Composting for Mortality Disposal on Hog Farms

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Introduction

Even on well-managed hog farms, some animals die before being marketed. For example, a 1,200-sow farm that produces 2.2 litters per sow per year and sells weanling pigs may need to dispose of 36 sow carcasses and 7,920 stillborn and other dead piglets annually. A finishing farm producing 10,000 market hogs annually should plan for the disposal of approximately 300 pigs each year (Table 1). These examples are based on a 3 percent annual mortality rate for breeding sows and market hogs and the loss of three stillborn and nursing piglets per litter produced. Farms with lower mortality rates will have lower disposal needs, and those with higher rates will have higher disposal needs. To meet this need, a practical, cost-effective, and environmentally sound means to dispose of routine death losses is essential on all hog farms.

Traditional mortality disposal methods on hog farms include burial, on-farm incineration, and transport to rendering plants. Mortality composting was initially developed as a means of disposing of dead birds on poultry farms. More recently, composting has become an accepted method of dead swine disposal in some states. Table 2 summarizes the advantages and disadvantages of the traditional methods of dead swine disposal and mortality composting. For producers willing to learn the principles of composting and who can provide adequate management, composting is an effective method of dead swine disposal that is safe, biosecure, and environmentally sound.

Principles of Mortality Composting

The Process. When composting swine mortality, the dead animals, which are nitrogen-rich, are fully covered with and allowed to react with carbon-rich materials such as sawdust, cotton-gin trash, chopped cornstalks, or other similar material. Naturally occurring bacteria in the mixture then cause the conversion of these components into humic acids, bacterial biomass, and compost. During the process, carbon dioxide, water vapor, and heat are generated as by-products. In mortality composting, it is essential that each carcass, large or small, be fully covered and surrounded with the bulking agent to allow for the complete interaction of the carbon- and nitrogen-rich materials and to absorb the moisture and odors released by the carcass. The bulking agent also serves as an insulator to retain the heat and moisture that is generated during the composting process.

The bacteria involved in the composting process are aerobic, meaning they require oxygen. They are also thermophilic, meaning they thrive in warmer temperatures. Since the bacteria do the work of reducing dead swine to compost, it is important to understand their requirements. In fact, the compost pile and the resident bacteria can be considered a “living” organism that must be cared for if it is to process swine mortality successfully.

Nutrient Balance. Composting bacteria require the appropriate balance of carbon and nitrogen in the medium. Observations of successful composting units indicate that a carbon to nitrogen ratio of 20:1 to 35:1 directly around carcasses within the pile is optimum. Using high-carbon bulking agents such as sawdust, cotton-gin trash, chopped straw, or chopped corn stalks will generally produce a good balance of carbon to nitrogen in and around the carcasses. Poultry litter has been used successfully as a bulking agent. However, poultry litter and pig carcasses alone result in a lower carbon to nitrogen ratio. Blending higher carbon material such as sawdust with broiler litter will elevate the carbon to nitrogen ratio and improve composting performance.

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Table 1. Typical Swine Mortality Rates*

		Mortality at various performance levels			
Production stage	**Weight range**	**Excellent**	**Good**	**Poor**	**Your farm**
Birth (stillborns)	3 - 5 lb	1 pig/litter	2 pigs/litter	3 pigs/litter	___________
Birth to weaning	3 - 15 lb	< 10%	10 - 12%	> 12%	___________
Nursery	15 - 45 lb	< 2%	2 - 4%	> 4%	___________
Growing-finishing	45 - 270 lb	< 2%	2 - 4%	> 4%	___________
Breeding sows	300 - 525 lb	< 2%	2 - 5%	> 5%	___________

*Adapted from Mayrose and co-authors, Pork Industry Handbook Fact Sheet No. 100, 1991.

