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

Mortality Management and the Georgia Dead Animal Disposal Act

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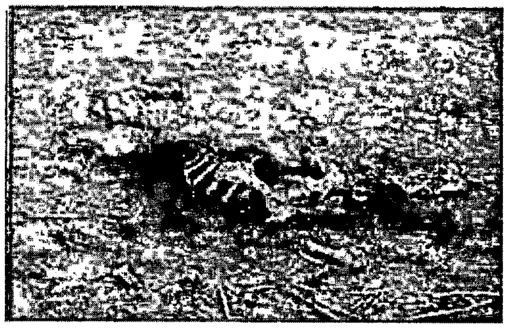
In Georgia, simple and straightforward rules on mortality disposal and management apply to all livestock and poultry operations, regardless of their size or permit status. These laws also include hobby farms, horse operations, exotic animal breeders and even licensed kennels.

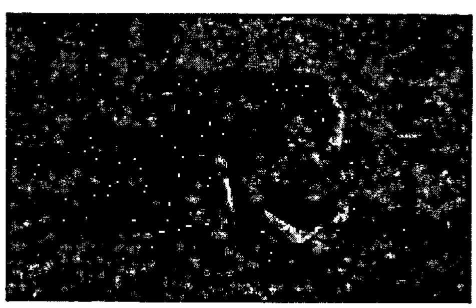
Proper management of mortalities on the farm has implications in nutrient management, flock and herd health, as well as farm family and public health. For this reason you must be familiar with the law and best management practices for dealing with dead animals. The Georgia Department of Agriculture enforces the Georgia Dead Animal Disposal Act.

Unlawful Practices

Abandonment

Though hauling off a carcass to the "back forty" may have been an acceptable thing to do historically, it has been forbidden since at least 1970 with the passing of the Georgia Dead Animal Disposal Act. This practice is ILLEGAL in all its forms, including carcasses abandoned on the surface, in open pits, ditches, water features and sinkholes, or in wells. There are good environmental, health and economic reasons why this is not an acceptable practice. Abandoning mortalities in surface and ground water resources such as creeks, ditches, sink holes and wells can contaminate water with not only harmful pathogens but also nutrients and organic material. Moving water (including ground water) can transport these contaminants for miles, which can potentially be extremely harmful to humans and animals. Leaving mortalities open to the surface attracts predators such as coyotes, vultures and dogs, which not only leads to transport of potential pathogens off-site but also endangers other healthy animals, especially nearby newborn livestock. Abandonment is not only a bad management practice but is also a misdemeanor that can carry a fine. Carcasses must be dealt with by an approved method within 24 hours of death or discovery.





Abandoning dead animals is ILLEGAL in all its forms, including carcasses abandoned on the surface, in open pits, ditches, water features and sinkholes, or in wells. It can also attract predators.

It is also possible to compost larger carcasses. The University of Georgia Swine Center and Teaching Dairy successfully composts larger stock, including mature dairy cows, and several farms across the state are composting cattle with guidance from Georgia Cooperative Extension and individual permission from the Georgia Department of Agriculture. Although it is not required, it is recommended that compost sites for other livestock also be approved by the Department of Agriculture.

Though composting of medium to large carcasses and land applying the material is proving to be feasible, this practice is NOT currently under consideration for goats and sheep. The prevalence of scrapie, a prion disease, in flocks across Georgia and the United States poses a biosecurity risk if compost from these animals is spread on land. This disease is a transmissible spongiform encephalopathy (TSE) similar to BSE (mad cow disease) and the human Creutzfeldt-Jakob disease.

Technical procedures on composting cattle carcasses are being developed; this appears to be a viable option for the future. Most composting requires storm water protection. Compost can benefit forest and crop land, but you will need to follow nutrient management guidelines. Contact your local Cooperative Extension office or USDA Service Center for information on composting facilities and best management practices.

Alternative Methods

Alternative methods are not specifically defined. They may include homogenization, digestion or chemical processes and technologies to recover products from mortalities. These must be approved on a case-by-case basis by the Georgia Department of Agriculture.

Catastrophic Mortality Events

Catastrophic events can result from a variety of causes. Examples include a simple act of nature like a storm knocking out ventilation systems, an animal disease outbreak or even intentional agro-terror attacks. A farmer's plan to deal with mortalities during regular operations will likely be inadequate during a major event.

Report all catastrophic events the Georgia Department of Agriculture. Response and assistance may also involve additional agencies including federal and state emergency management agencies, environmental agencies and public health agencies.

If a catastrophic mortality event is the result of disease outbreak, biosecurity considerations may dictate the method of transportation and disposal. At a minimum, a catastrophic mortality plan for an individual farm should identify a safe location on-site for burial, composting or other approved management technique. The Georgia Department of Agriculture may have additional recommendations and provide assistance on a case-by-case basis. Many state agencies are developing action plans for a variety of scenarios.

Summary

The purpose for mortality disposal is "to prevent the spread of infectious, contagious and communicable diseases." Also, legal implications and requirements are related to nutrient management and the permitting of animal feeding operations. Disposal of operational mortalities and catastrophic mortalities must be defined in the nutrient management plan.

Regardless of the cause of death, carcasses must be disposed of within 24 hours of death or discovery. Approved methods include burial or pits, incineration, rendering, composting, land filling or any method approved by the state veterinarian.

Other Methods

- Approved by state veterinarian on a case-by-case basis.
- Risk assessment for disease spread conducted by Georgia Department of Agriculture personnel.
- Specific procedures may be required by the Georgia Department of Agriculture if death was due to infectious, contagious or communicable disease.

Transportation on Public Roads

- Must be in covered, leak-proof containers.
- Specific procedures may be required by the Georgia Department of Agriculture if death was due to infectious, contagious or communicable disease.

Penalty for Violations

- Administrative Hearing
- Fine up to $1,000 per violation
- Consent Order by the Commissioner of Agriculture
- Guilty of a misdemeanor

Important Contacts

University of Georgia Cooperative Extension
Local County Offices
(800) ASK-UGA1
www.caes.uga.edu/extension

Department Biological and Agricultural Engineering
(706) 542-3086
www.ugaengineering.org

Department of Animal and Dairy Science
(706) 542-2581
www.ads.uga.edu

Georgia Department of Agriculture
Livestock and Poultry Field Forces
(404) 656-3665
www.agr.georgia.gov

Animal Mortality / Transfer Log

Date	Animal ID #	Animal Type	Disposal/ Transfer Method	Weight	Notes
Examples	*425*	*Dry Cow*	*Sale Barn*	*1500*	*Old cow bad feet*
2/15/2010	------	*Newborn Calf*	*Compost*	*100*	*Calf belonged to cow #733*

Composting Poultry Mortality: *A Critical Daily Management Chore*

MISSISSIPPI STATE UNIVERSITY EXTENSION

Normal everyday mortality from any commercial poultry operation can be managed efficiently and safely by composting, if the proper procedures are followed. Composting is the **biological decomposition and stabilization of organic matter under controlled conditions.** It is an aerobic process (meaning that oxygen is required) carried out by microorganisms that metabolize organic waste as an energy source. Composting is a naturally occurring process in which beneficial microorganisms, such as bacteria and fungi, reduce and transform organic wastes (in this case, poultry mortality) into a final product (compost material) that is a valuable fertilizer and soil amendment.

Composting daily mortality on the farm has several advantages, including these:

1) averts the potential for groundwater pollution that, in the past, was associated with burial or use of disposal pits;
2) avoids the high fuel cost and potential air pollution concerns associated with incineration; and
3) prevents potential disease spread associated with moving poultry carcasses off the farm.

This publication addresses the daily management chores required to ensure proper operation of either a bin/alleyway or in-vessel poultry composter.

The Facts

Across the country, the number of farms continues to decrease. This is true in the poultry sector as well as other agricultural segments. However, farms that remain tend to be increasing in size. For example, many broiler farms today generally have anywhere from six to twelve broiler houses on the farm, whereas, a generation ago, two to four houses were more common. In addition, individual house size is larger today than it was a generation ago. The increase in individual farm size potentially means more mortality to deal with in a smaller geographic area on a daily basis.

In most cases, daily mortality losses are small but continuous throughout the flock grow-out period. Therefore, dead bird disposal is a daily chore associated with chicken production. In addition to producing a usable end product, composting this daily mortality is cost-effective, environmentally sound, and biosecure.

Requirements for Composting

Creating compost is like baking a cake: you have to follow a specific recipe or it is not going to turn out very well. The microorganisms require carbon, nitrogen, oxygen, and moisture in the right amounts to work properly. Any elements lacking or in excess will cause the microorganisms not to flourish, resulting in inadequate heat and a poor composting environment. Whether using a static bin, alleyway, or in-vessel composter, **good composting requires that you follow a recipe.** Years ago, bin composters that included primary and secondary bins were a popular mortality-management option. Today in Mississippi, however, alleyway composters are a more popular choice because they are less labor intensive, are simpler to manage, and appear to do a better job of handling the larger birds (9.75 pounds and up) that many integrators are now growing. In-vessel rotary drum composters have recently become another mortality management option that yields excellent results when managed properly.

