Composting Guide for Producers/Contractors

Purpose: Develop windrow (compost) piles as per CFIA requirements to initiate Biological Heat Treatment (BHT).

Introduction:

Composting is a natural biological decomposition process that takes place in the presence of carbon, nitrogen and oxygen, and generates heat. The temperatures achieved in the compost piles during the composting process may be high enough to inactivate certain viruses and bacteria responsible for specific diseases in animals.

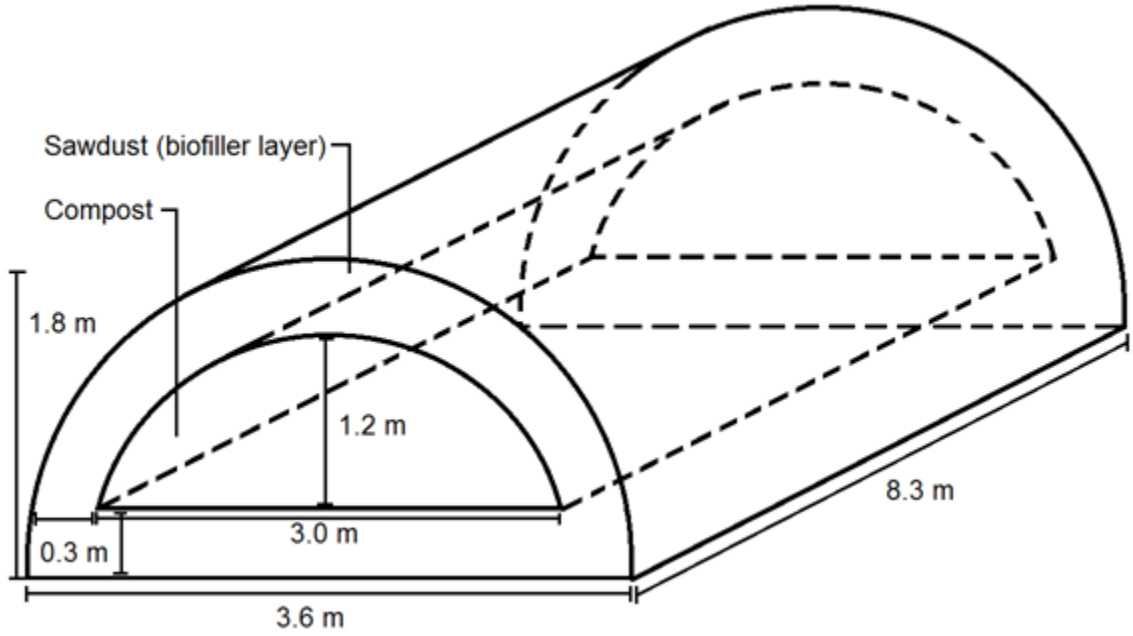
Composting is a two-stage process. In the primary phase, the temperature of the compost pile increases, organic materials break down into relatively small compounds, soft tissue decomposes, and bones partially soften. In the secondary phase, the remaining materials, mainly bones, break down fully to a dark brown or black humus, containing primarily non-pathogenic bacteria and plant nutrients.

Biological heat treatment (BHT) describes the process of treatment that occurs during the primary phase of composting when the temperature rises rapidly, heating materials in the compost pile to such a level that organisms contained in the pile are affected. This process is essential for managing pathogens during composting, as containment and eradication of such pathogens is a primary goal of disease control. The product is non-stable compost that may be free of infective agents, if sufficient temperature has been achieved over time. Further testing may be required to ensure that the pathogen has been inactivated. The partially-composted material requires further composting to achieve a usable end product.

Composting Process

Biological heat:	Inactivation of specific pathogens present in the compost
treatment (BHT):	Pile by the heat produced during the composting process. For disease control purposes, bio-heat treatment of carcasses is to occur during the first phase of composting.
Biofilter layer:	A top cover layer of carbon source and/or bulking agent materials that maintains proper conditions of moisture, pH, nutrients, and temperature to enhance the microbial activities and that deodorizes the gases released from the piles at ground level.
Bulking agent:	A nutrient material for composting that has larger particle sizes than carbon sources and maintains adequate air spaces within the compost pile, e.g. bark chips.
Carbon sources:	Various materials may be used as a carbon source provided that they have large C:N ratio, such as sawdust, straw, corn stover, poultry litter, ground corn cobs, baled corn stalks, wheat straw, semi-dried screened manure, hay, shavings, paper, silage,

leaves, peat, yard wastes, vermiculite, and a variety of waste materials (e.g. matured compost). The CFIA recommends soft wood shavings.



