Small Stock Mortality Composting

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Why Compost Sheep and Goat Mortality?

All livestock producers encounter mortality. Goat and sheep operations may experience annual mortality losses of up to 10% of young before weaning and 5% of adult breeding animals. For a producer with 30 breeding females, two-thirds of whom have twins, this would mean a loss of about 5 young and 2 adults. Severe disease or internal parasite outbreaks may add to this loss. Finding appropriate carcass disposal methods can be challenging.

The State of Oklahoma Department of Agriculture, Food and Forestry lists five acceptable options for animal carcass disposal: 1) rendering, 2) burial, 3) incineration, 4) landfills, and 5) composting. Finding a rendering service for sheep and goats is difficult. Since July 1, 2006 there has been no rendering facility in Oklahoma that accepts goat carcasses or offal (Dan Parrish, Director, Agric. Env. Mgt. Serv. Div., Oklahoma Dept. of Agric., personal communication). Burial may be expensive if proper equipment must be rented. Further, there are rules on burial that must be followed. Carcasses may not be buried less than 1 foot above flood plains or within 2 feet of the water table or bedrock. Burial cannot take place within 300 feet of water sources, houses, public areas or property lines and carcasses must be covered with a minimum of 2.5 feet of soil. The cost to purchase and operate an incinerator is not economical for most producers. Not all landfills accept carcasses, and those that do charge disposal fees.

Composting is an inexpensive, environmentally friendly method of disposing of animal mortality that is commonly used in the poultry and swine industries. In the same way that microorganisms degrade vegetative waste and turn it into a rich soil amendment, animal carcasses can be turned into an organic matter-rich material that can be spread on pastures and other agricultural land. When properly done, animal composting generates no odor and temperatures generated during composting are high enough to kill most pathogens. However, animals suspected to have died from severe zoonotic diseases, i.e., diseases that can be passed to humans, such as anthrax, should not be composted. Sheep and goats that die from scrapie should never be composted as the agent responsible for this neurological disease is not killed at common compost pile temperatures. However, for most cases of mortality, composting is a safe, low-cost alternative to other carcass disposal options.

Mortality Composting Basics

To successfully compost animal mortality requires attention to the basics of a good compost pile: proper carbon to nitrogen ratio (C:N), moisture content, available oxygen, and pore size of material. Proper composting is done by aerobic microorganisms, meaning that they need oxygen to survive, in a temperature range of 130 – 150°F. These microorganisms require nutrients in the form of carbon and nitrogen in a C:N ratio of roughly 30:1 or 30 parts carbon for each part nitrogen. Animal carcasses are high in nitrogen and the surrounding compost material should be high in carbon to create the proper C:N ratio. There are many suitable carbon sources for mortality composting. One commonly used material is sawdust. Wood shavings and old hay or straw can be used when mixed with other material, such as manure or finished compost, in a 50:50 mixture. Mixtures of animal bedding and manure, such as that from horse stalls, are an acceptable carbon source. Used bedding after a livestock show at a local fairgrounds or horse arena can be a source of carbon material. Poultry litter has been used in mortality composting as a source of nutrients and microor-
ganisms but it is very high in phosphorus. Because of environmental concerns, the Oklahoma Department of Agriculture, Food and Forestry (ODA) requires mortality composting piles using poultry litter to be covered and runoff prevented.

Optimum moisture content for a compost pile is around 50%. If the material is too dry, the bacteria have insufficient moisture and composting will be very slow. If the material is too wet, water fills the pore spaces in the compost pile resulting in aerobic bacteria being replaced by anaerobic bacteria that do not require oxygen. Decomposition by anaerobic bacteria is very slow, generates odors, and does not produce sufficient heat. Squeeze a handful of the compost material. If water drips out, it is too wet. If none sticks to your hand, it is too dry. For a more accurate moisture level reading, use a portable moisture probe.

If the particle size of material making up the carbon source is too small, there is inadequate pore space to trap oxygen. If the material is too large, such as chopped hay or straw, there can be too much air transfer and heat, odors and moisture can escape the pile. Sawdust, mixtures of shavings and manure, or bedding and manure all have good sized particles providing adequate pore space.

**Site Selection**

After deciding to compost mortality, the next decision is where to construct the compost pile. Use ODA guidelines for animal burial to properly situate your mortality compost piles away from streams, wells, roads and property lines. Do not compost in areas with poor drainage or excessively sandy soil. A firm surface near the pile is needed for equipment and vehicle access and for storage of the carbon source. It is best to place compost piles away from public view. Mortality compost piles can be made with no surrounding structure; however, curious animals may dig into the pile so some type of surrounding wall or fence is beneficial.

**Mortality Composting Bins**

Depending upon the level of mortality expected, the amount of funds available and the permanence desired, different types of bins can be constructed.