Particle Size, Porosity, and Quantity of Coverage Material. Demonstration work with composting indicates that the physical characteristics of the bulking agent are also important. For aerobic bacteria to thrive, bulking agents that allow 25 percent to 30 percent free airspace within the pile should be used. Coarse, damp sawdust has excellent physical properties for composting dead swine because it forms a stable pile around the carcasses, provides airspace within the pile, and helps retain heat and moisture. Ginning trash obtained from cotton gins has also performed effectively as a bulking agent in swine mortality composting. Straw or cornstalks, if chopped to reduce particle size, can be used for composting. However, long straw or cornstalks tend to form mats in a compost pile that restrict the composting process. Extremely light materials, such as peanut hulls, do not hold moisture or heat adequately and allow flies to enter the pile and odors to escape. When very low-density carbon sources such as peanut hulls are used, they should be mixed with greater quantities of denser material such as sawdust or cotton-gin trash.

The amount of high-carbon bulking material needed for a composting operation depends mainly on the quantity of mortality to be processed and on the extent to which secondary compost is recycled back into primary composting (see discussion on recycling secondary compost). Workers at the University of Missouri have recommended 100 cubic feet of sawdust per 1,000 pounds of mortality to be composted. Depending on moisture content, hardwood sawdust typically weighs about 20 to 25 pounds per cubic foot. Manager experience and judgment are the most important factors for keeping adequate quantities of material on hand to insure proper coverage of all mortalities as they occur in the operation.

Moisture. Composting bacteria require water; therefore, the compost pile should have a 45 percent to 60 percent moisture level for optimum results. To promote the heat-generating process of composting, it is often necessary to add water to compost piles when carcasses are added and covered. However, too much moisture also can restrict the composting process. Excessively wet or water-logged compost restricts free air space and loses aerobic activity. One simple test for compost pile moisture content is to take a handful of bulking material from inside the pile, firmly squeeze it, and then gently release. If water drips from the material when squeezed, it is too wet. If the material crumbles apart easily when released, it is too dry. If the material remains in some intact form when released, it is approximately the correct moisture content for composting.

Composting Methods

Primary and Secondary Compost Phases. As with poultry composting, static pile and bin composting are the most common methods used on commercial hog farms. The main difference between swine mortality composting and poultry composting is that, for larger hogs, composting pile space and the required composting times are greater. Managing swine mortality composting in primary and secondary phases can promote a more rapid and complete breakdown of carcass material.

A primary phase compost pile starts with a base layer of absorbent, high-carbon bulking material at least 12 inches deep. Add mortalities as they occur and promptly cover them with bulking material. Assess the moisture conditions of the material each time carcasses are added. If moisture levels are too low, add water as the carcasses are placed. Place each additional carcass

Table 2. Advantages and Disadvantages of Swine Mortality Disposal Methods

Method		Advantage (+) or Disadvantage (-)
Burial	(+)	Prompt burial gets dead stock out of public view.
	(+)	Prompt burial coverage prevents odor, flies, and scavengers.
	(-)	Poor or delayed coverage can result in odor, flies, and scavengers.
	(-)	Burial pits can collect rainwater.
	(-)	Depending on burial location, groundwater could be contaminated.
	(-)	Virginia regulations require permits for the burial of waste materials including animals.
	(-)	Burial pits can be difficult to dig in winter.
Incineration	(+)	Prompt incineration gets dead stock out of public view.
	(+)	Modern incinerators reduce carcasses to ash and are biosecure.
	(-)	Older, less efficient incinerators may generate smoke and odor.
	(-)	Modern incinerators have large capital costs and fuel requirements of one to two gallons per hour.
	(-)	Virginia law requires that incinerators be equipped with an “afterburner” for pollution control.
	(-)	Virginia law requires a separate Department of Environmental Quality Permit for on-farm
Rendering	(+)	Rendering converts animal mortality to useful by-products.
	(+)	Prompt transport to rendering plants removes dead stock from the farm.
	(-)	Storage of dead hogs in “dead boxes” or other methods prior to hauling can cause odor and attract
	(-)	There are only a few rendering plants in Virginia that process dead stock.
	(-)	Some rendering plants charge fees for accepting carcasses.
	(-)	Vehicles and personnel traveling to and from the farm and rendering plant can compromise bio-
Composting	(+)	Proper composting generates minimal odor, fly, or scavenger problems.
	(+)	Prompt composting gets dead stock out of public view.
	(+)	Proper composting has low potential for pollution and produces a final product that can improve soil
	(+)	On-farm composting is considered biosecure.
	(-)	A readily available supply of carbon-rich bulking material such as sawdust, cotton-gin trash, or other
	(-)	Some initial capital cost is necessary for construction of composting facilities.
	(-)	Poorly managed compost units (inadequate bulking material, delayed carcass coverage, etc.) will result in odors and attract flies and scavengers.

