(11) Composting Dead Swine

The operation of composting facilities for dead swine differs somewhat from poultry facilities. The time required for complete breakdown of the carcasses is longer and the materials used can be different. However the basic composting process is still same.

(i) Composter location - The composter should be located away from areas of sensitive water quality such as streams, ponds and wells. A location at or near the crest of a hill will eliminate or minimize the amount of offsite surface water around the composter. If the composter must be located at the lower portion of a slope a diversion should be constructed above it to divert surface water away from the facility.

When locating the composter, consider the farm residence and any nearby neighboring residences that might be affected. While composting facilities do not generally produce offensive odors, if properly managed, the handling of dead swine and compost on a daily basis may not be aesthetically pleasing. Also, consider traffic patterns for moving dead swine to the facility, moving the composting ingredients to the composter and removing the finished compost. The site for the composter should be well drained and provide all weather capability for access roads and work areas.

(ii) Composter design - The composting facility should be designed and consturcted according to the requirements of NRCS Standard 317 for Composting Facilities. It should be under roof and have a concrete floor. The roof should be high enough to allow equipment to load and unload the compost bins. The walls of the facility should be constructed of a durable material such as treated lumber or reinforced concrete. The walls should not exceed 6 feet high. The structural components of the composting facility should meet the requirements of NRCS Standard 313 for Agricultural Waste Storage Structures.

Total bin area and volume requirements depend upon the size of the operation and expected mortality. Actual death loss data should be used in sizing composters for existing operations. For planning purposes and sizing composters for new operations, use the information in Table 1. A minimum of 20 ft^3 of volume is needed in both primary and secondary bins per pound of carcass composted daily. Square bins offer the best opportunity to reduce heat loss through the sides of the bins, although length to width ratios of up to 2:1 are acceptable. Width of the bins should be based upon the width of the loader bucket used to work the compost. The bins should be at least two feet wider than the loader bucket. Excessively large bins should be avoided. Experience has shown that bins with 100 to 200 square feet of surface area work well.

	Avg. Wt. lbs.	**Annual Death Loss, percent**
Sow Herd[1]	375	6-8
Nursery[2]	32	22-26
Finishing	150	5-30

[1]Includes all mature animals, farrowing, gestating and boars
[2]Includes losses in farrowing house prior to weaning

Table 1. Average annual death loss for swine in confinement.

A typical layout for a composting facility should consist of a minimum of 3 bins. Each bin should have 3 permanent sides with the fourth side removable for access to load and unload the compost. Additional bin space can be provided for storage of finished compost until it can be spread on the land and for storing fresh sawdust. A concrete pad in front of the bins, wide enough to allow equipment to back and turn while loading or turning compost during all weather, has been found to be very useful.

(iii) Composting ingredients and recipe - As in all composting processes, the proper carbon to nitrogen ratio must be achieved for the most efficient composting of dead swine. Experience thus far indicates that sawdust is an ideal carbon source due to its small particle size, ease of handling, absorbency and high carbon content. Other materials have been used such as chopped straw and ground corn stalks, but with less success. Important properties for composting materials are a high carbon content, friability so that the material

can settle completely around the carcasses and low moisture content.

If sawdust is used as the carbon source, approximately 100 ft^3 of sawdust per 1000 lbs. of carcasses is required on average. If the mortality of the herd is not known, an estimate of $^1/_3$ to $^1/_2$ yd^3 of sawdust per sow in a farrow to finish herd will be needed per year.

The carbon - nitrogen ratio should be between 20 and 30 to 1. A precise ratio does not seem to be necessary to obtain good composting. It does appear that the addition of supplemental nitrogen will help in the start up of new composting operations and obtaining the desired composting temperatures. To achieve the optimum ratio of 25 to 1, ammonium nitrate can be added to the mix. If a recipe of 4 cubic yards of sawdust per 1000 pounds of carcasses is used, to obtain the 25 to 1 ratio, add 3 pounds of ammonium nitrate in granular form per 100 pounds of carcasses.

The proper moisture content of the compost mix is important. If it is too wet, the process will go anaerobic and generate odors and excess leachate. If it is too dry the composting process will be very slow and the desired high temperature may not be reached. The ideal moisture content is between 50 and 60 percent.

The moisture content of the compost will be governed primarily by the moisture content of the sawdust. The sawdust should be moist, to the extent that it feels damp, but you should not be able to squeeze water from it. Sawdust from kiln dried lumber will probably have a moisture content of 20 to 30 percent. Sawdust this dry will need 1 to $1^1/_2$ gallons of water to each cubic foot of dry sawdust. Green sawdust from fresh cut, unseasoned logs may have a moisture content as high as 80 percent. Green sawdust should be allowed to dry before use or should be mixed with dry sawdust.

