Organic Burial Composting of Cattle Mortality

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Story in Brief

Effective May 1, 2004, composting was approved as a method of disposing carcasses or portions of carcasses of large animals (cattle, other ruminants, horses, and swine) unless otherwise directed by the state veterinarian. Although rendering, extrusion and incineration are approved as methods of large animal disposal, burial is the only method other than composting that is feasible for most cattle producers. Incineration or open burning may be used as long as the carcass is reduced to ash, but other local regulations may exclude burning. Burial guidelines designed to protect water quality limit the land available for burial. In addition timely access to equipment to bury mortality is often a challenge.

Introduction

Composting is the decomposition of organic materials under predominately aerobic conditions. While it occurs naturally under a wide range of conditions, in order to achieve rapid decomposition, specific conditions are required. These “proper” conditions are often thought of in terms of the compost “recipe”. The primary consideration in determining the proper recipe is the carbon to nitrogen (C:N) ratio and the moisture content. Other factors that are used to define an ideal “recipe” are listed in Table 1.

Composting is accepted and approved as an environmentally sound method of mortality disposal that also addresses animal health and disease concerns. Normally, composting involves the use of primary and secondary bins with a fairly high degree of management. With these systems, management can be the limiting factor that affects decomposition. This slower decomposition rate results in a lower efficiency of the composting facility.

Composting with low management input is an effective mortality disposal method and can best be expressed as organic burial composting (OBC). In concept, it is simply the burial of mortality in a sufficient amount of carbon to ensure that decomposition takes place in a manner that is acceptable from an environmental and animal health perspective. The objective of this demonstration was to illustrate to cattle producers and the Arkansas Livestock and Poultry Commission the use of composting as a method of dead animal disposal.

Experimental Procedures

The total required volume of carbon material for OBC was based on the size of the composting animal plus additional material to absorb access water and malodor. Design calculations indicated that surrounding a 1,400-lb cow with 18 inches of sawdust exceeded the carbon requirements while providing the necessary moisture and odor control. However, for lower density and carbon sources with lower C:N ratios such as rice hulls and straw, a minimum of 24 inches of supplemental carbon source is required to ensure adequate carbon for decomposition to occur and adequate moisture and odor control.

On September 23, 2002, the carcass of a mature dairy cow was placed on an 18-inch pad of green sawdust. Due to reach limitations of the skid steer being used, it was not possible to place the T-posts and net wire around the carcass as planned. Instead, the carcass was covered without any structure to keep the sawdust from sliding down slope. Then, an existing fence and cattle panels were used to build a fence around the pile. While this approach covered the carcass and prevented animal access to the pile, it also increased the amount of sawdust needed to cover the carcass. This pile was located outside and exposed to the weather.

From October 24, 2002 to December, 2003, an additional 14 cows, mostly mature animals with a few heifers, were added to the pile. Initially, more sawdust was added with each additional mortality. After all available sawdust was used, other farm carbon sources such as waste silage and waste hay were used. Typically the addition of the new mortality was accomplished by partially excavating the pile, adding the mortality, then covering the animal with a blend of existing compost and new carbon material.

Results and Discussion

On October 2, 2002, 9 days after the first carcass was placed, the pile temperature was 126°F. The temperature climbed to a recorded peak of 129°F on October 7. By October 24, the temperature had dropped to 119°F. On this date the pile was excavated in four separate locations that included the front leg area, the body cavity area, the tail/hip area, and the head area. In the front leg area only one large leg bone and hoof with some connective tissue was found. In the body cavity area the only identifiable pieces were a few hairs. In the tail/hip area only a few large bones were located. In the head area, the skull and some soft tissue were found. While excavating the pile, no excessive odors or flies were observed. In the 31 days since placement of the carcass, the decomposition process had almost completely processed the mortality.

If the pile is left undisturbed, decomposition will continue, but at a greatly reduced rate. If space is limited, the pile can be turned and mixed after the temperature drops back down to about 110°F. It should then reheat to the 130 to 140°F range for a period of time. This turning helps to aerate and mix the material to accelerate the decomposition. If space is limited, it is possible to leave the compost undistributed in the pile or windrow, although it will require significantly more time to completely decompose the mortality.

From September, 2002 to December, 2003, 15 animals had been disposed of in the compost pile that had expanded from a 15 x 15 ft pile to a 15 x 45 ft windrow. The most rapid decomposition (31 days) took place with the first animal being placed in green sawdust (almost completely decomposed within 31 days). As more mortality was added to the pile and other carbon sources were used, the rate of
decomposition decreased.

Additional Observations. On occasion when a fresh carcass was excavated or was not adequately covered, excessive odors did occur. However, the recommended layer of carbon material seemed to do a good job of filtering the odors to background levels. If the animal being composted is large and swells to the point of removing the compost, additional carbon material should be added to the compost pile to cover the animal.