such that there is about eight inches of bulking material separating it from other carcasses or from the compost bin wall (Figure 1). Do not pile carcasses directly in contact with other carcasses or with compost bin walls. Take care to avoid protruding carcass parts or very thin coverage. When these situations occur, composting action on the carcass is poor and odor and fly activity will result.

Once a primary pile has been built up to a height of approximately six feet, top it off with a protective layer of bulking material and leave it to compost for two to three months. If the pile contains several large carcasses or a large number of carcasses in general, allow a primary composting time of three months. For piles containing mostly small pigs and afterbirth tissue, the required primary composting time is substantially less. Be sure that the intended primary composting time occurs from the time the last carcasses were placed in the pile. The effective management of primary and secondary mortality compost piles requires a record of the numbers, the estimated weights, and the dates carcasses were placed.

By the time a pile completes its primary phase, the internal pile moisture level and temperature will have declined substantially. You may then turn the pile to form a secondary compost pile (Figure 1). Typically, you should add water to the material as it is turned. The added air and moisture associated with turning primary compost into secondary piles reinvigorate the composting action and cause the temperature to rise. The reinvigorated secondary compost allows for further breakdown of the remaining carcass tissues, cartilage, and bones. After two to three months in a secondary phase pile, the remaining mortality material is sufficiently broken down to allow for further storage or agricultural land application. Some larger bony material, such as skulls, femur bones, and blade bones may remain after the secondary phase of composting (Figure 2); however, these are usually easily broken and are relatively non-odorous and inert.

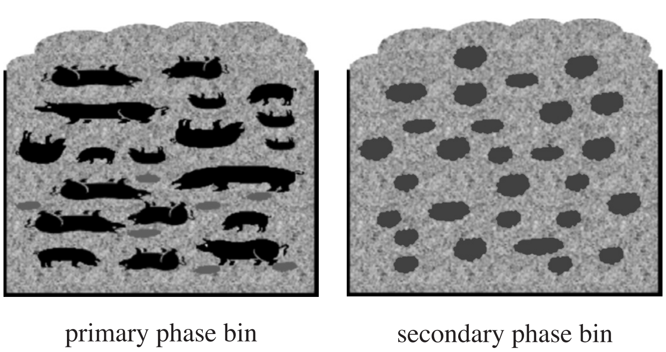

Figure 1. Primary and secondary phase process.

Recycling Secondary Compost Material. One valuable use for compost material that has completed or nearly completed a secondary composting phase is recycling it as bulking material for primary compost piles. Experience at the Virginia Tech Tidewater Agricultural Research and Extension Center (AREC) swine unit and other locations indicates that secondary compost material can replace up to half of the bulking material when loading carcasses into new primary piles. In fact, using some secondary material in primary compost piles actually enhances composting when fresh carcasses are placed into primary piles.

Determining if the Process Is Working. The most practical means of determining if a compost pile has the correct blend of ingredients and is functioning properly is to check the internal pile temperature. A long-stem compost thermometer is an essential tool for anyone employing composting for mortality disposal (Figure 3). Within two to four days after loading carcasses into a pile, or after mechanically turning a primary compost pile, the internal temperature should increase. The carcass decomposition rate in a compost pile is most rapid within a temperature range of 110˚ to 150˚F. Maintaining a temperature range between 130˚ and 150˚F for five days is considered necessary for the destruction of pathogens. Ideally, a freshly loaded or recently turned compost pile will maintain an internal pile temperature of 130˚ to 150˚F for about two weeks followed by a gradual decline in internal pile temperature. Internal pile temperatures above 160˚F are excessive and are

Figure 2. Some bones remain after secondary composting completion.

