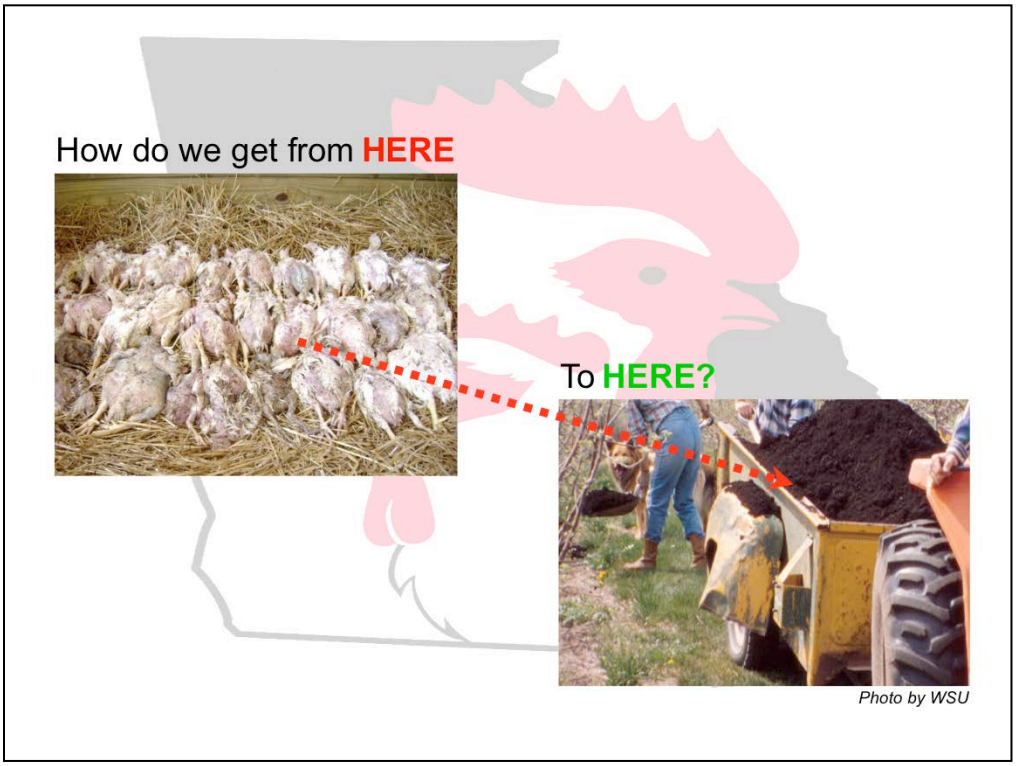
Composting 101

How to Effectively Operate a Poultry Mortality Compost Bin

Dr. C.S. Dunkley
Extension Poultry Scientist
Department of Poultry Science
The University of Georgia

THE UNIVERSITY OF GEORGIA
COOPERATIVE EXTENSION
College of Agricultural and Environmental Sciences
College of Family and Consumer Sciences



The objective of this presentation is to show the necessary steps to obtain a compost product from daily poultry mortality.

Introduction

- Composting is an ancient technology that has Roman and Biblical references and can be adapted as a means of daily mortality disposal.

- Carcass composting offers several benefits:
    1. Reduced environmental pollution
    2. Generation of a valuable end-product
    3. Destruction of many pathogens
    4. Free from unpleasant odors
    5. Easy to handle
    6. Can be stored for a long time
    7. Relatively inexpensive

Composting is an age-old practice that can be beneficial for the environment.

It is a natural process that generates a value-added end-product.

