

# Composting Dead Pigs

Franklin Kains

46 Old Cottage Place, Kitchener, ON N2K 4K2

*Email:* kains@golden.net

## ■ Introduction

The disposal of mortalities has become more of an issue for swine farmers in recent years. Burial has fallen out of favour due to a perceived higher risk of ground water contamination and aesthetic concerns. Dead stock rendering, which at one time was free, must now charge for their service (e.g. \$0.09/kg in Alberta and Saskatchewan). As swine farmers adopt tighter biosecurity protocols, some find on-farm pick-up of dead stock too risky. Thus, many are moving to alternative methods of deadstock disposal. One alternative is composting.

## ■ Composting Principles

The principles of composting of agricultural wastes are well covered in the literature. From the publication *On-farm Composting Handbook* comes the following quote:

*Composting is the aerobic, or oxygen-requiring, decomposition of organic materials by microorganisms under controlled conditions. During composting, the microorganisms consume oxygen while feeding on organic matter. Active composting generates considerable heat, and large quantities of carbon dioxide and water vapour is released into the air. Carbon dioxide and water losses can amount to half the weight of the initial materials. Composting thus reduces both the volume and mass of the raw materials while transforming them into a valuable soil conditioner.*

Composting will be optimized if several conditions are kept within a range, as shown in **Table 1**.

**Table 1. Optimal conditions for composting**

Condition	Reasonable range	Preferred range
Carbon to nitrogen (C:N) ratio	20:1 – 40:1	25:1 – 30:1
Oxygen conditions	> 5 %	>> 5%
Particle size (diameter)	3 -12 mm	Varies
Temperature (°C)	6 - 18	13 - 15

There are several options for composting of pig mortalities of which 3 will be discussed.

### ■ Bin System

In this system, composting takes place in 3-sided open front bins in which the pig mortalities are buried in a substrate of high carbon material – sawdust, shavings or straw. A typical size is 4 m wide, 5 m deep and 1 ½ to 2 m high. The bin walls are constructed of poured concrete walls, precast concrete blocks, wood planks or large round or large square bales. They may or may not have a concrete floor depending on the porosity of the underlying soil and the annual rainfall. They may or may not have a roof.

In concept, the system follows a 3 bin – 3-month cycle. To begin, a 300 mm layer of substrate is laid on the bottom of the first bin. Mortalities are added as they occur and covered with 600 mm of substrate. Subsequent mortalities are dug into the pile while maintaining a 300 mm layer of substrate between the layers of dead pigs. After 3 months, a second bin is started while the first bin is left to sit while it goes through its primary heating stage. Through this period temperatures should rise to 55 -70°C.

After the first bin has sat undisturbed for 3 months, its contents are moved to a third bin where it will again sit for 3 months while it goes through a secondary heating. Nine months after the first pig was added, the composting process should be complete. The third bin is then cleaned out and the contents stockpiled for later spreading. The cycle then repeats itself.

If everything has gone well the compost will have a dark earthy appearance with no odour and no identifiable pig parts with the exception of the jaw and spine bones of large sows. These will have decalcified and crumble easily if crushed. About half of the total volume will have disappeared as water vapour and carbon dioxide.

The bin system has been used for at least 15 years and is well described in a number of web-sites of the provincial and state governments, agricultural universities and producer organizations. (See the references for a list of 7 websites.) The following are essential highlights from these publications.

### Sizing

To determine the size of the bins, an estimate of the weight of mortalities is needed. In reviewing the various factsheets, there is a significant difference in the bin sizing calculations as illustrated in **Table 2**.

**Table 2. Recommendations for mortality rates and bin size for a 1000 sow farrow to finish herd from various sources**

Publication	Weight of dead pigs/day (kg)	Size of primary bin (M <sup>3</sup> /kg of dead pigs/day)
British Columbia, Alberta, Manitoba, Missouri	265	1.25
Saskatchewan	57	1.6
Ontario	294	0.5 with sawdust, 1.0 with straw
Minnesota	312	0.9

Table 2 shows a 5-fold difference in the weight of dead pigs/day. Much of this is due to the underlying assumptions made of herd performance and mortality levels. **Table 3** estimates the mortalities followed by the underlying assumptions used. Review these as well as your own mortality records to determine what is appropriate for your operation.

