

Composting Swine Mortalities in Iowa

Composting Gains Popularity

With more than 25 million hogs produced annually in Iowa, cost effective mortality disposal alternatives that minimize risks to herd health and the environment are essential. Following the lead of the poultry industry, where composting has been used successfully for more than a decade, swine producers are finding that composting is a flexible and reasonably priced disposal method that can be used year round. Results of a statewide survey of Iowa swine producers conducted by Iowa State University and the Iowa Pork Producers Association during March of 2001 show that about 12 percent of producers now rely exclusively on composting to dispose of their mortalities. An additional 6 percent of producers say they rely on composting as a backup disposal method when timely rendering service is not available.

Swine producers say they are attracted to composting for a variety of reasons. Composting allows them to manage mortalities promptly, as they occur. With properly designed composting facilities, there is no need to call for rendering service or to worry about options if the rendering truck can't make it that day. Composting also eliminates the need to wait for the ground to dry up or thaw out so that burial can be accomplished.

Composting facilities and equipment

Covered bins versus open windrows?

Composting in moderately sized roofed bins is the recommended method for Iowa's highly variable climate. Use of covered bins simplifies management of the composting operation and maximizes the potential for success regardless of weather conditions. Covered bin systems reduce the potential for seasonal odor problems caused by overly wet compost. Bins also minimize space requirements, improve heat retention during cold weather, and help to avoid problems with scavenging insects and animals. Bin systems need not be complicated or costly. Old corn cribs, open front livestock buildings, and other types of unused farm structures can often be converted for composting at a relatively low cost.

Though sometimes used for emergencies, composting in open piles or windrows is not recommended for day-to-day mortality management. Open systems are vulnerable to saturation during wet weather, which can lead to odor production and release of contaminated leachate.



Figure 1. Composting rapidly decomposes swine mortalities, producing a soil-like product that can be spread on cropland. (Photo by Tom Glanville, Iowa State University.)

While these problems can be reduced to some extent by using extra cover material and turning the piles more frequently to break up wet spots, the material, labor, and management resources required to successfully operate open systems during adverse weather conditions will be higher than for bin composting systems.

Equipment

Most of the equipment used in swine mortality composting is commonly found on livestock farms. Machinery needs include a skid loader, or tractor with front-end loader, to load and unload composting bins or windrow; and a solid manure spreader to spread finished compost on cropland. A stainless steel composting thermometer with a three- or four-foot long stem is needed to check internal pile temperatures.

Cover material

The material used to cover the carcasses is an important part of the composting system. The ideal cover material retains heat, absorbs excess moisture, and provides a barrier that helps discourage insects and scavengers. Cover materials also must provide much of the carbon, which is essential to the microbes that decompose animal carcasses. Due to its excellent ability to retain heat and absorb excess moisture, sawdust is generally acknowledged as the best cover material. Unfortunately, sawdust and recycled wood products are in high demand for many other uses, making them increasingly hard to obtain and raising their prices substantially in recent years.

Alternative cover materials that are much easier to obtain include chopped cornstalks or straw. Since these tend to be less absorptive and have poorer insulating properties than sawdust, their use requires more care during cold or wet weather. Poultry litter, a mixture of sawdust and poultry manure produced during turkey and broiler production, has been used successfully for carcass composting in the poultry industry. Not only does litter have the desirable characteristics of sawdust, the bacteria and nitrogen added by the manure make this mixture more biologically active than sawdust alone. Bedding from swine hoop buildings also can be used as cover material. Since the quality of used bedding from hoop buildings varies considerably, care should be taken to avoid materials that are saturated with liquid or that contain high proportions of manure because these conditions can lead to slow decay and/or excessive odor production.



Figure 2. This low-cost bin composting system was constructed with used materials and is located inside a converted farm building. (photo by Kris Kohl, Iowa State University)

Disposal area

Swine composting operations require cropland or pasture land for final disposal of the finished compost. The finished compost will contain some recognizable bones, particularly if large breeding animals or finishing hogs are composted, so locating the disposal area away from non-farm residences is recommended. If the composting operation is functioning properly, however, bones will be free of all soft tissues, and they will be dry, brittle, and of little or no attraction to scavenging animals or insects.

Producers frequently ask about the fertilizer value of their compost. Unfortunately, the nitrogen value of the compost is difficult to predict because it can vary considerably depending on the type and amount of cover material used. Sampling and testing the compost for nutrient content is the only reliable way to determine its fertilizer value.

Composting procedures

Mortality composting is begun by placing a 12-inch layer of cover material in the bottom of the bin. Decaying carcasses release excess moisture, so a thick absorptive base layer plays an important role in preventing release of excess liquid.