Figure 3. Using a long stem composting thermometer to check proper temperature.

actually detrimental to the compost bacteria population. They may also increase the risk of pile combustion. For these reasons, limit the height of active compost piles to approximately six feet (see discussion on troubleshooting in Table 5).

Swine Mortality Composting Units

Mortality composting can be done with static piles or elongated windrow piles that may or may not have an overhead roof structure. Bin composting is similar to static pile composting, except that the pile is established in bins, each with at least three sidewalls to contain bulking material and covered swine carcasses. Temporary bins for mortality composting have been constructed using round hay bales as sidewalls with no overhead cover (Figure 4). More permanent bin structures are constructed on impervious surfaces (usually concrete) with treated lumber or concrete sidewalls and a roof overhead to prevent excess rain infiltration.

Figure 4. Temporary bins for mortality composting

Surfaces on which to Compost Mortality. If properly located, it is feasible to safely compost swine mortalities on compacted earth surfaces. However, experience has demonstrated that composting on a hard, impervious surface has significant advantages. The most commonly used surface is formed concrete that has been designed to support heavy equipment such as a tractor equipped with a front-end loader. A concrete surface facilitates pushing and scooping compost material with mechanical equipment and completely eliminates the potential for leaching at the pile base. Another important consideration is that the USDA Natural Resources Conservation Service (USDA-NRCS) Conservation Practice Standards (Code 316, Animal Mortality Facility) require that mortality composting units be constructed on concrete. Therefore producers seeking to participate in the USDA backed cost share or other conservation programs must follow these guidelines.

Roofed Structures for Composting. A well-planned roofed structure with multiple bins allows for better moisture control and better overall management of mortality composting. A pole-type structure with a concrete slab floor may be constructed using treated poles and lumber with trusses or rafters covered with metal roofing (Figure 5). Typically, the treated support poles are set first and the concrete floor is then formed and poured around the poles. An alternative construction method that has been used successfully is to construct both the floor and bin sidewalls out of formed concrete (Figure 6). You should consult a public (USDA-NRCS or Cooperative Extension) or private design engineer when planning a composting structure.

Siting a Mortality Composting Unit. Factors to consider when determining a site for a swine mortality composting unit include ease of operation, public perception, and environmental safeguards. A composting unit should be convenient to the hog barns so that dead pigs can be moved and placed in the compost promptly. There should be easy access and operational room for equipment used in loading, turning, and unloading compost from bins or stationary piles.

Although it is an essential component of livestock production, moving and handling dead animals is not aesthetically pleasing. If possible, it is best to site composting facilities out of direct public view. Trees or other visual screens may be helpful for this purpose. A well-constructed, well-maintained composting facility looks similar to other practical farm structures and can actually improve the overall appearance of mortality handling on the farm.

Figure 5. A pole-type structure with a concrete slab floor

Figure 6. Structure constructed with both the floor and bin sidewalls out of formed concrete

The site must be well drained and not prone to flooding or the pooling of water around the composting unit. All-weather access is essential. The required minimum distance from a well is 100 feet; a distance of at least 200 feet is recommended. Plumbing a water source to the unit is important so that water can be added to compost piles as needed. The site should be chosen and managed to prevent any seepage or direct runoff from compost piles into ditches, streams, or any other surface waters or sensitive areas. Maintaining grass or other vegetative ground cover around the compost work area helps to assure runoff prevention and improves overall appearance.

Sizing a Mortality Composting Unit. Compost units must be properly sized for individual swine operations. Indeed, adequate size of compost bins can be considered another requirement for composting bacteria. A composting unit is intended for routine mortality, not large, single event death losses such as a major disease outbreak or a barn fire. To properly size the composting unit, you need an estimate of the weight of average daily mortalities. You can determine the weight using farm production records or industrywide averages (Table 1).

Secondly, you must calculate the necessary volume of primary and secondary composting bins. There should be at least 20 cubic feet of primary bin volume for every pound of average daily mortality. Moreover, the number and volume of secondary composting bins should equal that of the primary bins. Some storage space for additional bulking agent material may also be built into the system or located close by.