This section is for the composting of all poultry species in a barn or secure structure on site. There are many different barn sizes and types, and production methods that may be specific to each type of poultry for efficiency and animal welfare. The method of commercial poultry production, barn size and configuration will dictate if in-barn composting is applicable. Typically broilers, game birds, water fowl, pullets, turkeys and turkey breeders are raised on the floor, broiler breeders and layer breeders are raised on slatted floors with nesting boxes, and egg layers may be housed in conventional or enriched cages, aviaries, or raised on the floor. Most floor type systems can accommodate in-barn composting with the movement of welfare equipment. Modern caged egg layers with manure belts to an external storage are the exemption for in-barn composting, as the cages are solid and fixed with narrow isle ways. In this case, an external secure structure on site or out-of-barn composting may be assessed if appropriate biosecure movement occurs. An alternative method of disposal may be necessary. Please note that caged egg layers with a manure pit, there needs to be an assessment that the pit can be accessed safely and that there is adequate space for compost windrow construction.

Poultry In-Barn General (template) Process:

The process is similar with most poultry; however it may be necessary to modify the process for barn specific situations.

- Site assessment,
- agreement for in-barn composting,

- develop composting team (contracting), loader operator(s), composting lead, labourers,
- order materials for composting,
- empty feeders and waterers onto the floor,
- raise feed and water lines and equipment, and move additional equipment as applicable,
- use loader to clear the central composing area moving litter and carcasses to the side(s) and mixing, ensure complete and consistent mixing,
- mix feed and broken eggs if applicable with carcasses,
- build a maximum 3.6 m wide by 15 to 30 cm deep base of fresh shavings starting at the far end of the barn,
- check the mix and adjust for moisture or carbon, build compost pile of the mixture of carcasses and litter, (it is best to build from the side if possible, if not possible build the base as needed to limit driving on it and compressing it),
- any carcasses that roll off the pile are to be moved and incorporated into the pile, arrange carcasses so that legs and wings do not stick out of the pile,
- clean up sides to incorporate all materials to be composted into the pile,
- cover the compost pile with 30 cm of fresh shavings, it may be possible to cover the pile from the end or side, or it may be necessary to shovel shavings by hand, ensure that all carcasses are covered,
- check that all carcasses are covered,
- mark compost pile for starting point and each monitoring point with marker paint,
- maintain the pile and leachate as required,
- monitor compost pile for temperatures,
- release compost pile when adequate time and temperature has been achieved for inactivation of disease agent.

Once the compost pile(s) have been constructed, CFIA will ensure the pile has been constructed appropriately and the temperature has raised to 37C. CFIA will return for 6 consecutive days to ensure the monitor and record compost temperatures have been maintained. If the appropriate temperature has been marinated CFIA will issue a BHT letter that outlines that virus within the pile has been deactivated.

Carbon source

Composting materials should be mixed and no larger than 2.5-5 cm. Mortality management does not require a precise C:N ratio, however for an effective process, a C:N ration of 30:1 or greater is recommended. The primary nitrogen source in the piles is the carcasses (C:N ratio between 5:1 and 10:1). Some provinces may have requirements for composting and the minimum C:N ratio.

Mortality management requires the addition of a carbon amendment, which serves several key functions:

- surrounds the carcasses, making them less accessible and attractive to pests
- absorbs excess liquids released by decomposing carcasses
- provides structure and porosity, promoting air movement throughout the pile
- provides an important energy source for microbial growth. The rapid growth of thermophilic bacteria (45-70°C) produces heat required for BHT.

The type of carbon material used influences the success of the process. For example, wood chips, saw dust, and straw do not work as well as soft wood shavings due to their sizing. Using these materials requires longer decomposition times, and the leaching of liquids from piles is more likely than with shavings. It is recommended to order a moist carbon source for the mix and a dry source for the base and cover.

Many use soft wood shavings as the source of carbon as they are readily available, provide a good mix of small and medium sized particles that support microbiological activity, and have good liquid absorption.

The final mix should have moisture content between 50–60% (wet weight). A dry mix (< 20%) will not decompose properly and will require additional water. On the other hand, excessively wet compost material will require additional dry amendment. When determining the mix, it is necessary to take into account that the carcasses have moisture content of 80%, however they are enveloped in the hide. It is recommended to order moist shavings for mix, and to open 10% of smaller carcasses or all of larger carcasses to develop a moisture mix and to promote microorganism growth.

The quantity of amendment required may be reduced fourfold if there is comminution of carcass size. Note that with highly infectious diseases, commination or grinding of carcasses is not recommended. To reduce carbon requirements, finished compost material may be used to replace up to 50% of the shavings. Substituting > 50% of the carbon with finished material may limit the carbon availability and decrease the rate of carcass decomposition.

The Hand-Squeeze Method (to determine the moisture content of compost mix)

1. Squeeze a handful of compost firmly several times to form a ball.
2. Evaluate the ball of compost:
    - If the ball is crumbly or breaks into fragments, the moisture content is much less than 50%. Add water to the compost pile. If water is not accessible on-site, identify an external source.
    - Bounce the ball on your hand 3-4 times. If the ball remains intact, the moisture content is approximately 50%. This is within the desired range.

