**Manure Storage & Handling—Composting Overview**

**Application:** used as a treatment for solid manure to reduce odor and increase nutrient density

### Pros
- Appropriate for solid manure.
- Reduces flies.
- Reduces pathogens in the manure.

### Cons
- Only appropriate for solid manure.
- Added costs in infrastructure and time for management.
- Can result in nitrogen loss.

### Description

Composting is a biological process in which microorganisms convert organic material into a soil-like material (compost). This technique is appropriate to use on solid manure such as poultry litters, bedded pack manures, or separated solids. Composting offers several potential benefits: 1) it produces less odor than stockpiling, 2) it creates a more stabilized and uniform product for land-apply that is easier than typical solid manure, 3) it reduces the presence of pathogens and weed seeds in the manure, and 4) it creates a more nutrient dense product that is more economical to haul.

Efficient composting requires optimum conditions for the growth of the right microbial consortium; major participants include bacteria, fungi, and actinomycetes, with bacteria being the most prevalent. Bacteria are generally the fastest decomposers and thrives at the beginning of the process. As more of the easily degraded material is consumed, fungi and actinomycetes become more important as they can break down the more difficult materials. To thrive these microorganisms require a steady supply of oxygen (strive to maintain a 5 to 15% oxygen concentration), adequate moisture (50 to 60%), and a carbon-to-nitrogen (C:N) ratio between 30 and 40. During the composting process the C:N ratio will decrease, the pH will become more neutral, and some of the nitrogen will be lost through ammonia volatilization.

As the microorganisms break down the raw material, they obtain energy to support their growth, but also generates substantial amounts of heat. Throughout the composting process the organic matter is consumed, reducing the volume of the material and enriching its nutrient concentration. At various times the compost pile will need to be re-wetted and turned. The heating of the pile is responsible for killing weed seeds present in the manure and for the reduction in pathogen concentrations. During the composting process, organic matter in the manure is broken down and converted to carbon dioxide; this causes a reduction in volume (up to 50% of the initial volume). The frequent turning of the compost also reduces its particle size and causes frequent mixing that results in a more uniform product for land application.

Although composting offers a technique to reduce odor, not enough oxygen, or too much or too little water, can result in significant release of odors. In order to successfully compost, a suitable recipe must be developed that ensures a balance of organic materials for the microorganisms. This recipe can be developed from chemical analysis of the manure and bulking agent or from prior experiences from composting manure on your farm. If basing the recipe on chemical analysis, the ratio of manure to bulking agent should try to achieve a carbon-to-nitrogen ratio of 40:1.

There are several methods for composting, ranging from simple windrowing or static pile techniques, to more complicated techniques like in-vessel forced aeration systems. In windrow composting the material to compost is laid out in long rows that are turned on a regular basis. The height and width of the windrow is typically based on the equipment used to turn the pile. Generally, the piles need to be turned on a weekly or bi-weekly basis. In the static pile technique the pile must be small enough to allow passive aeration. Adding bulking material to encourage a porous structure can help facilitate this, but mixing and rebuilding the pile periodically is still required. This type of system requires minimal labor, but it is relatively slow and there is a potential for odors. Thus, static systems are only recommended for processing small amounts of manures or mortality management.
A variation of this is the passively aerated system in which the need for turning is eliminated by the use of placing perforated plastic pipes at intervals of 12- to 18-inch intervals in the base of each windrow. A chimney effect of hot gasses raising up from the pile draws air into these pipes and into the base of the pile. If odor abatement is a major concern, about 6 inches of finished compost should be placed over the pile or windrow to reduce potential odor emissions. A more expensive variation of this is a forced aeration system. In this system, air is pressurized and forced through the pile. This speeds up the composting process and reduces odor potential. Due to the capital expense, forced aeration systems are mostly found in commercial composting operations.

One of the largest advantages of composting, when done correctly, is the potential of a product that will be low in odor during land application. Composting tends to result in a product that has reduced pathogens, parasites, and weed seeds in manures, offering additional benefits. In all cases, runoff or leachate from compost piles must be confined or controlled.

Figure 1. Windrow compost pile of manure and bedding material from a hoop building. Periodic turning of the compost is required to maintain an aerobic environment. In cases where compost is not stored under cover, care should be taken to select a composting site away from locations where runoff channels and water pools.

Figure 2. Under-roof static pile composting for mortality management. Adding sufficient bulking material (woodchips and corn stover in this facility) are required to minimize odors. Piles are turned periodically and bins are used to keep new and old compost separated. Bins should be sized to accommodate your loader bucket size.

Figure 3. A pull type drum-style windrow compost turner being used to flip the compost. Visible heat is being released from the pile as it is flipped. When using this type of turner, the compost pile width and height must be less than the turner. Spacing between windrows should accommodate the width of the tractor.

Figure 4. Self-propelled drum-style compost turner.
Effectiveness

<table>
<thead>
<tr>
<th>Component</th>
<th>Effectiveness</th>
<th>Notes</th>
</tr>
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<tbody>
<tr>
<td>NH₃</td>
<td>-10 to 10%</td>
<td>Addition of carbon sources to N-rich manure reduces ammonia volatilization</td>
</tr>
<tr>
<td>H₂S</td>
<td>30 to 70%</td>
<td>Effective as long as an aerobic environment is maintained in the compost</td>
</tr>
<tr>
<td>Odor</td>
<td>0 to 50%</td>
<td>Can be effective, but if not well managed odor could get worse</td>
</tr>
<tr>
<td>Particulate Matter</td>
<td>-10 to 30%</td>
<td>Turning the pile can result in more particulates being emitted.</td>
</tr>
<tr>
<td>Volatile Organic Compounds (VOC)</td>
<td>—</td>
<td>Expected to be high carbon is consumed during composting</td>
</tr>
<tr>
<td>Greenhouse Gases</td>
<td>10 to 60%</td>
<td>High if originally a slurry manure, low if originally a solid manure</td>
</tr>
<tr>
<td>Cost</td>
<td>$ to $$$</td>
<td>Depends on type of system chosen and current manure practices</td>
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Cost Considerations

The cost of composting varies considerably and is based on the following: current manure management practices, type of composting system chosen, how the compost is utilized, and the level of management devoted to making the compost system successful. For example, mechanical compost turners can cost more than $100,000. An additional cost might include the pouring of expensive concrete pads that could provide a firm surface to drive on while turning the piles.

More Information

- [https://www.extension.org/pages/8849/equipment-and-software-for-manure-composting#.U_NzNcVdV8E](https://www.extension.org/pages/8849/equipment-and-software-for-manure-composting#.U_NzNcVdV8E)
- [https://www.extension.org/pages/8844/composting-livestock-or-poultry-manure#.U_NzLcVdV8E](https://www.extension.org/pages/8844/composting-livestock-or-poultry-manure#.U_NzLcVdV8E)

References


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