Carcasses placed in the composting bins should not touch each other and should be at least 9 to 12 inches from bin walls. Too many carcasses in one spot leads to localized wet spots and poor decay. Carcasses that are too close to the cool exterior side walls of the bin will decay slowly and are less likely to be exposed to the high temperatures necessary to kill disease-causing microorganisms. After a layer of carcasses has been placed in the bin, add 6 to 9 inches of cover material. Complete coverage is essential to avoid problems with insects, rodents, and scavengers. Daily layering of new carcasses and cover material continues until the bin is filled to a depth of about 5 feet. In some instances, it may help to segregate large and small carcasses in separate bins. This allows smaller carcasses to move through the treatment process quickly, minimizing the amount of bin space tied up in lengthy treatment cycles. To ensure continuous coverage throughout the composting cycle, it may be necessary to add cover material from time to time as material within the bins settles. This is particularly true when large carcasses are composted.

In a properly operating facility, new material added to bins reaches temperatures of 120 to 150°F within 24 to 48 hours. Internal temperatures can be monitored with a long-stemmed (36- to 48-inch) composting thermometer. For an accurate picture of internal conditions, probe the bin at several locations. It is normal to find hot and cool spots within the same bin, so a single temperature measurement can be misleading. If a bin fails to heat up, too much or too little moisture is the most common cause. It may be necessary to unload the bin and mix in compost from an active (hot) bin to remedy the problem.

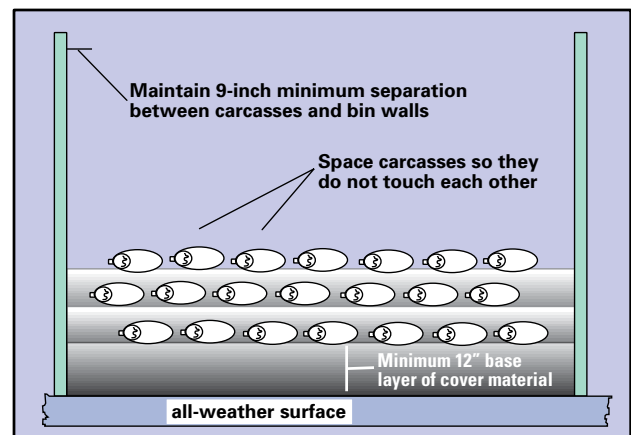


Figure 3. Animal carcasses should not touch each other, and should not be placed in the cool zone near composting bin walls.

After a bin is completely filled, it must undergo a primary heating cycle of 60 to 90 days. The length of the primary heating cycle will vary with the size of carcasses placed in the bin. For farrowing house and nursery losses, an initial heating cycle of as little as 30 days may be adequate. If the bin is filled with larger market-weight animals or breeding stock, primary heating cycles as long as 6 months may be necessary.

Following the primary heating cycle, the partially composted carcasses are removed from the primary bin and placed in a secondary bin. The mechanical action of moving the compost breaks up the pile, redistributes excess moisture, and introduces a new oxygen supply. Once this takes place, a secondary heating cycle occurs, accompanied by further decomposition. By the end of a 60- to 90-day secondary heating cycle, even large carcasses of breeding stock are normally reduced to a few large bones that are free of soft tissues which cause odors or attract insects and predators.

Sizing and layout

Bin-type composting systems located under a roof are recommended for best year-round performance, optimal processing, and minimal problems with runoff and scavengers. Total bin volume for a swine mortality composting operation is based on average daily weight of animals to be composted. Typically, about 20 cubic feet of primary bin volume is recommended for each pound of average daily loss, with an equal amount of secondary bin space.



Figure 4. Checking internal temperatures with a composting thermometer is a quick way to determine if moisture and other conditions are suitable for rapid decay and pathogen reduction. (Photo by Tom Glanville, Iowa State University.)

Use Table 1 to estimate the amount of primary bin volume for your particular operation. Write in the annual number of pre-wean and nursery pig litters produced by your operation in the first two rows of column B. The annual number of pigs produced by your finishing operation, and the average breeding stock population, are entered in the bottom two rows of column C. Multiply the values in columns B and C by the compost volume factor in column D, and enter the result in column E. The sum of all the values in column E (entered in Total box) is the estimated total amount of primary composting volume needed for your operation. You will need an equal volume of secondary bin space.

