

Composting Dead Poultry

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Introduction

An acceptable system of disposal for dead birds is essential to any well run poultry farm operation. Moreover, Virginia law requires that poultry producers have an approved means for disposing of dead birds. There are generally two categories of disposal problems: (1) Normal mortality, which is typically about 0.1 percent per day, but fluctuations up to 0.25 percent per day are not uncommon, and (2) Whole flock disposal.

Research at the University of Maryland, and field application in other poultry states, have shown that normal mortality can be handled efficiently and safely by composting dead poultry. Composting is a natural process in which beneficial organisms--bacteria and fungi--reduce and transform organic wastes into a useful end product--compost--which can be used as a fertilizer and soil amendment. Although simple in concept and design, dead poultry composters require attention to detail and careful management. Effective July 1, 1992 properly constructed and properly managed dead bird composters are an acceptable method of handling normal flock mortality in Virginia.

Composting is not recommended for whole flock disposal cases. Such cases require special permission and supervision from the Virginia State Veterinarian's Office.

Principles of Composting

Composting is a controlled biological decomposition process that converts organic matter to a stable, humus-like product. The process depends upon microorganisms which utilize decomposable organic waste both as an energy and food source. The composting process converts a material with potential odor and other nuisance problems into a stabilized product that is reasonably odor and pathogen free, and which is a poor

breeding substrate for flies and other insects. In addition, the volume and weight of the composted product is less than that of the original raw waste because composting converts much of the carbonaceous material to gaseous carbon dioxide. Heat generated during the process destroys pathogenic organisms and weed seeds that might be present in the raw waste, and helps to drive off moisture. In turn, because of the reduced volume and weight, hauling and spreading costs are less than that required for the raw wastes. The "controlled" nature of composting distinguishes it from other natural processes such as rotting and putrefaction.

Chemical and physical properties of the raw wastes affect the rate of composting. Particle size and surface area of the waste material influence the type of microorganisms involved and the degree of biological activity in the composting process. For this reason, smaller carcasses, or those which have been slit or ground, usually compost more easily than large, whole carcasses.

Moisture content will largely determine whether the process will be "anaerobic" (without oxygen) or "aerobic" (with oxygen). For dead bird disposal, aerobic systems are preferred because they are faster and produce fewer odors and other objectionable features. Ideal moisture content for aerobic composting is about 60 percent. At a 70 percent moisture content, the process begins to go anaerobic. A moisture content of 50 percent or below will slow down the composting process. High moisture level can be controlled when working with a wet waste by using a little extra straw, litter, or other bulking agent. Low moisture contents are increased by sprinkling the pile with a measured amount of water.

The carbon:nitrogen ratio (C:N) also affects the rate of biological activity. Carbon:nitrogen ratios of 15:1 to 35:1 are acceptable. If the C:N ratio is less than 25:1, organisms cannot utilize all of the nitrogen available, and nitrogen is then lost as ammonia. This, in turn,

results in an unpleasant odor, possible air pollution, and loss of potential fertilizer value. When the C:N ratio exceeds 30:1, the rate of composting decreases. Inorganic nitrogen such as urea or ammonium nitrate can be mixed with the carbonaceous material to lower the C:N ratio to 30:1, or below.

Temperature is a good indicator of biological activity in the compost pile, and is easily measured. Moisture content, oxygen availability, and microbial activity all influence temperature. Two or three days after wastes are mixed and placed in piles, thermophilic microbes should begin to dominate. These organisms prefer a temperature of 100 degrees F to 150 degrees F. As conditions in the pile change, for example, due to an unfavorable moisture content, change in the C:N ratio, or decreasing oxygen supply, the temperature may drop and the microbial population will shift back to a regime of lower temperature microbes.

As long as the pile temperature is increasing, it is functioning well and should be left alone. As the temperature peaks, and then begins to decrease, the pile should be turned to incorporate oxygen into the compost. After turning, the pile should respond to the mixing and incorporation of oxygen, and temperature should again cycle upwards. Ideally, the turning process should be continued until the reheating response does not occur again, indicating that the compost material is biologically stable.