If the moisture content, carbon-to-nitrogen ratio (C:N), oxygen level, levels of bulking agent (or carbon source), and mortality are correct, the composting process works very well. However, if one or more of these ingredients is not adequate, you will have issues maintaining adequate temperature and achieving efficient composting. Improper compost management can also become a source of disease spread by producing odors that may attract dogs or wild animals, which can dig into a bin or alleyway composter and drag off dead birds. Flies can also be a major issue if neighbors are involved. In addition, improper management may lead to the generation of pathogens, such as clostridium, that may potentially result in botulism or gangrenous dermatitis. However, using the proper recipe will produce optimum composter performance, and that will mean few odors or pathogens and a poor breeding ground for flies.

The **composting process is directly affected by several factors**, including these:

- temperature
- oxygen
- moisture
- particle size
- surface area
- size and activity level of microbial populations
- physical properties of the wastes
- C:N ratio

Composting converts much of the carbonaceous material to carbon dioxide. Therefore, the volume and weight of the compost is less than that of the original waste product. Temperature is critical because the heat generated during the composting process can destroy fly larvae and pathogenic organisms and helps to drive off moisture present in the carcasses. The rate at which composting occurs, the types of microorganisms present, and the level of biological activity involved in the composting process are a result of the surface area, particle size, and physical properties of the waste material.

Composting poultry mortality should be an aerobic process. This means oxygen is required for the microorganisms to perform at their best. The bulking material used is important to the oxygen supply. For example, litter or sawdust that is too fine will limit the oxygen supply and microbial growth. Some common bulking materials are listed in **Table 1**. Slower microbial growth means lower composting temperatures that may not kill pathogens and, in turn, increase composting time. **Moisture level is also important** in determining whether the composting process is occurring under aerobic or anaerobic (without oxygen) conditions. A moisture content in the 50–60 percent range seems to work best. The process tends to slow down at a moisture content of less than 50 percent, and anaerobic conditions begin to occur at a moisture content of greater than 70 percent.

Table 1. Common composting bulking agents.

Carbon Source	C:N Ratio
Sawdust/shavings*	200–750:1
Straw	48–150:1
Corn stalks	60–73:1
Finished compost*	30–50:1
Horse manure	22–50:1
Cattle manure	19:1
Turkey litter	16:1
Broiler litter*	12:1

*Things we have tried.

One good thing about composting is that **it is a fairly forgiving process.** If you mess it up, you can fix it relatively easily. Conditions that are too wet can be remedied by adding increased amounts of bulking material to absorb the moisture. Conditions that are too dry can be adjusted by adding limited amounts of water. Generally, the addition of water is less common because it appears that most producers have more problems with compost being "too wet" than "too dry."

An important point to keep in mind is that it is **better to add too much bulking agent than not enough.** This sounds simple enough, but it can actually be difficult because birds are constantly increasing in size; therefore, adjustments must continually be made to the amount of bulking agent added to balance for size increase. While a 1:1 ratio of bulking agent to mortality may be fine for 1-week-old chicks, there will be times when even a 4:1 ratio of bulking agent to mortality may not be enough for market-age birds each weighing 10 pounds or more. Growers must constantly adjust bulking agents not only to fluctuations in mortality rates (5 birds vs. 15 birds per house per day), but also for individual bird size (1 pound each vs. 10 pounds each). Some growers catch on quicker than others; but with a little practice, composting is a process that anyone can master.

The C:N ratio will also affect composting rate because it affects biological activity of the microorganisms. **A C:N ratio of 25–30:1 appears to work quite well.** Some nitrogen will be lost as ammonia if the C:N ratio drops below 25:1. This may likely result in unpleasant odors and a loss in potential fertilizer value. Unpleasant odors may result in unpleasant neighbor relations or, in some cases, even lawsuits if issues cannot be resolved. Therefore, it is important to properly manage your composter at all times to avoid any such situation that could threaten your farming operation.

In a bin or alleyway composter situation, as long as the temperature is increasing, the process is working well. **Bin or alleyway composters all have several features in common:**

1) a roof that drains water away from the composter;
2) a concrete slab floor; and
3) a bin (or bins) constructed of treated lumber or concrete that is sturdy enough to support the weight of the compost and capable of withstanding the stress applied by a tractor and front loader during turning and/or cleanout.

This type of structure allows the compost to be stored and housed in an environmentally sound manner, provides protection from rain and other adverse weather, preserves nutrients in the compost, and prevents nutrient losses and runoff to surface or ground water. When compost temperature peaks in a bin composter and then begins to decline, the material should be turned to incorporate additional oxygen. The turning process should cause the temperature to begin to once again increase. Bin and alleyway composters are sized to the number of chicken houses located on the farm. As a general rule, each cubic foot of composter space can handle 15 pounds of dead birds.

For an in-vessel rotary drum composter (**Figure 1**), the turning process occurs automatically on a daily basis (or perhaps more often, depending on how you have the timer set). These units have a built-in thermometer that allows you to constantly monitor the temperature inside the drum (**Figure 2**). **In-vessel composters use forced aeration and/or mechanical agitation** to control moisture and heat levels more effectively and promote rapid composting. As a result, composting can be more closely controlled, leading to faster decomposition and more consistent product quality. Effects of weather are diminished because the compost material is contained inside the drum. Public acceptance of a rotary drum composter may be better, simply because a drum composter may be more aesthetically pleasing than a bin or alleyway composter. Because of the perception many individuals currently have of agriculture, public acceptance of agricultural practices is an important issue that every farming operation must take seriously today.

Enforcement and Registration

The Mississippi Department of Environmental Quality (MDEQ) is charged with investigating complaints against livestock/poultry operations within the state. **Odor issues make up the greatest number of complaints to MDEQ, with fly complaints coming in a close second.** Composters should be located on the farm in a convenient location but as far from neighbors as possible. Keeping compost and litter dry can go a long way in resolving both of these issues. At no time should black fluids seep from the sides or bottom of a bin or alley composter. Seepage of black fluids is usually the result of poor carcass placement (carcasses placed fewer than 6 inches from the sides of the composter), carcasses piled in the composter instead of being layered in, not enough carbon source, or excess amounts of rainwater blowing into the compost bin. However, odors and flies aren't the only complaints received. Neighborhood dogs can dig dead birds out of a bin or alley composter and drag the carcasses home, and other varmints can steal carcasses and scatter them in nearby fields and/or along roadways. Enforcement efforts at the state level (not just in Mississippi, but across the country) will likely increase in the future in response to pressure from neighbors and from the federal level.

Currently, the Mississippi Board of Animal Health (MBAH) regulates dead bird composters in Mississippi, and each composter should have an MBAH permit number associated with it, similar to the permit for South Farm at Mississippi State University (**Figure 3**). In addition, the composter must be located at least 150 feet from the property line and 600 feet from the nearest dwelling. It is the MBAH that determines the size composter you will need based on the size of your farm, so make sure they are included in your mortality management decisions when you are initially building or adding additional houses. If you are a poultry farmer in Mississippi and your composter does not have a permit number on-site, or if you do not know if your composter is registered with MBAH, contact MBAH at (601) 832-3351 to verify your farm's status.

Figure 1. Rotary drum composter.

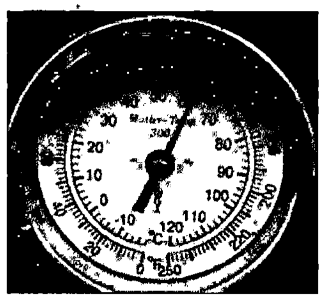


Figure 2. Temperatures above 130°F will kill pathogenic bacteria, fly larvae, and viruses.

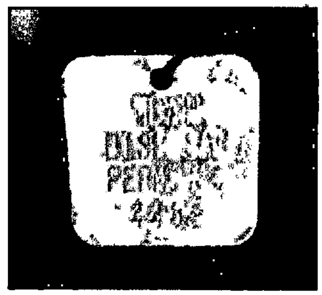
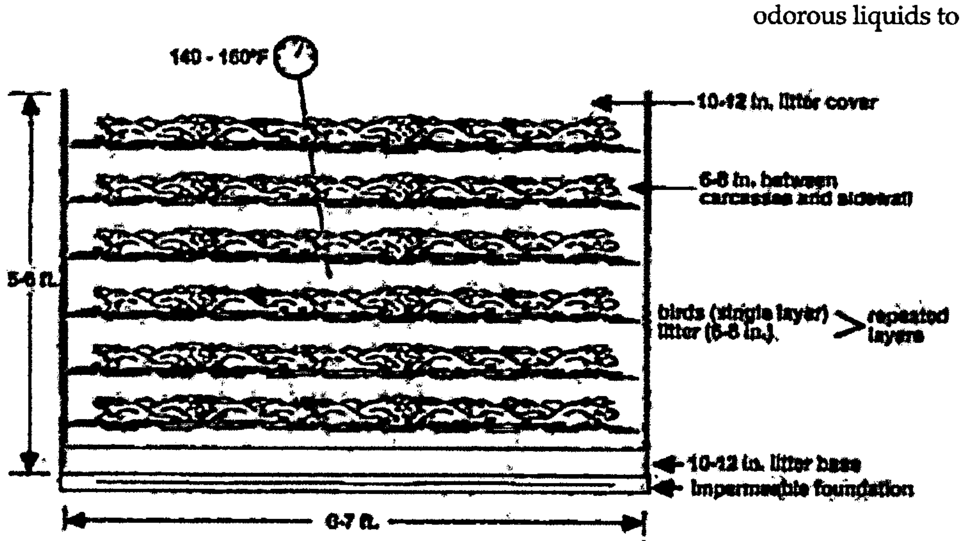


Figure 3. Mississippi poultry mortality disposal permit.