Table 2 also shows a difference in the volume of the bins per unit weight of mortalities. As the Ontario numbers suggest the substrate used will affect the size of bin required. Obviously there are a number of variables that can alter the appropriate size of the bins – e.g. mortality rates, type of substrate, general management of the composting process.

In the light of these differences, how should the bins be sized? If the bins are undersized and many farmers admit that theirs are, then the composting process will not have proceeded as far or as fast as it should. The operator will be more inclined to use less substrate so the bins do not fill as quickly increasing the risk of odour, flies and leachate problems. More storage area

may have to be provided to allow the finished compost to cure for a longer period of time before spreading.

**Table 3. Daily mortality rates**

Type of herd	Barn Capacity	Kg of deads/day
Sows to early wean	1000 sows	56
Nursery	1000 weaners to 25 kg	12
Finishing	1000 finishers to 115 kg	17
Farrow to finish	1000 sows + 3500 weaners + 7000 finishers	217

#### Assumptions

##### **Sow herd**

Sow mortality:	5%
Av. wt. of sow mortalities:	200 kg
Sow productivity:	27 pigs/sow/year including pigs born dead
Preweaning mortality:	19% including stillborn pigs
Av. wt. preweaning mortalities:	2 kg

##### **Nursery**

Nursery cycle:	56 days
Nursery barn mortalities:	5%
Av. wt. of nursery mortalities:	13 kg

##### **Finishing**

Finishing barn cycle:	120 days
Finishing barn mortalities:	3%
Av. wt. of finishing mortalities:	66 kg

#### **Number of bins**

The system is based on a 3 bin system. In fact, for large operations this will lead to excessively large bins. What are the recommended limits? It is suggested the depth be in the range of 1.5 – 2.0 m deep. Shallow piles will have lower temperatures. Deep piles can pack down, excluding oxygen. Both conditions will slow the composting.

The bin should be a minimum of 1 m wider than the bucket that will turn the material. Bins that are over 5 m deep are more difficult to fill and empty.

Further, bins that are square work better than those that are shallow and wide. This suggests a maximum bin width of 5 m.

## Substrate

A variety of organic materials can be used as substrate as noted in **Table 4** taken from the Minnesota factsheet.

**Table 4: Carbon to nitrogen ratio of substrates and other materials (by weight)**

Substrate	C:N ratio
Sawdust	200 – 750 :1
Straw	48 – 1
Corn stalks	60 – 73: 1
Finished compost	30 – 50: 1
Horse manure	22 – 50: 1
Turkey litter	16: 1
Animal carcasses	5: 1
Swine manure	1 – 3: 1

The substrate of choice is sawdust. It has a high C:N ratio to balance the low ratio in the mortalities. It has the appropriate size of the particles – large enough not to pack down and exclude oxygen, yet small enough to act as an insulator to hold the heat in.

Straw is not as good a substrate as it has a lower C:N ratio and requires more of it to achieve the ideal C:N ratio of the composting mass. It is more porous and not as good an insulator. The pile will be cooler and composting will take longer. Some operators as a compromise only use straw as the 300 mm base of substrate under the carcasses and sawdust for the rest.

Composting mortalities in a static pile is different than other composting. The Alberta factsheet describes the process well:

*The compost pile is an inconsistent mixture. It is composed of a large mass of material (the animal) with a low C:N ratio, a high moisture content, and nearly zero porosity surrounded by a material (the substrate) with a high C:N ratio, moderate moisture levels, and good porosity. The animal and the substrate are*

*layered into the pile, and no mixing is done until after the high-rate stage of composting has occurred and the animal has fully decomposed. Composting livestock mortalities (primary stage) can best be described as 'above ground burial in a bio-mass filter with pathogen kill by high temperature.*

The decomposition process is anaerobic (lacking oxygen) in and around the animal mortality, but as gases are produced and diffused away from the mortality, they enter an aerobic zone. Here the gases are trapped by the surrounding material, ingested by the micro-organisms, and degraded to CO<sub>2</sub> and H<sub>2</sub>O. The surrounding material supports bacteria to form a biological filter, or biofilter.”