Table 1. Simplified method for estimating primary bin volume				
(A) Phase of operation	(B) Litters per year	(C)* Number of animals	(D)** Volume factor	(E) Primary bin volume (cubic feet)
Pre-wean pigs	675 litters		X 0.41	= 277
Nursery pigs	675 litters		X 0.26	= 176
Finishing pigs		5,800 pigs	X 0.17	= 986
Breeding stock		300 sows	X 0.57	= 171
			Total	= 1610

* For finishing pigs, use annual number marketed. For breeding stock, use average year-round population.

** Volume factors based on 20 cubic feet of primary bin capacity per pound of average daily loss. Weight of mortalities is calculated assuming average mortality rates as follows: pre-wean mortality, 25 pigs/litter @ 3 pounds/pig, nursery mortality, 2 percent (assume 95 pigs/litter) @ 25 pounds/pig, finishing mortality, 2 percent @ 150 pounds/pig, and breeding stock mortality, 3 percent annually @ 350 pounds/animal.

Example values shown in italics in columns B and C of Table 1 are for a 300-sow farrow-to-finish operation producing 675 litters per year, and marketing 5,800 finished pigs per year.

Approximate dimensions for each bin can be estimated following these steps:

- Step 1: Estimate minimum bin width.** Side-to-side dimensions of at least twice the loader bucket width are recommended to provide sufficient maneuvering room. For a skid loader with a 4 foot wide bucket, for example, bin widths of at least 8 feet are suggested.
- Step 2: Select front-to-back bin dimension.** One to two times the minimum bin width is suggested. For the 8 foot wide bins in this example, a front-to-back dimension of 12 feet is used.
- Step 3: Calculate individual bin volume:** Multiply bin width (from step 1) by the front-to-back dimension (from step 2) to obtain bin floor area. Then multiply the floor area by the anticipated working depth to obtain the bin volume. Working depths of 5 feet or less are recommended (bin walls should be about 1 foot higher than the working depth). In this example the bin floor area is 8 feet X 12 feet = 96 square feet. Using a 5 foot working depth, the individual bin volume is: 96 square feet X 5 feet = 480 cubic feet.
- Step 4: Estimate number of primary bins:** To determine the number of primary bins needed, divide the estimated Total Primary Bin Volume (sum of values in column E of Table 1) by the Individual Bin Volume (step 3). If a fractional value is obtained, round UP to next whole number. For this example, dividing the total primary bin volume of 1610 cubic feet by the individual bin volume of 480 cubic feet yields a value of 3.35. Rounding this value UP, 4 primary bins are recommended.



Figure 5. This simple four-bin swine mortality composting unit includes space for dry storage of cover material behind the bins. (Photo by Palmer Holden, Iowa State University.)

Step 5: Estimate number of secondary bins: The number of secondary bins should equal the number of primary bins. In this case, 4 secondary bins are recommended.

Step 6: Additional bins for cover material: If space to stockpile dry cover material is NOT available in adjacent buildings, construction of 2 or more additional bins for this purpose is recommended.

Step 7: Select bin layout: Bin layout is usually dictated by the geometry of the available space. Linear and tandem layouts, like the floor plans shown in Figure 6, are most common. If bins will be located outdoors where they are not shielded from wind, the tandem layout is recommended to help retain heat during cold weather.

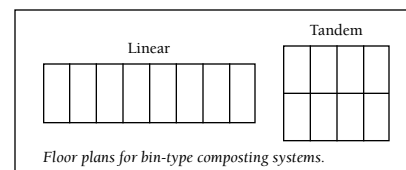


Figure 6. Typical floor plans for bin-type composting systems.

Frequently Asked Questions

- Q. My composting operation is very odorous, the decay is slow, and internal pile temperatures are low even during summer months. What can I do to improve this?**
- A.** Excessive odor production accompanied by low internal temperatures is typical of compost that is too wet. Excess water is normal in the *immediate* vicinity of the swine carcasses, but each carcass should be surrounded by sufficient amounts of cover material to absorb the liquid and prevent any from seeping out of the base or sides of the pile. Material in the outer envelope of the compost pile (a few inches beneath the outer surface) should feel slightly damp, but if squeezing a handful of the envelope material causes water to drip out, it is too wet. Excess moisture is usually caused by failure to protect the composting operation or cover material stockpiles from excess precipitation, or by using too little absorptive cover material over and around the animal carcasses.
- Q. My compost fails to heat up, even during warm weather. Excess moisture does NOT seem to be the problem. What else could cause this?**
- A.** Likely causes are use of cover material that is extremely dry, or too little nitrogen in the cover material. Animal carcasses release considerable

moisture into the cover material immediately surrounding them, but dry or extremely porous cover materials can draw moisture away from the carcasses or encourage excessive moisture evaporation. If so, the zone around the carcasses may become too dry for rapid bacterial decay and heat production. If this happens, do not add water directly to the top of the compost bin. This can saturate the pile, causing seepage, anaerobic conditions, and excessive odor. To increase the water content in a controlled way, add water to stockpiled cover material, and then mix the moistened cover material into the compost pile. If moisture content appears adequate, insufficient nitrogen in the cover material is a likely cause of low internal temperatures. To boost the nitrogen content, mix a small amount of manure into the cover material. Avoid adding large amounts of manure at one time as this can lead to odorous releases of ammonia.

