MARYLAND COOPERATIVE EXTENSION
UNIVERSITY OF MARYLAND
COLLEGE PARK•EASTERN SHORE

Fact Sheet

Fact Sheet 537

Composting Dead Birds

Increasing size and concentration of production is a long-established and continuing trend in the broiler industry. Delmarva broiler farms average 50,000 head and range in size up to 400,000 head. Inevitably mortality occurs in broiler farms. The disposal of these dead birds poses a biological and environmental problem.

Poultry producers use any of several traditional methods to dispose of dead birds. These methods are not always economical, and their biological and environmental implications are questionable. Since 1985, the Department of Poultry Science at the University of Maryland at College Park has been studying the merits of composting as a way to dispose of dead birds.

Disposal Requirements

Any dead-bird disposal method should be able to accommodate the normal percentage of mortality for market-aged birds. The normal mortality rate of broilers is 0.1 percent per day, but daily fluctuations in mortality rates of up to 0.25 percent are not uncommon. The following formula demonstrates a method of estimating peak dead-bird disposal requirements in birds of market age and weight:

$$\text{Pounds per day} = \frac{\text{Theoretical farm live weight}}{400}$$

$$\text{Pounds per day} = \frac{\text{Farm capacity x market weight}}{400}$$

$$\text{Pounds per day} = \frac{100{,}000 \text{ x } 4.5}{400}$$

$$\text{Pounds per day} = 1{,}125$$

Similarly, a 50,000-head farm growing 4-pound birds would have a disposal capacity requirement of 500 pounds per day.

What Is Composting?

Composting converts nitrogenous materials (for example, manure and birds) and carboniferous materials (for example, cellulose paper, straw stover and sawdust) into humic acids, bacterial biomass and organic residue (compost), with the action of aerobic, thermophilic, gram-positive, spore-forming bacilli (for example, Bacillus spp.). In the process, heat, carbon dioxide (CO_2) and water vapor are generated as byproducts (Table 1).

Table 1. A compost recipe that satisfies the nutritional requirements for compost bacteria (1,000-pound batch)[*]

Ingredient	Volume proportion	Weight proportion	Pounds	Percentage	Percentage of moisture	C:N ratio
Manure	2.0	1.5	1,500	57.7	30	25
Dead birds	1.0	1.0	1,000	38.5	70	5
Straw	1.0	0.1	100	3.8	10	85
	Total		2,600	100		
	Weighted average				44.6	19.6

[a] Sussman, V. 1984. **Easy Composting.** Rodale Press; Emmaus, Pennsylvania.

Like other aerobicaily respirating life-forms, compost bacteria have certain needs. These are:

- Oxygen (in 25 to 30 percent free airspace);
- Nutrients, in certain proportions and in adequate amounts (for example, 15 to 35 parts carbon to 1 part nitrogen);
- Water (about 45 to 55 percent moisture);
- Bulk (mass retains heat and maintains optimal thermal environments for respiration--around 140° F); and
- Time (rates of bacterial respiration vary with the requirements listed above). Two consecutive 7-day periods are required to reduce broiler carcasses to bony residues. Compost continues to react and stabilize for extended periods when stored 6 months or more.

Caution: If composts fail to heat up or are malodorous, it is usually because the piles are too wet. Saturated piles quickly become anaerobic, excluding needed oxygen. Wet composts can easily be corrected, however, by turning them over and by adding more manure.

What Are the Advantages of Composting?

Composting is a fairly odorless and biologically sound practice. The typical temperatures generated (around 150°F) in composted matter destroy pathogenic bacteria and viruses and exceed the human waste treatment requirements of the Environmental Protection Agency (130°F x 15 days). It produces a useful and inoffensive product which may be field-applied, with manure or separately, as a specialty soil amendment and fertilizer.

Composting is simple and inexpensive. The materials needed are readily available to the broiler producer (manure, dead birds, straw or an alternative carbon source, and water).

How Do You Design a Composter?

Here are some easy guidelines to help you design your own poultry farm composter.

First, determine the maximum daily disposal requirement of the farm in pounds per day.

Pounds per day = <u>Farm live weight at market age</u>

$$400$$

$$\text{Pounds per day} = \frac{93{,}333 \text{ birds} \times 4.5 \text{ pounds}}{400}$$

$$\text{Pounds per day} = 1{,}050$$

Then, determine the size, number and configuration of your primary composting boxes.

1. The primary capacity (cubic feet) should equal the requirement (pounds per day).
2. The primary and secondary bins should be 5 feet high.
3. The width of the primary and secondary bins should be determined by the width of your manure-handling equipment, but should not exceed 8 feet.
4. The depth of primary bins should not exceed 6 feet.
5. Smaller primary bins work more efficiently than larger bins. The more small primary bins you have, the more efficient your composting operation will be.