Thus, it is important to have enough cover of the substrate over the mortalities to allow this bio-filter process to occur. High odour levels and leaching of liquids from the pile are often associated with insufficient substrate above (600 mm), below and on the sides (300 mm).

Finished compost can be used for up to half of the substrate. It is suggested that new material should be used on top of the pile as the top cover as it is a more effective bio-filter. Poultry litter is also used to supplement the substrate and get the process going quickly.

### **Moisture content**

Much of the literature suggests placing a roof over the composter. The advantage of the roof is 2 fold. It prevents excess water from getting on the pile and getting too wet, a more significant factor in areas of high rainfall. Further, it will provide some wind protection to the pile so that it retains more heat and the composting process is accelerated. An open front shed covering the compost bins and facing south (similar to the commodity bins now common on dairy farms) can exploit the winter sunshine to enhance the composting process.

### **Temperature**

Keeping the temperature in the ideal range will be a good indicator that the compost process is preceding well. This can be monitored with an inexpensive thermometer with an extended probe driven into the pile.

### **Siting**

Siting must be done with care. It must not be close to wells, watercourses or neighbouring residences or property lines distances that are usually set by provincial or local regulations.

## Permits and Siting

Most provinces and states recognize composting as an acceptable alternative for disposing of dead pigs. However, most do have a list of requirements that must be met. Siting will be a major concern with minimum separation distances required to wells, watercourses, neighbouring residences and property lines. Most do not require a concrete floor but do require a tight soil to prevent ground water contamination as well as control of the runoff. Some require that compost from mortalities be spread on the farm and not sold off-farm. It will be important as a first step to familiarize yourself with the rules that are in place that apply to your farm. At present they are in review in at least Ontario and Alberta.

The issue of biosecurity should be considered. The compost site should be close enough to the barn to ensure it will be well managed but not so close as to create a biosecurity risk, particularly as it relates to rodents and vermin.

Although mortalities on swine farms is a fact of life, the daily view of dead pigs being hauled to the composter will not present a good image of the farm to neighbours, visitors or those servicing the farm. The ideal location would be out of sight while still convenient to the barn for easy management.

## Troubleshooting

Most of the references have a troubleshooting section. One of the better ones is the Ontario factsheet (see References). The major indicators of problems are temperature (too high or too low), the failure to decompose, odour, flies and vermin. Each has its own set of solutions. The single largest problem is inadequate amounts of substrate under, over, beside and between the carcasses.

## ■ Windrows

The windrow system is commonly used to compost other agricultural wastes but is not often recommended for the composting of dead pigs. Comparing it to the bin system, it simply replaces the bins with long rows of substrate into which the pigs are buried. Again, the windrow is left for a minimum of 3 months after the last pig is placed in it to go through the primary heating phase. Once this is complete, it is turned over into a new windrow and left for another 3 months to allow for the secondary heating.

This system sounds simpler than the bins. However, it takes more management to keep the windrows in shape. Wind can erode away the substrate thus reducing the cover over the carcasses. Furthermore, with the

sloping sides of the windrows, it will take more substrate. Given this, most of the other parameters noted for the bin composters apply to the windrow system.

There is an interesting variation on the windrow system. There are some farmers separating their liquid hog manure. The liquids are sent to conventional long-term storage while the solids are composted in a windrow. The advantages of this are that the liquids are much easier to agitate and pump and the composed solids can be sold off the farm.

With this in place there is a ready made pile of substrate already in a windrow that can be used for the disposal of dead pigs. This substrate will be somewhat high in nitrogen and might take longer to decompose but the advantage is that there is lots of it to ensure good coverage of the carcasses.

The downside of the system is that that portion of the composted manure that included mortalities should not leave the farm. Thus any windrows that are used for dead pig disposal must be kept separate from the compost that is to be sold commercially.

## ■ In-vessel Composting

The bin and windrow systems are static systems at least for the first 3 months while the compost goes through its primary heating. This maintains the cover over the mortalities to keep the odour down. During this period there is no attempt to introduce extra oxygen to enhance the composting process.

If the materials to be composted are enclosed in some type of container and regularly turned so as to introduce more oxygen to the process, the rate of composting can be increased substantially. This is called in-vessel composting.