Q. I have trouble getting my compost bins to heat up during cold weather. What can I do to improve heat production and retention?

A. If your composting operation works well in warm weather, but not during the winter, try increasing the size of your cover material stockpile or of your composting bins. Most cover materials produce small amounts of heat while stockpiled. Larger stockpiles help to retain this heat, providing warmer material with which to cover the carcasses that are added to the composting bin. It's also important to use composting bins that are large enough to retain heat during cold weather. Small bins contain insufficient amounts of biodegradable material to produce and retain heat during cold, windy weather. It's also important to **not** let carcasses freeze before putting them into the compost bin. Frozen carcasses require tremendous amounts of heat for thawing before decomposition can begin.

Q. How can I tell if a material will make a good cover material for carcass composting?

A. Stockpile some of the potential cover material and use your composting thermometer to monitor internal temperatures. Good cover materials have sufficient moisture, porosity, and nutrient content to promote self-heating. Avoid cover materials that show little potential for self-heating.

Q. Can I reuse finished compost as cover material to compost subsequent mortalities?

A. Yes, if the moisture content of the finished compost is acceptable (neither too wet nor too dry), limited reuse is possible. Continuous reuse may ultimately

lead to a nutrient imbalance that reduces biological activity.

Q. My swine composting operation is working great and I would like to make some extra money by composting pigs from neighboring farms. Are there any limits on the size of on-farm composting operations or other regulations that I need to know about?

A. Composting dead animals that do not originate on the same farm where the composting facility is located requires a permit from the Iowa Department of Natural Resources (IDNR). Contact IDNR for further information about permits and operating requirements for commercial composting facilities.

Iowa's animal mortality composting regulations

Administrative rules of the IDNR state that on-farm composting of dead animals generated on the same farm as the composting facility is exempt from having a permit if the following operating requirements are met:

- Dead animals are incorporated into the composting process within 24 hours of death and covered with sufficient animal manure, animal bedding, crop residues, or clean wood waste (free of coatings and preservatives) necessary as bulking agents and to prevent access by domestic or wild animals.
- Composting is done in a manner that prevents formation and release of runoff and leachate and controls odors, flies, rodents, and other vermin.
- Dead animals are not removed from composting until all flesh, internal organs, and other soft tissue are fully decomposed.
- Storage of finished compost shall be limited to 18 months and shall be applied to cropland or pasture land at rates consistent with the nitrogen use levels necessary to obtain optimum crop yields and shall be applied in a manner as to prevent runoff to surface waters of the state.
- Application of compost to other lands shall require prior approval by IDNR.
- Composting must be done on an all-weather surface of compacted soil, compacted granular aggregates, asphalt, concrete or similar relatively impermeable material that will permit accessibility during periods of inclement weather and prevent contamination of surface and groundwater.

- If composting is done in a permanent structure, composter construction shall utilize weather and rot-resistant materials capable of supporting composting operations without damage. (Although not mandatory, a roof over the composting facility is recommended to prevent excess moisture accumulation that can lead to production of undesirable odors and leachate.)
- Composting must be done outside of wetlands or the 100-year flood plain and at least 100 feet from private wells, 200 feet from public wells, 50 feet from property lines, 500 feet from inhabited residences, and 100 feet from flowing or intermittent streams, lakes, or ponds.

More information

For additional information visit Iowa State University's award winning swine mortality composting web site on the Internet at: www.abe.iastate.edu/pigsgone/

Written by Tom Glanville, Ph.D, Department of Agricultural & Biosystems Engineering, Iowa State University, Ames, Iowa.

Special thanks to Jay Harmon, Ph.D., Department of Agricultural & Biosystems Engineering, Iowa State University, and Ubbo Agena, Iowa Department of Natural Resources, for their technical review of this publication.

This publication was made possible, in part, through a research and demonstration grant from the Leopold Center for Sustainable Agriculture, Iowa State University, and by support from Iowa State University Extension.

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