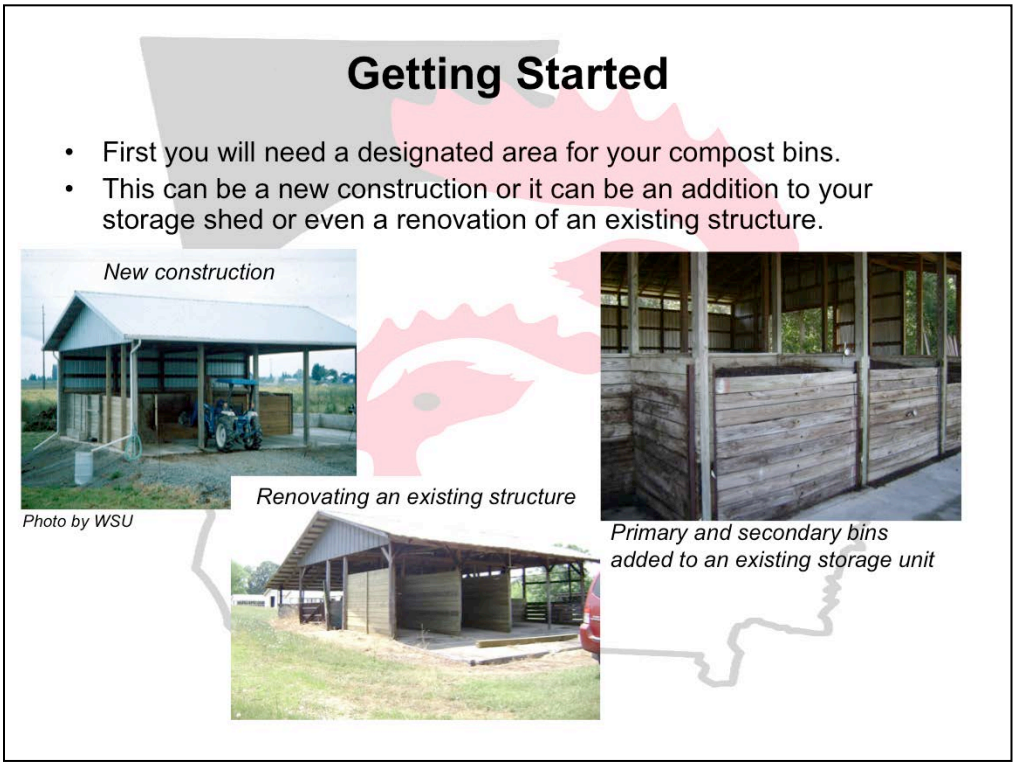
Introduction

- Composting daily mortality can be a useful, cost-effective management tool when practiced correctly. However, it can be environmentally harmful if it is not managed and monitored properly.
- This material is designed to present basic step-by-step directions on how to construct a mortality compost pile and manage it on a day-by-day basis.
- Composting is a natural biological decomposition process that takes place under aerobic (requiring oxygen) and thermophilic (high temperature) conditions.
- The composting process is achieved by providing the right mixture of carbon, nitrogen, water and air to encourage microbial growth.
- A carbon:nitrogen ratio of 25:1 to 40:1 is necessary to maintain an efficient compost pile. Moisture content of 40% to 60% should be maintained.

Bin composting is the method of composting that is discussed in this presentation. It is the most suitable method for daily mortality composting but is not feasible for mass mortality.

Bin composting is also the simplest contained composting method.

The process is carried out by heat loving micro-organisms in the presence of oxygen.



Bin composting dead birds can be done in a new construction, an addition to a stock (storage) house or a renovation to an existing farm structure.