**Permanent bins**

Permanent bins are constructed on a concrete pad of sufficient strength for the equipment to be used in building and turning compost piles, usually a tractor or skid steer with a bucket. The concrete pad helps prevent runoff and liquid seepage into the ground and provides a good working surface. A graved area surrounding the pad helps when working in wet weather. The structure should be large enough to accommodate expected annual mortality and house a minimum of three bins, two working bins plus a third that can be used to store additional carbon source or where material is transferred as piles are turned. Permanent bins usually have a roof sheltering the pile from the weather allowing for better control of composting conditions.

Bins should be constructed from pressure treated wood with a minimum depth and height of five feet. Bin width should be a minimum of six feet wide or 1.5 times the width of tractor or skid steer buckets used in constructing and turning compost piles. When constructing the walls of the bins, spaces should be left between boards to allow for air exchange. The front of the bin should be removable or hinged and could be wooden or a type of gate made with mesh wire to enhance air exchange. Should a roof not be constructed, covering bins with a tarp helps protect the pile from rainfall that could make the compost too wet resulting in poor decomposition and odor generation.

Permanent bins are the most expensive to construct but provide the most control over the composting process and, once built, can be used for many years. An alternative to building a structure for permanent bins would be to utilize an unused storage or equipment shed.
Low-cost alternatives

There are many low-cost alternatives to wooden bins. Two wire stock panels can serve as a bin by shaping them in a circle to enclose a mortality compost pile. Eight wooden pallets on edge can be held in place by t-posts or wired together to make an easy, low cost bin. Wire with small openings or unused chain link fence held in place by t-posts or wired to stock panels will help hold compost material in piles and prevent disturbance from wildlife and dogs. Bins should be made so they can be easily opened to build and turn compost piles, as well as for removing completed compost.
Table 1. Estimated construction cost of different types of composting bins.

<table>
<thead>
<tr>
<th>Bin type</th>
<th>Estimated cost(^a), $</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permanent composting structure with 5” thick concrete pad, gravel work area, 3 – 6’ x 6’ bins with 5’ side walls, pressure treated lumber, metal roofing</td>
<td>&gt;5,000</td>
</tr>
<tr>
<td>Permanent simple structure with 3” thick concrete pad, 2 – 5’ x 6’ bins with 5’ walls, pressure treated lumber, tarp covering</td>
<td>500 - 700</td>
</tr>
<tr>
<td>Non-permanent stock panel and wire</td>
<td>25 – 30</td>
</tr>
<tr>
<td>Non-permanent pallets and 8 t-posts (pallets assumed free)</td>
<td>25 – 30</td>
</tr>
<tr>
<td>Non-permanent woven wire and t-posts</td>
<td>25 – 30</td>
</tr>
</tbody>
</table>

\(^a\)All costs are estimates and can vary depending on several factors such as materials used, labor, etc.

Windrow systems

Farms with large numbers of animals may wish to consider a windrow system for mortality composting. In this system, successive mortalities are added to the end of the pile made for the previous mortality. Usually, a portion of the covering carbon source material is removed and the carcass placed and covered. This continues until the row is considered complete.

Mortality Composting Process

Ensure you have plenty of carbon source material before beginning mortality composting. Approximately 100 ft\(^3\) (3.5 yd\(^3\)) or 4 to 5 tractor buckets of the carbon source mixture are needed for each 100 lbs of mortality. If two or three carcasses are layered in a bin, the total will be somewhat less on a per animal basis as the base layer will be used for more than one carcass. However, too thin a base or covering layer of carbon source will lead to poor decomposition, excessive leachate or odors.

Building the pile:
1. Cover the base of the bin with 18 inches of carbon source material as an absorbent layer to trap liquid leached from the carcass during composting.
2. Place the carcass in the middle of the base a minimum of 12 inches from bin walls or sides.
3. Use a knife to lance the rumen and thorax. This provides access by microbes to the inside of the carcass and prevents the rumen from bursting due to gas build up from ruminal microbes.
4. If the bin is of sufficient size, add another carcass to the layer. Place adult carcasses back to back 8 to 10 inches apart and lamb or kid carcasses 6 inches apart with feet pointing to the pile’s edge.
5. Cover the carcass layer with 6 to 12 inches of carbon source material.
6. Add enough water to create a suitable moisture content of roughly 50%. Two to three five-gallon buckets of water can be added per 100 lbs mortality. Adjust the amount depending on the dryness of the carbon source.
7. A second layer of carcasses can be added as described.
8. After all carcasses have been added, top off the pile with 18 inches of carbon source material creating a cone shape to shed rainwater if no roof or tarp covering will be used.

