Proceedings 2004 Poultry Information Exchange. Surfers Paradise, Qld., AU. April 19, 2004. pp. 39-42.

COMPOSTING POULTRY LOSSES

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HISTORY

Composting is a natural, biological process by which organic material is broken down and decomposed. Bacteria, actinomycetes and fungi digest nitrogenous and carbonaceous organic matter and reduce it into a stable humus. This process has been used since ancient times. During the mid-1980's the Delmarva poultry industry was experiencing high mortalities and faced with many disposal challenges. Disposal by pits and burial was inadequate and posed increasing concerns with possible pollution of ground water since this region has very porous, sandy soils and a high seasonal water table. As an alternative to burial, the University of Maryland developed a procedure by which dead birds could be composted using carbon sources (i.e. litter) that were readily available on poultry farms. In 1988, poultry extension specialists from the Universities of Delaware and Maryland implemented a dead bird composting demonstration on a 120,000 capacity broiler farm. Over the next two years over 100 metric tons of dead from this farm were composted. Success of this demonstration rapidly spread and during the next 10 years this alternative disposal method was adopted by many poultry producing areas of the USA. This disposal method has been used successfully for broilers, layers, turkeys and other livestock species (i.e. swine); also used in a wide range of climatical conditions; is ready adoptable to many poultry operations; is biosecure, low cost and environmentally sound; and recycles nutrients from carcasses to produce a non-offensive safe fertilizer.

CURRENT DISPOSAL OPTIONS IN THE USA

Although different regions of the USA vary widely in method of dead bird disposal, composting of routine broiler mortality is the most predominant method. It is estimated that 40% of meat-type mortalities are composted, ~20% incinerated, ~20% rendered and ~20% buried. For layers, rendering and incineration are predominant and composting is the least used disposal option. Each disposal option has advantages and disadvantages. The decision on which method to select is based on numerous factors. These include; type of poultry, size operation, availability and capability of labor to handle materials, access to material handling equipment, carbon sources and cost, energy (petroleum-base materials) cost, local water and air quality regulations, investment and operating cost, proximity to neighbors or other poultry operations, potential biosecurity risk, availability of markets or use for the end product, and public perception. Composters generally have low to medium investment and operating cost, fit well with most broiler operations of various sizes (particularly larger capacity farms), and is widely accepted by the environmental community and poultry industry in the USA. A *properly* operated composter is biosecure, addresses most air and water quality issues, and provides a useful end product. However, some operations lack the labor, skill, commitment and equipment for material handling to *properly* compost. In recent years incinerator design and energy efficiency has improved and popularity of this disposal option has increased, particularly for small to medium capacity farms. This method is the most biosecure and involves minimum labor to operate. However, escalating fuel cost and more stringent air quality regulations are growing concerns with this disposal option. Recovering the nutritional value of carcasses via rendering has and continues to be a viable option in the USA. The transportation cost, product quality and concerns with disease spread has greatly reduced the use of pickup programs of "fresh" dead from farms. In locations with rendering facilities capable of processing whole birds, on-farm freezers designed to accommodate the dead from an entire flock has grown in popularity. From a labor standpoint, this system is well received by growers. However, investment and operating cost of the freezers, and associated transportation cost are concerns. These units are limited in that they are not designed to accommodate high mortalities such as a heat loss event. Experimental and limited field studies have been done with different preservation techniques (acid and alkaline solutions; lactic and yeast fermentation) but they have limited commercial adoption to date. With any protein recovery system, the public perception of refeeding "dead" to poultry or other species that is intended for human consumption will be a concern. Historically, burial has been the predominant method of disposal since it is the cheapest and least labor intensive of any system. Due to water quality concerns many states have banded all burial systems or hold the grower legally responsible for pollution of groundwater. In situations of catastrophic losses, burial may be permitted but disposal at a landfill or composting is often preferred.

COMPOSTING REQUIREMENTS

In the presence of oxygen (> 5%), moisture (40-60%), and a proper carbon to nitrogen ratio (20:1 to 35:1), microorganisms will rapidly compost carcasses. This process produces carbon dioxide, water vapor, heat and compost. Under proper conditions thermophilic organisms will cause the compost to heat to temperatures ranging from 57 to 63 C. Under these slow-cooking conditions, the organisms will rapidly degrade all soft tissue and most bones and feathers. Research has demonstrated that under the sustained heat of *proper* composting, pathogenic organisms, weed seeds and fly larvae are destroyed.