Composter Operation and Management

The MBAH provides every client with the following information and guidelines to assist them with managing and operating their composter. The requirements for proper and complete decomposition of dead carcasses are reasonably simple and inexpensive. The materials needed (dead birds, litter, alternative carbon sources, water) are readily available on every poultry farm. Careful attention to proper management is essential for successful composting. Failure to manage the system will result in an odorous situation that attracts flies, scavengers, and other vermin to the site. Proper management is vital for avoiding nuisance complaints.

Orderly loading of ingredients is necessary for efficient compost activity. Layer ingredients into the composter as illustrated below.



- Place an initial layer of 8–12 inches of fresh litter on the floor. This litter will supply bacteria to start the process and will also help absorb carcass fluids or excess water that may be added to the composter.
- Next, add a thin layer of bulking material such as peanut hulls, coarse shavings, or straw. Now, add a layer of bird carcasses. Arrange the carcasses in a single layer side by side and touching each other. Place carcasses no closer than 6 inches from the walls of the composter. Carcasses placed too near the walls will not compost as rapidly because of lower temperatures and may cause odorous liquids to seep from the compost pile.
- A small amount of water may be needed after each carcass layer. Typically, thoroughly wetting the carcasses will add sufficient water to the mix to achieve the needed moisture level. If much water is needed, the litter is likely too dry and low in live bacteria. Using finished compost material or fresh litter directly out of the chicken house can prevent this situation.
- Next, add a layer of litter. This layer should be twice as thick (8–10 inches) as the layer of carcasses underneath. If only a

partial layer is needed for a day's mortality, the portion used must still be covered with litter. The rest of that layer can be used with subsequent mortality.

- After completing the initial layer, add subsequent layers of carcasses, bulky ingredient, and litter until a height not exceeding 5–6 feet is reached. The last layer will be a cap of 8–10 inches of litter. Compost piles limited to 5–6 feet in depth, with adequate porosity and moisture levels, do not pose a fire hazard. Keep in mind, however, the potential for spontaneous combustion; monitor temperatures throughout the composting process. Excessive height can induce compost temperatures that exceed 170 degrees Fahrenheit and increase the chance of spontaneous combustion.
- Larger birds may require extra care during composting. Additional water or carbon material may need to be added to better facilitate the decomposition process, and additional heating cycles may be needed to produce an acceptable end product. See **Table 2** for guidelines on troubleshooting carcass-composting issues.

Summary

Composting is the controlled biological decomposition and conversion of solid organic material into a humus-like product called compost. Composting poultry mortality is a viable process with a beneficial use; however, **it requires daily attention** and must be managed correctly. By properly managing a combination of oxygen, moisture, and nutrients, composting can turn large quantities of organic matter into useful compost in a relatively short period of time. Proper management will be necessary to prevent odors and flies from becoming an issue for you and your neighbors.

Do not forget: if you grow commercial poultry in Mississippi, your dead bird disposal method should be registered with the Mississippi Board of Animal Health, and you should have a silver-colored permit tag on-site verifying that fact. If this is not the case, contact the MBAH and follow the necessary steps to register your operation.

Table 2. Troubleshooting guide for carcass composting.

Problem/Symptom	Probable Cause	Suggestions
Improper temperature	Too dry (less than 40% moisture)	Add water.
	Too wet (more than 60% moisture)	Add bulking material and turn pile.
	Improper C:N ratio	Evaluate bulking material and adjust as necessary.
	Improper mixing of ingredients	Layer ingredients appropriately.
	Adverse environment	Ensure adequate cover.
Failure to decompose	Improper C:N ratio	Evaluate bulking material and adjust as necessary.
	Carcasses layered too thickly	Single-layer the carcasses.
	Carcasses at outside edges	Maintain 6–10 inches between carcasses and edges.
Odor	Too wet	Add bulking material and turn.
	Too low C:N ratio	Evaluate bulking material and adjust as necessary.
	Inadequate cover over carcasses	Cover with 10–12 inches of bulking material.
Flies	Inadequate cover over carcasses	Cover with 10–12 inches of bulking material.
	Poor sanitation conditions	Avoid leaching from pile.
	Too wet	Turn pile and add bulking material.
	Failure to reach proper temperature	Assess C:N ratio and layering.
Scavenging animals	Inadequate cover over top	Maintain 10–12 inches of cover. Avoid initial entry with fence, barrier, or cover (where vultures may be a problem).

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NORTH CAROLINA STATE UNIVERSITY
COLLEGE OF AGRICULTURE & LIFE SCIENCE

POULTRY SCIENCE FACTS

A Cost Comparison of Composting and Incineration as Methods for Mortality Disposal

All poultry production operations have to determine how they will deal with the issue of disposal of mortality. There are numerous methods used to dispose of the mortality and the method selected should be based upon the situation of each particular farm and by restrictions placed upon them by regulatory agencies. Generally, these restrictions are based upon the method's impact upon disease control, air, and water quality. In addition, some states have passed legislation prohibiting burial or pit disposal methods.

The most common methods of disposal are:

- Burial (several different variations)
- Rendering
- Composting
- Incineration

An additional method of disposal is extrusion of the mortality to produce a value added protein product. Other procedures such as fermentation, acid preservation and refrigeration are used temporarily to maintain the mortality before it is rendered. These methods are not used frequently because of the monetary investment in labor and equipment.

Burial is very common and can be as a disposal pit or trench burial. Trench burial is generally utilized when there are catastrophic losses and disposal pits are typically used for normal daily mortality. The major concern with burial disposal is the potential impact upon ground and surface water contamination.

Rendering is a good method which converts mortality to an added value product as a protein feed stuff. The major disadvantage to rendering is the potential for spread of disease organisms through an inadvertent mistake or a lack of biosecurity during the transportation of carcasses to the rendering plant.

Composting is a more recent procedure developed for the disposal of poultry mortality. The method uses naturally occurring microorganisms (bacteria and fungi) to convert mortality and litter into a product which can be used as a soil amendment on the farm. It is important to note that the final composition of the compost can be highly variable depending upon the management of the process.

Incineration is the most biologically safe method of all disposal methods because it reduces the carcasses to ash using very high temperatures. There is no threat to water quality and is safe from the threat of spreading disease. Incineration also will not promote problems of insects or vermin. There may be some concern for air quality if the incinerators are not properly designed or if they are improperly managed.

Criteria for Selection of Disposal Method

The criteria a person must use to determine the most suitable disposal method needs to include the economics of each method, the reliability of the procedure, the degree of biosecurity the method offers, and the way the method will fit into one's particular operation.

The cost of labor, the availability of needed equipment and the amount of mortality which needs to be disposed of all have to be considered in the disposal assessment. The pattern of mortality is also important. Carcass mass is rather consistent in a breeder or layer operation but a grow out operation will have a varied amount as body size increases with age. Catastrophic losses can create havoc with any disposal method and alternative procedures should be in place in case of a severe disease outbreak or a management problem such as ventilation failure which may cause high losses. When evaluating the disposal methods, one should examine carefully the most recent information available. Technology has been changing rapidly and sound management decisions should not be made from inappropriate or outdated information data.

Incineration was a very popular method until the 1970's when fuel prices escalated and made the method costly. Most information on the efficiency of incineration is based upon the older styles of incinerators and not the newer designs. The newer designs utilize an improved single burner in combination with a redesigned fire box which enhances combustion. Newer incinerator design was evaluated in a recent study at NCSU for its efficiency. During these studies carcasses from the following groups were used to evaluate the incinerators: 3-week old broilers, 7 week-old broilers, 65 week-old broiler breeders, 72 week-old commercial layers and 18 week old turkey toms. A new style incinerator[1] was used having a capacity of 250 pounds for the smaller carcasses and 200 pounds for the larger carcasses. Five loads from each class of bird were incinerated and there were no differences noted in fuel efficiency between the first burn and subsequent burns. The results were calculated on a carcass mass of at least 1000 pounds. It was evident from the data gathered that the carcass fat acted as a fuel for the incineration which increased the efficiency of the incinerator. The broilers, which were incinerated when three weeks-old, had little or no carcass fat while the seven week-old broilers, the broiler breeder, commercial layer and turkey had substantial body fat. The labor required to properly manage the incinerator was recorded. Results of the fuel efficiency for the new design incinerator are shown in Table 1. Additionally, an older design incinerator[2] with 2 burners was tested at the same time that the 3 week-old broilers and the 72 week-old layers were incinerated to evaluate the extent of the efficiency gained with the newer designs.

Table 1.