(iv) Composter operation - Complete composting of dead swine will take approximately six months. Three months for primary composting and an additional three months for secondary composting after the pile is turned for aeration. A typical scenario would involve a minimum of three bins. The first bin is filled with carcasses over a two month period. The second bin is then filled with carcasses over the next two months. At this time the contents of the first bin are moved to the third bin for secondary composting. Bin number 1 can now be used for filling. At the end of the next two months the contents of the third bin are removed for final disposal and the other two bins are turned leaving one bin available for filling. This scenario can be followed for any size operation by increasing the number of bins.

Bins are filled by first placing a foot of sawdust on the floor of the bin. Carcasses are placed in layers with at least one foot of sawdust between each layer. Larger animals should have one foot of sawdust between carcasses in a layer. It is important to keep the carcasses in the compost pile completely covered with at least one foot of sawdust to minimize odors and rodent problems. Never leave hoofs, legs, ears or snouts sticking out of the compost.

The temperature of the compost pile should be monitored to insure that the pile reaches a minimum of 135°F. If the pile does not reach this temperature, harmful pathogens will not be destroyed. If this occurs, the compost pile should be dismantled and the cause of the incomplete composting assessed, such as too little or too much moisture, too little sawdust, etc. The pile should be rebuilt, correcting the problem, and allowed to compost for the necessary amount of time.

A probe type thermometer with a 36 inch stainless steel stem is a good choice for monitoring the temperature. The thermometer should be installed so that it penetrates at least one third of the pile depth.

A logbook is a useful record keeping tool in a composting operation. Dates and weights of carcasses placed in the composter provide a record of death losses and a basis for improving death loss statistics. Temperature readings, amount of fresh sawdust on hand and used and dates when compost is transferred from primary to secondary bins are record keeping items that can aid in managing the composting operation. Finally, dates and amounts of finished compost removed for land spreading also provide data for future management and planning decisions.

(v) Compost utilization - The finished compost should be a dark, granular, nearly black, humus-like material with very little odor. Some resistant parts such as teeth may still be identifiable, but should be soft and easily crumbled. Finished compost can be used as a starter material for new carcasses being composted. This will provide some heat and a source of bacteria to enhance the startup of new compost. Experience has shown that up to 50% of the sawdust requirement can be filled using finished compost.

Finished compost can be spread on cropland or pasture land with a conventional manure spreader. The compost should be applied at agronomic rates for the crop being grown. The spreading rate should be based on a laboratory analysis of the compost for nitrogen (N), phosphate (P_2O_5) and potash (K_2O) content. If a lab analysis is not available, estimates of the nutrient content of compost are given in Chapter 4.

(vi) Example problem - Refer to the following worksheet for an example of how to size a compost facility for a swine operation. A blank worksheet can be found in Appendix A of this chapter.

Worksheet - Swine Composter

Example. Size a composter for a 200 sow, farrow to finish operation. There are 200 mature animals, 700 nursery pigs and 1640 finishing pigs. Use Table 1 to estimate mortality.

1. Calculate weight of carcasses composted. Use data from actual experience, or use Table 1.

Sow Herd.
#sows x avg.wt. x %(Table 1)/100 = lb. loss/yr.

200 x 375 lb. x 7 %/100 = 5250 lb./yr.

Nursery.
#pig spaces x avg.wt. x %(Table 1)/100
= lb. loss /yr.

700 x 32 lb. x 24 %/100 = 5376 lb./yr.

Finishing.
#pig spaces x avg. wt. x % (Table 1)/100
= lb. loss/yr.

1640 x 150 lb. x 11 %/100 = 27,060 lb./yr.

Total = 37,686 lb./yr

lb. composted daily = (lb./yr.)/365
= 37,686 lb./yr/365 = 103 lb./day

2. Calculate primary and secondary bin volume.

lb. composted daily (Step 1) x 20
= primary bin volume, cu. ft.

103 lb./day x 20 = 2060 ft.^{3} primary bin

lb. composted daily (Step 1) x 20
= secondary bin volume, cu. ft.

103 lb./day x 20 = 2060 ft.^{3} secondary bin

3. Calculate bin area (uses volumes from Step 2).

bin volume, cu. ft./depth (usually 5-6 ft.)
= bin area, sq. ft.

2060 ft.^{3} / 6 ft. = 343 ft.^{2} primary bin

bin volume, cu. ft. / depth (usually 5-6 ft.)
= bin area, sq. ft.

