COMPOSTING

THIS CHAPTER REVIEWS ALL ASPECTS OF COMPOSTING INCLUDING:

- **the process**
- **advantages and disadvantages**
- **substrate types**
- **siting**
- **sizing**
- **equipment**
- **management**
- **windrows**
- **in-vessel composting**
- **what to do with finished compost**
- **troubleshooting**
- **sizing bin composting units.**

Modern commercial in-vessel composting units can handle all sizes of farm animals.

Composting is managed decomposition. The process is quite similar to what happens in natural environments.

During composting, micro-organisms, in the presence of oxygen, break down organic matter to produce a stable, dark, soil-like material that has very little odour. Compost contains nutrients and organic matter useful for plant growth.

Composting deadstock is much like following a recipe – with a carbon-rich substrate as the other key ingredient. With time and attention to detail, both the deadstock and the substrate break down and the end product is compost.

Scale is an important consideration for this option. Deadstock-composting systems can be designed for an individual farm or a centralized facility servicing several farms.

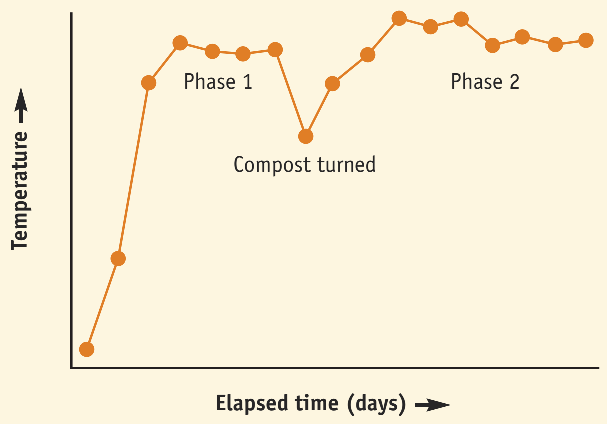
Livestock producers are not unfamiliar with composting. Until a few years ago, most of the mortality compost systems were designed to handle small animals, such as chickens and piglets. However, since the mid-1990s, more swine operations have adapted the process to manage for larger pigs. In recent years, more cattle producers have been using composting. Systems now exist to successfully compost all sizes of farm animals.

ADVANTAGES	DISADVANTAGES
• improved biosecurity because no external vehicles enter property • minimal to moderate start-up costs, depending on the chosen system • relatively easy, if a few simple rules are followed • end product has value as a soil amendment • immediate disposal of deadstock is possible • animals of all sizes can be handled • natural heating process significantly reduces numbers of any pathogens • recycles on-farm nutrients	• labour involved to manage composting process – more than some alternatives • capital cost and substrate costs – higher than some alternatives • potential for scavengers and predators to dig in piles – proper management can greatly reduce the potential • the largest bones take longer to break down – screening may be needed to avoid possible inadvertent land application, resulting in neighbour concerns • movement and land application of finished compost from cattle carcasses to property not connected to the site where the compost was generated require federal SRM permits

Some bones, especially large ones, may not be decomposed by the time the composting process has been completed.

The heat generated by microbial decomposition in the composting process destroys most pathogens.

THE COMPOSTING PROCESS



WHAT HAPPENS DURING DEADSTOCK COMPOSTING

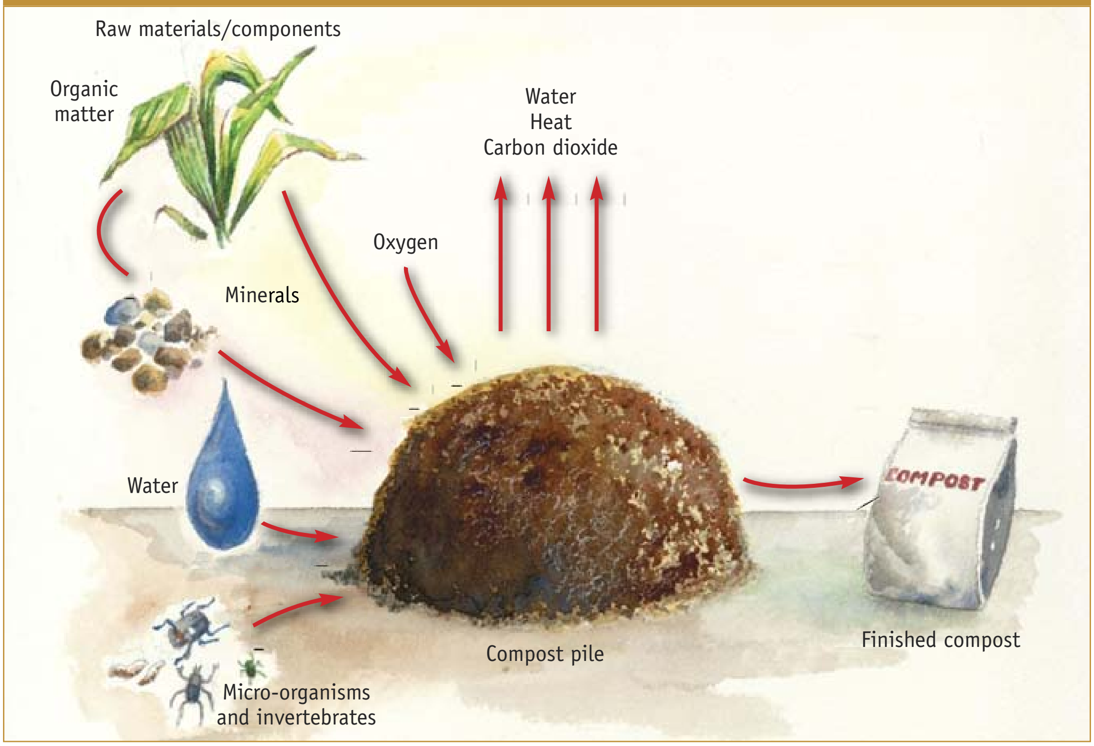
The composting process is dynamic. This managed ecosystem and its physical, chemical, and biological components change dramatically over time.