Poultry Composter Design

Composter size is based on farm capacity, overall bird market weight at the end of a production cycle, and projected normal mortality. Disposal requirements are estimated using the following equation:

Peak disposal requirement, lbs. = Farm capacity (number) x Market Wt. (lbs) x M where M = [Percent average daily mortality / 100]

For most Virginia conditions, the average M = 0.0012.

The required primary composting capacity, number of bins, and their configuration are determined by the following rules:

1. Primary (first stage) composting capacity (cubic feet) will be the same number as the disposal requirement (pounds per day) although the units of measure will be different.

2. Provide one cubic foot of secondary (second stage) bin capacity for each pound of disposal requirement.
3. Height of primary and secondary bins should be 5 feet.
4. Width of primary and secondary bins should conform to width of manure handling equipment, but should not exceed 8 feet.
5. Horizontal depth of primary bins should not exceed 6 feet.
6. Generally, many smaller primary bins work more effectively than fewer large bins.
7. Always provide a minimum of two primary bins.
8. Secondary capacity may be as adjoining companions to the primary bins, or more commonly, may be a larger common stacking area. Often growers use a portion of their litter storage structure for secondary composting.

Example: What capacity of first-stage composter bins is required for a grower with a 100,000-head capacity farm with a bird market weight of 4.2 pounds? How many primary bins are required (to match a 5-foot wide bucket loader)? Remember, bins will need to be a little wider than the loader bucket. How much secondary bin capacity will be required?

Peak disposal requirement, lbs. = Primary capacity, cubic feet = Farm capacity x Market Wt. x 0.0012
 = 100,000 x 4.2 x 0.0012

Primary capacity = 504 cubic feet

Primary bin size = 5 ft. high x 6 ft. wide x 6 ft. deep (6 ft. width selected to accommodate the 5 ft. bucket width) = 180 cubic feet

Number of Primary bins = 504 cubic feet / 180 cubic feet = 2.8, so use 3 bins

Secondary bin capacity: Should equal the daily primary disposal requirement. Width of bin should accommodate equipment on this farm, a 6 ft. width should be adequate. Vertical depth should be no more than 5 feet.

Secondary bin length (min.) = 504 / (5 x 6) = 16.8 ft.

Total secondary bin size (min.) = 16.8 ft. x 6 ft. x 5 ft. = 504 ft.³

Since the secondary bin may be located behind the three primary bins (similar to Figure 1), total secondary bin length may be 18 ft.

Key Construction Features

Composter design can vary considerably and still work well. However, experience indicates that certain features are common to all good composters.

Roof: Some materials are composted outside. However, this is not recommended for dead bird composters. A roof ensures all-weather operation and helps control rain, snow, runoff, and percolation, which can be major concerns.

Floor: A concrete floor is recommended to assure all-weather operation, and to secure the composter against rodents, dogs, and other nuisances. An impervious floor also will help dispel questions about contamination of the groundwater and other surrounding areas. An optional concrete apron, sloped away from the primary bins, is recommended. This provides an all-weather surface for equipment and operation.

Building Materials: Specify preservative pressure-treated lumber or other rot-resistant materials which resist the biological activity of composting. Use hot-dipped galvanized nails which resist rusting.

Access to primary bins: A method is needed to enclose and confine the compost mixture, but allow access with a bucket loader for efficient handling with farm equipment. One technique that works well is to construct channels on the sides of front bin posts using angle iron or wood cleats. Treated boards can then be slipped into the channels to form a front wall, or "gate," as layers are stacked in the bin. Conversely, the boards can be removed after the composting is completed to give access to the bin with a bucket loader.

Several different approaches can be taken in designing good dead bird composters. Figure 1, Figure 2, and Figure 3 show practical field applications.