2060 ft.^{3} / 6 ft. = 343 ft.^{2} secondary bin

4. Calculate number of bins (at least 3 bins required).

primary bin area (Step 3) / (100-200 sq. ft./ bin)
= # bins

343 ft.^{2} / 110 ft.^{2} / bin = 3.1 primary bins

secondary bin area (Step 3)/(100-200 sq. ft./ bin)
= # bins

343 ft.^{2} / 110 ft.^{2}/bin = 3.1 secondary bins

5. Calculate bin dimensions.

bin depth = composting depth (usually 5-6 ft.)
= 6 ft. depth

bin width = loader bucket width + 2 ft. min.
= 10 ft. width

bin length = bin area (Step 3) / bin width
= 110 ft.^{2} / 10 ft. = 11 ft. length

6. Calculate annual sawdust requirements.

lb. composted / yr. (Step 1) x 0.0037
= cu. yd. sawdust / yr.

37,686 lb./ yr. x 0.0037
= 139 yd.^{3} sawdust / yr.

Worksheet - Poultry Composter

The volume of the primary composter is calculated by the following equation:

$V_{min} = (B)(W_B)(M)(C)(F)/100T$

The volume required for secondary composting is equal to the volume of the primary composter.

1. B is the number of birds contributing to the composting facility.

   B = _____

2. T is the number days the birds are on the farm.

   T = _____

3. W_B is the maximum weight the birds achieve before being marketed.

   W_B = _____

4. M is the percent of the flock which is expected to die during the number of days (T) the birds are on the farm.

   M = _____

5. C for poultry is one cubic foot per pound of bird to be placed in the compost facility.

   C = 1ft³

6. F is the safety factor to account for unusual death losses which can occur during extremes of weather. 2.5 is generally used.

   F = 2.5

7. $V = B \times W_B \times M \times C \times F / 100 \times T$

V = ____ x ____ x ____ x ____ x ____ / 100 x ____

If the farmer knows the actual number of birds (N) he loses per day the volume is calculated by:

$V = N \times W_B \times C \times F$

The number of bins required is calulated by dividing the total required volume by the volume of an individual bin. An individual bin should be 6 feet or less deep. The width of the bin should be approximately 2 feet wider than the loader bucket used to turn the compost. Typical final dimensions would be 5'x 6'x 8'.

The volume of secondary compost space is equal to the primary volume. The secondary compost space is generally one volume and is not divided into separate bins.

Example. Size a compost facility for a 210,000 broiler operation. The birds reach a market weight of 4 pounds in approximately 6.5 weeks. The documented mortality is 2%.

V = 210,000 x 4 lbs. x 2% x 1 x 2.5 / 100 x 46

V = 913 ft^3

Assume a bin size of 5'x 6'x 8' = 240ft^3.

Number of bins = 913 / 240 = 3.8 use 4 bins

Secondary compost volume, use 913 ft^3.

(v) Compost utilization - The finished compost should be a dark, granular, nearly black, humus-like material with very little odor. Some resistant parts such as teeth may still be identifiable, but should be soft and easily crumbled. Finished compost can be used as a starter material for new carcasses being composted. This will provide some heat and a source of bacteria to enhance the startup of new compost. Experience has shown that up to 50% of the sawdust requirement can be filled using finished compost.

Finished compost can be spread on cropland or pasture land with a conventional manure spreader. The compost should be applied at agronomic rates for the crop being grown. The spreading rate should be based on a laboratory analysis of the compost for nitrogen (N), phosphate (P_2O_5) and potash (K_2O) content. If a lab analysis is not available, estimates of the nutrient content of compost are given in Chapter 4.

(vi) Example problem - Refer to the following worksheet for an example of how to size a compost facility for a swine operation. A blank worksheet can be found in Appendix A of this chapter.

Worksheet - Swine Composter

Example: Size a composter for a 200 sow, farrow to finish operation. There are 200 mature animals, 700 nursery pigs, and 1640 finishing pigs. Use Table 1 to estimate mortality.

1. Calculate weight of carcasses composted. Use data from actual experience, or use Table 1.

Sow Herd.
#sows x avg.wt. x %(Table 1)/100 = lb. loss/yr.

200 x 375 lb. x 7 %/100 = 5250 lb./yr.

Nursery.
#pig spaces x avg.wt. x %(Table 1)/100 = lb. loss /yr.

700 x 32 lb. x 24 %/100 = 5376 lb./yr.

Finishing.
#pig spaces x avg. wt. x % (Table 1)/100 = lb. loss/yr.

1640 x 150 lb. x 11 %/100 = 27060 lb./yr.