Efficiency of the different designs of incinerators

Species	Newer Design Incinerator Pounds of Carcass/Gallon Propane	Older Design Incinerator Pounds of Carcass/Gallon Propane
3 week old broiler	15.4	9.9
7 week old broiler	25.1	N/A
Broiler Breeder	28.0	N/A
Commercial Layer	31.1	11.1
Turkey	27.7	N/A

The results between the older model and the newer model show that increased efficiency has been attained. Thus, the economics of incineration may make it again a viable alternative for disposal of poultry mortality on some farms.

Composting of mortality was developed a number of years ago as an alternative to disposal pits due to the concern with the possibility of ground water contamination in areas of high water tables. Composting consists of the layering of a carbon source such as litter with carcasses combined with the proper amount of moisture and air introduction for maintenance of aerobic conditions to provide the optimal environment for the microbial degradation. Composting requires the monitoring of the compost temperature as an indicator of the microbial activity within the bin. The compost bin must be aerated by physically turning the compost material introducing oxygen, thus starting another heat cycle when the compost temperature declines. Previous work by the authors with forced aeration of the compost bin demonstrates that the mechanical turning of the compost is essential. It appears that the mechanical turning helps to mix the compost bin and eliminate micro environments established in the bins. This makes having a front-end loader essential for operation of a composter. The composting carcasses need to go through three heat cycles to insure complete decomposition and destruction of potential pathogens.

Comparison of Costs for Incineration and Composting

Incineration and composting were compared as mortality disposal methods in this study for three types of poultry. The types included were broilers, broiler breeders, and commercial layers. It would be inappropriate to use the same cost efficiencies of a particular method for all types of poultry as different body compositions exist. The following cost analysis is based upon data collected for each poultry type with regards to fuel consumption, composter capacities needed, and labor evaluations. Certain assumptions will still have to be made with regards to the amount of mortality and some fixed and variable costs that are specific for a farm. However, as long as an individual is aware of these assumptions, adjustments can be made when evaluating one's own operation (i.e. Cost of building materials, fuel, etc.). The size of the incinerator purchased and composter built is varied to best suit a farm based upon the type of poultry and the mortality expected.

A few assumptions to be made in the case of composting are whether a front-end loader is available, how the cost is assessed for time used and the labor involved. It is imperative that a front-end loader be used to turn the compost bin at the appropriate time to insure proper composting. Labor criteria will not include the cost of gathering carcasses but rather the cost of moving them from the house and disposing by the indicated method. Composting trials were conducted concurrently with the incineration trials to assess the labor costs to properly compost carcasses.

Commercial layers:

Assumptions to be made use a 100,000 hen production unit and are based upon an expected death rate of 0.5% per month. Using an average weight of 3.75 pounds will result in approximately 62 pounds per day or 22,500 pounds per year.

Assumption for incineration: Using a Shenandoah A-6 Incinerator (200 pounds capacity), and assuming fuel usage of 31.1 pounds of commercial layer carcass mass per gallon of propane which was arrived at through the work outlined above of Wineland et al., 1995. An inexpensive shed with only a roof needs to be constructed to protect the incinerator from the weather and prolong the life expectancy. Labor is calculated at 20 minutes per day to load and clean the incinerator.

Assumption for composting: A composter having a bin capacity (primary and secondary) as per *Composting Poultry Mortality*, Poultry Science and Technology Guide No. 47, North Carolina Cooperative Extension Service. Costs of the composting facility is from current costs utilized by industry constructed composters. Labor is assumed to be 30 minutes daily with an additional ¾ hour to turn the compost bin and 1½ hours to empty and spread the compost material on a field. The cost of a front-end loader will be charged at the rate of $20/hour with an average use of 1½ hours per week including turning use. The litter used in the composter is charged a value of $200 a year as litter is not available in a commercial layer operation and sawdust will need to be purchased.

Table 2.

Estimated Annual Cost of

Incineration and Composting of Commercial Layers

	Incinerator		Composting
Capital Investment			
Incinerator cost (Shenandoah A-6)	$2000		----
Shed and base slab cost or composter	$ 500		$1250
Water service	---		$ 150
Total	$2500		$1400
Annual Fixed Costs			
Building and/or incinerator (10 year life expectancy)	$ 250		$ 140
Interest on investment (10% interest rate, one half of investment at 10%	$ 125		$ 70
Maintenance and repair	$ 50		$ 80
Insurance (0.5% of investment)	$ 13		$ 7
Annual Variable Costs			
Fuel 724 gallons @ .70/gal	$ 507		---
Electricity	$ 55		---
Labor (20 min a day @ $6/hr) 365 days)	$ 730	(215 hr @ $6/hr)	$1290
Machinery	---	(32.5 hr @ $20/hr)	$ 650
Total	$1730		$2237

Broiler Breeders:

The assumptions to be made use a 10,000 breeder facility which has an average mortality for the hens of 0.35%/week and 1.5%/week for males. This will produce approximately 32 hens/week (8 lb.) and 15 males/week (11.5 lb.) for a total of 434 pounds of carcass mass (62 pounds per day) per week for 45 weeks (315 days) during the year (19,530 pounds).

Assumption for incineration: Using a Shenandoah A-6 Incinerator (200 pounds capacity), assuming fuel usage of 28 pounds of broiler breeder carcass mass per gallon of propane which was arrived at through the work outlined above of Wineland et al., 1995. An inexpensive shed with roof only is constructed to protect the incinerator from the weather and prolong the life expectancy. Labor is assumed to be 20 minutes daily to load and clean out the incinerator.

Assumption for composting: A composter having a bin capacity (primary and secondary) per *Composting Poultry Mortality*, Poultry Science and Technology Guide No. 47, North Carolina Cooperative Extension Service constructed at costs current in industry. Labor is assumed to be 30 minutes daily with an additional ¾ hour to turn the compost bin and 1½ hours to empty and spread the compost material on a field. The cost of a front-end loader will be charged at the rate of $20/hour with an average use of 1 ¼ hour per week. The litter used in the composter is not assigned a value as it will be negated by the value of the compost material.

Table 3.

Estimated Annual Cost of

Incineration and Composting of Broiler Breeders

	Incinerator		Composting
Capital Investment			
Incinerator cost (Shenandoah A-6)	$2000		----
Shed and base slab cost or composter	$ 500		$1250
Water service	---		$ 150
Total	$2500		$1400
Annual Fixed Costs			
Building and/or incinerator (10 year life expectancy)	$ 250		$ 140
Interest on investment (10% interest rate, one half of investment at 10%	$ 125		$ 70
Maintenance and repair	$ 50		$ 80
Insurance (0.5% of investment)	$ 13		$ 7
Annual Variable Costs			
Fuel 698 gallons @ .70/gal	$ 489		---
Electricity	$ 55		---
Labor (20 min a day @ $6/hr) 315 days	$ 630	(185.75 hr @ $6/hr)	$1114.50
Machinery	---	(28.25 hr @ $20/hr)	$ 565.00
Total	$1612		$1976.50

Broilers:

The assumptions to be made use a broiler farm having a capacity of 100,000 broilers, raised to 7 weeks of age and having 6 flocks per year. A broiler operation having a capacity of 100,000 may demonstrate a mortality profile such as:

Table 4.

Age (Weeks)	1	2	3	4	5	6	7
Total Mortality	0.972%	0.628%	0.484%	0.46%	0.476%	0.58%	0.904%
Carcass Mass (lb.)	332	532	744	1092	1584	2536	4876

This data is a compilation of normal mortality figures on two farms for 5 flocks each.

It is rather apparent that with increasing the bird's age, disposal becomes more of a concern and time consuming aspect. Because of the variability in a grow out operation, disposal method must be adequate to handle the maximum mortality.

Assumption for incineration: Using a Shenandoah A-15 Incinerator (500 pounds capacity), fuel usage is assumed to be 15.4 pounds of broiler carcass per gallon of propane through 4 weeks of age and 25.1 pounds of carcass per gallon of propane from 5 through 7 weeks of age. This assumption is based upon the data above produced by Wineland et al. 1995. An inexpensive shed with roof only is constructed to protect the incinerator from the weather and prolong the life expectancy. Labor for incineration will vary also with age of flock. It is assumed that the daily labor input will be 10, 20, 25, 30, 30, 45, and 75 minutes for weeks 1 through 7 respectively. The last week will require multiple loading of the incinerator.

Assumption for composting: A composter having a bin capacity (primary and secondary) as per *Composting Poultry Mortality*, Poultry Science and Technology Guide No. 47, North Carolina Cooperative Extension Service constructed at costs current in industry. Labor is assumed to be 20, 25, 30, 35, 40, 55, and 75 minutes daily for weeks 1 through 7 respectively. An additional ¾ hour to turn the compost bin and 1½ hour to empty and spread the compost material on a field is assumed for each bin. The cost of a front-end loader will be charged at the rate of $20/hour with an average use of 1 ¼ hours per week. The litter used in the composter is not assigned a value as it will be negated by the value of the compost material.

Table 5.

