Draft Guidelines for Emergency Composting of Cattle Mortalities

Emergencies Happen ... Be Prepared !

Fires, floods, building ventilation failures, and catastrophic disease …..such disasters don't happen often, but when they do livestock producers suddenly can be faced with livestock deaths and carcass disposal problems.

These draft emergency composting guidelines are based on preliminary findings of an on-going 3-year study at Iowa State University that was begun in 2002 at the request of the Iowa Department of Natural Resources (IDNR). The guidelines may be modified as additional findings become available, but are being published now in draft form to provide Iowa's cattle industry with the up-to-date recommendations on composting practices that:

- are suitable for large animal carcasses;
- can be implemented quickly using equipment and materials available on the farm;
- have acceptable impacts on soil, water, and air quality; and
- prevent the spread of disease.

For detailed information on methods and results of the cattle composting study, visit the project web site at: www.abe.iastate.edu/cattlecomposting

Why Consider Composting?

Iowa's cattle industry is facing new and difficult animal disposal issues that cannot be addressed solely through rendering or on-farm burial.

- In the event of agro-terrorism or a naturally-occurring disease outbreak local rendering capacity could be temporarily overwhelmed, as was the case in Great Britain during the foot-and-mouth epidemic in 2001.
- With consolidation of the rendering industry, haul distances have increased, making transportation more expensive and potentially in short supply in the event of a widespread livestock disease emergency.
- During an outbreak of a highly contagious livestock disease, off-farm disposal of diseased carcasses could increase the risks of disease transmission.
- USDA rules (implemented in January, 2004) that prohibit marketing of non-ambulatory cattle will increase the number of animals that must be disposed of through rendering or on-farm disposal.
- Burying many large animals requires high-capacity earthmoving equipment not found on most farms, and during at least 25% of the year frozen soils make burial in Iowa very difficult.
- Recent IDNR analyses of geographic data indicate that shallow groundwater, exposed bedrock, or other environmentally sensitive situations make large-scale burial undesirable in about 40% of Iowa.

Although composting is unlikely to replace rendering or burial for emergency disposal of cattle, it is a flexible disposal option that can help to overcome the problems outlined above. Specifically:

- Composting facilitates rapid on-farm containment of carcass odor and pathogens, and elevated temperatures produced during composting help to destroy pathogens;
- Most dairy and beef cattle farms have the equipment and materials necessary for composting;
- Unlike burial, frozen soils and seasonal high water tables do not seriously impede composting; and
- Carcass composting followed by land application of the compost poses less pollution risk to shallow groundwater than burial.

Disease vs Non-Disease Emergencies

Disposing of cattle that have a transmissible disease calls for extra precautions during composting. If infectious disease is the cause of death, the following composting procedures can help to reduce the risks of pathogen survival and disease transmission.

- To achieve high composting temperatures that are capable of killing pathogens as quickly as possible, cover carcasses with silage, or a 6-12 inch layer of moist manure capped with ground straw or ground cornstalks.
- To minimize the risk of releasing pathogens into the wind, do NOT turn the pile during carcass decomposition.
- Do NOT excavate and spread compost until approved by animal health officials. In emergencies involving highly contagious diseases, animal health officials may require burial or incineration of finished compost.

NOTE: Due to many unknown factors regarding the biodegradability of the prions that cause bovine spongiform encephalopathy (commonly called BSE or "mad cow" disease), composting should NOT be used for disposal of cattle suspected to have BSE.

For livestock deaths not caused by disease, less stringent composting procedures can be used.

- Ground cornstalks, ground hay, or similar dry porous materials that do not produce high heat quickly may be used to cover the carcasses.
- Turning of the compost pile is permissible (although not necessarily required) after a minimum of 60-90 days;
- Excavation and spreading of the compost on corn or soybean ground can be done as soon as soft tissues

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and internal organs are fully decayed and only skeletal remains are present (typically 8 - 12 months after composting is begun);

Site Selection

To protect property and water resources, and reduce disease risks, emergency composting systems should be sited:

- to avoid unnecessary transport of carcasses that may spread disease;
- at a location accessible by large trucks if cover materials will be transported to the site from off-farm sources;
- on well drained locations that are not subject to runoff or ponded water, and that are outside of 100 year floodplains or wetlands;
- at least 500 feet from homes, public roads, or other areas frequented by the public;
- at least 200 feet from public wells or visible bedrock outcrops, and 100 feet or more from private wells or streams
- near agricultural land where compost can be spread and utilized by commodity crops that are not consumed directly by humans or grazing animals.

To minimize problems caused by rodents or burrowing predators, select a site in an open field located well away from timbered areas or buildings that provide cover.

Planning, Construction, & Maintenance

Planning Guidelines

Long and narrow (base width of 16-18 feet) composting "windrows," with a cross-section like that shown below, are preferable to use of broad-based piles. Windrows take more space, but are easier to construct and maintain with typical on-farm equipment.

Since emergency composting operations are turned infrequently (if at all), use of "naturally ventilated" windrows promotes rapid decay, increased heat production and evaporation of excess moisture, and less odor.

