

Composting Animal Mortalities on the Farm

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Farm animals, like humans, are subject to disease, injury from accident or peer aggression, old age, environmental stress, genetic abnormality, and other maladies that can result in death. Management and disposal of animal mortality is considered a normal aspect of raising livestock and poultry. In the past, disposal was limited to burial at the farm or at landfills, on-farm incineration, and renderer pickup. Composting is now an efficient alternative for carcass disposal. It is cost-effective, environmentally and biologically sound, and easy to accomplish. With a correctly designed and operated compost system, carcasses are not placed where surface or groundwater would be contaminated. They are degraded to a useful farm product (soil amendment) without producing objectionable odors or attracting flies and scavenging birds or animals.

Although originally developed for broiler chicken farms, mortality composting has been successfully used to treat fish, swine, cattle, and horse carcasses of mature size. Composting is not limited to an occasional individual death, but can be used for catastrophic events where an entire flock of chickens might be lost to disease or a group of cows might be killed by flood or a lightning strike.

Mortality composting can occur in backyard-sized bins called minicomposters, in dedicated composter buildings, in temporary open bins fashioned from large bales of hay or straw, and in windrows or piles on a paved or well-drained soil surface. Minicomposters are managed with a dung fork and shovel, while larger bins and piles require the use of a tractor bucket or skid steer loader for moving and mixing material.

The Compost Process

The biological process of composting animal carcasses is identical to the process occurring in the composting of any other organic material. The needed parameters of air, water, nutrients, and carbon must be balanced to allow the compost process to initiate and continue at a rate sufficient to produce enough heat to provide for pathogen reduction in the mass. These conditions are obtained by an optimum mix of compostable materials where the mortality provides nitrogen and water while carbon materials such as sawdust, straw, paper, cornstalks, and other bulky, fibrous materials provide needed carbon and air space.

A variety of recipes for mixing different materials can be developed to compost agricultural products. Often, new mixtures of compost ingredients can be supplemented with old compost as a means of reducing the need for new carbon-containing materials (sawdust and straw). However, new material should account for at least half of the mix in order to maintain adequate levels of carbon for the compost process. Livestock bedding and poultry litter removed from animal grow-

ing areas can be used if it is dry and contains very little manure.

A very important factor in mortality composting is the moisture content of the compost mix. Too little moisture promotes dehydration, which preserves tissues, while too much moisture leads to foul odors and contaminating leachate. The moisture content of the compost mix should be 40 to 50 percent, as evidenced by a squeezed handful of compost mix leaving wetness on the palm of your hand without forming drops. A mix that is too dry or too wet will not develop the desired process temperature. The animal carcasses usually provide additional water in relation to their size and quantity. Large animals can provide considerable water and the starting compost mix can be slightly dry. Small animals loaded a few at a time will add little water, therefore the mix may need additional water. Old and dehydrated animals will require additional water.

The compost is managed in a pile or bin that is turned for aeration and mixing once or twice during the active compost period prior to placement in a curing pile. In the active compost period the animal carcasses are slowly cooked by the process heat and then degraded. The heat produced (135 to 150 °F) is sufficient to kill pathogenic disease

organisms. The total time required ranges from 2 to 6 months, depending on the size and number of the animals and the rate of the compost reaction.

A thorough understanding of the composting process should be obtained by reading practical compost literature and attending educational meetings or classes before attempting to compost mortality. Procedures should be practiced by composting yard waste or animal manure in backyard-sized compost bins. Once you understand and master the basic procedures, you will have better success with mortality composting.

Mortality Composting Systems

Minicomposters

Minicomposters are useful for poultry, piglets, rabbits, fish, and other small animals. Minicomposters can range from simple boxes made of pallets to constructed bins of wood and plastic mesh (Figure 1). The dimensions must be sufficient to allow heat retention in the mass of composting material. Minimum dimensions are 36 inches in height and 40 inches in length on any side. A minicomposter of this size will accept a maximum of 30 pounds of carcasses per day and can process up to a cumulative total of 600

pounds. Multiple bins can be constructed for greater amounts of mortality. Minicomposters can be placed in the animal growing area, because they are almost odorless and are biosecure when properly operated (see below for further discussion of biosecurity). Locating the minicomposter in a warm area protected from wind will help retain mass heat and improve the rate of composting.