Estimated Annual Cost of

Incineration and Composting of Broilers

	Incinerator		Composting
Capital Investment			
Incinerator cost	$3000		----
Shed and base slab cost or composter	$ 500		$3600
Water service	---		$ 150
Total	$3500		$3750
Annual Fixed Costs			
Building and/or incinerator (10 year life expectancy)	$ 350		$ 140
Interest on investment (10% interest rate, one half of investment at 10%	$ 175		$ 70
Maintenance and repair	$ 55		$ 80
Insurance (0.5% of investment)	$ 17.5		$ 7
Annual Variable Costs			
Fuel 3202 gallons @ .70/gal	$2241		---
Electricity	$ 175		---
Labor (27.5 hrs per flock @ $6/hr for 6 flocks/yr)	$ 990	(277 hrs @ $6/hr)	$1662
Machinery	---	(51 hrs @ $20/hr)	$1620
Total	$4003.50		$4093

Summary

The results of this study indicate that incineration of poultry mortality can be a viable alternative for an operation. It is true that a case could be made to alter the assumptions made in our study for either incineration or composting, but the assumptions were made based upon actual costs experienced in a poultry operations. The actual decision as to which method is best for a particular farm should be based upon the individual circumstances on each farm and the restrictions they must adhere to. One of the first steps in developing information from which to make an informed decision is to develop a budget similar to the ones presented, using a producer's own cost information.

[1]. new design incinerator used in the trials was a Shenandoah A-10

[2]. older design incinerator used in the trials was the two burner Shenandoah A-4

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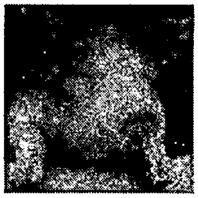

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Alternative Methods for the Disposal of Swine Carcasses

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Introduction

There is probably no one "best way" to dispose of swine mortality carcasses. The optimum system for any particular farm location would need to be selected based on a number of criteria, including the current state of the protein/oil market, the biosecurity required, the distance to processing sites, the local public's perception, and the government regulations that apply to that location. Regardless of the method of choice, the public's concern for the environment and increasingly restrictive regulations governing the disposal of dead pigs will continue to present new challenges for the swine industry. The tonnage of dead pigs produced annually is substantial. A typical 5000 sow farrow-to-finish farming system (with mortality losses of 7%, 10%, 5%, 1%, and 1% in the sow, neonatal, nursery, growing, and finishing herd, respectively) will produce over 200,000 pounds of dead pigs annually. In many farming systems in the USA, actual losses may be much higher. The integration of swine agriculture has concentrated these mortality losses into smaller and smaller geographic areas. A company in North Carolina responsible for handling most pig and poultry mortality carcasses in eastern North Carolina processes over 170 tons of mortality wastes per day. The disposal problem created in catastrophic situations, such as the hurricanes to hit North Carolina or a foreign animal disease outbreak such as foot-and- mouth disease, creates special problems and requires additional resources.

In the past, mortalities have typically been buried, incinerated, or rendered into fats and animal protein by-products for feed manufacturing. Now, each of these options is less acceptable or unavailable because of restrictive regulations or excessive costs. Buried animals have the potential to contaminate ground water and incinerator smoke can contribute to air pollution. In the USA, many rendering plants were closed when faced with heightened environmental regulations imposed by the Environmental Protection Agency (EPA), eliminating this disposal option for many hog operations. The industry's challenge is to find inexpensive, biologically safe, and environmentally friendly alternatives for the disposal of dead pigs.

On-Farm Procedures

The means of carcass disposal is dependent upon the economic size and networking of commercial pig farms, their geographical location and land-base, and available infrastructure and utility service. In North Carolina, most swine mortality carcasses from company-owned or large contract farms are delivered to a rendering plant, whereas smaller operations dispose of carcasses on the farm. On-farm disposal techniques include trench burial, disposal pit, burning, and composting. The major advantage of an on-farm system is biosecurity. Outside mortality collection trucks are not required to visit the farm, nor do farm trucks have to risk contamination when delivering mortality carcasses to a rendering plant or central collection site.

Trench Burial

Trench burial is used extensively because it is an inexpensive and efficient method of mortality disposal. Producers typically dig a trench with a backhoe to the width of the bucket and length dependent on the capacity required. After burial, the pigs slowly decompose until they are unrecognizable after a few years. The major disadvantage of burial is the possibility of contaminating groundwater, particularly in areas with sandy soils and a high water table. In colder areas it is difficult, if not impossible, to dig trenches when the ground is frozen. Also, predators can uncover carcasses if they are not buried deep enough, which is unsightly and increases the risk for the spread of diseases.

To our knowledge, every pig-producing region allows burial of dead pigs, although this is likely to change in the future for a few states in the USA. Because burial is such a basic technique for disposal of swine mortality carcasses, there is no research documenting its advantages or disadvantages, including whether or not it contributes to groundwater pollution. The burial requirements for various states' in the USA are reviewed in National Hog Farmer (Hermel, 1992).

Disposal Pit

Disposal pits are most frequently used in poultry, but in the swine industry they have some advantages over other burial techniques, especially for the disposal of afterbirth and dead nursery pigs. Disposal pits are easily built with solid walls and top but permeable base so carcasses can be added continually (Wineland, 1990). Provided the pit is built to exclude the entry of rainwater, little water will leak from the base because the decomposition process produces little water. For a review of the construction and operation of on-site disposal pits for poultry read Sweeten and Thornberry (1984).

The digestion process in a disposal pit depends on the successive interaction of a variety of organisms (La Riviere, 1977). Although there is some aerobic activity at the top of the pile the carcasses mostly undergo anaerobic digestion. Microorganisms anaerobically digest the carcass into substrates for bacteria that produce methane, carbon dioxide, and many other compounds, some of which are malodorous. Anaerobic digestion can generate hydrogen sulphide in concentrations that can exceed human safety levels (Malone 1988). Decomposition rate of mortality is enhanced by a variety of insects that consume flesh and burrow through the surface of the skin to increase exposure to microorganisms (Rives et al., 1992). Temperature, pH, and oxygen also affect the composting process. If the environment favors the growth of acid-forming bacteria, then a decomposition-inhibiting fermentation can occur. This acid fermentation can be prevented by periodic application of hydrated lime. Lomax and Malone (1988) showed that decomposition of poultry mortality was faster at 350C than at 240C, allowing for higher loading rates. A major advantage of disposal pits is that producers are able to dispose of their mortalities on the farm rather than have someone collect them and thus create a biosecurity risk.

Incineration

Among all the methods of mortality disposal, incineration generates the most public complaints in the USA and therefore is the least likely to remain an option (Murphy and Handwerker 1988). Incineration eliminates all pathogens but high operational costs and incineration's potential to contribute to air pollution (if not properly maintained and operated) decreases its usefulness for widespread use as a mortality carcass disposal option. Incinerators can be made from old low pressure (LP) gas tanks for less than $1000 (but last only about 5 years) or purchased fully insulated with afterburners to reduce emissions for less than $2000. Operational costs include grates that must be replaced every 2-3 years and the oil or gas fuel. A160-sow farrow-to-finish demonstration farm at Rocky Mount, NC averaged 844 gallons of fuel oil/year for the eight years ending 1990. If fuel oil costs $1/gallon, that alone is $5.27 per sow inventory per year. All major hog producing states in the USA allow for the incineration of hogs but specifically do not permit pigs to be burnt in the field. In the State of Missouri, farm incinerators must be inspected and permitted annually just as are industrial incinerators. The cost (about $2000 per year) to maintain an incineration permit is passed onto the farmer. The costs associated with this regulation are resulting in a rapid phase-out of farm incinerators in that state.

Composting

Many poultry producers are choosing composting as their disposal method of choice, but some find the labor costs prohibitive. Composting uses organic by-products such as dead pigs, straw, or sawdust and converts them into an odorless, inoffensive, generally pathogen-free product that can be used as a soil amendment or organic fertilizer. Composting pigs is very similar to composting garden waste. A succession of mesophilic and thermophilic microorganisms, including bacteria, fungi, and actinomycetes, feed on the organic substrates to produce carbon dioxide, water, minerals, and a stabilized organic matter called humus. The speed and efficiency of this aerobic process depends on the temperature, nutrients, moisture, availability of oxygen, and particle size.

Temperature

Some decomposition occurs at any temperature because of the diversity of temperature- sensitive organisms in a compost pile. However, the optimum temperature for microbial activity is less than 550°C (McKinley 1985). The temperature can be controlled by adjusting aeration and moisture and covering the pile with an insulating layer of the carbon source (e.g., straw or sawdust) each time pigs are added. In Missouri, decomposition of pig carcasses slowed considerably in winter but increased in the spring when temperatures rose. In North Carolina, our research compost piles containing swine mortality carcasses have consistently reached temperatures over 550°C, killing most of the Salmonella, and all of the Erysipelas, in broth cultures placed throughout the pile. Poultry compost piles routinely attain 700°C.

Nutrients

The microorganisms that decompose the pigs and produce the humus need appropriate nutrients to work effectively. The most important are carbon and nitrogen. Common carbon sources include sawdust, shavings, cotton gin trash, wheat straw and others. The primary nitrogen source when composting swine mortality carcasses is the carcasses themselves. A carbon/nitrogen ratio between 20:1 and 35:1 is optimal. Above that range, decomposition slows. Below 15:1, nitrogen is lost as ammonia, which reduces the value of the humus and creates an odor problem. Getting this ratio right is a major factor in successful composting. Phosphorous, sulfur, calcium, and trace quantities of other nutrients are also required for optimal cell growth during the composting process but are usually in adequate amounts in the carcasses and carbon source.

