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Environmental Considerations for Composting Livestock Mortalities

Composting is a recycling process where bacteria and fungi decompose organic material in an aerobic environment. Bacteria transform organic wastes (in this case, livestock mortalities) into a soil-like material.

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, which results in slower decomposition. During this stage, biological activity ends, and the mixture stabilizes. The composting process takes about six months, depending on the size and number of carcasses.

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. Although rare in the United States, composting does not kill bovine spongiform encephalopathy.
- Low risk of air or water pollution.

Disadvantages of Composting

- High initial cost.
- Labor intensive.
- Requires regular monitoring and maintenance.
- Requires land application or a 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 compost site should be treated through a vegetative filter strip or infiltration area before it reaches any water source. Diverting moving surface water from the compost site minimizes runoff from the compost.

The composting site should be located on high ground, well out of floodplain areas. The base of the compost site should be soil with low permeability. If low permeability is not achievable, a plastic liner (6 mm or thicker) can be used for the base.

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

An adjacent staging area for composting ingredients (sawdust, straw, crop residue) will eliminate the need to transport amendments from a distance. A nearby water supply provides convenience when moisture is required for the compost 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 and 35:1 is ideal. Amendments containing a high C:N ratio or carbon 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 good amendments should be relatively dry, containing less than 50% moisture. The proper moisture content is necessary for microorganisms' chemical reactions. Ideally, 35% to 50% of the pile volume would be small open spaces to allow air movement.

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 reduces 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 Fahrenheit; and thermophilic (high temperature) up to 150 degrees Fahrenheit.

Bacterial breakdown in the materials generates heat and causes the temperature to rise. As the pile warms, different bacteria grow at higher temperatures. The mass of composting material is more active, and organic material breaks down faster at higher temperatures; however, above 150 degrees Fahrenheit, the rate of composting decreases as bacteria are inactivated or destroyed by excessive temperatures.

Fresh air is drawn in as the warm air rises out of the pile. This process exhausts the carbon dioxide (CO_2) created in the pile and maintains an aerobic environment for bacteria. Temperatures remaining above 131 degrees Fahrenheit for three days 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, depending on the size of the animal.

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. A row design is an acceptable alternative to a bin design.

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.

