Environmental Considerations for Composting Livestock Mortalities

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Introduction

Composting is a recycling process where bacteria and fungi decompose organic material in an aerobic environment. Organic wastes (in this case livestock mortalities) are transformed by bacteria into a soil-like material similar to humus.

Composting generally occurs in two stages. The primary stage is characterized by a high rate of biological activity, rapid decomposition, and high temperatures. This is when most of the organic breakdown occurs. During the secondary stage, biological activity decreases as do temperatures resulting in slower decomposition. During this stage biological activity ends and the mixture stabilizes. Depending on size and number of carcasses, the entire composting process takes about 6 months.

Environmental Considerations

Composting should be done with the following environmental protection goals in mind:

- Protect ground and surface waters from pollution.
- Maintain air quality.
- Reduce the risk of disease transmission.
- Prevent nuisances such as scavenging animals, vermin, and flies.

Advantages of Composting

- Conserves nutrients contained in dead animals.
- Low odor.
- Research indicates that extreme heat kills most pathogens; but not bovine spongiform encephalopathy.
- Low risk of air or water pollution.

Disadvantages of Composting

- High initial cost.
- Labor intensive.
- Regular monitoring and maintenance are required.
- Requires cropland or plan for use of finished compost.

Composting Site Selection

To minimize the potential for environmental damage, select a site away from streams, ponds, drainage ditches, wells, or any direct conduit to groundwater. The site should be well drained and accessible during all types of weather. Any runoff from the composter should be treated through a vegetative filter strip or infiltration area before it reaches a water resource. Diverting water away from the compost pile minimizes the amount of runoff generated by the compost site.

The site should be located on high ground well out of flood-plain areas. The base of the compost site should be soil with low permeability. If low permeability is not achievable, a plastic liner (6 mil) can be used for the base.

Although composting does not usually generate odors, regularly handling and composting dead animals may be offensive to neighbors. Site the facility downwind (according to prevailing winds) from neighboring residences. Consider visibility and location of traffic patterns required for moving dead animals to the composter, adding amendments, and removing finished compost.

An adjacent storage area for composter ingredients (sawdust, straw, crop residue) will eliminate the need to transport amendments from a distance. Site the composter near a water supply to ease moisture regulation in the pile.

Material Mix

The proper compost mix requires a balanced source of energy (carbon) and nutrients (primarily nitrogen), proper moisture levels, and a stable porous structure to minimize odors and create an environment where microorganisms will flourish.

Animal carcasses are the nitrogen source so adding large amounts of carbon creates an environment for proper composting. Generally, a carbon/nitrogen (C/N) ratio between 15:1 to 35:1 is satisfactory. Amendments containing a high C:N ratio or C content must be added to create optimal conditions for composting.

Plant materials such as wood chips, sawdust, or straw are ideal amendments for on-farm composting. The moisture content of the compost mixture should be 50 to 60 percent. Ideally 35 to 50 percent of the pile volume would be small open spaces to allow air movement.

Water is necessary for micro-organisms' chemical reactions. A moisture level of about 45 percent creates a good composting environment. Use a hay moisture probe to monitor moisture levels. Compost should feel moist but not saturated.

Composters using straw or other crop residues may need to be in a roofed structure to keep rain from leaching through the pile and creating runoff. While a roof will reduce excess moisture from rainfall, it may require the addition of water to the pile to keep the microorganisms active.

Temperature

Aerobic bacteria in the composting process grow at two temperature ranges: mesophilic (middle temperature) up to 100 degrees F; and thermophilic (high temperature) up to 150 degrees F.

Bacteria break-down in the materials generates heat and causes the temperature to rise. As the pile warms, different bacteria will grow at the higher temperatures. The mass of composting material will be more active and organic material will break down faster at higher temperatures. However, above 150 degrees F, the rate of composting will decrease as bacteria are inactivated or even destroyed by excessive temperatures.

As the warm air rises out of of the pile, fresh air is drawn in. This process exhausts carbon dioxide (CO_2) created in the pile and maintains an aerobic environment for the bacteria. Temperatures that remain above 130 degrees F for three days will destroy disease-causing bacteria in the pile, resulting in disease-free compost for land application.

The composting process regulates its own temperature. However, to maintain high temperatures for the required amount of time, the pile must have some insulation. A layer of inactive material (sawdust or finished compost) placed over the entire pile will insulate it. The insulation layer should be a foot or more deep.

Composter Design

Composting ingredients should be stored in "bins" in the correct proportions for the size of mortalities being composted. Compost bins or structures are typically designed for a three-month storage and composting cycle.

Outside composting bins can be constructed from large bales (5 ft. to 6 ft. in diameter) of low-quality hay. Place bales end-to-end to form walls for three-sided enclosures (bins). In addition to providing a compost structure, the bales will help deter pests and absorb runoff.

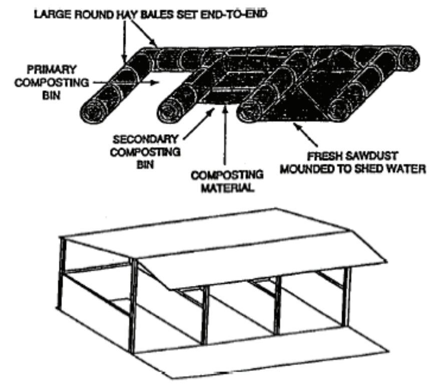

Figure 1. Bin Systems for Composting Livestock Mortalities

A minimum of two bins are required for primary and secondary composting phases. However, more bins may be necessary on larger operations. Avoid excessively large bins.

Field experience with swine composting suggests 1.25 to 1.5 square feet of bin area per sow is necessary for composting. A 100-sow herd would require 125 to 150 square feet of area in the primary and secondary composting bins.

Another method for determining bin size is to use the basis of 10 to 12 square feet of bin space per 1,000 pounds of carcass composted annually. For example, 10,000 pounds of death loss annually would require a composter with 100 to 120 square feet each for the primary and secondary bins. Consider providing an additional bin(s) for storage of sawdust or crop residue.

Bin configuration is not critical, but bins should be laid out so the contents are easily accessible with a front-end or skid steer loader. Square bins offer the greatest opportunity for reduced side effects (e.g. heat loss through walls). However, long narrow bins with access through both ends have been used. Primary and secondary bins should be located adjacent to each other to facilitate moving the compost.

Biosecurity

Control of pathogens and disease transmission is critical at livestock operations. Traffic patterns to and from the composter must be evaluated for biosecurity implications.

The composting process will destroy most diseases; however bacteria and viruses from fresh carcasses can be passed through the transport vehicle back to production areas.

It must also be noted that animals infected with transmissible spongiform encephalopathies should not be composted because the infectious agents are still present after composting.

Farm employees should be trained in biosecurity implications of operation and traffic control of the composter.

Scavenging animals and vermin also must be kept from the compost pile. Maintaining the recommended cover over the pile should reduce pest problems. Fencing may have to be installed if scavenging animals cause problems.

Resources

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