Moisture

The optimum moisture level is 45-55%. Since water is essential for nutrient solubility and cellular protoplasm, moisture content below 20% can severely inhibit the composting process. However, too much water will block air movement, causing the pile to become anaerobic, thus slowing the composting process and increasing the emission of odors associated with the process.

Oxygen

Decomposition occurs fastest in fully aerobic conditions. However, aerobic conditions probably exist only at the periphery of the 6X4X5 ft compost piles commonly constructed. Therefore, composting operators must mechanically aerate their piles by periodically turning the pile, inserting perforated tubes, dropping the piles from floor-to-floor or pumping air through them. Conversely, too much aeration can dehydrate the pile, waste heat, and fail to attain the temperature to operate successfully or to kill the pathogens. In practice, the piles are turned 2-3 days after temperatures peak. Turning aerates the piles and restarts the decomposition process.

Particle Size

The smaller the particle sizes of the compost the greater the surface area available on which microorganisms can work. However, some of the ingredients must be large enough to provide structural support and to trap the oxygen necessary for aerobic digestion. In practice, pig carcasses need not be cut open and the straw that we have used provides carbon, structural support and the aeration necessary. Murphy (1992) reported that by cutting into the thorax, abdomen, and muscles it is possible to compost pigs weighing up to 300 pounds. We have had similar success when we dismembered and cut into the thorax and abdomen of large sow carcasses.

As Feed for Animals

The opportunity to render dead animals into protein by-product meals and feed them to pigs in Europe is fast disappearing because of concerns with diseases, such as bovine spongieform encephalopathy (BSE). Minnesota specifically allows feeding carcasses to mink because of the large mink industry in the state. However, the hazard of feeding dead pigs to animals is well known by any farmer who has lost dogs and cats by allowing them access to pigs that died of Aujeszky's disease (pseudorabies). Regardless, the opportunities still exist for feeding unprocessed carcasses to animals. One 2000 sow hog farmer in Pasco county Florida has profitably feed processed dead hogs and poultry to alligators that are slaughtered for their meat and hides (Walker and others, 1992). A pig farm in Singapore fed all its dead pigs to crocodiles whose hides were sold to the local leather industry.

Off-Farm Procedures

Landfill and rendering are the two main opportunities for off-farm carcass disposal.

Landifll

Landfill opportunities are rapidly decreasing as municipal authorities refuse to accept carcasses. With landfill tipping fees of $10-50 per ton, costs are becoming prohibitive in areas that still allow this practice. Landfills are most often used when death losses exceed everyday disposal capacity or under disaster situations.

Traditional Rendering

For producers with access to a protein recovery plant, rendering has been, and will continue to be the best means for converting swine carcasses into a nutritionally valuable and biologically safe protein by-product meal. Unfortunately, the number of rendering facilities operating in the USA is decreasing, especially among small local plants that accept mortality carcasses. Many rendering plants have closed because of more stringent EPA regulatory action and/or because of the depressed world prices for fat, protein, and hides. As a consequence, the remaining plants are further apart making it cost-prohibitive to transport carcasses to these locations for disposal. To accommodate this transportation limitation, some areas have designated sites for the central pickup of carcasses. However, strict rules must be enforced to assure biosecurity when these central sites are used by many different producers (Parsons and Ferket, 1990). Other areas use technologies (freezing, fermentation, or acid preservation) that enable carcasses to be stored on-farm until enough accumulate to make a trip to the renderer more feasible.

Recently, a large poultry integrator has developed a purpose built freezer for holding dead broilers. They use it extensively for preserving carcasses before taking them to a renderer. Each freezer holds about one ton of dead broilers. The electricity costs at about $1.20 per day or $0.01 per pound of dead bird assuming $0.08 per kilowatt hour. These units are generally available for about $2000. Freezing may also become the storage method of choice for the preservation of small swine mortality carcasses.

Fermentation provides a system that can store carcasses for at least 25 weeks and produces a silage end product that is pathogen free and nutrient rich (Parsons and Ferket, 1990; Murphy and Silbert, 1992). Fermentation is an anaerobic process that can proceed in any size non-corrosive container provided it is sealed and vented for carbon dioxide (Parsons and Ferket, 1990); 55 gallon drums are commonly used. Daily, carcasses are ground to 1" or smaller particles, mixed with a fermentable carbohydrate (CHO) source and culture innoculant and then added to the fermentation container. The grinding aids in homogenizing the ingredients. For lactic acid fermentation, lactose, glucose, sucrose, whey, whey permeate, and molasses are all suitable as a CHO source. Under optimal conditions the pH of fresh carcasses is reduced from 6.5 to less than 4.5 within 48 hours. Properly prepared silage will remain biologically stable for months and is readily accepted for rendering. Fermented poultry offal, fed at up to 20% of growing-finishing pigs' ration, does not depress gains or increase feed-to-gain ratios (Tibbetts and others, 1987). But, no one has documented feeding hogs the silage from fermented whole birds or pigs and the practical application of feeding fermented mortalities is limited. The USDA Federal Swine Health Protection Act, which regulates garbage feeding, prohibits the feeding to swine of any mortality products that have not been either rendered, boiled for 30 minutes with agitation, or extruded at 284oC. Other potential uses for fermented carcasses are in mink or fox feed, extruded aquaculture feeds, and ruminant silage. Sanders (1990) reviewed the topic.

Fermentation with Lactobacillus acidophilus destroys many bacteria including Salmonella enterica ssp (Kahn 1969), Salmonella enterica Typhimurium (Slywester, 1968), and Clostridium botulin type E (Wirahadikusumah, 1968). Viruses labile to low pH do not survive fermentation and inactivation occurs rapidly at 400C, but more slowly at lower temperatures (Gilbert, 1983). Most importantly, in fermented silage, Aujeszky's disease virus (ADV) is rapidly inactivated at 200C to 300C but survives two days at 100C and nine days at 50C (Gilbert, 1983). The optimum temperature for fermentation is about 350C but silage temperature approximates ambient temperatures, indicating that ADV may not be inactivated in colder regions.

Ground mortality carcasses can also be preserved by the addition of inorganic acids. A 3.4% sulfuric acid solution added to ground, split, or punctured dead broilers preserves them for at least one month at a cost of $0.10 per pound of carcass (Malone 1988). When this acid-preserved product is rendered it has the same nutritive value as regular poultry-byproduct meal. In the past, sulfuric acid was used, and it worked well, but the inherent danger of handling the stock solution is a primary concern. Recent work at NC State University has demonstrated that phosphoric acid is a more practical acid for nutrient preservation and increases the nutritional value of the by-product meal by providing phosphorous and making the proteins more stable to microbial degradation. Middleton and Ferket (2001) reported that the inclusion of about 8% (w/w) phosphoric acid with ground poultry mortality carcasses eliminated coliforms and other spoilage bacteria, and prevented protein degradation as indicated by a rise in volatile nitrogen and silage pH over 6 weeks of storage. Only 5% phosphoric acid was needed to maintain the nutritional quality of silage for two weeks of storage. Addition of 500 ppm ethoxyquin to the phosphoric acid-preserved poultry silage was also found to significantly preserve lipid quality (Middleton et al., 2001). Phosphoric acid preservation of ground mortality carcasses with the antioxidant ethoxyquin resulted in superior protein and lipid quality in comparison to preservation by either lactic acid fermentation or freezing. Moreover, phosphoric acid preservation is technically more reliable than lactic acid fermentation, especially when the carcass grinding and acid application process is automated (Ferket et al., 1998).

Non-Traditional Rendering

Instead of using conventional rendering procedures, ground mortality can be converted into a feedstuff by fluidized-bed drying, flash dehydration, or extrusion. These technologies studied at North Carolina State University's Animal and Poultry Waste Management Center may emerge as an economical and environmental alternative to conventional rendering of dead pigs.

In fluidized-bed drying or flash dehydration, the material flows along a channel of super-heated air. Flash dehydration can be used to dry many types of wet wastes, but it is most applicable for drying animal by-products and offals. Depending on the moisture and fat contents, ground swine mortality carcasses must be blended with an organic carrier to facilitate the flash dehydration process. The current equipment can evaporate 500 gal of water per hour, using approximately 1300 BTU's per pound of water evaporated. In drying dead pigs, higher efficiencies have been documented, perhaps because the equipment burns some of the more volatile fats in the pigs. The high temperatures and short dwell times of flash dehydration cause little damage to protein quality, resulting in superior protein digestibility. If sterilization of the product is required, the meal can be dehydrated to about 10% moisture and subjected to extrusion processing. The cost to dehydrate turkey mortalities to 20% moisture is about $27 per ton of final product and $40 per ton if followed by extrusion (Personal communication, Duncan Nesbitt, Ziwex Recycling Technology USA Inc. 1992). These costs assume $1.10/gal for fuel, 12 cents/kwh and 75 cents per ton maintenance.