Most compost researchers agree there are two main phases of composting:

1. The first phase (the developing or heating phase) is characterized by high oxygen-uptake rates, and thermophilic (high) temperatures, from 46 °C to nearly 71 °C (115–160 °F). Here, thermophilic micro-organisms degrade fats, hemicelluloses, cellulose, and some lignins.
2. The second phase (the maturation or curing phase) may require one month or longer for completion. In this phase, aeration is not a determining factor for proper composting, and therefore it's possible to use a lower-oxygen composting system. A series of retarding reactions, such as the breakdown of lignins, occurs during this maturation or curing stage and requires a relatively long time. The maturation phase could be as long as five months at temperatures below 40 °C (104 °F).

Not all composting systems work equally well. Effective composting depends on managing the factors that affect the environmental and nutritional requirements for the microbes inhabiting the compost ecosystem. Some of the most important factors to ensure successful composting are summarized in the next chart.

ON-FARM COMPOST – KEY FACTORS



The key management factors for effective composting are: oxygen, carbon:nitrogen ratio, temperature, moisture and time.

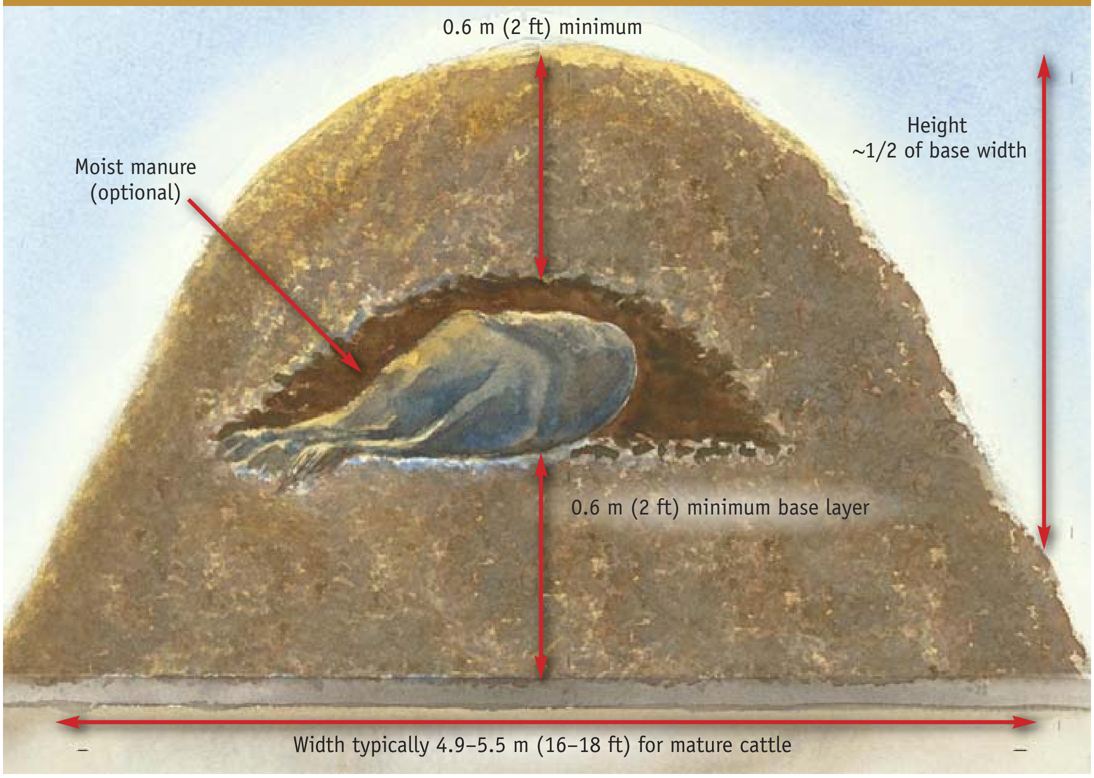
FACTOR	FUNCTION	MANAGEMENT IMPLICATIONS
OXYGEN	• composting is an aerobic process • microbes need oxygen to breathe • air (oxygen) must penetrate pile for effective composting • dense substrate and high moisture contents will cause anaerobic conditions	• anaerobic decomposition is slower and produces more odour and greenhouse gases (nitrous oxides and methane) • compost requires aeration – by mechanical turning or moving of piles, or with ventilation systems
CARBON AND NITROGEN	• carbon is required by micro-organisms for energy and cellular tissue • nitrogen is needed for enzymes and proteins • a balance is needed between carbon and nitrogen for optimal microbial function • ideal ratio of carbon to nitrogen (the C:N ratio) should be close to 25:1	• C:N of animal carcass = 4:1 • C:N of corn silage = 40:1 • combining these inputs in the correct proportions results in the proper final C:N ratio • if the C:N ratio is too low, there is a greater risk of odour problems • if the C:N ratio is too high, the composting process will take too long
TEMPERATURE	• composting generates heat – the composting environment, condition of materials, and type of microbes present will dictate the amount of heat produced • higher temperatures are required to break down complex materials (e.g., lignins) and pathogens	• ideal temperatures ○ phase 1: 46–71 °C (115–160 °F) ○ phase 2: below 40 °C (104 °F) • low temperatures will slow the composting rate – little composting takes place if conditions are frozen • extremely high temperatures can destroy composting microbes • substrates must be managed for insulating properties
MOISTURE	• microbial and chemical processes critical to composting require water • excess moisture can cause anaerobic conditions • dry conditions will slow composting rate	• ideal moisture content should be 40–60% • covered piles may require added moisture • uncovered piles may absorb rain and require more substrate or turning to maintain aerobic conditions • controlling factors also include volume and type of animals and substrate
TIME	• process requires proper ingredients and time to complete each phase	• small animals and fewer numbers compost quickly (2 months) • larger deadstock can take up to a year

