activity by taking daily temperatures. The best procedures to follow include:

- try and take temperatures daily whenever possible
- try and take temperatures from the same location and around the same time each day
- allow two minutes for the thermometer to reach a stable reading
- take a one foot and three foot depth reading from same area
- turn the pile ingredients whenever the difference between the two readings is greater than 20 degrees F



The easiest way to track the performance of your pile and determine the need for subsequent turnings is to take and record daily pile temperatures.

5. Curing

Once the compost mixture has completed the active compost phase, it must undergo a sustained period of curing. Curing is an important, and often forgotten, phase of the compost process. During curing, microorganisms continue the process of organic matter degradation (concentrating on organic acids, large particles, resistant compounds and other particles remaining after the active compost phase), but at a much slower, limited rate. Oxygen consumption, heat generation, carbon dioxide and water vapor evolution are all decreased as the material “matures”.

Curing is also essential in readying your product for market. Prolonged curing can make up for compost process shortcomings while also preventing the inadvertent distribution of an immature product. An immature compost product can potentially damage plant root systems due to the presence of volatile organic acids, high C:N ratios, high salt contents, or simply by competing with soil microbes or plant roots for available oxygen reserves.

When you have a reasonably mature product, you may wish to begin immediate distribution. Some facilities opt to screen the finished compost as a final processing step. Screening improves product quality by removing contaminants and other large, uncomposted particles from the finished product. Screening provides a uniform product that is aesthetically pleasing and therefore, has increased value. The costs involved, including capital investment and extra labor, often deter facility managers from choosing this option. In fact, if you take the time to properly inspect the feedstocks, removing contaminants prior to mixing, the screening step will often not be necessary. Regardless, whether to screen or not is an individual decision dictated by the needs of your community and consumers of the compost product.

Thomas Bandsaw Mills Trommel Screen 3010, made in Brooks, ME
(Photo courtesy of Thomas Bandsaw Mills)

VI. Trouble Shooting the Compost Process

No matter how well a facility process operates, there are invariably going to be nuisance problems from time to time. Nuisance problems are the number one complaint about compost facilities. Engineering and technology to correct these problems can be expensive and ineffectual. The key to remember is that these are "people problems" and that prolonged nuisance conditions can lead to facility shutdown. Complaints should be met with an immediate response, including an explanation of the cause, if known. Good siting can help avoid potential nuisances by ensuring that you have adequate buffers to neighboring residences. Remember, many people "smell" with their eyes. Valleys and gullies should be avoided whenever possible, as they can carry nuisance odors to neighboring residences. Access roads should be located away from residences, maximizing the use of existing visual screens (tree buffers). However, there is no substitute for proper site management.

Most problems are often interrelated and as a result, addressing one usually solves the others. The key to overcoming nuisance problems is to identify the root cause and correcting it. **The key to remember is that most compost problems can be avoided simply by optimizing the compost recipe (creating a homogeneous compost mixture that is 40-60% moisture, 6.5-7.5 pH, 20:1 to 30:1 C:N, and has adequate "air spaces" within the pile) at the onset of composting.**

The following section describes the most common nuisance problems associated with compost facilities and methods that have been developed to correct them. A condensed Trouble Shooting table immediately follows this section.

A. Odors: Odors signify a breakdown in the compost process. Left uncorrected, odors can drift off site impacting neighboring residences. Odor issues can be addressed by paying strict attention to process control. Incoming loads of seafood residuals should be immediately mixed with carbon amendment as soon as they are received. This is the first chance to control odors. If this is not possible, materials should be received in waterproof, airtight containers until they can be processed. Initial compost recipes should be thoroughly mixed, and the following parameters should be optimized: C:N (25:1 to 30:1), porosity (adequate air space distribution) and % moisture (45% to 60%). Finally, compost piles may also be covered with a 10 to 15 centimeter (4 to 6 inches) layer of sawdust, peat or finished compost to act as an odor scrubber.