The bin dimensions must also be determined. The height of a compost bin should accommodate a maximum compost pile height of six feet and bin width should be at least 1-1/2 times the width of the mechanical equipment that will be used to load and unload the bins. Sows and larger market hogs require a minimum bin size that allows laying individual carcasses in the bin for complete coverage with bulking material. Minimum compost bin floor dimensions of 7-1/2 by 10 feet are suggested for sows and 5-1/2 by 8 feet for market hogs. Table 3 provides examples of calculating the primary and secondary composting bin space needed for a swine finishing farm and a farrow-to-wean sow farm.

Finished Compost

Like other types of compost, properly processed swine mortality compost has beneficial characteristics as a soil amendment. The granular organic material that comprises finished compost can improve the tilth and water holding capacity of soils. Mortality compost also contains substantial quantities of plant nutrients. When applied properly, these nutrients can be used in crop production systems similar to the ways other organic fertilizer sources are used. In this regard, swine mortality compost has many of the same attributes as livestock manures and poultry-house litter.

The nutrient content of finished compost varies depending on the carbon sources used and the quantity of mortalities that are processed through the system. The degree to which secondary compost is recycled into primary compost piles will also affect the nutrient content of the final product and the frequency of land application. In general, as more mortalities are processed and secondary compost is recycled through the system, the more the nutrient density of the final product will increase. Table 4 illustrates variation in nutrient concentration of

Table 3. Example calculations for determination of bin volume and number of bins for swine mortality composting

Example A: Finishing farm marketing 10,000 head annually	
Farm death loss rate:	3% of all pigs placed
Average weight of dead pigs:	150 lb
Calculate average **daily** mortality weight:	3% x 10,000 pigs = 300 dead pigs annually
	300 deads x 150 lb average wt = 45,000 lb annually
	45,000 lb ÷ 365 days/year = 124 lb average daily mortality
Calculate volume of primary bin space needed:	124 lb x 20 cu ft/lb = 2,480 cu ft
Calculate number of primary bins to construct:	Assume 400 cu ft bins (8' x 10' x 5' [width x depth x height])
	2,480 cu ft ÷ 400 cu ft/bin = 6.2 or 7 primary bins
Secondary bins to construct:	Equal to primary bins or 7 secondary bins
Total 400 cu ft bins:	14 bins with 8' x 10' x 5' dimensions for each bin
Example B: 1,200-Sow farrow-to-wean farm producing 2.2 litters/sow/year	
Stillborn and nursing piglet losses:	3 pigs per litter
Average weight of stillborn and dead piglets:	4 lb
Weight of dead piglets per litter:	3 dead pigs/litter x 4 lb/pig = 12 lb/litter
Annual weight of stillborn and dead piglets:	2.2 litters/sow/year x 1,200 sows x 12 lb/litter = 31,680 lb
Sow death loss rate:	3% of all sows in herd
Average weight of dead sows:	440 lb
Annual weight of dead sows:	3% x 1,200 sows x 440 lb/sow = 15,840 lb
Calculate average **daily** mortality weight:	31,680 lb dead piglets/year + 15,840 lb dead sows/year = 47,520 lb
	47,520 lb ÷ 365 days/year = 130 lb average daily mortality
Calculate volume of primary bin space needed:	130 lb x 20 cu ft/lb = 2,600 cu ft
Calculate number of primary bins to construct:	Assume 500 cu ft bins (10' x 10' x 5' [width x depth x
Secondary bins to construct:	Equal to primary bins or 6 secondary bins
Total 500 cu ft bins:	12 bins with 10' x 10' x 5' dimensions for each bin

mature swine mortality compost from selected bins at the Virginia Tech Tidewater AREC mortality compost unit. The carbon source used as a bulking agent was primarily hardwood sawdust but some cotton-gin trash was used as well. The typical nutrient concentration for poultry litter is included for comparison.