The bin is started by layering compost ingredients in the minicomposter. A proven volumetric



Figure 1. Minicomposter.

ratio recipe of 2 parts poultry litter to 1 part fluffed straw in 6-inch layers has worked very well on broiler farms. Where poultry litter is not available, experiment with other materials (Table 1). Straw provides porosity, but can be replaced with sawdust. The bin should be layered to about one-third full with moisture adjusted by adding water as the layers are being formed. The intent is to have a compost mixture that rapidly heats and is brought up to optimum temperature (140 °F) before the dead animals are placed in the bin. A compost thermometer is necessary to determine when the bin is ready for loading and to make sure the proper temperature is maintained during the composting process.

The animals are buried in the center of the heating compost with a minimum of 6 inches of insulating compost cover on all sides, above and below the animals (Figure 2). For chickens, the procedure is based on the volume of birds to be treated: 1) dig a hole in the compost large enough to hold three times the volume of birds to be buried; 2) cover the bottom of the hole with straw equal to one-third the volume of the birds; 3) pour water over the birds equal to one-third the volume of the birds; 4) cover the birds with litter equal to three-quarters the volume of the birds; 5) smooth off the top of the compost to finish filling the hole. Birds can be loaded daily in this manner. Fish and other small

Table 1.

Materials useful for mortality composting:

- Floor bird litter
- Sawdust
- Wood shavings mixed with sawdust
- Shredded leaves mixed with sawdust
- Shredded newsprint mixed with chopped straw
- Pine bark chips (1 inch and smaller)
- Chopped corn stalks
- Chopped straw
- Chopped hay (aged)
- Spoiled silage
- Caged bird manure mixed with chopped straw or sawdust
- Chipped tree trimmings mixed with sawdust
- Peat
- Shredded cardboard mixed with sawdust