B. Vectors: Vectors are organisms capable of transmitting diseases to humans. These organisms include birds (sea gulls and crows), mammals (rats and other rodents) and flies. They are attracted to odorous, decaying materials, especially pieces of marine organisms that have not been properly incorporated into compost piles. Vectors can be discouraged by maintaining a neat and clean operation. Grinding seafood residuals also allows for better compatibility with amendments during mixing; making the waste products less odorous and

therefore, less attractive. In addition, thoroughly cleaning empty storage vessels also reduces attractiveness to vectors.

C. Leachate: Leachate results from poor moisture management during initial recipe formation and/or from prolonged exposure of compost windrows to heavy precipitation. As mentioned above, initial compost recipes should have a moisture content of 45% to 60%. Because leachate contains concentrated nutrients, it poses a significant threat to groundwater. In addition, if your piles are losing nutrients than your finished compost will be poorer in quality. There are several approaches to leachate management. The first is to prevent it. Leachate can be avoided by achieving proper mix ratios at the onset of composting. Additionally, composting under a roofed structure or by using water resistant covering materials can help minimize the effects of precipitation on leachate generation. Most Maine facilities try to capture the leachate by amending it with sawdust or other suitable materials, and then re-incorporating it back into the compost piles. Other facilities collect the leachate into a storage tank and then reuse it on the piles when moisture adjustments are necessary. Finally, leachate may be discharged onto a level vegetated surface for treatment. The key to leachate control is to manage moisture in the initial recipe development.

D. Dust, Noise and Traffic: All of these problems are often interrelated. Dust is created as a result of many compost facility operations including: materials off-loading, mixing, compost turning, screening and traffic. Dust conditions can also be exacerbated by prevailing winds, carrying particles onto neighboring properties. On site, dust can be an irritant to facility workers affecting the eyes and respiratory tract. Noise from compost equipment such as front-end loaders, grinders, mixers, transport trucks and compost turners can annoy neighbors directly abutting your facility. Increased traffic results in noise, dust, excessive speeds and bottlenecks. These issues can be addressed by developing daily operating hours, monitoring equipment noise, setting speed limits on access roads and soliciting feedback from your neighbors. In addition, dust conditions can be minimized by moistening dry compost piles and enclosing screening, mixing and turning operations.

Condensed Composting 'Trouble Shooting' Table

PROBLEM	CAUSE	SOLUTION
Piles fail to heat	Pile too wet or too dry	Adjust moisture to 40-60%
	pH too low or too high	Adjust pH to 6.5-7.5
	Mix is not uniform	Breakdown and re-mix piles; grind ingredients to make compatible
	Particle size is too small	Add "bulking" source to pile to increase porosity
	C:N too high	Adjust C:N to 20:1 - 30:1
	Pile mass too small	Combine piles to increase mass
"Uneven" compost temperatures	Mix is not uniform; particle size mismatch	Breakdown and re-mix piles; grind ingredients to make compatible
Odor Production Ammonia	pH too high (>8.5)	Lower pH to 7.5
	Pile too dry	Raise pile moisture to 40%
"Pungent-Rotting Smell"	Too much nitrogen in recipe	Add carbon source until C:N is between 20:1 and 30:1
	pH too low (<5.5)	Raise pH up to 6.5
	Pile too moist	Dry pile down to 60% moisture
	Poor Pile Porosity	Re-mix pile to increase porosity and/or add more bulking agents
Failure to produce a stabilized finished product	Compost pile has not completed active compost phase	Re-mix pile, adjust recipe and allow to continue composting until active phase has been completed
	Inadequate "curing" time	Allow pile to cure for additional time-up to 6 months if necessary

VII. Overcoming Challenges

Boothbay Regional Refuse Disposal District—Photo by Mark King

A. Composting in Maine

Operating a compost facility in Maine offers many challenges to the beginning facility manager. Seasonal fluctuations in weather conditions, as well as seasonal availability of feedstocks, require preplanning and site preparedness. In the spring, heavy rains can saturate piles, halting compost activity, while rendering access roads impassable. Likewise, sudden winter storms can paralyze a facility by freezing compost piles and halting compost activities. The key is to develop and stick with a successful operating plan that accounts for these weather factors.