As with all fertilizers, mortality compost should be applied in a manner that is agronomically sound and environmentally safe. Periodic analysis is important for land application systems because the nutrient composition of mortality compost varies substantially. You can use conventional manure spreading equipment to spread compost on crop or forage fields. You can also use gravity flow spinner-type spreaders if the compost moisture level is not excessive. On farms that maintain a Virginia Pollution Abatement (VPA) permit, land application of compost must be done in accordance with the farm nutrient management plan. This plan is an enforceable component of the VPA permit. Even on farms not required by permit to file a nutrient management plan, it is highly recommended that mortality compost be land applied in a manner that is consistent with crop nutrient needs and to prevent nutrient runoff. Specialists with the Virginia Department of Conservation and Recreation, USDA-NRCS, Soil and Water Conservation Districts, or Virginia Cooperative Extension can offer assistance in development of waste nutrient management plans.

Table 4. Assayed nutrient content of mature secondary phase swine mortality compost

	Moisture	Total N	N as NH^4	P as P_2O_5	K as K_2O
Sample*	(%)	(lb/ton)	(lb/ton)	(lb/ton)	(lb/ton)
Mortality Compost - 1	39	52	11	14	14
Mortality Compost - 2	32	50	9	13	11
Mortality Compost - 3	36	45	10	11	13
Mortality Compost - 4	31	69	11	29	15
Poultry Litter	29	69	13	52	44

* Mortality compost samples are from the Virginia Tech Tidewater AREC swine mortality compost unit in 2002. Poultry litter values are for comparison and represent an average of 1,054 samples reported by the Virginia Department of Conservation and Recreation.

Additional Considerations

Varmints. Mice in search of nesting places may be attracted to the crevices between compost bins, but they generally are harmless. More troublesome varmints, such as stray dogs, foxes, opossums, and scavenging birds, such as vultures and buzzards, can become problems at mortality composting sites. Inadequate carcass coverage, exposed carcass parts, and low composting temperatures will encourage these varmints. However, in properly constructed, well-managed composting facilities, unwanted animals are not a problem.

Insects. A variety of insects and arthropods such as earwigs, red-legged ham beetles, and centipedes may inhabit mortality compost piles. The vast majority of these should be considered beneficial or harmless. The most negative potential insect pests associated with compost piles are common house flies and green bottle flies. Some fly activity around livestock and poultry facilities is normal. But elevated fly populations at mortality compost units are indicators of poor compost management. Poor carcass coverage, low composting temperatures, excessive moisture, and seepage at the base of compost piles all contribute to heavy fly activity.

Troubleshooting. Correcting problems that may occur in mortality composting involves understanding the principles of effective composting. Consistently low temperatures or the failure of temperatures to increase after turning or carcass placement indicate that the compost requirements are not being met. Things to check for include poor carcass placement, inadequate aeration inside the pile, excessively wet or excessively dry compost. If the compost pile is too wet it should be turned and drier bulking material added to the pile during the process. If it is too dry, the pile should be turned and water added during the process. In some circumstances, the internal pile temperature may become excessively high (greater than 160˚F). In this situation, the pile should be turned to release heat and part of the pile moved to reduce pile depth.

If excess fly activity or intense odors are observed, piles should be checked for exposed carcass parts or shallow coverage. Add fresh bulking material or recycled secondary compost for proper coverage. Low compost temperatures may also contribute to greater fly activity and may indicate that the moisture content or particle size of the bulking material may not be acceptable. Seepage at the base of compost piles is unsightly, attracts flies, and generates odor. Small amounts of seepage can be corrected in future piles by having a sufficient layer of absorbent bulking material form the base of the pile. If excessive seepage is observed, the piles causing the problem should be turned and absorbent bulking material added during the process.

Regulatory Considerations and Technical Assistance

At this writing, the only entry in the Virginia Code related to swine mortality disposal is item 18.2-510 entitled "*Burial or cremation of animals or fowls which have died.*" This law, originally written in the 1950s, does not acknowledge that now the burial of waste is regulated by the Virginia Department of Environmental Quality (DEQ). Permits for the burial of waste materials, including animals, are required. The DEQ recommends that burial should take place only as a last resort and primarily in cases where the spread of disease is a concern as determined by the State Veterinarian. In addition, the DEQ recommends that the preferred methods of dead stock disposal include rendering, composting, and, when applicable, disposal in a permitted sanitary landfill.

