Composting Poultry Mortality in North Carolina

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Introduction:

Proper disposal of mortality is part of the daily management responsibilities of a poultry producer. The normal mortality of a commercial chicken or turkey flock results in the need to dispose of large quantities of birds. In addition, the pounds of carcasses that growers experience increase dramatically when poultry reach maturity (e.g., 4 pound broilers and 20 pound tom turkeys). Disposal pits, trench burial, incineration, and rendering have been standard methods utilized to dispose of the mortality. Composting techniques, however, have recently been adapted to poultry mortality to enable sanitary degradation of poultry carcasses. The product during proper mortality composting is subjected to high temperatures that destroy pathogenic bacteria normally associated with poultry disease making it a biosecure system. The compost has similar chemical and physical characteristics to poultry litter and can be utilized as crop fertilizer. Section 1 of this publication provides information on mortality composting and other mortality disposal technologies to assist in determining the optimum disposal method for a specific farm. Section 2 provides information that will enable poultry growers to design, construct, and manage a mortality composter.
Section 1:

Current Animal Disposal Regulations

North Carolina General Statute 106-403 requires that dead poultry be disposed of within 24 hours in a manner approved by the State Veterinarian (an officer of the Veterinary Division, North Carolina Department of Agriculture). General Statute 106-549 requires every person, firm, or corporation having a flock of more than 200 birds to provide and maintain a disposal pit or incinerator of a size and design approved by the Department of Agriculture. The purpose of these requirements is to prevent the spread of disease organisms from dead poultry to healthy birds. Poultry composters are currently being approved for mortality disposal on a permit basis. This assures proper design and operation which protects the environment. Poultry producers interested in constructing a mortality composter should write to the NCDA Rollins Laboratory requesting a permit. The request should provide information on composter design, flock size and type, grid number and county of farm, producer’s address, location of composter on a topographical map, and contracting company if the flock is under contract. Send information to Dr. John Atwell, NCDA, P. O. Box 12223, Raleigh, NC 27605.

Disposal of dead birds is also regulated by the Division of Environmental Management, an agency of the North Carolina Department of Natural Resources and Community Development. Their objective is to protect air and water quality.

Criteria for mortality disposal methods other than composting are covered in a publication entitled, “Proper Disposal of Dead Poultry;,” PS&T Guide No. 19, North Carolina Cooperative Extension Service.

Current Practices

Burial on the farm, disposal pits, incineration, delivery to a rendering plant, sanitary landfill, and mortality composting are disposal methods available for poultry mortality. The method selected should be one that best fits a specific situation. It should be based on factors such as cost, ability to meet design requirements, and how the method matches with flock size and management system. For example, burial on the farm or disposal pits would be a poor option in areas with high water tables or shallow rock formation since it would be difficult to meet design criteria. Landfill disposal will be a poor option in most areas of the state because of new regulations and limited landfill capacity.
Section 2:

Designing and Managing a Mortality Composter

Size Determination

The size of the composter is dependent on the quantity of mortality that must be composted. Daily mortality of broilers, roasters, commercial turkeys, broiler breeder pullets and commercial egg pullets near maturity should be considered in calculating composter size, including such factors as the bird weight near maturity. In contrast, only the average daily mortality of layers and breeders should be considered in calculating composter size for these types of poultry because weights and mortality are more uniform throughout their flock cycle.

Farm mortality records can be used as a basis for mortality calculations particularly in cases where marketing programs or other factors would have weights different from normal industry standards. Table 1 shows average mortality and weights for different types of poultry. It can be used along with Table 2 for estimating the size of a composter. Poultry producers may want to design a safety factor into the composter to accommodate unusually high mortality. This can be done by multiplying the mortality by a factor. For example, multiplying the pounds per day of mortality by 1.5 would accommodate 50% higher mortality than normal. Emergency capacity could also be designed into the storage section.

Table 1. Anticipated Mortality for Different Types of Poultry

The cubic feet of composter capacity necessary per 1,000 bird capacity is estimated in Table 2. This is based on allowing 2.0 cubic feet for combined primary and secondary composter volume per pound of bird mortality. Utilizing these estimates, the number of 5’ x 5’ x 8’ bins for standard size North Carolina poultry units are also shown in Table 2.

Storage capacity for compost that has gone through a secondary process, as well as storage for litter, straw, and other supplies, should be designed as part of the facility. Storage capacity is needed to allow compost to go through a third heating period and will vary greatly depending on how often the compost will be utilized and removed from storage. A minimum of three-months storage is recommended.

Table 2. Estimated Primary and Secondary Bin Capacity for Mortality Composting

Figure 1. Formulas and Example Calculations for Sizing of Mortality Composters.
Building the Composter

The construction of composting bins and storage areas can take many forms, depending upon what is most suitable on a specific farm. Composting works well in an existing building if the ceiling is high enough to allow mechanical turning of the compost. A composter can also be designed to attach to an existing building or be a stand-alone unit.