Extrusion is not a new technique for the food industry. It has been used to process human foods for more than 50 years, producing 13 billion pounds of product with a market value of $8 billion annually. If extrusion is used to process carcasses it will most likely be done centrally because of capital costs. However, if it can also be used on site to extrude full-fat soybeans and creep feed, individual farmers may be able to justify the cost.

Finely ground high-moisture material is mixed with an organic carrier to a moisture content of about 30% and then subjected to processing by friction heat, shear, and pressure within the dry extruder barrel. In the extruder barrel, a screw (or screws) forces the material through a series of flanged steam locks where temperatures of 115-1550C and pressures of 20-40 atmospheres develop within 30 seconds. The sudden decrease in pressure as the product leaves the extruder causes it to expand and lose 12-15% of its moisture. The food industry mostly uses single screw dry extruders because they are about 50% less expensive, in terms of capital and operating expense (Hauck 1990). However, double-screw systems can better cope with the high moisture ingredients and therefore may be more appropriate for dead pig disposal. Bacteria, molds, and viruses are readily inactivated by extrusion (Reynolds, 1990).

Summary

The age of the environment started in the 1980's and will continue into the 21st century and beyond. The swine industry has adopted, and will continue to adopt, those technologies that enable it to meet increasingly rigid environmental standards, particularly those that it can use to increase the value of its waste products. For farms that do not have ready access to rendering facilities, composting has been shown to be an effective method of disposal for swine mortality carcasses, particularly in the warmer, southern areas of the U.S. The cold northern winters may restrict outdoor composting, but it may be economical to provide composting space inside the hog units. Of all the techniques available to extend on-farm storage of carcasses, fermentation or acid preservation are the most attractive. Although it is not always possible, we need to adjust our thinking about dead pig disposal and consider how we can turn mortalities into a profit center. Recycling our mortality wastes will save the industry money, reduce the environmental impact of carcass disposal, and enhance the reputation of the swine industry.

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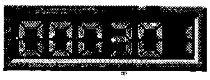

Poultry Mortality Disposal Guidelines for Alberta

Poultry Mortality Disposal - 3,621K PDF

An unfortunate reality of animal production is death loss. This factsheet will introduce you to alternative disposal methods and Alberta's minimum legal requirements for each system. In-depth information on mortality disposal can be found in Poultry Mortality Disposal in Alberta a publication available from Alberta Agriculture, Food and Rural Development. Computerized economic analysis software is also available for download at http://www.agric.gov.ab.ca/livestock/poultry/MeanInstall.exe

An online help guide for the program can be viewed at:
http://www.agric.gov.ab.ca/livestock/poultry/meanhelp.html

The five methods that can be used by Alberta poultry producers for the disposal of on-farm mortalities are:

- Rendering
- Composting
- Incineration
- Burial
- Natural Disposal

Rendering

Rendering is a heating process that extracts recyclable ingredients such as protein and fat from offal. It is simple, relatively low in cost and sustainable because a waste product is converted to a useful and valuable resource. **Advantages:**

- Nutrients are recycled
- Low maintenance

Disadvantages:

- Pick-up fees may be charged if your farm is not located near the rendering plant
- You'll need a biosecurity plan to prevent disease spreading to your farm from the rendering truck
- Purchase of a freezer may be required to store carcasses

An economic analysis for rendering can be found on page 16 of Poultry MortalityDisposal in Alberta.

Composting

Composting is a natural process which reduces and transforms organic wastes into a useful end product -

compost - which can be used as a fertilizer without danger of disease transfer. There are a few things you need to know before you can compost carcasses on your farm. The compost facility must be:

- Located at least 100 m from wells or other domestic water intakes, streams, creeks, ponds, springs and high water marks of lakes and at least 25 m from the edge of a coulee, major cut or embankment
- Located at least 100 m from any residences
- Designed in a manner to exclude scavengers
- Located at least 100 m from any livestock facilities, including pastures, situated on land owned or leased by another person

Advantages:

- Compost can be used as fertilizer, reducing fertilizer costs for crop operations
- Environmentally safe

Disadvantages:

- Initial cost of constructing compost facility
- Labour intensive since daily monitoring is required
- Land or a suitable market is required to utilize the finished product

An economic analysis for composting can be found on page 19 of Poultry Mortality Disposal in Alberta.

Incineration

Biologically, this is the safest method. Carcasses are burned using an approved incinerator that meets air emission guidelines. The incinerator must meet the guidelines of the Substance Release Regulation, the Code of Practice for Small Incinerators, and must meet any municipal by-laws. **Advantages:**

- Biologically the safest method - complete destruction of carcasses and potential disease agents

Disadvantages:

- Organic nutrients are not recycled, but destroyed
- Initial cost is high
- Ongoing costs for incinerator operation
- Improper operation of incinerator can create unpleasant odors and could result in a nuisance complaint.

An economic analysis of incineration can be found on page 22 of Poultry Mortality Disposal in Alberta.

Burial

A simple option which requires that a pit be dug and later filled with carcasses. The legal requirements for burial are:

- The weight of dead animals in the pit cannot exceed 2500 kg
- The pit must be located

  - at least 100 m from wells or other domestic water intakes, streams, creeks, ponds, springs and high water marks of lakes and at least 25 m from the edge of a coulee, major cut or embankment
  - at least 100 m from any residences
  - at least 100 m from any livestock facilities, including pastures, situated on land owned or leased by another person
  - at least 300 m from a primary highway, 100 m from a secondary highway and at least 50 m from any other road allowance
- The pit must be covered with
  - either a minimum of 1m of loose soil or 0.6 m of compacted soil (or)
  - a wooden or metal lid that is designed to exclude scavengers if quicklime is applied to the dead animals in sufficient quantities to control flies and odor.
- The bottom of the pit must be 1 m above the seasonal high water table.

Advantages:

- Capital expense is limited to land

Disadvantages:

- Nutrients are not recycled as in rendering and composting
- Risk of disease spread if carcasses are improperly buried
- Difficult or impossible to bury during winter
- Possibility of environmental damage due to leaching
- Large land base required for large operations

An economic analysis for burial can be found on page 25 of Poultry Mortality Disposal in Alberta.

Natural Disposal

Natural disposal is NOT an acceptable means of disposing of your dead birds. It will be difficult to dispose of birds this way since the location of disposal sites is subject to strict guidelines. The legal requirements are:

- Total weight of animals to be disposed at one site cannot exceed 1000 kg
- Disposal sites must be located 500 m from each other
- Sites must be located
  - at least 500 m from wells or other domestic water intakes, streams, creeks, ponds, springs and high water marks of lakes and at least 25 m from the edge of a coulee, major cut or embankment
  - at least 400 m from any residences
  - at least 400 m from any livestock facilities, including pastures, situated on land owned or leased by another person
  - at least 400 m from any provincial park, recreation area, natural area, ecological reserve, wilderness area or forest recreation area
- Disposal cannot create a nuisance.

Advantages:

- Advantages are outweighed by disadvantages, and this method is not recommended.

Disadvantages:

- Threat of disease transmission is high
- Does not promote a good image of the poultry industry
- Large land base required to meet siting requirements
- Possible surface run-off contamination, in addition to leaching that could damage groundwater resources.

To order a copy of Poultry Mortality Disposal in Alberta write to: # 204 J.G. O' Donoghue Building, 7000-113 Street,
Edmonton, AB T6H 5T6

This information is maintained by Brenda Schneider
Last Revised/Reviewed August 21, 2002

[Top of Document]

North Carolina Cooperative Extension Service

Water Quality & Waste Management

Formulating a Mortality Compost Recipe

Prepared by:
James C. Barker, Professor and Extension Specialist
Biological and Agricultural Engineering
North Carolina State University, Raleigh, NC

Published by: North Carolina Cooperative Extension Service

Publication Number: EBAE-174-93

Last Electronic Revision: March 1996 (JWM)

The following example formulates a poultry mortality compost recipe from three ingredients (broiler carcass, house litter and wheat straw) plus water. Typical moisture contents and carbon - to - nitrogen (C/N) ratios of various raw ingredients are:

	Moisture Content %wb	C/N
Poultry carcass	70	5
Fresh manure, swine	90	6
, poultry	75	6
, cattle	85	8
Poultry house litter, cake	50	7.5
, mixed	25	10
, stockpiled	40	15
Yard waste	72	14
Grass clippings	-	19

Horse stable manure	50	25
Legume grass hay	-	25
Potato tops	-	25
Fruit waste	-	35
Leaves	-	40-80
Peanut hulls	10	50
Cornstalks	12	60
Straw, oat	10	80
, wheat	10	130
Bark	-	100
Paper	20	170
Sawdust	25	500
Wood chips	-	700
Desired final compost mixture	50-60	20-30

To balance the C/N ratio, use these algebraic computations and assumptions:

Let:

A = weight of carcass
B = weight of litter
C = weight of straw

Let:

$$A + B + C = 1$$
$$B = 1.5\ A$$

i.e., by weight the recipe has 1.5 parts litter to 1 part carcass. For litter with higher C/N ratios, use 2 parts litter to 1 part carcass. How many parts straw are needed to balance the C/N ratio?

