
ODOR MANAGEMENT PRACTICES FOR COMPOSTING FACILITIES

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A frequent problem encountered at composting facilities is the generation of foul odors. This fact sheet is intended to provide guidance and answer some questions about the origin of foul odors and how to prevent and manage them.

What is aerobic composting?

Composting is a biological process that reduces organic matter to humus. When a plant or animal dies, the remains are decomposed by soil microorganisms and larger soil fauna and are eventually reduced to an earth like substance called humus. Humus forms a beneficial growing environment for plant roots. Aerobic composting refers to decomposition by microorganisms that require oxygen.

Why are aerobic conditions important?

If aerobic conditions are not maintained, anaerobic (low oxygen) decomposition will take place, and foul odors will be generated. With appropriate management practices, odors can be greatly reduced and even eliminated.

How are anaerobic odors generated?

Anaerobic odors can originate with the incoming feedstocks or bulking agents, which may have been stored without aeration for some time before transport to the composting site. Once those feedstocks or bulking agents are incorporated into the composting system, subsequent odor problems are usually a result of anaerobic (low oxygen) conditions. These odors include a wide range of compounds, of which the most notorious are the reduced sulfur compounds (i.e. hydrogen sulfide, dimethyl sulfide, dimethyl disulfide, and methanethiol), volatile fatty acids, aromatic compounds, and amines.

Ammonia is the most common odor that can be formed anaerobically as well as aerobically, and is usually more noticeable on the composting site rather than off-site. This is due in part because it is lighter than air and rapidly rises up into the atmosphere. Noticeable ammonia losses are primarily a result of low carbon to nitrogen (C:N) ratio. However, pH is also a contributing factor. If the pH is around 9, there is a reasonable equilibrium. A higher pH forces more ammonium into the gas form which you can smell.

How can the composting process be controlled to promote aerobic conditions?

Composting can be affected by many factors, but the four key factors that can be controlled more easily to promote aerobic conditions and reduce odors are:

1. Nutrient balance
2. Temperature
3. Moisture content
4. Aeration (Particle / pile size)

Nutrient balance is determined primarily by the C:N ratio in the compost mix. The typical ratio is 30 parts carbon to 1 part nitrogen. Too much nitrogen can cause accelerated microbial growth, which will rapidly use up the available oxygen, resulting in anaerobic conditions (odors). The excess nitrogen can also be released as ammonia gas, which is foul smelling.

In addition, high levels of nitrogen can cause the composting piles to become too hot, killing the aerobic microorganisms and resulting in anaerobic conditions (odors). Also, excess nitrogen released from the compost pad at large composting facilities may impact the quality of ground and/or surface waters.

Temperatures in compost windrows range from 40EF to 140EF. The heat is the result of the decomposition of organic material by microorganisms. These high temperatures are important because the rate of decomposition occurs at its maximum, and weed seeds and most microbes of pathogenic significance cannot survive. At temperatures higher than 140EF, most aerobic microorganisms die and anaerobic decomposition takes place. Therefore, composting proceeds at a slower rate at excessively high temperatures.

Moisture content in the composting mix ideally should be 55-60%. This provides the microorganisms with the moisture they need to survive and at the same time does not impede the movement of air through the composting windrows.

At high moisture conditions, liquids fill the porous spaces (free air pockets) in the compost piles, thus preventing the flow of air. Under these conditions, oxygen required for aerobic decomposition is very limited and rapidly depleted, resulting in anaerobic decomposition.

However, even at normally acceptable moisture contents, anaerobic conditions are likely if compaction or small particle sizes lead to inadequate free space for air flow (porosity).

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Aeration is important to allow proper air flow, and make oxygen available to the microorganisms. This also helps to maintain the moisture and the temperature in the windrows at the appropriate levels. Aeration depends on the size of the particles in the compost mix. Larger particle sizes and loosely packed material makes a compost pile highly porous, which increases air flow and reduces the accumulation of moisture. Small particles will be more compacted, making the flow of air more difficult. Oversized windrows will cause mechanical compaction of the compost, resulting in reduced porosity leading to anaerobic conditions.

How can odors caused by anaerobic conditions be managed?

The following are some operational practices that can help in reducing anaerobic odors:

1. Mixing with coarse, dry bulking agents
2. Turning the windrows
3. Forced aeration
4. Sizing the windrows uniformly
5. Placing an aerobic biofilter layer over the windrows

Mixing with coarse, dry bulking agents helps to increase porosity and reduce moisture in the incoming material. If the materials accepted at a site are already anaerobic and odorous, they need to be combined promptly

with coarse, dry bulking agents with an approximate C:N ratio of 30:1. The dry bulking agents will absorb any excess moisture, reduce the concentration of odoriferous material, and add porosity, which allows immediate oxygen penetration. This is also a good preventive practice for incoming feedstocks and bulking agents.

Turning the windrows is very important for redistributing the moisture, providing aeration, and maintaining even temperatures. The optimum frequency of turning depends on how thoroughly materials are mixed initially, the C:N ratio, any existing anaerobic conditions, and porosity of the windrows.

Generally, windrows must be turned more frequently during the active stages of the composting process, especially if the moisture content is too high. On the other hand, excessive turning may reduce particle size, thus decreasing compost porosity and air flow.

Forced aeration systems are utilized by some composting facilities to increase oxygen flow between turnings. Basically, these systems blow air deep into the windrows.

Sizing the windrows uniformly facilitates oxygen diffusion and natural air convection. This practice is helpful whether using standard windrows or forced aeration windrow systems.

Placing an aerobic biofilter layer over the windrows is a technique used to prevent the release of odors. Sometimes between turnings, pockets of anaerobic decomposition forms deep in the windrows. These pockets can cause odor problems when handling the composting material. The aerobic organisms in the biofilter layer will metabolize the compounds responsible for odors produced by the anaerobic organisms.

The biofilter layer must be at least six (6) inches thick, and consist of shredded yard waste, authorized bulking agents, or cured compost.

Are there other ways of managing odors?

Yes, there are products such as enzymatic catalysts that can be used to degrade odorous compounds. These are normally applied to the surface of the compost windrow or sprayed in the airspace above it. Their effectiveness still needs to be verified.

Also, oxidizing chemicals such as hydrogen peroxide and potassium permanganate can be used to chemically oxidize anaerobic odors. These chemicals can be effective if incorporated evenly in the windrows and in low concentrations to prevent accidental kill of the aerobic microorganisms.

How long should odors be monitored?

Monitoring the generation of anaerobic odors is an ongoing process. The easiest way to monitor odors is to use your nose. Understanding the factors leading to anaerobic conditions and how they interact will allow you to operate your composting facility for odor prevention, and to manage excessive odors adequately.

For more information about solid waste issues and composting, please contact your local health department, Ohio EPA district office, or the **Composting Unit** in Ohio EPA Central Office at (614) 644-2621.

Ohio EPA District Offices:

Northeast Ohio:
330-963-1200

Northwest Ohio:
419-352-8461

Central Ohio:
614-728-3778

Southeast Ohio:
740-385-8501

Southwest Ohio:
937-285-6357