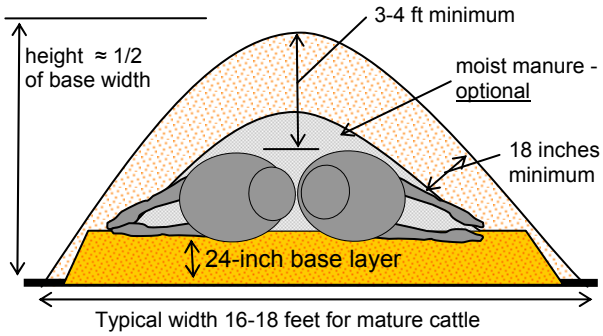

Figure 1. Recommended cross-section for composting full-sized cattle carcasses.

The following guidelines for windrow dimensions and proportions are suggested for full-sized dairy or beef cattle:

- To facilitate easy placement and covering of large carcasses without compacting cover/base materials or soil beneath, windrow base widths should be no more than 2X the loader reach;
- To avoid excessive pile widths that can lead to poor oxygen penetration, no more than two full-sized carcasses should be laid side-by-side (as shown above);
- To avoid release of excess liquids and odor, restrict loading to a single layer of carcasses;
- To minimize excessive pile settling and wind erosion, initial pile heights of approximately 1/2 X the base width are recommended. Completed piles are typically 16-18 feet wide at the base, and have initial heights of 7-8 feet ;
- For single carcasses (or a few small carcasses) a minimum pile width of 8 -10 feet is suggested to provide sufficient pile volume to retain heat during cold weather; and
- Approximately 8 feet of pile length will be needed for each pair of full-sized carcasses composted. If available space requires the operation to be broken into two or more parallel windrows, leave at least 2-3 loader lengths between adjacent windrows to facilitate pile maintenance. Figure 2 illustrates example site dimensions for composting 100 cattle carcasses in two parallel windrows. The total composting area (2 windrows+ space between) in this case is approximately 0.4 acre.

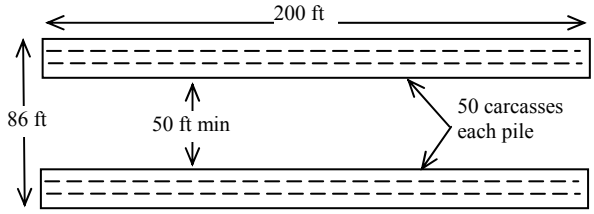

Figure 2. Example composting site dimensions for 100 cattle carcasses in two parallel windrows.

Cover Material Selection & Quantities

Three cover/base materials: corn silage; ground cornstalks; and feedlot manure capped with ground hay; have been field tested. Preliminary temperature and odor data, as well as visual decay observations, have shown that all three: produce complete decay of soft tissues and organs (not bones) within 8-12 months (depending on time of year); retain offensive odors and leachate; and are structurally stable when exposed to seasonal winds and precipitation.

- Corn silage is considered to be the best cover material for cattle carcasses that may be infected with disease. Due to its favorable moisture and readily degradable compounds produced by the ensiling process, silage typically rapidly produces

pile temperatures of 130 °F or higher in the vicinity of the carcasses, and sustains these temperatures much longer than other cover materials that have been field tested.

- A thin (6-12 inch) layer of feedlot manure placed directly over the carcasses and capped with ground hay produces internal temperatures somewhat lower and less enduring than those produced by silage.
- Ground cornstalks typically have very low moisture and nitrogen content and so must rely on seepage of liquid and nutrients from the carcasses to become biologically active. As a result, they produce heat more slowly than the other cover materials.

Regardless of the type of cover selected, avoid using materials that are too wet. If a handful of material produces drops of liquid when squeezed, it is too moist and may produce slow decay and release excessive amounts of odorous gases and liquid seepage.

Composting requires large quantities of cover/base material. Using the windrow configuration shown in figure 1, about 12 cubic yards of cover/base material are needed for each 1,000 lb animal composted. At cover material densities typical in newly constructed piles, this is equivalent to 1 ton of ground hay or straw, 1.4 tons of ground cornstalks, or 3.2 tons of corn silage.

Beef or dairy operations considering composting for emergency disposal should stockpile plenty of cover materials as part of their emergency response plan. For the 100 animal composting operation illustrated in figure 2 then, approximately 100 tons of ground hay or straw (200 large round bales), 140 (280 large round bales) tons of ground cornstalks, or 320 tons of corn silage would be needed for cover/base material.

Construction Procedure

Construction of emergency composting windrows is begun by placing a 24-inch thick layer of cover material on the ground to absorb excess liquid released by the carcasses.

Following placement of the base layer, cattle carcasses are positioned on top of it as shown in the diagram. A loader equipped with pallet forks is recommended for positioning large carcasses on the pile without tearing up the base layer. Laying carcasses on their sides, back-to-back, with legs projecting out and downward as illustrated, reduces the amount of maintenance needed to keep carcasses covered as pile settling occurs.