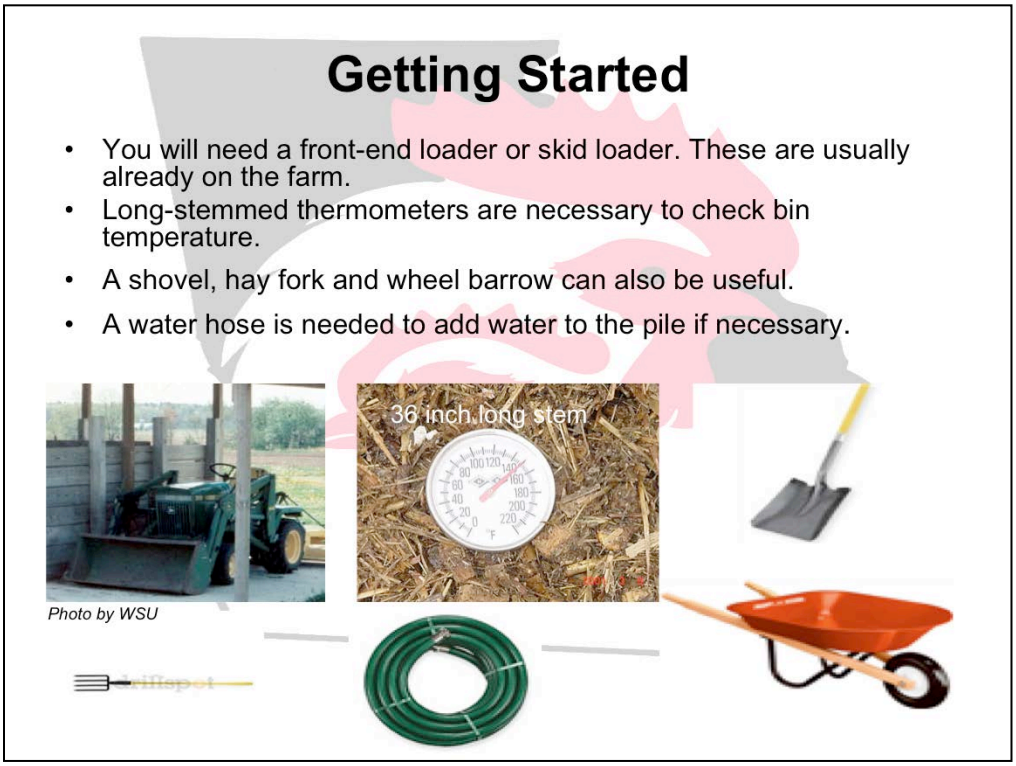
Getting Started

- Whatever you use as your structure, you should ensure that it has the following characteristics:
  - Concrete floor
  - Primary bins enclosed on three sides
  - Front wide enough to allow for a front-end loader
  - Roof
  - Space for secondary composting and material storage

Photo by WSU

Several criteria are to be considered when beginning your mortality compost.

A correctly operated compost requires a covered area with a concrete or impervious floor to prevent rain or storm water from reaching the compost.



Basic equipment is necessary for the daily operation of the compost bin.

Getting Started

- Now that we have our facilities and equipment in place, we turn our attention to the materials that will be placed in the bins.
- A carbon-based material is needed in the mix. This can be supplied by the addition of poultry litter.
- We will also need the dead birds.

Thermophillic microbial activity fuels the compost process as the multiplication of these microbes generate the heat that is necessary for the carcasses to break down. Growth of these microbes must be encouraged by providing the necessary components: carbon, oxygen and water.

Layering the Primary Bin

1. Place an initial layer of 8 to12 inches of fresh litter on the concrete floor.

2. The litter should be pre-heated by adding water and allowing time to pass so that the litter will be actively composting when it is added to the compost pile.

Pre-heating the litter will give the compost a jump start. This can be done by adding some water to the litter that will be used to layer the bin. The first layer of 8 to 12 inches of litter is necessary to absorb any leachate that may come from the decomposing carcasses.

Layering the Primary Bin

3. You can add a thin layer of bulking material such as straw, peanut hulls or coarse shavings, but it is not necessary.

4. Add bird carcasses in a single layer. Place them side-by-side and touching each other but not on top of one another. Carcasses are to be placed 6 to 10 inches from the wall. If the carcasses are placed on top each other, the deterioration process will slow down. If birds are placed too close to the walls, they will encourage pest infestation and cause a lack of carbon coverage.

The bulking material is a high carbon material that serves to aereate the pile. The pile should be aereated because the microbes involved are aerobic.

Layering the Primary Bin

5. A small amount of water may be needed after each carcass layer; typically, thoroughly wetting the carcasses will be sufficient.

6. Add a layer of litter 6 to 8 inches thick.

If the litter is too dry it will be necessary to add water to speed up the heating process.