Total = 37,686 lb./yr

lb. composted daily = (lb./yr.)/365
= 37686 lb./yr/365 = 103 lb./day

2. Calculate primary, secondary, and total bin volumes.

primary bin volume, cu. ft. = lb. composted daily (Step 1) x 20

primary bin vol. = 103 lb./day x 20 = 2060 ft.^{3}

secondary bin volume, cu. ft. = primary bin volume, cu. ft.

secondary bin volume = 2060 ft.^{3}

total bin volume, cu. ft. = primary bin volume, cu. ft. + secondary bin volume, cu. ft.

total volume = 2060 ft.^{3} primary volume + 2060 ft.^{3} secondary volume = 4120 ft.^{3}

3. Calculate bin sizes using Indiana Standard Drawing IN-ENG-59, 60, or 61 (Swine Composter - Timber or Reinforced Concrete) OR use Steps 4-6.

4. Calculate bin area (uses total volume from Step 2).

total bin area, sq. ft. = total bin volume, cu. ft. / depth (usually 4-6 ft.)

total bin area = 4120 ft.^{3} / 6 ft. = 687 ft.^{2}

5. Calculate number of bins (at least 3 bins required).

number of bins = total bin area, sq. ft. / single bin area (100-200 sq. ft.)

bins = 687 ft.^{2} / 120 ft.^{2} = 5.7 bins

Round number of bins up to nearest multiple of three.

OR

Modify depth and/or single bin area (Steps 4-5) within given ranges and recalculate the number of bins.

Use 6 bins

6. Calculate bin dimensions.

bin depth = composting depth (usually 4-6 ft.)
= 6 ft. depth

bin width = loader bucket width + 2 ft. min.
= 10 ft. width

bin length = single bin area (Step 5) / bin width
= 120 ft.^{2} / 10 ft. = 12 ft. length

7. Calculate annual sawdust requirements.

lb. composted / yr. (Step 1) x 0.0037
= cu. yd. sawdust / yr.

37686 lb./ yr. x 0.0037
= 139 yd.^{3} sawdust / yr.

Worksheet - Swine Composter

1. Calculate weight of carcasses composted. Use data from actual experience, or use Table 1.

Sow Herd.
#sows x avg.wt. x %(Table 1)/100 = lb. loss/yr.

_____ x _____ lb. x _____ %/100 = _____lb./yr.

Nursery.
#pig spaces x avg.wt. x %(Table 1)/100 = lb. loss /yr.

_____ x _____ lb. x _____ %/100 = _____ lb./yr.

Finishing.
#pig spaces x avg. wt. x % (Table 1)/100 = lb. loss/yr.

_____ x _____ lb. x _____ %/100 = _____ lb./yr.

Total = ______ lb./yr

lb. composted daily = (lb./yr.)/365
= _____ lb./yr/365 = _____ lb./day

2. Calculate primary, secondary, and total bin volumes.

primary bin volume, cu. ft. = lb. composted daily (Step 1) x 20

primary bin vol. = _____ lb./day x 20 = _____ $ft.^3$

secondary bin volume, cu. ft. = primary bin volume, cu. ft.

secondary bin volume = _____ $ft.^3$

total bin volume, cu. ft. = primary bin volume, cu. ft. + secondary bin volume, cu. ft.

total volume = _____ $ft.^3$ primary volume + _____ $ft.^3$ secondary volume = _____ $ft.^3$

3. Calculate bin sizes using Indiana Standard Drawing IN-ENG-59, 60, or 61 (Swine Composter - Timber or Reinforced Concrete) OR use Steps 4-6.

4. Calculate bin area (uses total volume from Step 2).

total bin area, sq. ft. = total bin volume, cu. ft. / depth (usually 4-6 ft.)

total bin area = ______ $ft.^3$ / _____ ft. = ______ $ft.^2$

5. Calculate number of bins (at least 3 bins required).

number of bins = total bin area, sq. ft. / single bin area (100-200 sq. ft.)

bins = _____ $ft.^2$ / _____ $ft.^2$ = ______ bins

Round number of bins up to nearest multiple of three.

OR

Modify depth and/or single bin area (Steps 4-5) within given ranges and recalculate the number of bins.

Use _____ bins

6. Calculate bin dimensions.

bin depth = composting depth (usually 4-6 ft.)
= _____ ft. depth

bin width = loader bucket width + 2 ft. min.
= _____ ft. width

bin length = single bin area (Step 5) / bin width
= _____ $ft.^2$ / _____ ft. = _____ ft. length

7. Calculate annual sawdust requirements.

lb. composted / yr. (Step 1) x 0.0037
= cu. yd. sawdust / yr.

_____ lb./ yr. x 0.0037
= _______ $yd.^3$ sawdust / yr.