Composter Operation

Experience in Maryland, Virginia, and elsewhere has shown that a simple mixture of poultry litter or cake; straw, hay, or peanut hulls; and dead birds will allow the naturally occurring microbes to begin to work and produce an inoffensive and useful compost. It will be important to assure proper moisture levels to promote growth of aerobic bacteria and fungi.

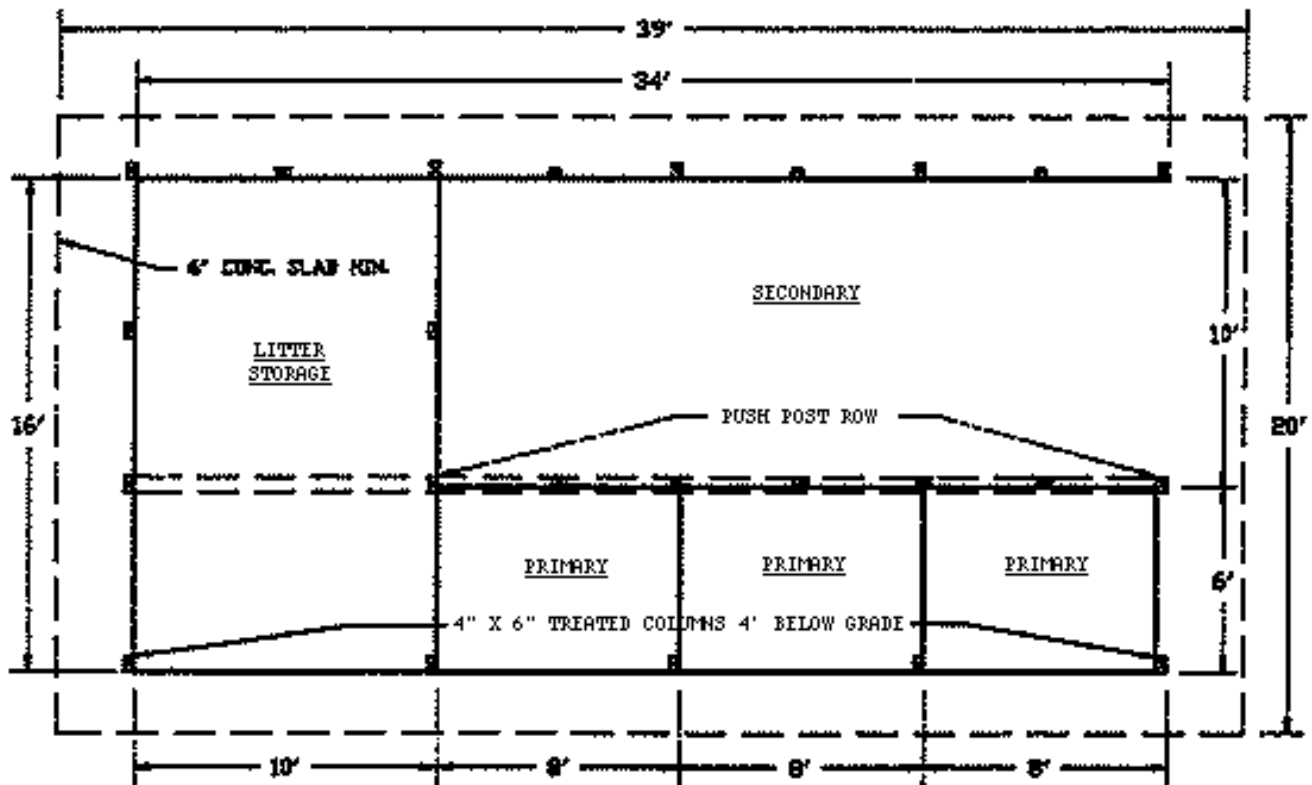


Figure 1: Typical layout which combines litter storage with primary and secondary treatment bins.