The preceding list of factors applies to any composting of well-mixed materials. What happens with deadstock is somewhat different, however, at least for part of the process.

Unless the deadstock is ground (broken up) before mixing with the substrate, we are normally dealing with a non-homogeneous material. Typically, the deadstock are added to a bed of substrate and covered with substrate (this has been referred to as "above-ground burial"). The deadstock begin to break down anaerobically. Liquids move into the substrate. Any odours generated are captured by the covering material, which acts as a biofilter.

It may not be until the material is mixed that active composting begins throughout the pile. For this reason, it is not wise to turn the pile too soon in the process.

STATIC PILE – CROSS-SECTION



Composting larger deadstock is more effective when they are laid on a thick base of substrate and covered by enough material to maximize aeration and insulation.

COMPOSTING METHODS

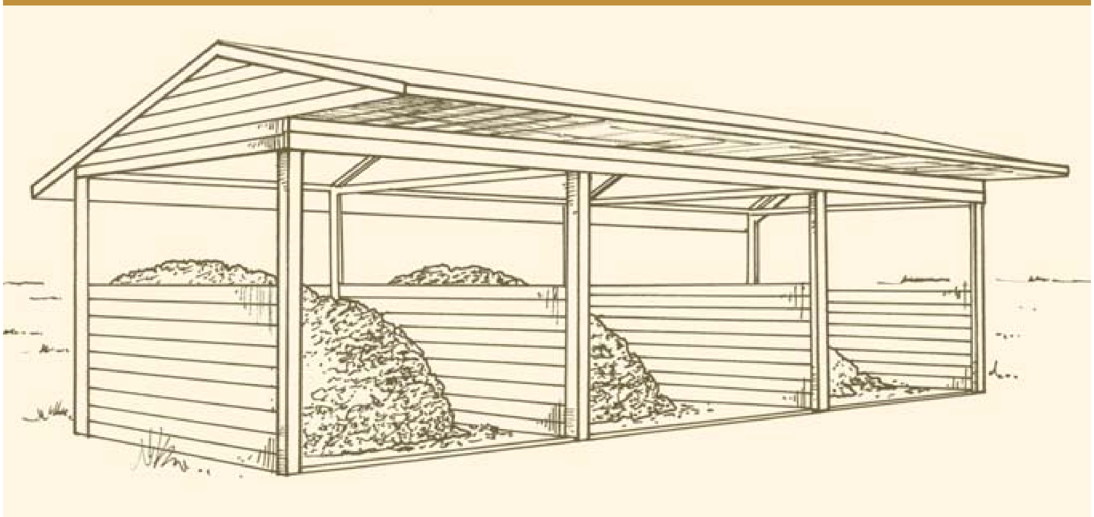
There are two broad groupings of compost systems: those designed for ongoing deadstock and those intended for large volumes or batches.

Large-volume or "catastrophic" losses of animals are often associated with a fire, with suffocation as a result of a power failure, or as a result of a disease outbreak. For example, when avian influenza was confirmed in British Columbia in 2004, many of the infected carcasses and birds of no value (e.g., spent hens) were composted.

The issue of cause of death has an impact on the selection of the most appropriate compost strategy. Some compost systems ensure higher and more uniform compost temperatures, which are more effective in controlling or destroying pathogens. If spread of disease is a concern, a system that ensures higher temperatures throughout the entire compost volume is desirable.

A number of composting strategies can be adopted. The most common of these are described here, along with a description of the main options for each.

STATIC PILE METHOD OF COMPOSTING



A static pile is the most common system currently in use. It's fairly easy to set up and operate. At its simplest, it's a pile of material on bare ground. A more complex version is a covered building with a concrete floor where the composting takes place in a series of bins.

If the static pile system will be loaded, mixed and emptied with a tractor or skid-steer loader, a concrete floor is preferred for ease of use, cleanliness, and runoff management.

Roofed or covered static piles reduce the risk of runoff or leachate, and make moisture content easier to manage.

Walls can be made of bales, wood or concrete. They must be 1.2–1.8 m (4–6 ft) high – tall enough to encourage desirable temperatures and low enough to discourage anaerobic conditions.

Windrow systems can be more practical for operations with ongoing deadstock. The windrow is extended and turned as needed.

Composting is possible in long plastic tubes, such as those more commonly used to store corn silage or haylage. For deadstock, a fan blows air into the tube at one end and the air exits at the other end. This system is better suited to batch conditions, where it can be filled at one time.

In-vessel systems such as the horizontal drum can compost small volumes more quickly with less substrate. They are more expensive.