Field research experience indicates that carcasses need not be punctured or splayed to achieve decomposition.

As shown in figure 1, cover depths of 3-4 feet are recommended at the centerline, where maximum settling occurs as carcasses rupture and decay. Along the sides of the piles, the outer extremities of the carcasses should be covered with at least of 18-inches of material to retain heat and odors.

Operation & Monitoring

Research experience has shown that 1,000 lb cattle carcasses are reduced to skeletal remains, without turning the compost piles, in 8-12 months depending on external air temperatures. As previously noted, piles should not be turned if carcasses are believed to be diseased.

In non-disease situations turning the pile may accelerate decay, but also can release odors and pathogens if done too early in the decay process. Turning of piles containing large carcasses should be delayed at least 60-90 days following construction to avoid release of objectionable odors. If odor becomes a problem following turning, cap the turned pile with at least 12 inches of fresh cover material. Turning during cold weather is not recommended as this will unnecessarily chill the pile and slow carcass decay.

Rapid pile settling, and rodent or scavenger activity, can cause occasional carcass exposure. Check the condition

of the windrow each week, and repair exposures with additional cover material.

Appearance of liquid at the toe of the windrow can be caused by excess precipitation, use of cover materials that are too moist, overloading of the pile with too many carcasses (caused by stacking), or inadequate use of absorptive base and cover materials at the time of construction. Field research experience with cattle composting windrows loaded and constructed as described, have resulted in very little release of visible liquid. If liquid is noted, use a dry porous cover material, such as ground cornstalks or ground straw, to temporarily absorb the liquid until it can evaporate or infiltrate into the soil.

Compost Disposal

Preliminary results of field biosecurity tests using two common avian vaccine viruses suggest that composting windrows constructed with the recommended depths of cover material can retain and inactivate viruses within 3-4 weeks during cold weather, and in a matter of days during warm weather. Nevertheless, if cattle death was caused by a potentially contagious disease, skeletal remains and cover material should not be excavated until advised to do so by animal health officials. If the safety of the finished compost cannot be ascertained by sampling and testing, skeletal remains and cover materials can be incinerated, buried, or rendered to further reduce disease risks.

Skeletal remains and cover materials for non-diseased cattle can be spread on corn or soybean ground using a dry manure spreader. At the present time, spreading on grazing land, or on land used to produce human or animal food crops that will be consumed without further processing, is not recommended. Skeletal remains (bones) are normally clean and dry, but the bones of mature cattle can be quite thick and may not totally decompose for several years. Turning bones under the soil with a moldboard plow is advisable if the disposal area is located near to non-farm residences frequented by pets or children. Disking has not been a successful method for covering large bones.

The nutrient content of finished cattle mortality compost can be highly variable and is heavily dependent on the carcass loading rate and amount and type of cover material used. Limited sampling of cattle mortality compost has shown total N content in finished compost of roughly 0.6-0.7% (wet weight basis) where silage and ground cornstalks have been used as cover material. Total P_2O_5 content for the same composts were in the 0.4-0.5% range (wet weight basis).

FAQ's

Q. *What about carbon to nitrogen ratios? I read that C:N ratios need to be in the range of 20:1 - 30:1 for good composting.*

A. For large commercial/industrial composting operations where minimum composting time is the primary goal, and where the organic materials to be composted consist of small particles that are easily mixed, C:N ratios of 20:1-30:1 are the desired target. In on-farm mortality composting, however, the primary goals are immediate containment of carcasses to prevent release of disease and odors, and low cost of disposal. Carcass degradation DOES occur at non-optimal C:N ratios, it just takes longer. Since minimum carcass decay time is not a goal for most livestock producers, and achieving a uniform C:N ratio throughout the pile would require costly and time-consuming grinding of carcasses and mixing them with a carbon source, livestock producers are generally willing to accept longer decay times.

Q. *Would carcass decay times be decreased if the compost were turned more frequently?*
A. Yes they probably would, but as noted in the previous question, the critical issues in emergency livestock disposal are rapid containment of carcasses to prevent the spread of disease and to minimize air and water pollution. Turning the compost is time-consuming and costly, it can release odors and pathogens if done too soon during the decay process, and also can chill the pile and reduce decay rates if done during cold weather. In most cases, livestock producers are willing to forego rapid carcass decay in order to avoid these potential pitfalls.

Q. *If I don't have sufficient quantities of silage, cornstalks, hay, or straw for emergency disposal, are there alternative cover materials that I could use? How can I locate them in an emergency?*
A. Alternative materials that have good potential for mortality composting include, turkey or broiler litter, coarse sawdust or wood shavings, ground wood waste, leaf mulch, and coarse-textured municipal yard waste composts. Avoid materials that are fine textured (similar to soil) as these can result in extremely slow decay. For assistance in locating suitable composted or recycled waste materials contact the Energy & Waste Management Bureau of the Iowa Department of Natural Resources at: http://www.state.ia.us/dnr/organiza/wmad/index.html or by phone at 515-281-4367.

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