There are a few building features which are essential to insuring that the composting process works consistently and is compatible with environmental and nuisance concerns. These common features include:

- **Roof.** A roof is necessary to prevent rainwater from reaching the compost and creating fly breeding situations and unsatisfactory composting conditions. It will also prevent runoff from the compost into the ground or surface water. A roof overhang of two feet with guttering is recommended if compost bins are located on the sides of the building.

- **Foundation.** An impervious weight-bearing foundation such as concrete is critical for an all weather operation. Concrete allows easier cleaning, preventing litter and compost runoff during rain events. It will assist with rodent control as well.

- **Building Materials.** Pressure-treated lumber will resist rotting which the composting activity encourages.

Figures 2A, 2B, 3, and 4 show layout drawings of composters that are freestanding as well as those constructed as an extension of existing buildings. The size of the composting building should be based on the size and number of composting bins needed (as described in an earlier section under “Size Determination”). The cost of materials for composters will vary considerably. The composter design shown in Figures 2A and 2B which is sized for 50,000 turkeys has an estimated material cost of $3,500. Copies of these drawings and material listing are available through your local county extension agent’s office.

Composter Bin Design

Bins constructed inside the composting building need to meet certain criteria to facilitate composting and enable easy turning of the compost. The primary and secondary bins should be 5 feet high. The depth of the composter should not exceed 6 feet. The width of compost bins should match the width of the compost handling equipment but not exceed 8 feet. Smaller bins will make the composting process more efficient, particularly for mortality during the early part of the production cycle. The smallest bin that is recommended which supports the composting process is 4’ x 4 x 4.

Composting Poultry Mortality

Composting is the natural degradation of organic sources (such as dead poultry and litter) by microorganisms. Whole turkeys and chickens will be degraded, except for a few bone fragments and feathers, within three weeks. For composting to work, three agents must be present in the
correct ratio: a nitrogen source (birds and litter), a carbon source (straw, peanut hulls, or pine shavings), and aerobic (oxygen requiring) microorganisms. When all three agents are combined, the temperature increases (greater than 140°F) and the birds are decomposed to produce water, carbon dioxide, nitrogen, and carbon. The 140°F plus temperatures of the composting system will destroy disease-causing organisms, thus making it a sanitary method of mortality disposal.

Recipe

Ingredients in a mixture to attain a carbon to nitrogen (C:N) ratio in the range of 20:1 to 35:1 carbon to nitrogen and 45 to 55% moisture are necessary for the composting process. A typical recipe of one part by weight dead poultry, 1.5 to 2.0 parts by weight poultry litter, and 1/10 part by weight straw are combined to achieve a C:N ratio of 25:1 with a 45% moisture (Table 3). While optimum moisture is critical to the composting process, experience shows that water does not need to be added to litter that has normal moisture levels. A rule of thumb for correct moisture is that the mixture should look like chewing tobacco. However, some dry litters, (such as those from turkey brooder houses) or wet manures (from under broiler breeder slats or cage layer cages) may make it necessary to adjust the moisture to attain good composting. Example: Add water to brooder litter or use litter from the scratch area in the breeder house. Field experience has also shown that the material that has gone through the compost cycle can be partially substituted for the litter, but a carbon source (such as straw or peanut hulls) must continuously be added to keep the C:N ratio at the optimum level (Table 3).

Table 4 Average Mortality Compost and Litter Nutrient Analysis

Layering Composting Bins

The three ingredients are layered into the bins every day until the bin is full. The ingredients of the compost mixture should be layered in the bin in the following order of straw, dead birds, and litter (see Figure 5). One should begin by placing twelve inches of litter on the concrete floor of the bin then add successive layers of straw, dead birds, and litter. The mortality layer should not be placed within six inches of the side of the bins to optimize composting of the mortality. Each day’s mortality should be immediately covered with litter to avoid insect pest and animal varmint problems. If the pounds of mortality are low, such as during the start of the flock, use only the portion of the bin needed, adding portions of each layer until that layer is complete. Be sure each day’s mortality is covered with the appropriate layer of litter.

Figure 5. Compost Layer Schematic

Mortality pickup, disposal, and layering of the composter should be a daily routine by the poultry grower. Once the daily mortality is picked up, carcass weight should be determined and other
ingredients weighed-out according to the recipe in Table 3 and the ingredients layered. Once the grower gains experience, the measurement can be performed on the basis of volume, using buckets, front-end loader, or other equipment. The activity takes about 20 minutes a day for a broiler grower with a 100,000 bird capacity or a turkey grower with a brooding capacity of 26,000.