COMPARISON OF COMPOSTING SYSTEMS

FEATURE	STATIC – UNCOVERED	STATIC – COVERED	WINDROW	IN-VESSEL (DRUM)	PLASTIC TUBE
STRUCTURE	• *base* natural soil, clay or concrete • *walls* 1.2–1.8 m (4–6 ft) high, hay, straw, wood, concrete • no cover	• *base* concrete • *walls* wood or concrete • *cover* roof structure or heavy-duty tarp	• *base* concrete or natural soil • elongated mound on field – located in accessible area (e.g., near fencerow, headlands)	• long insulated drum with rotation by electric motor • typically 9.1 m (30 ft) by 1.2 m (4 ft) diameter	• similar to tubes or bags used for ensilage • fan attached to one end to reduce incidence of anaerobic conditions
HOW IT WORKS	• substrate added to cover deadstock • piles left intact – no turning of piles	• batch system – 3–4 bins with substrate on one end and finished product on other end • may need to add water	• windrow is elongated with substrate and fresh deadstock • material is turned regularly	• continuous flow – substrate and deadstock can be added and finished product removed daily • reaches high temperature within 14–28 days	• batch system – substrate and deadstock added at once to bag • fans aerate the bagged material • material emptied from bag when completed
RUNOFF MANAGEMENT	• need adequate substrate base layer below carcasses	• minimal risk of leaching or runoff	• regular turning and substrate management can reduce risk	• minimal risk of leaching or runoff	• minimal risk of leaching or runoff
RUNOFF/ LEACHING POTENTIAL	• high	• low	• high	• low	• low
CAPITAL COST	• low	• high	• low	• high	• high
OPERATING COSTS	• moderate	• moderate	• moderate	• low	• low
LABOUR	• low	• low	• low	• low	• low
AMOUNT OF SUBSTRATE	• high	• high	• high	• low	• low
TIME TO COMPOST	• long	• long	• moderate	• short	• moderate
SUITABLE FOR	• small operations (e.g., cow-calf)	• most operations	• large operations with ongoing need to manage deadstock • flexible to handle catastrophic events	• operations with daily deadstock – normally small ones (e.g., swine, poultry) • may need to cut up larger deadstock to fit into unit	• only suitable for small deadstock or where deadstock are ground and then blended with substrate • no further mixing

Continuous mechanical turning is not practical for on-farm deadstock composting. It would only cause partially decomposed carcasses and bones to resurface. This approach is more suitable for the roofed, channel systems normally designed for centralized composting. In centralized units, deadstock from many farms (or catastrophic losses from a single farm) would ensure a faster loading of the channel.

CHOOSING THE SUBSTRATE

A vital part of the compost process is the substrate (also known as "carbon source" or "co-composting material"). The substrate serves several useful purposes:

- provides the energy source for ensuring microbial activity
- surrounds the carcasses so they're less accessible to scavengers
- serves as a biofilter to prevent the release of any odour originating inside the compost mass
- soaks up any liquids released as the carcass decomposes, thus reducing the potential for runoff or leaching
- provides the bulking agent that allows air to move within the compost
- insulates the pile, helping to hold the heat that's generated.

Below are some useful selection criteria for substrates:

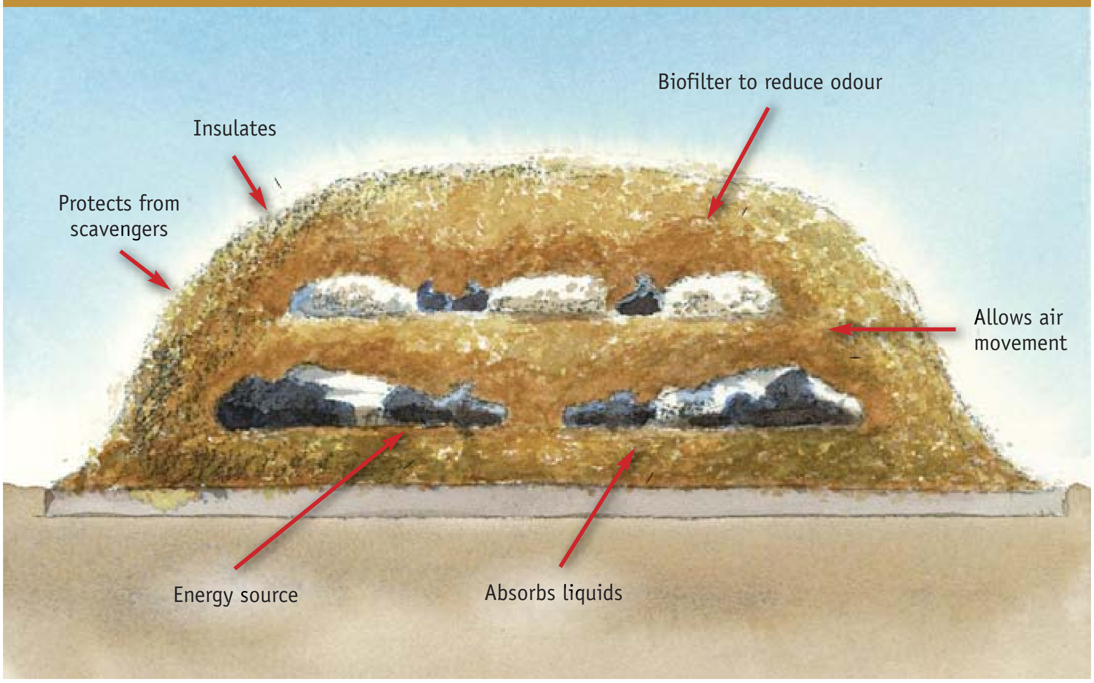
- C:N ratio – total carbon to total nitrogen, needed for nutrient balance
- moisture content
- ash content – how much non-organic material the feedstock contains
- total nitrogen – expressed as either a dry or wet weight
- pH – the acidity or alkalinity of the substrate, which should be between 5 and 9
- bulk density – the weight per unit volume (too dense leads to anaerobic conditions)
- particle size – if too small, anaerobic conditions prevail; if too large, there is poor surface-area contact and reduced capacity to absorb liquids.