Layering the Primary Bin

7. Repeat steps 2 through 6 until the pile reaches a height of 5 to 6 feet.

8. The last layer will be a cap of 8 to 10 inches of litter. This will help to eliminate odors and prevent flies and scavengers from invading your compost pile.

The Primary Bin

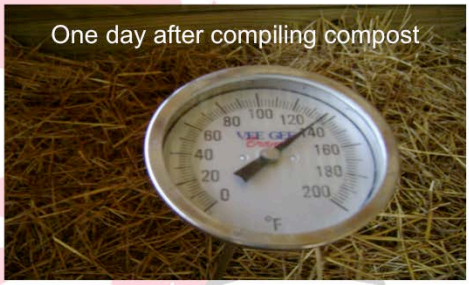
- When you have completed one primary bin you can move on to the bin next down the line. The number of bins required depends on the size of the farm. The dimensions of the bins depends on the size of the equipment available on the farm.

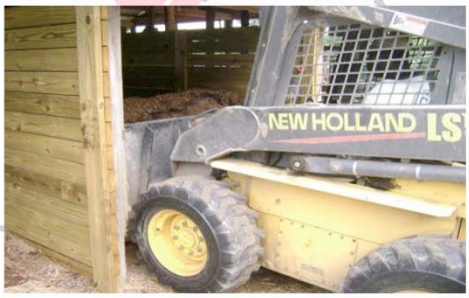
For more details about bin sizing, refer to University of Georgia Extension Bulletin 1266.

The composting process occurs in two phases: 1) Primary Phase and 2) Secondary Phase. The primary phase takes place in the primary bins and the secondary phase takes place in the secondary bin.

The Primary Phase

- Temperature should rise to ~ 140ºF <u>within</u> 5 days and remain there for at least 7 to 21 days.
- The temperature will drop gradually after the first temperature spike.
- When the temperature falls below 130ºF you will need to turn the pile for a second heating phase.





The temperature will begin to fall when the microbial activity is slowing down. The pile can begin to cool down earlier than usual for a number of reasons (see the troubleshooting section).

Secondary Phase

- The secondary bin is essentially used for additional carcass decomposition.
- This secondary phase is also referred to as the maturation or curing phase.

When the pile is turned, all the carcass may not be fully decomposed. Turning allows you to re-constitute the pile and add water so that it can re-heat.

Secondary Phase

- Transfer the pile from the primary bin to the secondary bin.
- Add water to allow the pile to undergo a second heating phase to complete the decomposition of any un-decomposed material that might remain.

Secondary Phase

- The temperature will quickly elevate again to 140ºF or more, after which it will begin a gradual downward trend.

Monitoring Your Bins

- In order to have an efficient compost bin, it must be monitored frequently, especially during the primary phase of the process.
- Temperature, moisture content and time are all essential when managing and monitoring your compost bin.

Proper management of the compost pile is essential in order for it to operate effectively. Monitoring the bins is an important management tool.

Temperature

- Temperature is **Very Critical,** especially in the primary phase.
  - The decomposition process at thermophilic temperatures of 105 to 160ºF is faster than at mesophilic temperatures of 50 to 105ºF.
  - If the temperature exceeds **149ºF** for more than two days, the pile should be turned to prevent thermal inactivation of important microbes.

Note: High temperatures *are* beneficial for rapid decomposition, but temperatures that are *too high* can inactivate beneficial microbes!

The temperature should be checked regularly to ensure that it is at the required levels.

Temperature

Extreme temperatures (more than 160ºF) lasting for more than two days have been shown to spontaneously combust and result in fires in litter piles.

High temperatures in the compost piles will destroy microbes.

Extremely high temperatures that last for too long can also destroy the heat-loving microbes that are necessary for the compost pile to operate effectively.

Apart from the destruction of thermophilic microbes from extreme temperatures, temperatures that are too high for too long can cause fires.