B. Winter Composting

Maine winters are notorious for being long and cold. Accumulations of snow and ice, coupled with extended periods of subzero temperatures, can spell disaster for outdoor (exposed) facilities if caught unprepared. Excessive snow must be removed

and access ways kept open to allow continued facility operations. Cold temperatures slow the compost process by increasing the amount of heat lost by the compost pile. As this continues, pile microorganisms slow down their metabolic activity, further exaggerating the heat loss, which may result in complete halting of compost activity.

Prior to the onset of colder weather, composting piles may be combined to increase mass (to retain heat) and prevent freeze-ups. As a general rule, finished piles should be at least five feet high by 10 feet wide to assure enough mass to sustain thermophilic temperatures throughout the winter season. Piles (windrows) may also be covered with a commercially available pile cover. The covers, manufactured from a wide variety of materials, help insulate compost piles by preventing heat loss and cold infiltration. In addition, the covers shed water further protecting the pile's surface from freezing. Even if the piles do freeze, it is important to remember that this is only a temporary condition and that the compost process will take off again once the piles thaw.

Spring composting provides additional challenges to facility operators. Periods of heavy rains and slow ground thawing may result in pad rutting and site accessibility issues. This problem can be avoided by designing and constructing an impervious composting surface as well as planning for durable year-round access during the site selection and development phase.

C. SEASONAL AVAILABILITY OF FEEDSTOCKS

Many composting feedstocks are available on a seasonal basis. Leaves, for example, are collected primarily in the fall and to a lesser degree during spring clean-up. They must be composted in large quantities. Facilities must develop contingency plans to make allowances for this sudden influx. Seasonal feedstocks will require additional storage as well as adequate space for their immediate processing. Some facilities may wish to compost on a "seasonal basis", operating only when the feedstocks are available. This method works well for small communities who save a portion of space at the local transfer station to handle incoming leaves in the fall.

VIII. Compost Health and Safety Issues

Prior to beginning composting at any facility, it is important to take a step back and review the process for any potential health and safety issues that operators and facility employees might face. This extra step will help you to avoid unnecessary and costly injuries. The majority of potential issues revolve around the compost process itself, and the myriad of equipment used to facilitate daily operations. This Chapter will discuss the major of the Health and Safety issues associated with the compost process, including identification of the potential hazard(s) and introduction of specific steps that can be taken to avoid or eliminate hazards.

When attempting to identify potential hazards, the first step is to conduct an "audit" of the process. This specifically means sitting down and critically reviewing how the compost materials (feedstocks) flow through the facility, from initial receipt to completion of the composting process. Materials handling at each individual step of the process should be considered.

A. Categorizing and Addressing the Hazards

As alluded to above, most potential compost facility hazards fall into one of two categories: **equipment hazards** and **personal exposure hazards**. Equipment hazards involve traumatic, direct contact injuries such as: slips and falls, strains and sprains, entrapment, crushing injuries, amputations, electrocution, injuries from flying debris, or repetitive stress injuries. Equipment injuries are usually more prevalent when employees are physiologically stressed (over worked, fatigued), or may simply be due to ergonomic issues such as bad posture. Personal exposures usually result from indirect contact as a result of equipment use or feedstock manipulation. These hazards include: fumes, dust and other respiratory irritants (bioaerosols), leachate, noise, and environmental stressors (such as extreme heat or cold, wind and precipitation). The majority of personal hazards are elevated through the use of personal protective equipment (e.g., goggles, gloves, boots, hearing protection, respiratory protection).

Both equipment and personal hazards may be reduced or avoided by developing "protective measures" beforehand, including:

1. Planning regular breaks for personnel to rest and refocus. Mandatory stretching targeting frequently used muscle groups should be considered as well.

2. Dividing tasks among multiple employees to reduce potential for overwork or early fatigue.

3. Encouraging proper posture, lifting techniques, and other ergonomically correct methods to reduce the potential for repetitive stress and other injuries.