TYPICAL PROPERTIES OR RANGES OF PROPERTIES FOR A VARIETY OF POTENTIAL SUBSTRATE MATERIALS

MATERIAL	NITROGEN (%, dry weight)	C:N RATIO (weight to weight)	MOISTURE CONTENT (%)	BULK DENSITY (kg/cubic metre)	pH	PARTICLE SIZE (cm)
CORN COBS	0.6	98	15	330	7.6	3–10
CORN STALKS	0.6–0.8	60–73	12	20	7.6	10–25
CORN SILAGE	1.2–1.4	38–43	65–68	550–685	3.8	1–6
HAY	0.7–3.6	15–32	8–10	160	–	5–30
STRAW	0.3–1.1	48–150	4–27	35–225	7.6	5–30
SAWDUST	0.06–0.8	200–750	19–65	210–270	6.0	0.1–0.8
WOOD CHIPS – HARDWOODS	0.06–0.11	451–819	40	445–620	7.6	1–4
WOOD CHIPS SOFTWOODS	0.04–0.23	212–1,313	40	445–620	6.0	1–4
BROILER LITTER	1.6–3.9	12–15	22–46	450–610	8.5	1–4
BEDDED CATTLE MANURE	1.5–4.2	11–30	67–87	785–990	7.9–8.2	5–30
BEDDED SHEEP MANURE	1.3–3.9	13–20	60–75	440–650	8.0–8.3	5–30
TURKEY LITTER	2.6	16	26	465	5.6–7.5	1–4

Readily available materials such as old corn silage and sawdust can be suitable substrates for composting.

COMPOST PILE CROSS-SECTION SHOWING FUNCTIONS OF SUBSTRATE



Composting substrate materials provide the following functions: energy and air for microbes, insulation to maintain temperatures, absorption of liquids, filtering of odours, and protection from scavengers.

MANAGEMENT IMPLICATIONS OF SUBSTRATE MATERIAL

The best choice for substrate goes beyond the physical and chemical properties highlighted in the preceding table. Other factors include:

- availability – sometimes quantities of spoiled feed or bedding are available on-site and these make obvious choices as substrate
- cost – of materials, transporting, storage and handling are obvious considerations
- contaminants – when using substrates from off-farm, make sure that they do not contain foreign material such as metal, glass or chemical contaminants
- mixtures with finished compost – it's also possible to use a portion of the "finished" compost as substrate material
  - this reduces the amount of substrate needed, and helps to inoculate the fresh materials – thus accelerating the process
  - amounts of up to 50% of the substrate volume may be used, but levels this high are only practical if the C:N ratio of the finished compost is higher than 30:1.

Some materials provide more insulation, so more of the heat is trapped within the pile. While this may not have a big impact on the compost process, it promotes more effective destruction of pathogens, which are a concern for some producers.

Substrate particles need to be large enough to allow for airflow through the compost but small enough to decompose effectively. An ideal particle length is in the range from 3 to 13 mm ($^1/_8$–$^1/_2$ in.). Some materials (e.g., corn stalks, corn cobs, straw) will compost better if they are first chopped to the desired length.

Enzyme and microbial products are being marketed as compost accelerants. They may help to speed up the composting process, especially when using materials that have low background levels of bacteria, such as old litter or dry leaves. Whether or not these products will help the composting process depends on individual circumstances.

SITING

Choosing the most appropriate composting site is critical.

✔ Select a location that is out of view of neighbours and the public.

✔ Comply with any environmental or building regulations for your area by checking with the chief building official and bylaw officer in your municipality.

✔ Choose an area away from wells, watercourses and tile drains.

✔ Avoid areas with seasonally high water tables, unless composting takes place on an impermeable surface with leachate collection and a means to prevent stormwater runoff.

✔ Locate the composting site away from animal feed, housing units and wildlife habitat.