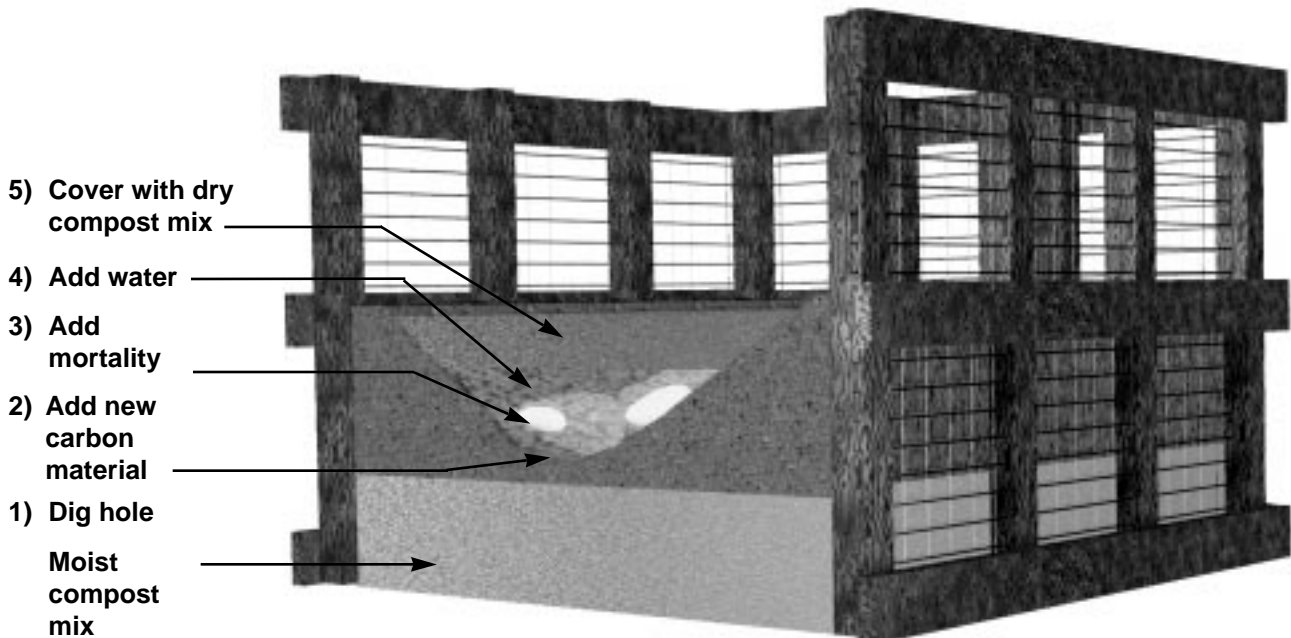


Figure 2. Loading a minicomposter.

animals can be loaded in the same manner. (Refer to Fact Sheet 537, "Composting Dead Birds," and Fact Sheet 642, "Minicomposter Dead Bird Disposal," Cooperative Extension Service, University of Maryland, for more information.)

When the minicomposter bin is filled, and at least 7 days after the last addition of animals, the unit can be disassembled and the compost removed to be disposed of or stored as manure. One-third to one-half of a bin of compost can be used in place of new materials for the start of a new compost cycle.

Two-Stage System

Two-stage composting is used where animal numbers normally exceed the capacity of minicomposters or the weight of the animals is greater than 30 pounds, but less than 300 pounds (larger animals may be reduced in size). In two-stage composting, the first stage mix generates heat and major tissue breakdown while the second stage after turning continues the process. This process is usually accomplished in two or more bins with compost mix being moved from one bin to another during the turning process.

Composting bins can be made in a variety of designs and materials—wood, masonry, or even temporary construction. The size of a

bin is a compromise between the number and size of the animals to be composted and the size of the equipment to be used for moving the compost. Small bins allow better management of the compost process under conditions of normal mortality expectations. Bins of about 200 cubic feet capacity (5 feet by 8 feet by 5 feet high) are suitable for animals of less than 300 pounds in size and allow entrance with the average tractor bucket. Larger animals and larger equipment require larger bin dimensions, but the bin height should not exceed 5 feet. The total number of bins required for the farm is based on the need of 1 cubic foot of primary bin and 1 cubic foot of secondary bin for each pound of mortality expected per day, regardless of animal type.

Ideally, bins should be constructed of treated lumber or concrete on an impervious surface and covered by a roof (Figure 3). The impervious floor allows use in all weather conditions and assists in identifying the production of leachate from saturated compost. Roofing allows improved compost moisture control in both wet and dry weather. Many states provide cost sharing for the construction of permanent bins. Approved designs and operational practices are available from



Figure 3. Freestanding composters.

your local Natural Resources Conservation Service office.

Temporary bins constructed with large bales of hay or straw have been used for this process. The bales provide an insulated back and divider wall to separate different batches of compost (Figure 4). The temporary bins can be placed in the field where the compost will eventually be spread, but must be accessible to turning equipment.

Animals are loaded into a primary bin as part of the initial compost mix before heating initiates. Start with a base layer of compost material at least 1 foot in thickness to act as a sponge. Animals are sequentially loaded in layers and covered with the compost mix until the bin is full. Small animals can be placed side by side in layers no more than 8 inches thick with 6 inches of compost mix between and around the layers. Add water if necessary as the layers are being constructed (Figure 5). At each loading make sure that the top animal is covered with at least 6 inches of compost mix.

Animals weighing less than 300 pounds can be composted whole with no preparation. Larger animals require opened thoracic and abdominal cavities, and sliced large muscle masses.