The basic requirements for most meat-type composting systems are similar. The recipe, by volume, requires 1 part birds to 1.5 - 2 parts carbon to 1 part straw or other bulking agent and saturating the feathers of birds with water if the carbon materials are excessively dry. Carbon for this recipe can be any combination of litter, cake, spent compost or sawdust. Many recipes now eliminate the straw and reduce or eliminate the water when small-particle cake is used as the carbon source. Layer hen carcasses have a higher feather to soft tissue ratio and can be a little more challenging to fully degrade. Carbon materials that provide more aeration such as wood chips or straw may be needed initially. One reported layer hen operation uses cage layer manure, layer hen carcasses and straw in the primary bins in a 1:1:0.25 mixture initially. Afterwards, layers hen carcasses, recycled compost and water in a 1:1.5:0.25 were used successfully. For static pile systems, this process involves starting with a 20-25 cm layer of litter. If the litter is too dense, a bulking agent to increase air-holding ability may be required. An 8 cm layer of straw, coarse shavings or wood chips may be required. Some innovative individuals have also recycled their degradable paper feeder lids or egg cartons as the bulking agent. Mortality are then placed on the pile at a depth not to exceed 15-25 cm deep. With excessively dry litter, the feathers should be saturated with water. A distance of 15 cm should be maintained between the mortality and the edge of the structure or pile. Filling this space with litter will act as insulation, prevent seepage, flies and odors. A minimum of 8-10 cm of litter should be used to cover the carcasses. **Do not leave any exposed carcasses!!!** Within 4 days the temperatures should reach 57-66 C. By 10 to 14 days temperatures will start to decline. Within the first 14 days more than 95% of the soft tissue should be decomposed. With 2-bin systems, the compost can be moved from the primary to a secondary bin within the first 14 days or after the flock has moved. This turning process aids in mixing and aerating the compost. Temperatures following turning in the secondary bin are often equal or greater than in the primary bin. It is a good practice to cap off the compost in both the primary and secondary bins with an 8 to 10 cm of litter. To avoid the potential for spontaneous combustion (>71 C), height of the compost should not exceed 1.5 m. A long-stem thermometer should always be used to monitor the composting process.

Since composting is both an art and science, experience is needed to correctly compost and to identify potential problems. The following is a list of some of these issues. If the compost is not heating to 57-66 C within 4 days the compost mixture maybe too dry or too wet, use of an inactive litter source or there is lack of oxygen. To correct the situation, this may require removing the mixture and adding water, dry carbon source, fresh active litter, or a less dense bulking agent, respectively. When there is black liquid seeping from the compost, this is an indication the birds have been placed too deep in a layer, inadequate or too wet litter used, too much water added to the carcasses, rain onto the compost, or birds placed too close to the edge of the pile or structure. These conditions lead to flies and odour. Not covering the mortality each day creates fly, odour, and varmint problems and increases potential disease risk! Carcasses must be covered with 8-10 cm of litter to discourage domestic or wild animals/birds from digging into the compost. In some situations it may require laying a wire partition or netting on top of the covered compost after each day's activity. Improper composting **should not be tolerated** by the poultry industry since it can create nuisance and potentially spread disease from farm to farm.

COMPOSTING METHODS

The method of composting to select is based on resources available (material and manpower), size and type poultry, farm capacity, availability of equipment and skilled operators, proximity to neighbors, and whether it is routine or catastrophic mortality events. For most meat-type composting systems, the rule-of-thumb in sizing the capacity for a two-stage bin system is determined by; assessing the maximum daily disposal factor (farm capacity times market weight in kg divided by 400). This factor times 0.06 cubic meters will determine the volume of bin capacity needed for primary and secondary bin space, respectively. For layers, a rule-of-thumb is 0.16 cubic meters of primary and secondary bins space per kg of daily mortality. Height of these bins should not exceed 1.5 m, width of bins is often determined by the size of the loader's bucket.

For small capacity farms with no material handling equipment and growing small birds, mini-composters have been used successfully. These 90 cm (h) x 100 cm (w) structures are placed on the litter inside houses and can process up to 270 kg per flock. The structures can be made from wire or wood with 2.5 x 2.5 cm mesh screens. After the flock is marketed, the compost is removed from the house during cleanout.