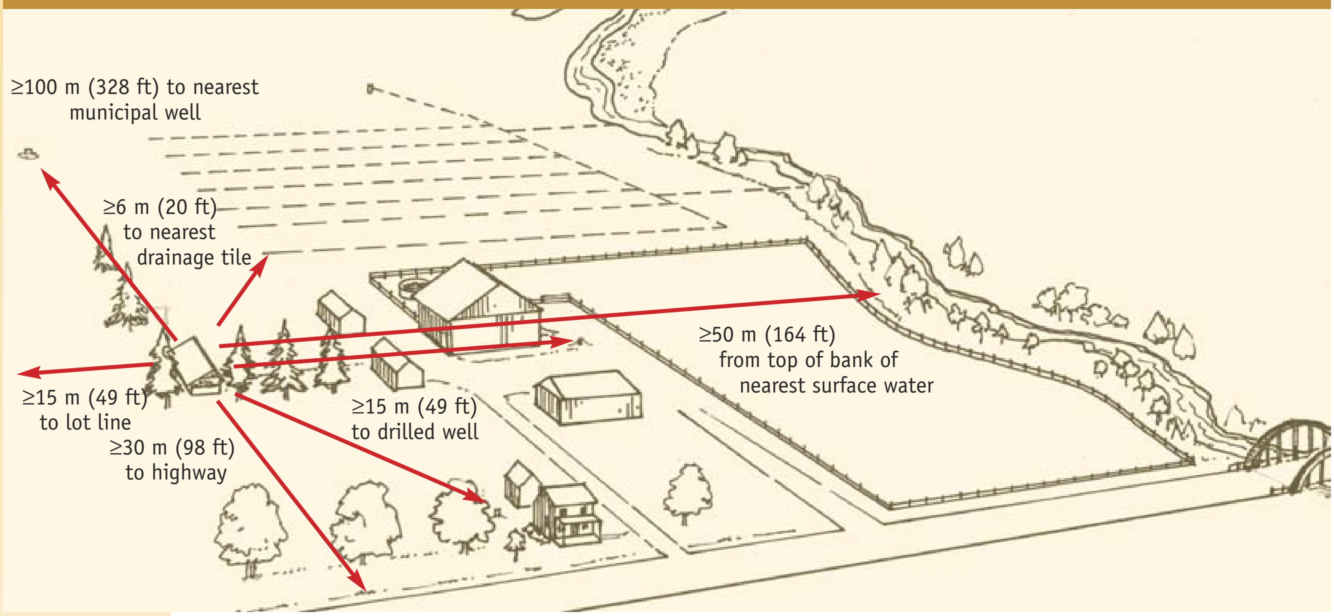
✔ Avoid any biosecurity risks (e.g., traffic patterns or vermin access) and make necessary changes to reduce the risk of spreading disease.

✔ Allow space for handling deadstock, substrate and finished compost.

✔ Ensure the site is convenient, with easy access for managing and monitoring the system.

✔ Ensure convenient access to a water supply so that water can be added to compost if needed.

LOCATION OF COMPOSTER AND TYPICAL SEPARATION DISTANCES



The composting process generates leachate that can pollute surface water, stormwater and groundwater if not managed effectively. Compost leachate can contain organic matter, organic nitrogen, nitrate and ammonia, phosphate, other nutrients and salts. This should be strongly considered when siting facilities and planning risk prevention. Clean rainfall from outside the composting area needs to be excluded so that it does not flow through the area and become contaminated. All runoff or leachate from within the operational areas must be collected and managed.

SIZING

The size of the compost unit will depend on the size of the livestock enterprise, the average animal size, the typical mortality rate, and the type of compost unit to be used.

The total annual amount of substrate needed can be estimated based on the typical annual mortality rate (considering size, number and species of deadstock) and the types of substrate available. It is important to be able to access the desired quantities of substrate throughout the year.

Some of the systems described earlier are commercially available units, and it's reasonable to expect the supplier will take a lead role in sizing the unit.

The following will focus on the sizing considerations for the static-pile systems, which are usually designed by the livestock producer.

For each static-pile composting unit, plan for at least three composting bins. Two bins are needed for the primary stage of composting (first-heat stage), and a third one is needed for the secondary stage of composting (second-heat stage).

Some larger operations will need more than one composting unit. One or more bins may also be needed for storing the substrate or the finished compost.

The size of bins required must be calculated for each individual operation. Each primary composting bin needs at least 1.25 m^3 (44.14 ft^3 or 1.63 yd^3) for every kg (2.2 lb) of "average daily deadstock" that will be composted, if sawdust is the substrate. However, the composting bins should be 50% larger than this to allow for an unexpected increase in mortality rate or expanded production.

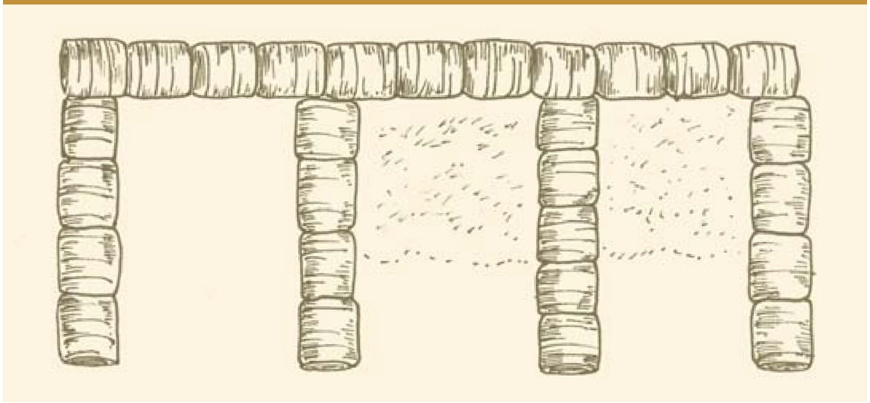
If you plan to use less dense substrates, such as straw and corn silage, you will need more bin space per kilogram of deadstock. Each secondary bin should be at least two-thirds the size of the primary bin.

In general, a storage bin for substrate should equal the volume of two primary bins. If a storage bin for finished compost is desired, it should be equal in volume to one primary bin.

Consider all management and site factors when planning a compost system for on-farm deadstock.

Three separate bins are recommended: two for the primary stage and one for the secondary stage.

SIMPLE LARGE-BALE COMPOSTING UNIT



EQUIPMENT LIST

A COMPOST THERMOMETER is the way to keep track of compost temperatures. It should be constructed of stainless steel with a 6-mm ($^1/_4$ -in.) diameter shaft and measuring at least 1 m (39 in.) in length. Take the internal temperature of the pile at several locations, including close to the last deadstock added. Temperatures should remain between 55 °C and 65 °C (130–150 °F) for at least seven consecutive days.