Example: A disposal system designed to dispose of 1,050 pounds of dead birds per day.

A width of 7 feet and a length of 5 feet (with a height of 5 feet) can accommodate the equipment on this farm.

The number of primary treatment boxes needed is:

$$= \frac{\text{Primary capacity}}{\text{L x W x H of a primary box}}$$

$$= \frac{1{,}050}{175}$$

$$= 6 \text{ primary treatment boxes}$$

The 6 boxes can be arranged in any of several configurations to suit the needs of a particular situation.

Next, determine the size and shape of your secondary treatment box(es).

If width and height are to be 7 feet and 5 feet, respectively, and total capacity equals the daily disposal requirement (1,050 ft^3), then

$$\text{Length} = \frac{1{,}050}{7 \times 5} = 30$$

The calculations shown can be applied to broiler farms of varying sizes and types of birds. The general rule for design is to build 1 cubic foot of primary capacity and 1 cubic foot of secondary capacity for each pound of dead birds.

Figure 1 illustrates the basic unit of the dead-bird corn-poster. Figures 2 and 3 illustrate two multicompartmentalized practical applications of the design.

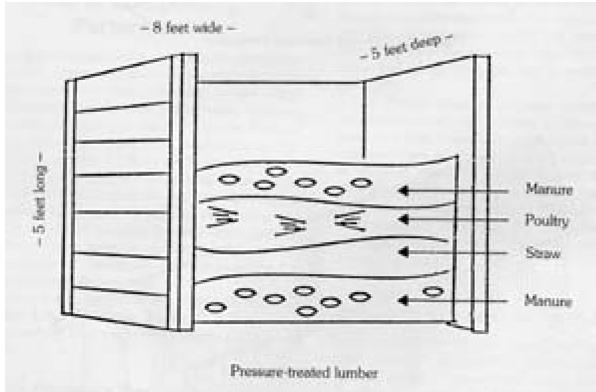

Figure 1. A simple poultry composter.

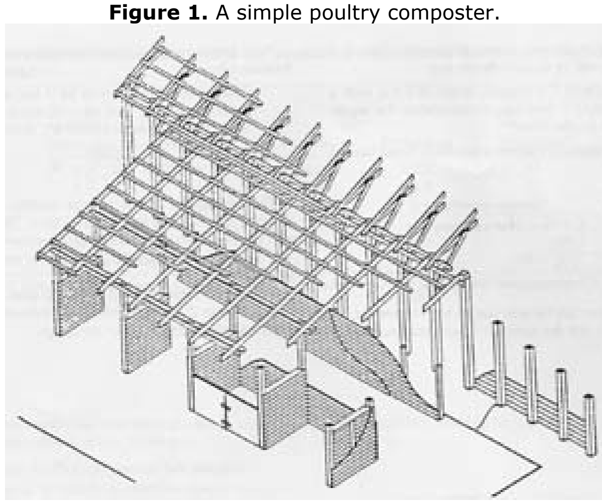

Figure 2. Delaware two-stage composter.

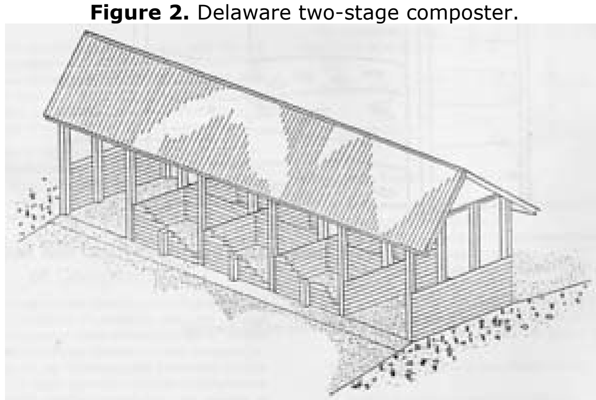

Figure 3. Maryland free-standing, two-stage composter.

Essential Construction Features

Composters can vary considerably and yet do a good job. All good composters have certain features in common, such as:

- **Roof.** While composting of some materials may be done in the open, this does not work well with dead-bird composts. A roof ensures year-round operation and controls rainwater and percolation, which can be major problems.
- **An impervious, weight-bearing foundation, such as concrete.** Again, this is critical to a year-round, all-weather operation. It secures the composter against rodents, dogs and other intruders. It also prevents contamination of the area surrounding the composter.
- Rot-resistant building materials. Pressure-treated lumber resists the biological activity of composting. When ordering materials, specify that you need pressure-treated lumber or a similar material.

How Is Composting Performed?