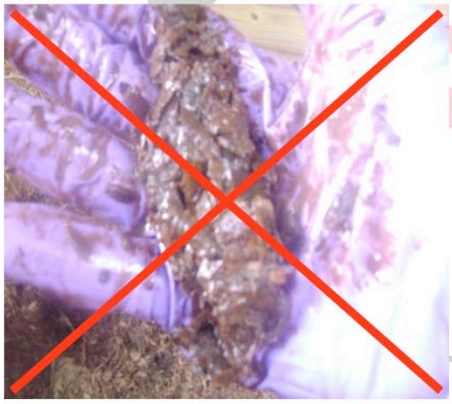
Moisture

- Excess moisture in the pile will result in a compost pile that does not heat up, reduction in the oxygen content of the pile and retardation of growth and activities of some of the beneficial microbes.
- Excess moisture will also result in the pile becoming anaerobic and giving off unpleasant odors.
- Too little moisture will also prevent the pile from heating up and will delay the decomposition process.

The microbes need moisture to survive. The right balance must be met; that is, it must not be too wet and it must not be too dry. When the pile becomes too wet, the microbial environment becomes suitable for anaerobic microbes, which will result in the production of offensive odors.

Moisture

- When squeezed into a ball, compost with the appropriate moisture content will not drip water and will loosely hold its shape when released.



Taking a handful of material from the pile is a simple way to test the moisture content.

When squeezed into a ball, the compost material should loosely hold its shape.

If it drips, it is too moist and more carbon material should be added to reduce the moisture content in the pile.

If the ball does not keep its shape the pile is too dry, water should be added to increase the moisture content in the pile.

Time

- The time that is required to complete the composting process depends on several factors:
  - Temperature profile achieved
  - Compost formulation
  - Size and weight of carcasses
  - Warm climate versus cold climate
  - Mixing and aeration
  - Pre-heating the litter
- Murphy and Carr (1991) reported that "composting broiler carcasses required two consecutive seven-day periods to reduce carcasses to bony residues." Again, this is dependent on the previously mentioned factors.

There is no fixed time that can be determined for carcasses to decompose.

Preheating the litter before it is added to the pile will help to speed up the process.

Time

- The end of the secondary phase is marked by:
  - Internal temperature of 77 to 86ºF
  - Reduction in bulk density of about 25%
  - Product color is dark brown to black
  - Lack of unpleasant odor at turning

Photo by WSU

The end product of the process is about 25% less than was started out with and can be easily stored until it is to be used.

Troubleshooting

- When operating a composter it is always good to be aware of the problems that one can encounter and the possible suggestions that can help to alleviate these problems.
- On the following slides we will address some of the most common problems, their causes and solutions.

1. Improper Temperature

Probable Cause	Suggestions
1. Too dry.	1. Add water.
2. Too wet.	2. Add bulking material and turn the pile.
3. Improper mixing of ingredients.	3. Layer ingredients appropriately.
4. Improper C:N ratio.	4. Evaluate bulking material and adjust as necessary.

Remember to check temperatures regularly!

If you are unsure of the moisture content of the pile, do the moisture check by squeezing a handful of the pile in your hand.

If the ball drips, the pile is too wet.

If the ball falls apart without keeping its shape, the pile is too dry.

If the ball loosely keeps its shape, the moisture content is just right.

2. Failure to Decompose

Probable Cause	Suggestions
1. Improper C:N ratio.	1. Evaluate bulking materials and adjust as necessary.
2. Carcasses layered too thickly.	2. Single layer the carcasses.
3. Carcasses on outside edges of the pile.	3. Maintain 6 to 10 inches between carcasses and the edges of the pile.

The C:N ratio should range from 25:1 to 40:1.

3. Odor

Probable Cause	Suggestions
1. Too wet.	1. Add bulking material and turn.
2. Improper C:N ratio.	2. Evaluate bulking materials and adjust as necessary.
3. Inadequate cover over carcasses.	3. Cover (cap off) with 8 to 10 inches of bulking material.

If you are smelling the pile, something is wrong.