Although there was easy access to the pile by dogs and wild animals, no indication was ever found that animals had dug into the pile. Dogs have dug into other compost piles; if this occurs, restrict the animals from gaining access to the compost.

Due to the concern for water to leach from the pile into ground and surface water, the ground surface down slope from the pile was regularly inspected for signs that the pile was leaching and potentially becoming a source of water contaminates. However, in spite of the fact that the pile was exposed to the weather, no signs of significant water and nutrient movement into the down slope vegetation were ever observed.

One problem observed was that sawdust was prone to blow and slide off the pile. This was addressed by putting a top layer of waste silage on the sawdust. Of the various carbon sources utilized in the demonstration, the green sawdust performed the best in terms of rapid decomposition; however, waste hay and waste silage also worked but at a significantly reduced rate.

The time required to decompose a carcass depends on the size of the carcass, the initial heat of the pile, and whether the pile is turned. Based on a demonstration in Maine, a mature cow placed on a pad of actively composting material (110°F) should be mostly decomposed in 3 to 4 months. At this time, it may be turned and allowed to compost an additional 2 months. If the carcass is placed on a pad that has not yet started to heat, the decomposition will be slow and it may take up to 6 months before most of it is decomposed. At this point, turning the pile should complete the decomposition in an additional 2 months. If the pile is not turned, the total time to complete decomposition may take as long as 8 to 12 months.

Once the decomposition is complete, up to half the compost may be reused as a source of active preheated carbon/compost. The remainder is suitable for land application. Any bone fragments that are left should be brittle and easily broken. The bone fragments may be added back in the next compost pile until decomposition is complete.

There are two basic approaches that apply to the outside composting of large mortality: pile/bin and windrow (Figures 1 and 2). Both approaches start as a pile, however new carcasses are added repeatedly to one end, forming a windrow in the windrow method. Both approaches can be done without the use of some type of sidewall, such as fencing or wooden walls. However, the use of sidewalls will reduce the volume of carbon material required, and help to ensure the 24 inches of cover. Walls will also help to prevent pets and other animals from digging into the pile.

Temperature in the compost pile varies, with the temperatures at the carcass tending to be the highest. One of the critical features of the disposal of animal mortality is disease control. Composting exposes disease-causing organisms to heat, the toxicity of decomposition products, and the microbial antagonism. Of these, heat is probably the most effective in destroying disease-causing organisms. It is generally considered that temperatures of 122 to 140°F will kill most viruses. These temperatures also are effective in killing the bacteria that cause anthrax and tuberculosis. It should be noted that while these temperatures will kill the anthrax bacteria, it would not kill spores of anthrax or prions associated with bovine spongiform encephalopathy (BSE). Some bacteria such as clostridia can survive these temperatures. For this reason, while elevated temperatures are generally effective in killing bacteria, composting sites should be isolated from the rest of the farm and properly managed. Proper management will help ensure elevated temperatures and prevent the access of disease vectors, such as flies and animals, to the composting mortality.

In the traditional method of determining the ratios of the compost ingredients, the ingredients are thoroughly and uniformly mixed. However, when composting animal mortality, it is not practical to grind the mortality to achieve a uniform mixture. Thus, for larger carcasses, there are pockets of low C:N ingredients (the mortality) buried in a larger volume of higher C:N ingredients (the carbon source material). The moisture content within the compost pile also is not uniformly distributed and tends to be highest within and around the mortality.

As a result of these conditions, there are likely to be pockets of anaerobic decompositions in and immediately around the mortality. There also may be a tendency for water from the mortality to saturate the carbon material adjacent to the mortality, resulting in moisture migration to the compost mixture. This means additional carbon material, above the requirements for an ideal recipe, needs to be placed under, to the side of, and on top of the mortality. The extra carbon material serves as a sponge to absorb excess water from the mortality. It also serves as a “biological” filter where odors and objectionable gases are treated prior to being released to the air.

In summary, the composting of large animal mortality should be considered above ground burial of animal carcasses in organic burial composting. The basic concept is to compost the mortality in sufficient carbon material to provide the minimum C:N ratio needed for decomposition, absorb excess moisture from the mortality, and filter odors. In practice, it is simply placing the mortality in the center of a pile of carbon material and leaving it for an extended period of time. After building the compost pile, management will probably be limited to adding additional carbon material, to maintain a cover over the mortality. Mixing and re-piling is an option to increase the decomposition rate. However, it will probably only be done if there is limited area that can be dedicated to mortality disposal. After decomposition, the composted material is suitable for land application as soil amendment or reuse as a portion of the carbon material for the next mortality.