The tissues slowly cook; this is followed by rapid degradation. The compost temperature

starts to decline 7 to 10 days after the last animals are added to the compost. Use a long-stem thermometer to determine when the compost temperature peaks and turn when the temperature falls to less than 130 °F. The compost mass is then turned for aeration by moving the compost to a secondary bin (the two-bin system), ensuring that any exposed animal parts are fully covered with at least 6 inches of compost mix. The animals are essentially reduced to bone after an additional 10 to 20 days. After this period, sawdust-based systems can be recharged with new animal carcasses as long as most of the sawdust particles are identifiable and new sawdust is added to maintain the original volume. If a majority of the particles appear composted, turn again and place one-third of the volume in a curing pile or manure storage shed for a minimum of 30 days before field spreading. The remaining one-third of the compost should be mixed with new sawdust to start a new bin.

In this process the control of pathogens is maximized when the entire mass reaches temperatures greater than 130 °F for at least 3 days. The combination of the cooking process, rapid degradation, and compost cover provides control of odor and flies, but large bones may still remain. As with minicomposters, a thermometer is necessary for management of the two-bin system.



Figure 4. Temporary bale bin composter.

System for Large Animals

Large animal composting is simply the burial of the animal carcass in a compostable medium. Although silage, chopped straw, and other materials can be used, sawdust is preferred because it is absorbent and the small particles come into intimate contact with the animal tissue. Because large animal composting is usually not needed on a daily basis, a loading density of 10 pounds or less of animal per cubic foot of sawdust will be successful. The animals must be placed on and covered with a minimum of 12 inches of sawdust. The base is a sponge for fluids and the cover is a biofilter for odor capture. Large animals should be placed in the composting mass backbone down with legs spread so that fluids do not readily drain. The cover compost mix should contact the opened body cavities (Figure 6). Animals can be loaded to the maximum density in compost bins or piles at a single loading or they can be placed in the bin or pile as needed until the maximum loading density is reached.

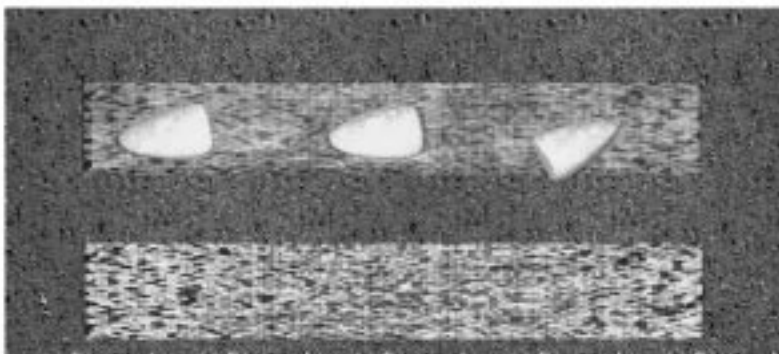
The compost is turned for mixing about 3 months after the maximum loading density is reached regardless of when loading started. The last animal placed must be given adequate treatment time. After turning, any exposed animal parts must be fully covered with compost. After 3 or 4 months of additional composting the material can be field spread (time may increase during the cold months). Although some large bones remain, they lose structure and are easily broken in

the spreading process. Odor is minimal because the process is undisturbed for such a long time and a deep compost cover is maintained.

Although bins are preferred for containment, steep-sided, peaked compost piles can be equally effective. The location should be high, dry, easily accessible, and located away from surface waterways. Compost made from straw, leaves, or materials other than sawdust may require a tarp cover or roof to shed rain. When steeply piled, sawdust forms a surface crust that sheds rain and prevents compost saturation.

Composting Catastrophic Mortalities

Catastrophic mortalities are those caused by uncontrolled events (power failure, flooding, disease, etc.) in which a large number of animals die in a short period of time. The principles of composting these mortalities are the same as described above. Catastrophic mortality composting can occur in static windrows without bins or dividers (Figure 7). The base of the windrow should be no more than 12 feet wide, while the windrow height should be limited to 6 feet. Windrows can be extended to any length to fit the site. Windrows located outside should be on high, dry ground away from surface waterways. Windrows should be shaped to shed water and oriented on sloped land to run parallel to the slope so that surface runoff is not captured by the compost. The mix of materials,



loading procedure, and turning schedule are the same as described for either the two-bin or the slow composting systems.