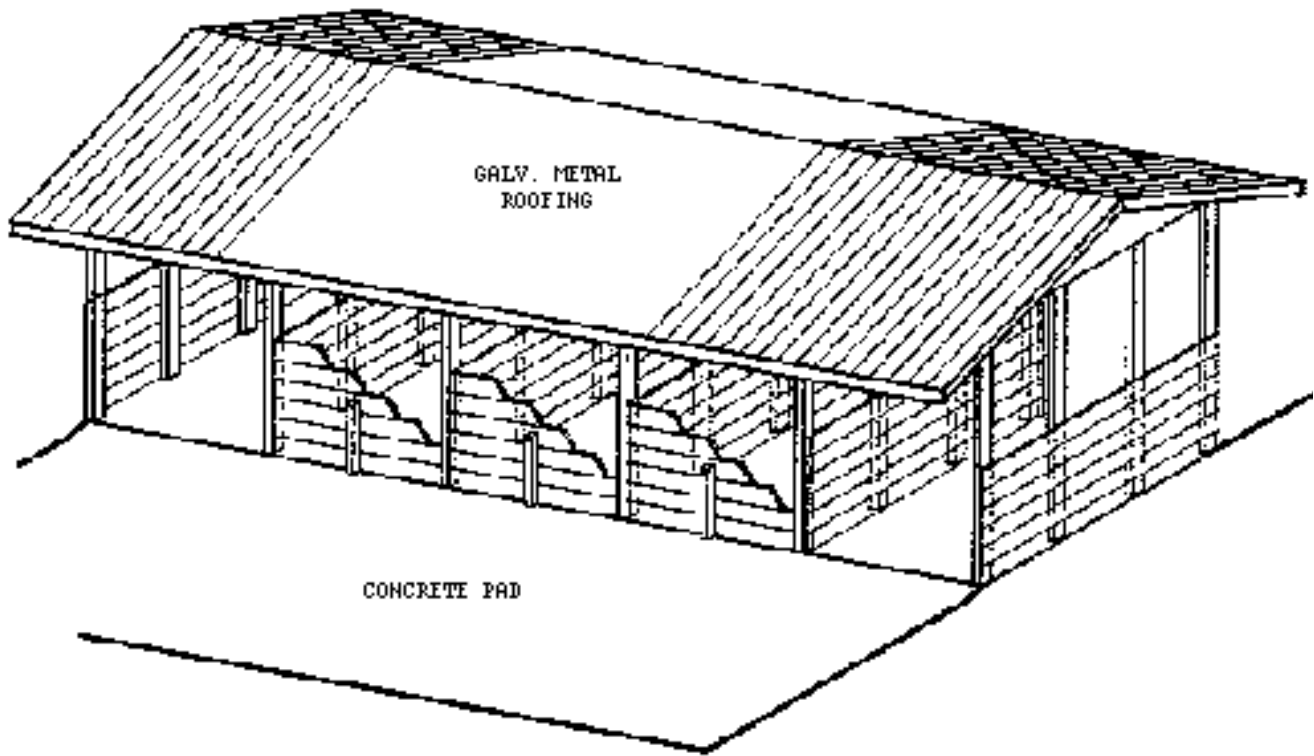


Figure 2: Free-standing, two-stage dead bird composter.