LOADING EQUIPMENT is needed to move substrate and deadstock, to move finished compost, and depending on the system, to mix composting materials. In many cases, a tractor-mounted front-end loader or skid-steer loader is used. The most suitable equipment will depend on the compost system design, equipment available on-farm, frequency of use, amount of material being handled, location of the composting system, and available labour.

It's possible that pieces of the larger bones will remain after the bulk of the deadstock has completed composting. These bone fragments are easily broken down and pose no health risk or hazard to tractor tires or other equipment. However, they can be unsightly when spread onto the land. Remaining bones can be added back into the input end of the system where they will be further composted.

MANAGEMENT

A complete composting cycle has three main stages: loading, the primary heating stage, and the secondary heating stage.

In situations of catastrophic losses where the compost pile can be built in a very short period of time, the loading stage can be either reduced or eliminated, thus reducing the total composting cycle by up to one-third.

Space deadstock evenly when loading.

Typically in a bin system, deadstock under 25 kg (55 lb) take 45 days for each stage, for a total of 135 days for the complete cycle. For deadstock 25 kg and over, allow 90 days for each stage, giving a total of 270 days.

However, it may take a year to completely compost deadstock over 200 kg (440 lb).

LOADING PRIMARY BIN

1. Fill one of the primary bins over a period of 45 to 90 days, depending on the average weight of the deadstock.
2. Spread 0.6 metre (2 ft) of substrate to make a base to absorb any leachate.
3. Place the deadstock on the substrate, at least 0.3 m (1 ft) from the edge of the bin. Space the deadstock evenly on the substrate. Place larger deadstock on their sides to maintain the recommended pile height of less than 1.8 m (6 ft). If needed, cut the ligaments and tendons in the legs and fold them down. Cutting open the body cavity of larger deadstock will reduce bloating and promote increased microbial activity.
4. Immediately cover the deadstock with at least 0.6 m (2 ft) of substrate. Ensure all parts of the deadstock are covered with substrate.
5. When adding more deadstock, skim off a portion of the top layer of substrate and add new deadstock to the pile, being sure to cover them properly.
6. Once the primary bin is filled, leave the material to compost for an additional 45 to 90 days. While one primary bin is composting, another primary bin can be filled.
7. Make sure all deadstock are completely covered with 0.6 m (2 ft) of appropriate cover material. Settling of the pile or wind action may reduce the depth of substrate over time.

Heat and steam are generated during the primary stage.

Mix and fluff materials when moving to secondary bin.

LOADING SECONDARY BIN

1. Move the pile from the primary bin to the secondary bin after 45–90 days from the last addition of deadstock, and the second primary bin has been filled.
2. The secondary bin represents a second heating stage. When moving the material, try to mix and fluff it to create a more uniform blend of materials and to increase the air space within the pile. This optimizes the second heating stage.
3. Cover surface with a fresh layer of substrate to act as a biofilter.

Specialized equipment is available to turn compost windrows.

COMPOST WINDROWS

1. Follow a loading process similar to the bin system, except there are no containment walls around the pile. A base of substrate is established, substrate and deadstock are layered into the windrow, and the entire pile is capped with substrate.
2. Instead of transferring material to a secondary bin, the pile is turned using a front-end loader or specialized equipment to introduce oxygen and re-blend the material.

MAINTAINING MOISTURE

For a pile or windrow with a roof or cover, the top layer of substrate may be left flat or concave (dished) so that any added moisture will be more easily absorbed.

A convex or peaked shape may be appropriate for any uncovered piles to limit the amount of rain or snow that will soak into the pile. Although a peak may be desirable during a wet period, the pile may need to be flattened or dished to capture moisture during a dry period.

You could also use a rain-shedding tarp system over the piles. These must be breathable to allow oxygen transfer.

Build peaked piles to shed rain and snow. This will help keep the pile aerobic.

MONITORING

Any composting system should have a basic level of monitoring, especially when you're starting out. Check the pile regularly to monitor the substrate cover, temperature and moisture. Record the information.

Throughout the composting cycle, watch for and take steps to prevent scavenging by animals.

Excessive leachate/runoff and odour from a pile are indicators of a problem with the compost recipe or pile management.

A simple record-keeping system should include:

- dates
- details about deadstock added
- substrate used
- pile temperature
- pile moisture.

If tarps are used to cover a windrow compost pile, the tarps need to be held down in a secure manner.

Good records will help you make decisions for future improvements to the system, and demonstrate due diligence.

SAMPLE COMPOSTING RECORD SHEET (USE ONE SHEET PER BIN)

BIN TYPE (Primary, Secondary)	BIN # (1, 2, 3...etc)	DATE INITIATED	COMMENTS:

DATE	TEMPERATURE	MOISTURE LEVEL	DEADSTOCK ADDED (species and weight)	SUBSTRATE ADDED (amount and type)	OBSERVATIONS/COMMENTS
June 2, 2009	62°C	45%	1 calf, 45 kg	Sawdust, 70 kg	

WINTER COMPOSTING

As the air temperature drops, it's more difficult to establish microbial activity in a composting pile, especially in uncovered piles. If possible, avoid starting a new pile from December to February. If a new pile must be started in the winter, consider using finished compost from the previous year as part (up to 50%) of the starter substrate, since the appropriate micro-organisms will already be present to kick-start the heating process. **If the deadstock is frozen, it should be thawed before being added to the pile.** Some in-vessel units are equipped with supplemental heaters to help start the process in cold weather.

IN-VESSEL COMPOSTING

Composting "in-vessel" refers to a closed vessel, usually with continuous mixing.