- If the ball feels slimy and has a musty, soil-like odour, the moisture content is much more than 50%. Add a dry amendment to the compost pile.

If excessive moisture is a problem, use a loader to add a dry amendment. Once the carcasses have decomposed, turning the pile reduces excess moisture. Covering the pile with a roof or plastic tarp protects the pile from precipitation.

Collect and redistribute any runoff onto the pile when moisture is needed. If this is impossible, use alternative systems to manage these contaminated liquids.

Table 1: Troubleshooting Guide:

Sourced from the Saskatchewan Agriculture, Food, and Rural Revitalization document Composting Animal Mortalities: a Producers Guide

Problem	Probable Cause	Other Clues	Solution
Pile fails to heat	Materials too dry	Cannot squeeze water from material; moisture reading is below 20 per cent	Add water, liquid manure or wet bulking agent
	Materials too wet	Materials look and feel soggy; pile slumps; moisture reading is more than 60 per cent	Add dry bulking agent
	Slow decaying or not enough nitrogen	C:N ratio greater than 50:1; large amount of woody materials	Add more carcasses; perhaps cut or poke holes in the carcasses
	Poor pile structure or bulking agent used is too porous	Pile settles quickly while not excessively wet	Add/mix existing bulking agent with sawdust
	Cold weather and/or small pile size	Pile height less than four feet	Enlarge or combine piles; add highly degradable materials (manure)
Failure to maintain temperature Failure to decompose carcass tissues	Compost has dried out	Looks very dry; wind is blowing materials	Open pile and add water or liquid manure
	Cold weather		Ensure adequate cover with bulking agent and avoid frozen carcasses
	Too much moisture	Looks soggy; moisture reading is above 60 per cent	Add fresh bulking agent to absorb moisture

	Improper C:N ratio		Improper mix of ingredients or very old sawdust or straw
	Carcasses layered on top of each other	Carcass is intact even after two to three weeks from adding to the primary pile	Make sure 1 foot of bulking material between layers
	Carcasses placed on the outside edge of the pile.	Maintain at least 1 foot of space between carcass and outside edge of bin	
Problem	**Probable Cause**	**Other Clues**	**Solution**
Smell of decaying flesh	Inadequate cover of bulking material over the carcass		Cover the carcass with at least 1 foot of bulking material
	Extended period of low temperature		Add manure and partially cut up the carcasses and cover with 2 feet of bulking material
Pile overheating: temperature greater than 160 F (71 C)	Insufficient aeration in the bulking material over the carcass	Pile is too moist	Add drier material and mix with the moist material.
	Pile is too large	Height is greater than 7 feet	Decrease pile size
	Low moisture		Add water or liquid manure
Extremely high temperature; greater than 170 F (77 C)	Spontaneous combustion	Low moisture content; pile interior looks and/or smells charred	Decrease pile size; add water to charred or smoldering sections; break down pile
High temperatures or odours in the curing (secondary) pile	Compost is not stable		Turn and mix pile until temperature and moisture are within limits
	Pile is too large	Higher than 7 feet	Decrease pile size
	High nitrogen level		Add more bulking agent

Ammonia odours coming from pile	High pH level		Add manure
Rotten-egg odour coming from pile	Anaerobic conditions	Low pile temperatures	Add dry bulking agent and mix top layer (if in primary bin) or the whole pile (if in secondary bin)
	Materials too wet; poor pile structure; pile compacted		
Problem	**Probable Cause**	**Other Clues**	**Solution**
Run-off and/or leaching problems	Heavy rainfall		Cover the pile, make sure you have a curb on the base to catch run-off
	Too much moisture	Looks soggy; moisture reading is above 60 per cent	Add fresh bulking agent to absorb moisture
Fly problems	Inadequate cover over the carcasses	Maintain 1-foot layer on top of carcass	Maintain 1-foot layer on top of carcass
	Poor sanitation conditions		Avoid having standing water around the facility; keep the surrounding site clean and free of garbage or debris
	Moisture too high	Looks and feels soggy	Add more cover of bulking material
Scavenging animals	Inadequate cover over the carcasses		Maintain 1 foot of cover on top of the carcasses; keep gates closed at all times
Pile doesn't reheat after turning in the secondary bin	Low moisture	Cannot squeeze water from material; moisture reading is below 20 per cent	Add water and mix
	Composting near completion	Approaching expected composting time period	None required
Compost contains lumps of materials	Poor mixing of materials or insufficient	Visible raw material; lumps of compost	You should have mixed the pile in the secondary bin as

and large bones Texture is not generally uniform	mixing/ turning in the secondary bin		frequently and as thoroughly as possible
	Active composting not complete	Curing pile heats or develops odours	Increase secondary composting time or improve composting conditions