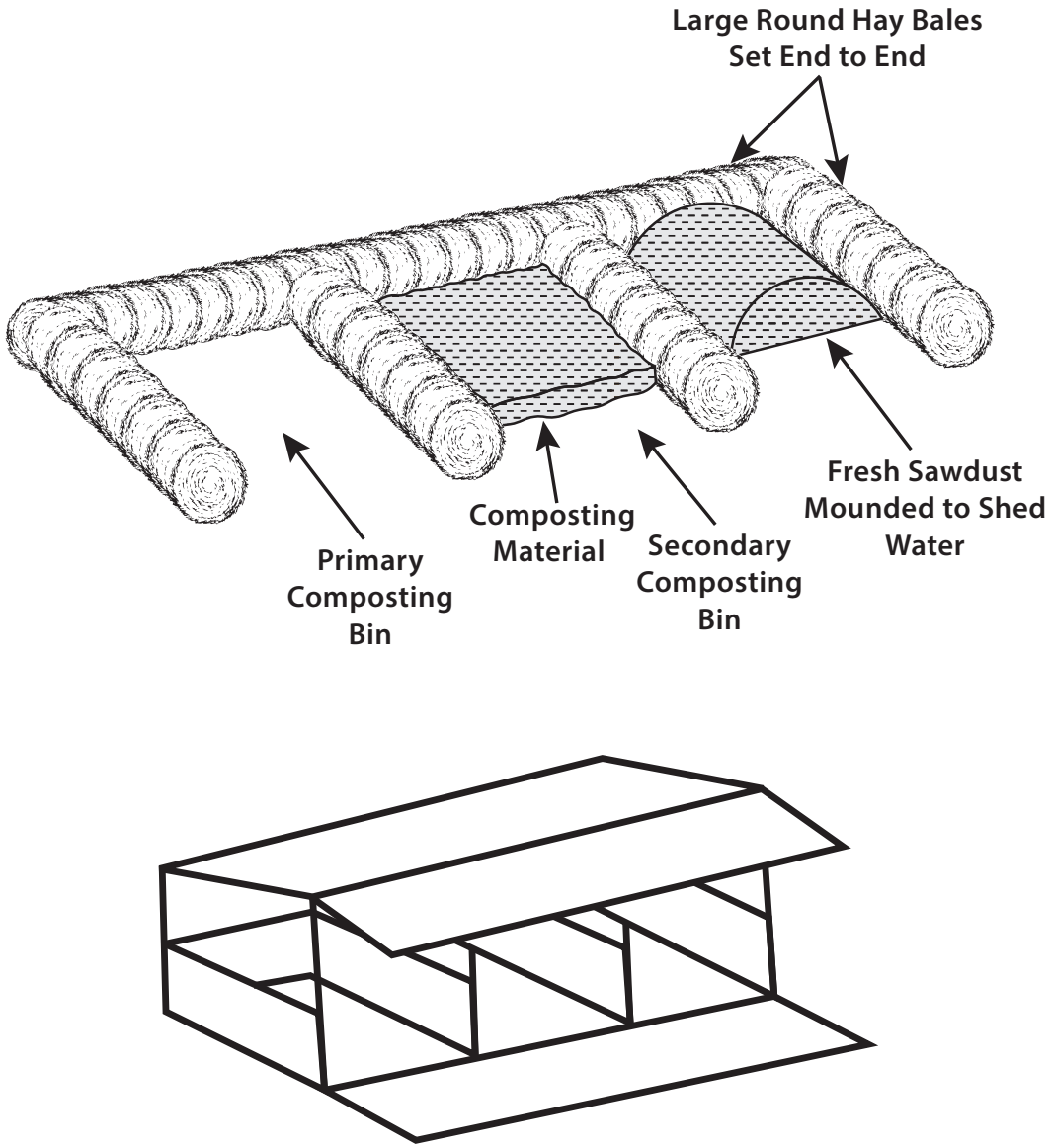

Figure 1. *Bin systems for composting livestock mortalities.*

Outside composting bins can be constructed from large bales (5 to 6 feet 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 deter pests and absorb runoff.

Experience with swine composting suggests 1.25 to 1.5 square feet of compost bin area for every live sow in an operation. 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 annual death loss would require a composter with 100 to 120 square feet for each of the primary and secondary bins. Consider providing one or more additional bins for storage of sawdust or crop residue.

While bin configuration is not critical, bins should be laid out so the contents are easily accessible with a front-end or skid steer loader. Although square bins offer the greatest opportunity for reduced side effects (e.g., heat loss through walls), some producers have had success with long, narrow bins with access through both ends. Locate primary and secondary bins adjacent to each other to facilitate moving the compost.

Biosecurity

Pathogen control and disease transmission is critical at livestock operations. Animals infected with transmissible spongiform encephalopathies should not be composted because the infectious agents are still present after composting.

Traffic patterns to and from the composter must be evaluated for biosecurity implications. The composting process destroys most diseases; however, bacteria and viruses from fresh carcasses can be passed through the transport vehicle back to production areas. Farm employees should be trained in biosecurity implications of operation and traffic control of the composter.

Scavenging animals and vermin must be kept away from the compost pile. Maintaining the recommended cover over the pile should reduce pests. Fencing may be necessary if scavenging animals cause problems.

Regulatory Requirements

It is important to follow all state and federal regulations when composting livestock mortalities. State regulations include general requirements for design and construction, location, operations, and closure. These regulations apply to all facilities. Permits and/or registration may be required, depending on site size.

In Kansas, manure and livestock composting operations are regulated by the Bureau of Waste Management, Kansas Department of Health and Environment (KDHE). Information on specific regulations can be found online (*https://www.kdhe.ks.gov/DocumentCenter/View/2713/Regulations-Applicable-to-Manure-and-Livestock-Composting-PDF*), or a copy can be obtained by contacting a local KDHE office.

Resources

Bass, Tommy. *Livestock Mortality Composting for Large and Small Operations in the Semi-Arid West.* Montana State University Extension. *https://extension.colostate.edu/docs/pubs/ag/compostmanual.pdf*

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