After a couple weeks, the pile will have shrunk and additional carbon source may be added to the covering layer. Check the pile occasionally to ensure animals have not disturbed it, that no portions of the carcass are visible, for noticeable odors, and pile temperature.
Pile Temperature

After building the pile, bacteria will be working and generating heat. After three or four days, pile temperature should reach over 130°F and remain at that temperature for up to two weeks before beginning a gradual decline. A compost pile temperature above 131°F for a minimum of 3 days reduces pathogens below detectable levels and is needed to fulfill the requirements of a Class A biosolid allowing the completed compost to be used on public and private land. Requirements for Class B biosolids are less stringent and require a temperature in excess of 104°F for 5 consecutive days with a temperature of 131°F or greater for at least 4 hours during that period. Class B biosolids can be applied to agricultural land. For further information see http://www.epa.gov/owm/mtb/biosolids/503pe/index.htm. Temperature in excess of 145°F kills most weed seeds. A pile temperature that is too high, greater than 160°F, can affect bacterial survival. It is best to monitor temperature using a 36” or 48” compost thermometer thrust into the pile’s core. Compost thermometers range in cost from $115 - $150. Two sources of long-stem compost thermometers are REOTEMP Instrument Corporation, Heavy Duty Windrow Thermometers, http://www.reotemp.com/ and Omega Engineering Corp., Compost Thermometers, http://omega.com/. If a thermometer won’t be used, insert a long piece of metal rod, such as a piece of rebar, into the pile withdrawing it occasionally to feel if the pile is heating. At temperatures above 130°F, the tip of the rod can be held in one’s hand for only one or two seconds.

Figure 3. Use these minimum depth recommendations to ensure proper spacing and thickness of carbon source layers when layering carcasses.

Figure 4. Compost thermometers are 3 to 4 feet long.

1Listing of trade names, proprietary products, or vendors does not imply endorsement by Langston University of the products or vendors named or criticism of similar products or vendors not mentioned.
When the temperature of the pile decreases to environmental temperature, or below 110°F, the pile should be turned to mix contents and aerate the pile. By this time, all flesh and soft tissues will have been decomposed and mainly bones are left. For carcasses of adult animals, this occurs two to three months after the pile is built. Lamb and kid carcasses may take only a few weeks. Use a tractor bucket to pick up material and either dump it back on the pile or move it to a new bin. Make sure enough covering layer is put on the turned pile. Moisture can be added if the pile is too dry or the pile can be allowed to dry if it is too wet, from trapped rainfall, for example. After turning, the pile should heat again and continue composting. After another two month period, the compost could be turned again and left to cure for several weeks before use.
Troubleshooting Mortality Compost

Low temperature

Low temperatures are usually the result of either too little or too much pile moisture or an improper C:N ratio. Remove some of the covering layer and check pile moisture using the handful squeeze method. If nothing sticks to your palm, add water. If water drips out, turn the pile and allow it to dry. Check the temperature a few days later to see if the pile has begun heating. A pile will also not heat sufficiently if the carbon source material does not pack tightly enough. For example, chopped cornstalks and long-stem hay or straw allows too much air movement to the extent that heat is lost and composting is poor. These materials should be mixed with manure or finished compost before using.

Pile odor

Odors can arise from compost that is too wet. Turn the compost and add additional carbon source. Wooden bins may trap rainwater if not covered and composting material on the sides and bottom can become too wet. Too low a C:N ratio and too thin a covering layer also contribute to odor. Make sure there is a good C:N ratio, the covering layer is at least 18 inches thick, and carcasses are a minimum of 12 inches from the pile’s edge. The covering layer not only acts to shed rainwater, it also serves as a biofilter trapping gasses and odors generated by the composting process.

Failure to decompose

Failure to decompose is due to improper C:N ratio or carcasses that were laid too thickly or too close to the edge of the pile. Ensure that the pile is properly constructed and use fewer carcasses per layer.
Insect/fly larvae

Seeing insects or fly larvae is due to insufficient covering layer over carcass or liquids leaching from the pile creating odors. Build the pile with a thick absorbent base, ensure an adequate cover throughout the decomposition process and maintain a clean area surrounding the pile.

Compost Use

About one-half of the material from a mortality compost pile can be reused in a new pile and mixed with additional carbon source material. This reduces the amount of carbon source that needs to be on hand and also provides a source of bacteria for the new pile. The remaining composted material is a nutrient-rich medium that can be applied to pasture and other agricultural land. It is not recommended to use small stock compost on vegetables or areas where food is produced for direct human consumption.

Summary

Mortality composting is an easy, lawful, low-cost alternative for producers to dispose of livestock losses. Select sites away from water sources and the public. Producers may wish to construct permanent wooden bins on a concrete pad or use simple wire or pallet enclosures in which to compost. A carbon source such as sawdust, wood shavings mixed with manure, stable bedding or other carbon-rich material is needed to combine with the carcass to obtain a C:N ratio of 30:1. Temperatures in a properly made pile will be high enough to kill most pathogens. A portion of the resulting compost can be reused and the remainder spread on pasture land.

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References