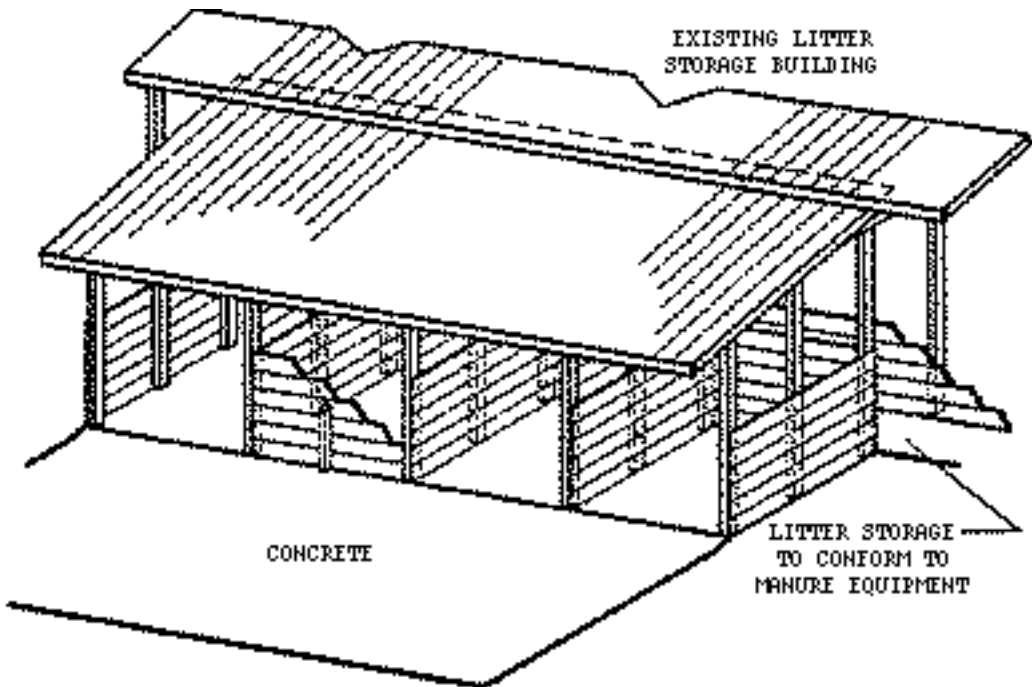


Figure 3: Two-stage composter shown as a lean-to structure on the side of litter storage building.

A recommended “recipe for composting dead birds is shown in Table 1. The first few days of operating a new composter will take more time than after routine procedure is learned. Normal daily operation of a bird composter designed to handle 1050 pounds per day is about 20 minutes. This includes loading primary bins, monitoring temperatures, and moving compost.

Determine the weight of a day’s supply of dead birds. Ingredients can be weighed out according to the recipe, weighing them in buckets on scales at first, then using a loader once the weight of a full loader bucket is determined for each ingredient. Depending upon needs - mortality and bird weight - you may add partial layers, full layers, or entirely fill primary compost bins. Ideally, composter bins should be sized so that an average day’s mortality will equal one layer of dead birds. Each successive day the birds should be layered in the bin (Figure 4) with other elements added: straw, birds, litter. Water may or may not be necessary. Use water sparingly at first since, H piles are too wet, oxygen will be excluded and anaerobic conditions will develop, resulting in heating failure and high odor production. This condition can be remedied by turning the piles while adding additional dry litter.

Within two to four days of loading, internal bin temperature should increase to 135 to 150 degrees F. A 36 inch probe-type thermometer should be used to daily monitor temperature in bins or piles. As dead birds accumulate, successive primary bins should be loaded. When the last available bin is filled, the first should have undergone 7 to 10 days of composting and reduction, and will be ready for secondary treatment. As a

Table 1. Typical recipe for composting dead poultry

Ingredient	Parts by Weight
Caked litter or manure	1.5 to 3
Dead birds	1
Straw*	0.1
Water (added sparingly)**	0 to 0.5

* Other carbon sources may also be used such as peanut hulls, sawdust, or shredded cellulose paper. However, straw has been shown to be an excellent material for this purpose.

** The requirement for water will vary depending on moisture content of straw, litter, and other factors. Too little moisture or too much moisture may adversely affect composting. The mixture should be damp, in the range of 40-60 percent moisture. If moisture is required, it should be added to each element during the layering process while building the compost stack.