Vessels can be in the configuration of a rotating cylinder that rotates slowly and tumbles the mixture. Other types rely on mixing augers to keep the material aerated. The vessels are insulated to retain heat generated from the process. The continuous mixing ensures constant temperatures throughout the compost and thus speeds the process.

The enclosed system does not require the extra cover to act as a biofilter, and can reduce the substrate volume substantially. These systems are suitable for smaller animals. Large animals would require cutting into smaller pieces.

An in-vessel composter is more expensive to own and operate than a static-pile system, but greatly reduces the composting time to produce a product of uniform consistency.

Properly finished compost resembles potting soil and should not contain any recognizable parts of deadstock.

FINISHED COMPOST

Properly finished compost has a slight earthy smell. In colour and texture, it resembles a rich potting soil. As mentioned earlier, if fragments of bones remain, they should be screened out.

In most cases, the best way to use the finished compost is through land application. It represents a source of nutrients and organic matter that can be put to use for improving soil health and plant growth.

If there are large enough quantities, be sure to get a nutrient analysis of the finished compost and include it in your nutrient management plan or strategy. The finished compost is best spread on the property where generated.

TYPICAL NUTRIENT CONTENT OF FINISHED COMPOST FROM DEAD CATTLE	
Dry Matter (%)	30
Nitrogen (%, as is)	0.74
C:N Ratio	25
Phosphorus (%, as is)	0.20
Potassium (%, as is)	0.36

TROUBLESHOOTING GUIDE

Even though composting is a relatively simple practice, problems can occur.

Sometimes, a rather easy fix may mean the difference between successful composting and giving up on the practice altogether. The table below contains tips on the causes and solutions of some of the more common problems that have been encountered when composting deadstock.

PROBLEM / SYMPTOM	PROBABLE CAUSE	POSSIBLE SOLUTIONS
TEMPERATURE TOO LOW	• too dry (less than 40% moisture) • too wet (more than 60% moisture) • improper C:N ratio • inadequate mixing of ingredients • adverse environment	• add water • add substrate and mix pile • evaluate substrate and adjust as necessary • layer ingredients appropriately • ensure adequate cover
FAILURE TO DECOMPOSE	• C:N ratio too high • deadstock layered too thickly • deadstock on outside edges • frozen carcasses	• evaluate substrate and adjust as necessary • ensure thinner layers (or single layer) of deadstock • maintain 0.3 m (1 ft) between deadstock and edges • thaw deadstock before adding
ODOUR	• too wet • C:N ratio is too low • inadequate cover over deadstock	• add substrate and turn/mix compost • evaluate substrate and adjust as necessary • cover with 0.6 m (2 ft) of substrate
FLIES	• inadequate cover over deadstock • poor sanitation conditions • too wet • failure to reach proper temperature	• cover with 0.6 m (2 ft) of substrate • avoid leaching from pile • turn pile and add substrate • assess C:N ratio and layering
SCAVENGING ANIMALS	• inadequate cover over deadstock	• maintain 0.6 m (2 ft) cover • install a fence or barrier

WORKSHEET FOR SIZING BIN COMPOSTING UNITS

A. Determine the annual weight of deadstock on your farm.

LINE	STEPS	SAMPLE FARM	YOUR FARM
1	Enter the number of deadstock per year.	*60 head*	_______ deadstock/year
2	Enter the average weight of the deadstock.	*125 kg*	_______ kg/deadstock
3	Enter the kg of deadstock per year.	*60 × 125 = 7,500 kg/year*	_______kg/year

B. Determine the volume needed for a composting unit consisting of two primary bins and one secondary bin, and the number of units required.

LINE	STEPS	SAMPLE FARM	YOUR FARM
4	Calculate volume of one primary bin: divide the total weight of annual deadstock (calculated in Line 3) by a conversion factor to account for substrate density and deadstock size (under 25 kg or 25 kg and over). Conversion factors for common materials are listed in the chart at the bottom of the page.	Example is based on deadstock 25 kg and over, using sawdust as a substrate. *7,500 ÷ 703 = 10.7 m³*	_______ ÷ _______ = _______ m^3
5	Calculate the volume of one secondary bin: multiply the volume of one primary bin (Line 4) by 0.67*.	*10.7 m³ × 0.67 = 7.17 m³*	_______ × _______ = _______ m^3
6	Calculate the number of units: divide the volume of one primary bin (Line 4) by the proposed pile height (1.4–1.8 m) and divide by a maximum floor area of 6 m^2 per bin. (Note: floor area may be greater if bins are no more than 2.45 m wide.)	*10.7 m³ ÷ 1.8 m ÷ 6 m²* *= 1.00*	_______ m^3 ÷ _______ m ÷ _______ m^2 = _______

C. Determine the approximate volume of a storage bin needed for an annual supply of substrate.

LINE	STEPS	SAMPLE FARM	YOUR FARM
7	Calculate the approximate volume of substrate storage bin: multiply the volume of one primary bin (Line 4) by 2**	*10.7 m³ × 2 = 21.4 m³*	_______ × 2 = _______ m^3

* The volume of the secondary bin should be at least two-thirds the volume of one primary bin.

** Generally, the volume of substrate required for one year of composting will equal the combined volume of two primary bins. A larger bin may be necessary if a very coarse and low-density substrate is used.

CONVERSION FACTORS

SUBSTRATE	DEADSTOCK UNDER 25 kg	DEADSTOCK 25 kg and OVER
SAWDUST	1,406	703
STRAW	730	365
CORN STALKS	595	297
CORN COBS	1,784	892
CORN SILAGE	2,677	1,338