Animals raised on bedding or litter can be composted in the bedding or litter where they were housed if the whole population is involved and adequate space is available. The compost process will kill disease organisms and assist in control of disease, as well as treat the mortality.

Biosecurity

A primary concern with concentrated confinement agriculture is the spread of infectious disease among the animals. Control of disease requires diligent management on the part of farmers to minimize disease spread from contaminated animals (those which are diseased or were exposed to disease that could be transmitted to others). Pathogenic organisms may be transported by people, animals, vehicles and wind, within and among farms. Under disease conditions, it is preferable to keep any mortality on the farm rather than risk disease spread through transport of the carcass to some other location.

Composting carcasses is a good biosecurity measure because most pathogenic organisms common to animal production can be killed by exposure to thermophilic temperatures (135 to 155 °F) in a compost pile or bin. However, some pathogenic organisms such as BSE (mad cow disease) and scrapies in sheep may not be controlled at compost process temperature. Farmers with known cases of these temperature-resistant disease organisms should seek the advice of their veterinarian.



Figure 6. Preparing a large carcass for compost.

For optimum disease control compost processes should be done as described for two-stage bins—measuring the temperature and turning the compost to assure that process temperatures have been reached and that the mass of the composting material remains aerobic. Surveys of microbes in poultry and swine mortality composting systems indicate that no deleterious pathogens survive systems maintained in the recommended manner.

Legal and Environmental Issues

In most states composting animal mortality is generally recommended. However, some states may prohibit some practices or require permits, which may dictate specific procedures, locations, or structures. Many states provide cost-share money to farmers to fund approved compost structures. Contact your local Cooperative Extension Service or Natural Resources Conservation Service office to obtain information about regulations and assistance programs.

Odor, Insects, Vermin, and Scavengers

Odor is not generated in a correctly mixed and loaded mortality composter. The presence of odor is an indication that management has failed to operate the composter correctly. Excessive loading, too low or high moisture content, or lack of adequate cover completely surrounding the carcass are usually responsible for odor. Odor can also occur outside the composter from a partially decaying animal carcass that has not been incorporated into the compost in a timely manner. Monitoring compost temperature is a good check to avoid odor. Temperatures that are too low or do not increase after loading indicate a problem with the process and forewarn of impending odor.

The heat produced in mini-composters and bin composters combined with the turning of compost prevents the development of insect larvae. The addition of a dry layer of composted material on the top of a bin reduces access to the moist conditions



Figure 7. Catastrophic mortality windrow.

required for egg laying. Other insects normally found in decaying woody products may be present in the compost during the process and should not be considered pests.

Compost bins or piles correctly mixed to produce heat and adequately covered with a blanket of compost mix to capture odor will not attract vermin and scavengers. In most situations, mortality composting trials in areas frequented by dogs, fox, buzzards, and raccoons showed no sign of disturbance. However, if the compost pile or bin content is turned without completely covering the carcass parts or without placing a new layer of compost mix over the surface, scavengers may be attracted to the scent. Carcasses not immediately incorporated into the compost pile or bin will also attract scavengers.

Compost Utilization

It is recommended that mortality compost be used solely for soil amendment on the land of the animal production unit. It can be land spread as manure or as a mix with manure and should be included in the farm

nutrient management plan. The mortality compost should not be used as animal bedding or feed supplement.

Summary

Dead animals are a fact of poultry, livestock, and fish production. Composting can be a good method of mortality treatment to control odors, flies, and disease. Composting can be rapid or slow; done in permanent facilities or at temporary locations. Farmers who want to adopt composting should thoroughly understand the composting process and provide the necessary conditions for compost production.