Regulatory consultants at the DEQ have indicated that, when it is performed properly, composting to dispose of routine swine farm mortality is exempt from permitting requirements under an agricultural exemption.

Technical assistance for establishing mortality composting systems and facility design is available from Virginia Cooperative Extension, the Virginia Department of Conservation and Recreation, and state and local offices for the USDA-NRCS. Technical standards for composting animal mortality in Virginia have been developed by the USDA-NRCS as Conservation Practice Standard Code 316, Animal Mortality Facility. In some cases, producers who wish to construct mortality composting facilities for improved mortality disposal and soil and water protection may be eligible for programs that offer cost-share assistance, low-interest loans, or tax-credit benefits. Participation in such programs typically requires that USDA-NRCS technical specifications for the practice be met in order to receive program benefits.

Summary

Composting as a method to dispose of dead animals was originally developed for poultry farms. Although there are some differences relative to poultry composting, demonstration trials and farm experience have shown composting to be a safe, effective method for mortality disposal on swine farms. Swine mortality composting does require a working knowledge of composting principles and good management to be effective. A well-managed composting system offers a viable alternative to burial, incineration, and rendering as methods for mortality disposal on swine farms. Table 5 provides a summary outline of procedures for effective swine mortality composting.

Table 5. Summary of general operating procedures for composting swine mortality

Site for composting	• Convenient to hog buildings. • Access for loading, turning, and unloading. • Out of direct public view. • At least 100 ft from wells. • Well drained on firm soil with grass or other vegetative covering around unit. • Safe from ditches, water courses, other sensitive areas.
Sizing of compost unit	• Primary bins: 20 cu ft/lb of estimated average daily mortality. • Secondary bins: equivalent space as primary bin space. • 6 ft maximum pile depth. • Bin size appropriate for full coverage of hogs (suggest 5-1/2 x 8 ft minimum for market hogs, 7-1.2 x10 ft minimum for sows).
Management (Primary bins)	• Minimum of 12 in of absorbent bulking agent for base layer. • Some active bulking agent around the first layer of carcasses helps get the process started. • Place carcasses so that they are at least 8 in from bin walls and from each other • Add water to carcasses and bulking agent if the material is dry. Be sure bulking agent is in full contact with all surfaces of the pig. • Fully cover all carcasses **immediately** with at least 12 in of bulking material. • Check the compost unit daily. Add bulking agent over any protruding carcass parts

Table 5. Summary of general operating procedures for composting swine mortality (cont.)

Management (primary bins) (cont.)	• Three days after significant carcass placement, check temperature with a probe thermometer. The internal pile temperature should exceed 130˚F over a two-week period for pasteurization. • Keep a record of the dates and estimated weights of mortality additions to piles. After about two months for small carcasses and about three months for large carcasses, the pile should be ready to turn and initiate a secondary composting phase. • A shallow layer of dry bulking material on top of the pile will help decrease fly activity.
Management (secondary bins)	• Turning the pile into a secondary bin should reinvigorate the composting process. Temperatures should rise. • If the material has dried during the primary composting phase, some water addition during turning is needed. • A shallow layer of dry bulking material on top of the pile will help reduce fly activity. • After two to three months in the secondary phase, the compost should be ready for land application. When large hogs are composted, expect to see some skull and large bone pieces remaining. • Some of the remaining secondary compost material may be recycled into a new primary composting bin (up to 50 percent of the new primary mixture).
Troubleshooting	• Internal temperature fails to increase above 130˚F and remain elevated for at least two weeks: Check for poor carcass placement, inadequate aeration inside the pile, and excessively wet or excessively dry compost. • Compost too wet: Turn and add dry bulking agent. • Compost too dry: Turn and add water to bulking agent. • Excessively high pile temperature (> 160˚F): turn and reduce pile depth. • Excess fly activity or odor: Check for protruding carcass parts or shallow coverage. Correct by adding proper coverage. Check for seepage and correct as needed. Check the temperature and ensure that composting activity is occuring in the pile. • Small amount of seepage: Correct carcass placement in future. Have an adequate bottom layer of absorbent bulking agent to absorb drainage seeping down through pile. • Large amount of seepage: Turn and add bulking agent.

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