4. Frequent training to reinforce proper and safe use of equipment.

5. Providing personnel with appropriate and necessary personal protective equipment (PPE).

6. Routine equipment inspection and maintenance.

B. Bioaerosols

This chapter would not be complete without mentioning ***Bioaerosols***. Bioaerosols are a group of respiratory irritants, including - bacteria, fungi, viruses, and organic dusts - that may cause respiratory and gastrointestinal issues when inhaled or ingested. Much study has been focused on bioaerosols since the mid-1990s due to health concerns from neighbors abutting large compost facilities. Results indicated that bioaerosols are generally transported on organic dust particles that did not travel far from the area of generation. Thus indicating that bioaerosols are a facility concern and do not pose a risk to facility neighbors. The studies further concluded that bioaerosols do not generally pose a risk to healthy individuals, but seem to specifically impact individuals who have chronic respiratory issues or have suppressed immune systems. Smoking was also found to be a contributing factor to the effectiveness of bioaerosol infections.

Recommendations arising from these studies all focused on reducing dust generation and limiting personal exposure risk by providing staff with initial and routine health monitoring, providing proper PPE (including respiratory protection) in areas where organic contaminants are prolific, or by simply removing susceptible personnel from areas where bioaerosols may be abundant. Dust generation may be reduced by keeping feedstocks and other materials moist, and by enclosing operations prone to excessive dust generation such as: grinding, mixing, and screening operations.

IX. Summary

- ✓ Set the goals of the Compost Program
- ✓ Create a continuing public education program
- ✓ Create the marketing plan for the compost before you create the compost
- ✓ Select a site that meets the goals of the program, fits the resources of your community or business, and is compatible with state regulations
- ✓ Follow the guidelines for making compost - - paying attention to the recipe, the mix, the flow of materials through the various stages of the operation, and the slope and condition of the working surface
- ✓ Record the temperature and odor of the piles and use them as your guides throughout the process
- ✓ Be prepared to modify your operation as compost conditions require
- ✓ Distribute the cured and finished compost

FOR COMMUNITIES

According to the latest Maine Waste Management and Recycling Plan (2008), 140 communities have instituted bans on the disposal of leaves and yard trimmings with their municipal solid waste. Currently, there are 35 centralized municipal leaf and yard waste programs in operation in Maine. We hope this guide will stimulate more towns to consider the composting option.

We encourage programs that have established successful track records in managing leaf and yard trimmings to think about taking their composting programs to the next stage and adding other source separated organics to their mix. Good examples would be certain kinds of food wastes and fish processing wastes. Food discards comprise as much as 25% of the residential waste stream as compared to 13-14% for leaf and yard trimmings. Such a move would require additional regulatory review and monitoring, but would provide an alternative management option at a potentially lower cost than other disposal methods currently available. For more information on composting these and other materials, please see Chapter X, (*Resources Available and Technical Assistance*).

X. Resources Available

TECHNICAL ASSISTANCE: Statewide

The following Maine professionals offer composting technical assistance to individuals, municipalities and businesses interested in developing compost facilities:

DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Remediation & Waste Management
Sustainability Division
17 State House Station
Augusta, ME 04333-0017
Phone: 207-287-7688 OR 1-800-452-1942

Mark King, Environmental Specialist Tel: (207) 592-0455 E mail: Mark.A.King@maine.gov	George MacDonald, Director Tel: (207) 287-2870 E mail: George.MacDonald@maine.gov

DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Remediation & Waste Management
17 State House Station
Augusta, ME 04333-0017
Phone: 207-287-7688 OR 1-800-452-1942

Solid Waste Facilities Regulation
Paula M. Clark
Phone: (207) 287-2651
E-mail: paula.m.clark@maine.gov

Bangor Region
Rick Haffner
Phone: (207) 941-4331
E-mail: rick.haffner@maine.gov

Portland Region
Mike Clark
Phone: (207) 822-6300
E-mail: Michael.s.Clark@maine.gov

Hazardous Waste, Biomedical & Waste Oil Facilities Licensing
Stacy Ladner
Phone: (207) 287-2651
E-mail: stacy.a.ladner@maine.gov