Disposal operations consist of adding the correct volumes of birds, manure and straw (or a similar substance) to a primary compost box. Depending on bird weight to be disposed of, you may add partial layers, full layers or full boxes of compost to the primary box. Within 2 to 4 days of loading, temperatures should increase rapidly and reach peaks of 135 to 150°F. As mortality increases, start loading successive primary boxes. When the last primary box is filled, the first one normally will have undergone at least 10 days of composting and reduction and will be ready for the secondary treatment box. After a flock is moved to market, continue turning and moving primary boxes into secondary treatment to prevent odors and fly breeding.

The normal daily operation of a composter designed to handle 1,050 pounds a day is 20 minutes. This includes loading, monitoring temperatures and moving compost.

Fly and Pathogen Control in Dead-Bird Composts

Containment and a two-stage operation of composting are essential to controlling pathogenic microorganisms and nuisance insects.

Fly larvae and pathogenic bacteria and viruses are destroyed through the combined effects of time and temperature in composting. Figure 4 describes the two-stage method which produces temperatures in excess of 130°F, and these elevated temperatures tend to persist for prolonged periods.

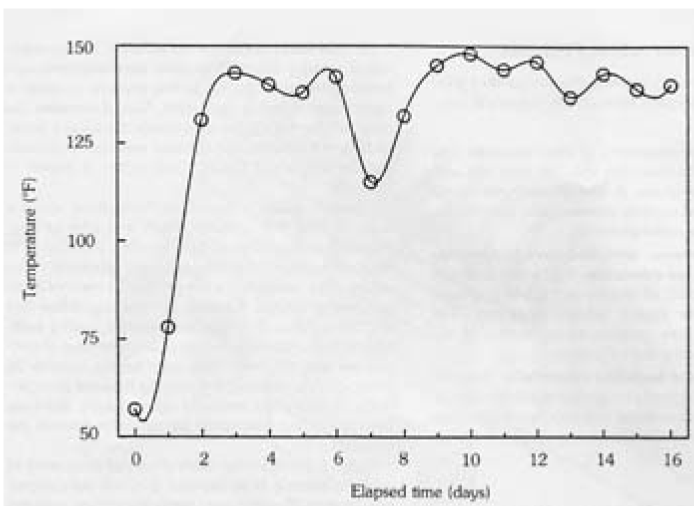

Figure 4. Heating process in typical two-stage dead-bird compost.[a] [b]

[a] Start date 4/20/89.
[b] Straw carbon source.
C:N ratio (approx. 18:1)

Biocidal temperatures are not achieved in the periphery of primary boxes. Pathogenic microorganisms and insect larvae may survive unless primary compost is turned and mixed at least once. Also, if carcasses are carelessly loaded against the sidewalls, the result is putrefaction, not reduction, of compost material. To prevent putrefaction, avoid placing birds within 6 inches of sidewalls.

Figure 5 shows temperature distributions within a mass of dead-bird compost before and after turning. Although temperatures of approximately 150°F occur in most of a Stage I mass, temperature gradients at the edges of the compost box are evident. These cool areas may permit survival, pupation and hatching of flesh flies and the survival of certain heat-resistant poultry pathogens. The temperature profiles of the same mass of compost are repeated immediately upon turning and after 24 hours. Mixing, aerating and moving material from primary to secondary treatment will uniformly distribute bactericidal and insecticidal temperatures through the compost mass.

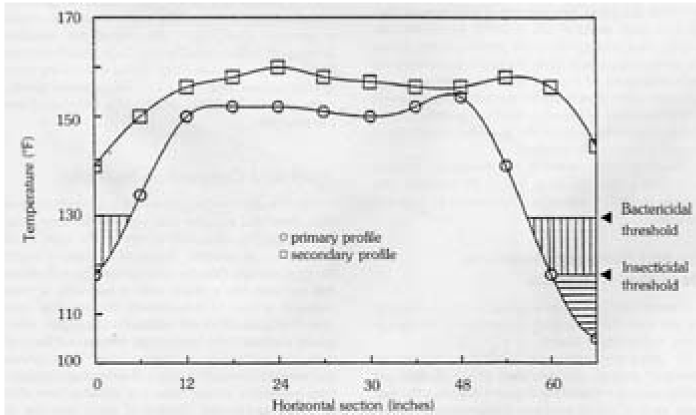

Figure 5. Heating process in Stage I and Stage II compost.

Figure 6 illustrates the distribution and occurrence of coliform bacteria in an exposed 6-month-old compost pile. Beyond 20 centimeters below the surface, coliform bacteria cannot be recovered. Core temperatures within this pile are maintained at 120°F+ over the winter. Measuring the active and aging dead-bird compost confirms that composting has the potential to control pathogens.