The two-stage bin system is the predominant system used by both the broiler and layer industries. This system has a series of primary bins, a secondary bin and for free standing units (not attached to a manure storage structure), may also have a compartment to hold litter. The structures are placed on a concrete pad, are made from pressure treated wood or concrete and have a roof.   Some units are being built with force-air systems to aerate the compost in the primary bin.   Although these structures work over a wide-range of farm conditions, they often require a front-end loader and semi-skilled operator for material handling. Farms lacking this equipment and skills sometimes fail to compost correctly.

On large capacity farms and those growing large birds, channel composters have worked quite well. Unlike the bin systems which can be more labor intensive, these are multiple rows of long (~15 m) bins with the width determined by the size of the front-end loader. Loaders are used to layer the dead and litter on the piles, thus reducing labor associated with material handling up to 50%. Some operations allow the compost to age for months in a primary bin before turning while others have loader access on both ends of the channel to allow transfer of the material from the primary to secondary bins on a regular bases. These bins are sometimes located inside a building which also contains the litter thus allowing an operator to work under a roof during all weather conditions. The popularity of this system has increased as our industry moves toward larger farms and market weights.

Within the past few years, rotary composters have been tested for dead bird disposal in the USA. Similar to units being used in AU, these systems aerate and mix the compost by rotating the drum several times per day and some have air compressors for additional aeration. A moist (~50%) mixture of wood chips, litter and sawdust is used for carbon to initially fill the unit approximately half full. As the amount of mortality increases (starting around 5 weeks of age), the carbon mixture is then added daily. BiobiN™ is yet another deviation of a forced air in-vessel composter being used in South Australia. These portable bins are delivered to the farm with aeration equipment. Litter or shavings are layered with birds in this unit in a fashion similar to the bin system. After each flock the unit is removed and replaced with a clean sanitized bin. Most rotary and in-vessel composters are designed to accommodate mortalities from 60-100,000 capacity farms.   *Managed properly*, these composters have the advantage of speeding-up the composting process, reduce labor, and aid in curtailing odors, flies and varmints.   Costs of these units are up to twice that of bin systems and they too require knowledge and management of the composting process.

When mortality exceeds 2 birds/1000/day or there is a catastrophic mortality event such as a major heat loss, composting systems designed for routine mortalities are often inadequate. Outside windrow composting has been used in the USA for these situations. This procedure involves layering 20-30 cm of carbon material in a 3-4 m wide bed. Similar to a bin system, birds and carbon source are layered up to 6 layers deep, but not to exceed 1.8 m high. Critical factors in this process are to layer carcasses no more than 2.5-3.0 cm deep, adding 1.8-2.4 cm of carbon over carcasses and to cap the pile with a litter or sawdust to cover any exposed birds.

This system will accommodate ~450 kg of carcass per linear meter of windrow. Turning the piles and temperatures in the compost will be similar to the bin systems. When it is necessary to depopulate a house due to a highly infectious disease such as avian influenza, the virus in the carcasses and litter can be inactivated by composting within the house. Similar to the outside windrow, a single windrow is formed in the center of the poultry house. However, we have found layering carcasses with litter may not be necessary and that a uniform mixture of the birds with litter in the windrow is often adequate. To accomplish this program, for birds up to market age, ~13 cm of litter (or supplemental carbon such as sawdust) should be adequate to windrow and cap the pile. The windrow is turned after 10-14 days and the compost can be removed after ~30 days. Cost of this process is estimated to be 50-75% less than just the tipping fees associated with carcass disposal at a landfill. Furthermore, the risk of spreading virus when transporting infected carcasses or litter is greatly reduced. This procedure was recently used to contain and inactivate H7N2 avian influenza on two Delaware poultry farms.

SUMMARY

Composting is the predominant method of disposal of routine mortality losses of meat-type poultry in the USA. It is also the preferred method for disposal of catastrophic mortality events. Many factors need to be considered to determine if composting is the best disposal option for a farm and what method of composting would be most appropriate. Labor and material handling of the carbon source(s) can sometimes be a limitation of composting poultry losses. Regardless of the method of composting used for dead bird disposal, it will require certain fundamental procedures to be followed. Failure to adhere to these basic concepts will limit the success of composting as a viable disposal option.