A commercial unit using this process has been developed by the Puratone Corporation of Niverville, Manitoba. They build the Biovator, a 1.2 m diameter insulated cylinder which to date has been built in lengths of 6, 9 or 12 m. Mortalities are placed in one end of the vessel along with 3 litres of shavings per kg of mortalities. The vessel is then rotated from 4 to 8 times a day over a 1 to 2 hour period. Interior paddles work the material to the far end where finished compost will emerge 4 to 10 days later. As compared to the 6 month composting time of the bin or windrow system, the Biovator speeds up the process by a factor of 30.

The doors on the loading end are sealed. At the discharge end the cover flap is left loose. This allows enough oxygen to get in to feed the process but seals the unit sufficiently to control the odours.

The Biovator models are designed to handle the following herd sizes:

**Table 5: Capacities of Biovator models**

Model	Herd size		
	Farrow to finish	Farrow to early wean	Finishing
6 m	300 sows	800 sows	4000 pigs
9 m	750 sows	1500 sows	7500 pigs
12 m	1500 sows	3000 sows	10000 pigs

It is rotated by a 1 hp motor. It will require a foundation to sit on (piers or walls) and an area at the end to receive the completed compost. For winter operation, they suggest the exhaust from a barn fan be directed into the Biovator to help maintain the temperature.

A more recent introduction has been the Dutch Composter manufactured by Dutch Industries of Pilot Butte, Saskatchewan. It is just now becoming commercially available.

Like the Biovator, it also is an in-vessel composter but operates in the vertical mode rather than horizontal. Dead stock and substrate are loaded into the top of the funnel shaped vessel either by tractor and loader or by the winch and cable attached to the top. At the bottom a grinding mechanism driven by a 5 hp motor macerates and continually mixes the contents. The vessel is insulated and has 2 – 2500 watt heaters to get the temperature up to 600C operating temperature. With the addition of the grinding and heating, the company claims that they can have finished compost in only 4 days. After day one nothing is recognizable of the original animals. The capacity of the machine is something over 1000 kg.

## ■ Conclusions

Composting is one of several options that can be used to dispose of swine mortalities. It eliminates the on-farm pick up of dead pigs and is therefore attractive to those seeking a higher level of biosecurity. It does not have the environmental risks associated with burial. It has a lower operating cost than incineration.

It does require a level of understanding of the process and a commitment to manage it well. This applies particularly to the bin and windrow system

whereas the Biovator option is somewhat more straight forward as it is a more contained and packaged system.

The economics and viability of these systems will vary widely as dictated by the cost and availability of suitable substrate and of equipment to move the mortalities, substrate and finished compost.

## ■ References and Resources

### Handbooks

On-Farm Composting Handbook, Publication NRAES-54, 1992; 186 pages, \$US25, contact: [www.nraes.org/publications/nraes54.html](http://www.nraes.org/publications/nraes54.html)

### Provincial, state and organization websites with composting factsheets:

*British Columbia:*  
[www.agf.gov.bc.ca](http://www.agf.gov.bc.ca)

Search on “*mortality compost bin design*”

*Alberta:*  
[www.agrc.gov.ab.ca](http://www.agrc.gov.ab.ca)

Search for “*swine mortality composting*”

*Saskatchewan:*  
[www.agr.gov.sk.ca](http://www.agr.gov.sk.ca)

Search for “*composting animal mortalities*”

*Manitoba:*  
[www.manitobapork.com](http://www.manitobapork.com)

Search on “*composting: an alternative*”

*Ontario:*  
[www.gov.on.ca/OMAFRA/english](http://www.gov.on.ca/OMAFRA/english)

Search on “*on-farm composting*”

*Minnesota:*  
[www.mda.state.mn.us/composting](http://www.mda.state.mn.us/composting)

Click on “*composting animal mortalities*”

*Missouri:*  
[www.muextension.missouri.edu](http://www.muextension.missouri.edu)

Search on “*composting dead swine*”

### Commercial

Biovator: The Puratone Corporation (2002), Niverville, Manitoba  
[www.puratone.com](http://www.puratone.com), 1-800-340-4421

The Dutch Composter: Dutch Industries, Pilot Butte, Saskatchewan,  
[www.dutchind.com](http://www.dutchind.com), 1-800-663-8824