**Monitoring and Turning (Aerating) the Compost**

The material in the first (primary) bin will go through a natural rise in temperature which will peak in the range of 140 to 160°F. Once the process has depleted the available oxygen, the temperature will begin to drop. This is an indicator that it is time to move the material to a second (secondary) bin. Using a front-end type loader, the material in the primary bin is moved to the secondary bin. During the transfer of material from the primary to secondary bins, mixing of the ingredients and aeration occurs. This is accomplished as the material is placed in the secondary bin by having the front-end loader raised high so that mixing action occurs as the bin is filled. A six-inch layer of litter should be added to the top of the new secondary bin to cap it. After the material goes through a second heat, it is removed from the secondary bin and placed in storage where it will go through a third composting and heat cycle. The final storage cycle should be in a shed or in a plastic covered outside stack. The stack should be on a site designed to avoid rain water runoff from the storage pile and nitrate movement into the ground water.

**Figure 6 Temperature Profile Turkey Mortality Composter**

Figure 6 shows a profile of the temperature cycle. The temperature in the compost can be monitored with a 36-inch, dial head, probe-type thermometer. When the temperature reaches its peak temperature and drops for several consecutive days (approximately 20°F drop), it is time to transfer and aerate the compost. The mortality is ready to field spread after going through three heat cycles (including a heat cycle during storage). If one wishes to break down the ingredients further or to have a more stable compost, the compost can be aerated again. This causes it to go through the cycle again each time it is turned (if there is sufficient moisture). Caution should be taken not to mix fresh litter with compost because mixing the higher moisture compost with fresh litter could possibly set up conditions favorable to spontaneous combustion.

**Use of Mortality Compost**

Mortality compost can be used as a nutrient source for crops just as fresh poultry litter or manures. Table 4 shows the comparative average nutrient values of poultry litter and mortality compost. Good nutrient management techniques include the testing of any animal by-product for nutrient content and then applying the manure product according to crop needs (using soil tests as a guide to spreading rates). Mortality compost is thought to release nitrogen at a slower rate and over a longer period of time than fresh litter. Nutrients in the final compost are similar to the poultry litter used in the recipe, except that the inorganic nitrogen level of the compost will be reduced. Studies on plant response to mortality compost are continuing.
Insects and Other Pests Associated with Composting

Insects associated with the composting of dead birds are relatively minor pests, as are animals such as raccoons, rodents, foxes, and wild dogs. All of these pests can be reduced or eliminated by proper construction and careful management of the composting process.

In general, insect pests are found in the upper 4 to 6 inches of compost or around the base of the pile. There will be few, if any, insects when the material is actively composting as long as the moisture content is within normal limits. The heat generated (140°F - 160°F) by the process usually deters insect breeding. Low moisture will also minimize odors that are attractive to carrion feeding insects.

Flies and carrion beetles serve as useful indicators of the overall “health” of the compost. When large numbers of these insects are present, it is likely that the material is not composting properly. Excessive moisture or poorly balanced carbon and nitrogen ratios should be suspected in such cases. Once the problem is isolated and corrected, insects will no longer find the compost pile attractive.

In rare cases, insects and other pests can become a problem when compost is spread in the field. This situation generally occurs only if the compost is applied at excessive rates without incorporation, and/or is applied before bird carcasses are completely decomposed.

General Considerations to Avoid Pests

Flies associated with bird mortality composters will always be present at levels similar to the normal background population for a particular farm. A well designed and managed composter will not contribute to either the number or species of flies already present in the area. The same can be said for other insects and animal pests that may be found in or around composters. The following suggestions will minimize or eliminate unwanted pest problems.

1. Composters should be designed and built to minimize moisture problems.
2. Site the composter well away from tree lines, ditches, dumps, and areas of heavy brush to discourage easy access by vertebrate pests.
3. Construct bins that are reasonably tight (no gaps accessible to animals). Bin lids will aid in keeping larger animal pests, such as raccoons and dogs, out.
4. Keep the site clean. Mow weeds and grass regularly. Keep at least a 50-foot perimeter clear around the site. DO NOT stockpile lumber or store old equipment on or near the site. Where replacement lumber or bin planking is kept on site, it should be stored on racks at least 18” off the ground.
5. Be observant. Rats and mice will often burrow along the edges of concrete pads, into the compost bins or into compost that is being held for later use. Bait all rat burrows as soon as they are spotted; place baiting stations or bait bars for mice.
6. Follow the 6 inch rule. Be sure that the top layer of birds is covered by at least 6 inches of litter or compost. Place dead birds 6 inches from the sides as well. Cover partially decomposed birds with 6 inches of compost when the pile is turned.
7. Follow the recommended composting proportions to maintain proper balance of water and carbon:nitrogen ratios; this promotes efficient composting.

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