TECHNICAL ASSISTANCE: Regional Resources

Androscoggin Valley Region

Fergus Lea: Senior Planner
Androscoggin Valley Council of Governments
125 Manley Road Auburn, ME 04210
Tel: (207) 783-9186
E mail: flea@avcog.org

Hancock County

Thomas Martin: Executive Director,
Hancock County Planning Commission
395 State Street Ellsworth, ME 04605
Tel: (207) 667-7131
E mail: tmartin@hcpcme.org

Kennebec Valley Region

Ross Nason: Environmental Planner,
Kennebec Valley Council of Governments
17 Main St. Fairfield, ME 04937
Tel: (207) 453-4258
E mail: rnason@kvcog.org

Penobscot and Piscataquis Counties

Eastern Maine Development Corporation
PO Box 2579
Tel: (207) 942-6389

Washington County

Judy East: **Washington County Council of Governments**
PO Box 631 Calais, Maine 04619
Tel: (207) 454-0465
E mail: jceast@wccog.net

Aroostook County

Jay Kamm: Environmental Planner,
Northern Maine Development Commission
PO Box 779 Caribou, ME 04736
Tel: (207) 498-8736
E mail: jkamm@nmdc.org

Portland Region

Greater Portland Council of Governments
233 Oxford St. Portland, ME 04101
Tel: (207) 774-9891

Southern Maine Region

Southern Maine Regional Planning Commission
21 Bradeen Street, Suite 304 Springvale, ME 04083
Tel: (207) 324-2952

Assistance for Maine's Island Communities:

Island Institute
410 Main St. Rockland, ME 04841
Tel: (207) 594-9209

Publications

Composting for Municipalities, Planning and Design Considerations

Editor: Mark Dougherty. Natural Resource, Agriculture, and Engineering Service, 152 Riley - Robb Hall, Cooperative Extension, Ithaca, NY. 14853-5701. 1998. 126 pages (NRAES publication #94)

The Art and Science of Composting

Edited by the Staff of BioCycle. JG Press, Emmaus, Pennsylvania. 1991. 270 pages.

Yard Waste Composting

Edited by the staff of BioCycle. JG Press, Emmaus, Pennsylvania. 1989. 197 pages.

On Farm Composting Handbook

Editor: Robert Rink. Natural Resource, Agriculture, and Engineering Service, 152 Riley - Robb Hall, Cooperative Extension, Ithaca, NY 14853-5701. 1992. 186 pages. (NRAES publication #54)

Municipal Leaf and Yard Waste Composting

Coordinated by Nancy E. Adams. University of New Hampshire Cooperative Extension, PO Box 200 Epping, NH 03042. 1993. 44 pages. *Heavily Appended, includes glossary.*

Keep It Off the Curb

Harmonious Technologies. PO Box 1865, Ojai, CA 93024. 1994. 218 pages. *A manual for managing a home compost program*.

Field Guide to On-Farm Composting

Editor: Mark Dougherty. Natural Resource, Agriculture, and Engineering Service, Cooperative Extension 152 Riley-Robb Hall, Ithaca, New York 14853-5701. 1999. 118 pages. (NRAES publication #114)
Field Guide format, plastic coated pages.

Useful Web Site Links

Maine Compost School: *www.composting.org*

Cornell Composting: *http://smallfarms.cornell.edu/resources/soil-health-ecology/*

The U.S. Composting Council: *www.compostingcouncil.org*

The Composting Council of Canada: *www.compost.org*

Composting – US EPA: *www.epa.gov/epaoswer/non-hw/compost/index.htm*

Food Waste Reduction: *www.epa.gov/epaoswer/non-hw/reduce/food/food.htm*

California Integrated Waste Management Board: *www.ciwmb.ca.gov/organics*

The Compost Resource Page: *www.oldgrowth.org/compost/*

The University of Maine Cooperative Extension: *http://extension.umaine.edu/*

Periodicals

BioCycle: Journal of Composting and Recycling

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