4. Flies

Probable Cause

1. Inadequate cover over carcasses.
2. Too wet (leaching).
3. Failure to reach proper temperature.

Suggestions

1. Cover (cap off) with 10 to 12 inches of bulking material.
2. Turn pile and add bulking material.
3. Assess C:N ratio and layering.

5. Scavenging Animals

Probable Cause

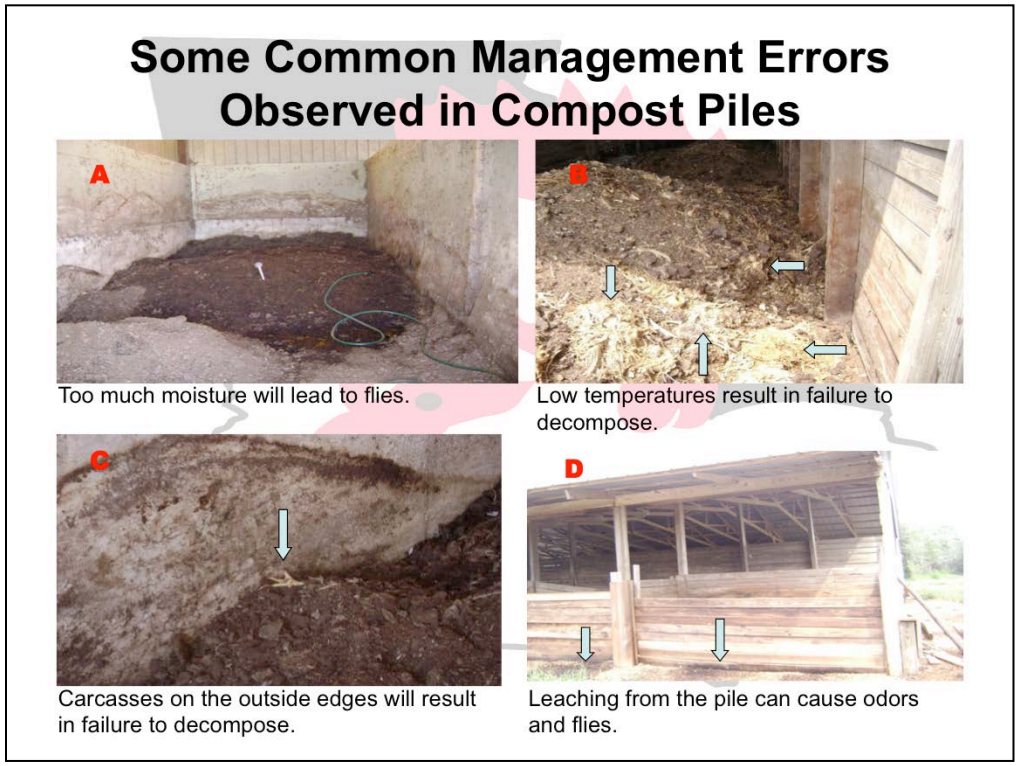
1. Inadequate cover over carcasses.

Suggestions

1. Cover (cap off) with 8 to 10 inches of bulking material. Avoid initial entry with a fence or barrier.

If scavengers are hanging around the pit, something is wrong.

It is also helpful to secure your premises from rodents and other scavengers that may be attracted to your farm.



A- The desirable moisture level in the pit should be 40 to 60%. If the moisture content is higher, it will result in low pile temperatures.

B- Low moisture levels and improper use of carbon sources will result in failure to decompose.

C- The walls and floors of the compost pit act as a heat sink and will pull the heat from the carcasses, slowing down the decomposition process.

D- It is important to make the first layer 8 to 12 inches thick to absorb the leachate generated from the decomposition process.

References

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- C.W. Ritz and J.W. Worley. Poultry Mortality Composting Management Guide. 2005. University of Georgia Extension Bulletin 1266.
- USDA – United States Department of Agriculture
- WSU – Washington State University

* Unmarked photographs provided by author.

Additional information on composting poultry mortality can be obtained at:
www.poultry.uga.edu/extension

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