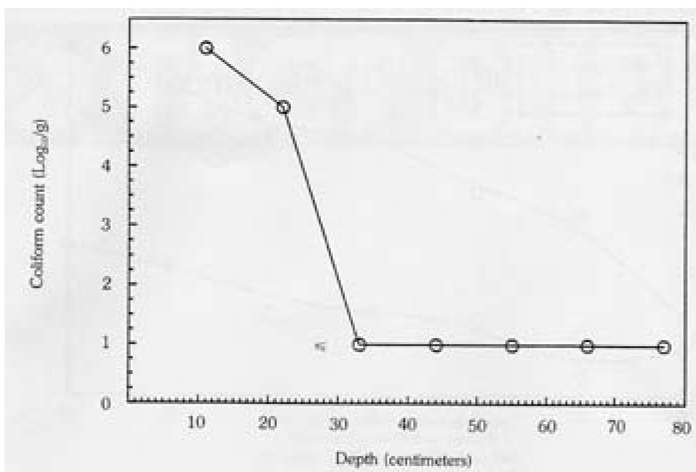

Figure 6. Survival and distribution of colifonn bacteria in aged dead-bird composts.

The Virginia-Maryland Regional College of Veterinary Medicine and the University of Delaware's Department of Animal Science and Agricultural Biochemistry completed two studies of the effect of heat on viruses in compost piles. The results showed the complete destruction of Newcastle Virus in Stage I and Infectious Bursal Disease Virus in Stage II (Table 2) of the composting process when experimentally infected specific pathogen-free (SPAFAS) chicks were introduced into compost piles.

Dead-Bird Compost as Fertilizer

Table 3 compares the nutrients of deep-stacked caked litter, dead-bird compost and built-up (12-flock) litter. The composting process does change the form, if not the content, of nitrogen. Elution of manure, cake and compost nitrogen through soil columns (Figure 7) shows that compost has a slower and, presumably, a more sustained release of (mineralized) nitrogen than does litter. This is consistent with utilization of inorganic nitrogen by bacteria in the composting process and the conversion of nitrogen to an organic form. The nutrients and humus in compost, and its soil-amending and plant-food properties, should make it a valuable byproduct of broiler production. Studies of plant response to graded levels of compost, manure and inorganic nitrogen are continuing at this time.

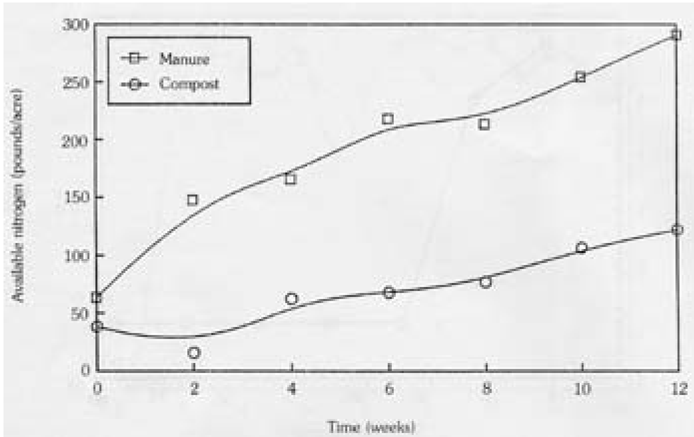

Figure 7. Nitrogen mineralization patterns for loamy sand amended with poultry compost and manure.

Table 2. Summary of virus isolations obtained from compost and composted bird samples[a]

Sample identification	Area sampled		
	Neck	Bursa	Other
Positive control	2/4[b] (NDV)[c]	4/4 (IBDV)[d]	--
11 days (primary)	0/8	2/8 (IBDV)	--
18 days (secondary)	Not tested	0/7	--
Compost 3/2/89	--	--	0/3

[a] Personal communication from J. Rosenberger, Department of Animal Sciences and Agricultural Biochemistry, University of Delaware, 1989.

[b] Number of samples containing viable virus over the total number assayed.

[c] Newcastle Virus.

[d] Infectious Bursal Disease Virus.

Table 3. Nutrients in manure and compost

Analysis	Builtup litter	Dead bird compost
Moisture, percentage	21.00	46.10 ± 2.19
Nitrogen, percentage	4.15	2.20 ± 0.19
Phosphorus (P_2O_5), percentage	3.80	3.27 ± 0.23
Potash (K_2O), percentage	2.85	2.39 ± 0.13
Calcium, percentage	1.70	1.33 ± 0.15
Magnesium, percentage	0.91	0.82 ± 0.10
Sulfur, percentage	0.51	0.40 ± 0.02
Manganese, parts per million	208.00	122.00 ± 18.00
Zinc, parts per million	331.00	245.00 ± 32.00
Copper, parts per million	205.00	197.00 ± 28.00

Conclusion

Composting is an economical and simple method of dead-bird disposal. Well-managed composting operations are inoffensive and do not attract or harbor vermin. Composting precludes ground water contamination. The conversion of bird and manure nitrogen to bacterial biomass and humus improves the value of compost as a fertilizer and soil amender. Since composting is a biological process, it requires a certain degree of management to provide correct amounts of food, air and water for the compost bacteria.

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