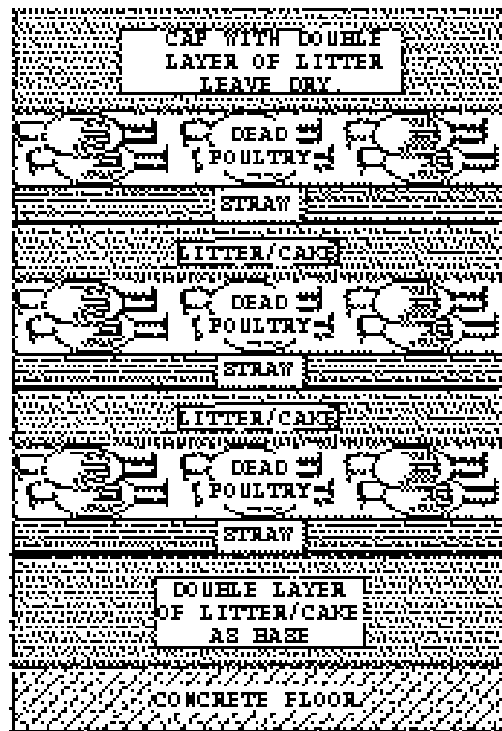


Figure 4: Layering arrangement for loading primary composting bins.

check, temperature in this bin should have peaked, and begun to fall. Material from this bin should be loaded into a secondary treatment bin (or stacking area) using the loader bucket. Allow material to “cascade” from the loader bucket to provide good turning and re-aeration as it is deposited in the secondary treatment area. If primary composting material is not moved on schedule, odors and fly breeding are likely to occur.

As birds near market weight, filling a primary bin in two or three days may be common. At this higher loading rate, the bottom of the bin may heat normally, followed by rapidly declining temperature. This will likely be caused by compaction and oxygen exclusion from the rapidly accumulating layers. Avoid this problem by loading two bins on alternate days to help prevent compaction, and to allow bin temperatures to be maintained longer.

Fly and Pathogen Control

Good facility design, construction, and containment, and strict adherence to two-stage operation is essential to control pathogenic organisms and nuisance insects. By keeping all material within the bins, fly larvae and pathogenic bacteria and viruses are destroyed through the combined effects of time and composting temperature. However, the effective temperatures are not usu-

ally achieved around the edges of primary bins. For this reason, disease organisms and insect larvae may survive without effects of turning and mixing in the secondary compost phase. Careless loading of carcasses against bin sidewalls generally will result in putrefaction and poor composting. To prevent these problems, do not place carcasses closer than 6 inches to sidewalls or the top surface to allow composting temperatures to “work.”

Dead Bird Compost as Fertilizer and Soil Conditioner

Compost will be highly variable in nutrient content depending upon the amount and composition of the manure and straw used, the age of the compost, and storage and handling. Dead bird compost samples analyzed at the University of Maryland had an average analysis as shown in Table 2. Because of its variability, compost should be tested like other agricultural organic wastes to assure best utilization. Dead bird compost should equal, and probably exceed, fertilizer quality of most other composted materials.

Summary

Composting offers a convenient and environmentally acceptable method of disposal of normal poultry flock mortality. Careful attention to daily management will

Table 2. Composition of dead poultry compost*

Analysis	Amount
Moisture, percent	46.10 +/- 2.19
Nitrogen, percent	2.20 +/- 0.19
Phosphorus (P ₂ O ₅), percent	3.27 +/- 0.23
Potash (K ₂ O), percent	2.39 +/- 0.13
Calcium, percent	1.33 +/- 0.15
Magnesium, percent	0.82 +/- 0.10
Sulfur, percent	0.40 +/- 0.02
Manganese, parts per million	122.00 +/- 18.00
Zinc, parts per million	245.00 +/- 32.00
Copper, parts per million	197.00 +/- 28.00

* University of Maryland, 1991.

assure that all carcass tissue is exposed to the essential composting processes of heat and time. Disease and insect problems are minimal, and ground or surface water contamination as a direct result of composting are practically nil. The composting process stabilizes ingredients to a useful organic fertilizer that will not attract flies, rodents, or dogs.

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