Implications

For infrequent mortality disposal such as on cow-calf operations, burial of the mortality in a carbon source such as waste hay at an appropriate site is recommended. This method allows for disposal in a legal, efficient, and economical manner. When composting is exposed to the weather, the compost material (carbon source) may be sawdust, hay, etc., but may not contain manure. When the compost is protected from the weather, compost material (carbon source) for the carcasses may be sawdust, hay, etc., and may contain manure. Composting involving manure must be done in a bin(s) that has a concrete floor to provide an all-weather base, roof to exclude excess moisture and rot-resistant bin construction to support the compost material and withstand stresses applied by tractor loader.

Literature Cited

Fig. 1. Recommended organic burial composting (OBC) with Pile Method.

- Select the location of the compost pile. Ensure that the pile will be isolated from the rest of the farming operation on dry ground that is not in a drainage way, and will be accessible to equipment used to move the carcasses and carbon material. Ideally the site should not be visible, or conspicuous, to neighbors and the public.
- Make a 24-inch thick pad of carbon material that is large enough so that when the carcass is placed there will be at least 24 inches from the carcass to the edge of the pad. For a mature cow, this results in a pad that is about 9 x 10 ft.
- Add water to the pad as needed to ensure the pad has a moisture content of about 50%
- Place the carcass on the center of the pad. Consider that the animal may bloat and expand early in the composing process.
- (Optional) Some form of retaining walls can be used. One inexpensive method is to set a tee-post at each corner. Then wrap a 48-inch high net wire around the four posts and secure the wire to the posts. The posts will hold the wire in place until the enclosure is filled. The use of the fence will reduce the amount of carbon material needed to cover the carcass and reduce the chance of pets and wild animals digging into the pile. It will also reduce the land area required to compost.
- Cover the mortality with at least 24 inches of carbon material. Note that if a fence is not used, 24 inches of cover over the center of the carcass will likely result in less than 24 inches of cover part way down the slope. Therefore, more than 24 inches will be required at the top. When finished the pile should be mounded and shaped so that the amount of rainwater that infiltrates the pile is minimized.
- Maintain the carbon cover. It is likely that there will be shifting and settling of the cover material as the carcass decomposes. Therefore, additional material should be added as needed to maintain cover and water shedding ability. In some cases, the composting animal may bloat and extend extremities, including feet which will require additional sawdust, straws, or related material.
- After 3 to 4 months, the pile may be mixed and restacked for an additional 2 months. If the pile is not mixed and restacked, then the total duration of the composting needs to be 9 to 12 months. If a compost thermometer is used, the pile should be turned and mixed when the temperature falls below 110°F if a faster decomposition rate is desired. The composting period is considered finished when there is no soft tissue remaining.
- Once the composting is complete, the mixture may be land applied or reused. When reusing the composted material, no more than half of the carbon source should be reused compost.
Fig. 2. Recommended organic burial composting (OBC) with Windrow Method.

- The windrow method of composting uses the same dimensions for pad thickness, edge distances, and moisture requirements as the pile method above. The advantage of using windrows is a possible savings in carbon material and a reduction in the land area required to compost several cows.
- Start the windrow with the process described for the pile approach above.
- With each new dead animal, the “working” end of the pile is opened and reopened.
- If desired, some carbon material from the existing windrow can be pulled down to form a pad for the new mortality. Ideally, the earlier carcass is not disturbed, unless it is ready for mixing.
- Moisten the new pad as needed.
- Place the carcass in the center of the new pad.
- (optional) Add two new tee-posts at the new corners of the pad then wrap additional net wire around the new length and end of the windrow.
- Cover the carcasses with the carbon source material.
- Maintain the cover.

Since a windrow is built over time, the original mortality will likely be decomposed and ready for disposal before the most recent mortality is decomposed. This provides the management options of (1) leaving the windrow alone until the last mortality is decomposed, then utilizing the compost or (2) starting at the original end of the windrow, then utilizing the completed compost.
Table 1. Range of conditions for rapid composting.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Reasonable range(^a)</th>
<th>Preferred range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon to nitrogen (C:N) ratio</td>
<td>20:1 – 40:1</td>
<td>25:1 – 30:1</td>
</tr>
<tr>
<td>Moisture content</td>
<td>40 – 65(^%)^2</td>
<td>50 – 60(^%)</td>
</tr>
<tr>
<td>Oxygen concentrations</td>
<td>Greater than 5(^%)</td>
<td>Much greater than 5(^%)</td>
</tr>
<tr>
<td>Particle size, diameter in inches</td>
<td>1/8 – 1/2</td>
<td>Varies(^b)</td>
</tr>
<tr>
<td>pH</td>
<td>5.5 – 9.0</td>
<td>6.5 – 8.0</td>
</tr>
<tr>
<td>Temperature, °F</td>
<td>110 – 150</td>
<td>130 – 140</td>
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</table>

\(^a\) These recommendations are for rapid composting. Conditions outside these ranges can also yield successful results.

\(^b\) Depends on the specific materials, pile size, and weather conditions.