$$C = 1 - A - B$$
$$= 1 - A - 1.5\ A$$
$$= 1 - 2.5\ A$$

$$A \times 5 + B \times 10 + C \times 130 = 1 \times 20$$

$$A \times 5 + 1.5\ A \times 10 + (1 - 2.5\ A) \times 130 = 1 \times 20$$

$$5\ A + 15\ A + 130 - 325\ A = 20$$

$$5\ A + 15\ A - 325\ A = 20 - 130$$

$$-305\ A = -110 \quad \text{which is the same a}$$
$$305\ A = 110$$

					Parts by weigh
carcass:	A = 110 / 305	=	0.36	0.36 / 0.36	= 1.0
litter:	B = 1.5 A = 1.5 x 0.36	=	0.54	0.54 / 0.36	= 1.5
straw:	C = 1-A-B = 1 -.36 -.54	=	0.10	0.10 / 0.36	= 0.2

1.00	2.7

To balance the moisture content, use these algebraic computations:

```
          Average moisture content of solid ingredients  =

             0.36 x 70%  +  0.54 x 25%  +  0.10 x 10%    =   39.8 %

      Let:

                                 D     =   weight of solid ingredients
                             1 - D     =   weight of water needed
                       D + (1 - D)     =   1

         D x 39.8  +  (1 - D) x 100    =   1 x 50

          39.8 D  +  100  -  100 D     =   50

                  39.8 D  -  100 D     =   50  -  100

                           -60.2 D     =   -50      which is the same as
                            60.2 D     =   50
```

						Parts by weight		
solid ingred:	D	=	50 / 60.2	=	0.83	0.83 / 0.83	=	1.00
water:	1 - D	=	1 - 0.83	=	0.17	0.17 / 0.83	=	0.20

Mortality Compost Recipe:					Parts by weight							Pounds per 100 pounds compost mix
carcass:	1.00	x	1.00	=	1.00	0.36	x	0.83	x	100	=	30
litter:	1.50	x	1.00	=	1.50	0.54	x	0.83	x	100	=	45
straw:	0.27	x	1.00	=	0.40	0.10	x	0.83	x	100	=	8
water:	2.77	x	0.20	=	0.57	1.00	x	0.17	x	100	=	17

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EBAE 174-93

Back to Animal Operations | Back to Compost | Return to WQWM Home Page

Water Quality Initiative publication WQ211 — Reviewed October 1, 1993

Composting Layer Mortalities: Agri-Foods Composter

Charles D. Fulhage
Department of Agricultural Engineering, University of Missouri-Columbia

Joseph M. Vandepopuliere and Jesse J. Lyons
Department of Animal Sciences, University of Missouri-Columbia

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Composting poultry carcasses is a common way for turkey and broiler operators to manage bird mortalities. However, managers of poultry laying operations face their own set of challenges. In turkey and broiler operations, litter is a primary and convenient ingredient in the composting recipe. In laying operations, birds are maintained in cages, rather than reared on the floor. Therefore, no litter is available for the composting process. This publication describes a cooperative field research project between the University of Missouri and Agri-Foods, Hawk Point, Mo. The purpose of the project was to investigate the feasibility of composting bird mortalities in a typical layer operation. See MU publication WQ205, *Composting Poultry Carcasses in Missouri*, for more detailed information on composting mortalities.

Production facilities

The Agri-Foods layer operation consists of 10 buildings, each housing about 50,000 layers. Mortality averages about 0.75 percent per month, with a 3-pound average bird weight. Daily carcass weight under these conditions is about 375 pounds. Conventional composter design suggests providing 1 cubic foot of primary and secondary composting volume per pound of daily mortality, with an added safety factor of 2.5 to allow for periods of unusually high mortality because of conditions such as heat stress.

These design factors indicate primary and secondary composting volumes of 937.5 cubic feet for the Agri-Foods facility.

Composter

Agri-Foods' compost handling equipment included a skid-steer loader. The bucket size on this loader suggested a minimum composting bin width of 7.5 feet. Primary composting bins were sized at 7.5-feet wide by 6-feet deep by 5-feet high. These dimensions resulted in a volume of 225 cubic feet per bin, and four bins were constructed to provide required primary composting volume. Secondary composting bins were constructed 10-feet wide by 10-feet deep by 5-feet high, with a volume of 500 cubic feet per bin. Four secondary bins were built, for a total of 2,000 cubic feet of secondary composting volume. Extra secondary volume was provided so that compost could be stored for longer periods in the facility and to provide storage for ingredients such as straw. Figures 1, 2 and 3 show details of composter construction.

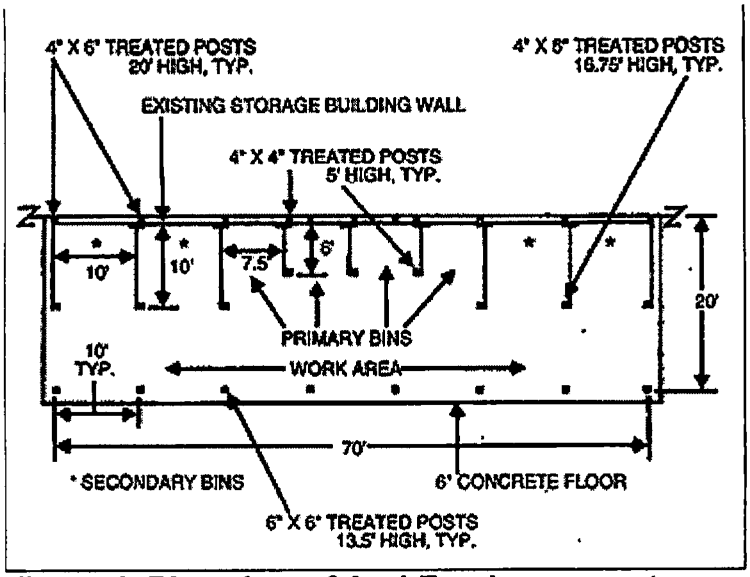

Figure 1. Plan view of Agri-Foods composter.

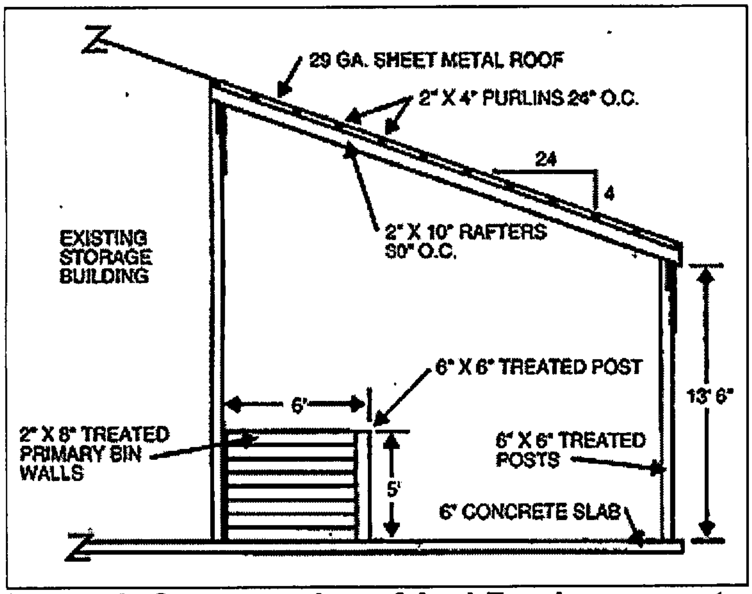

Figure 2. Cross section of Agri-Foods composter showing primary bins.

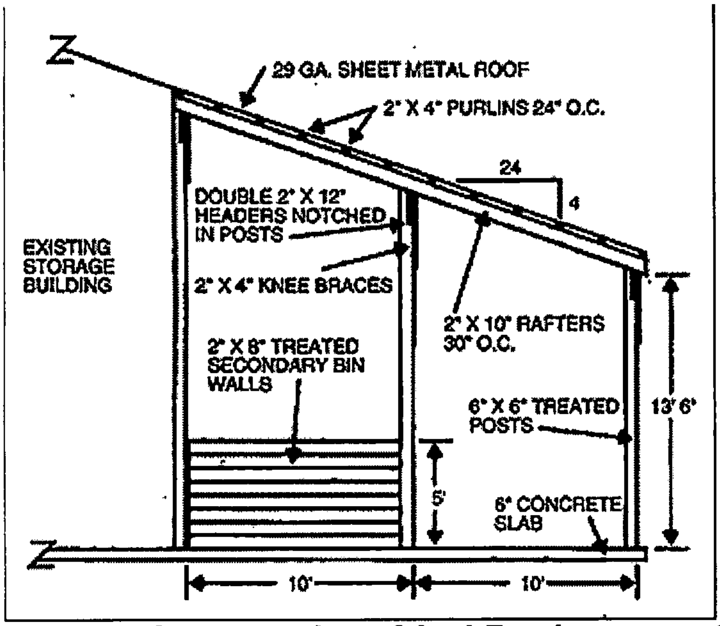

Figure 3. Cross section of Agri-Foods composter showing secondary bins.

Composting trials

The primary objective of the Agri-Foods project was to evaluate the effectiveness of various composting recipes. Wheat straw and fescue hay were used as a carbon source. Also, raw cage layer manure served as a nitrogen and moisture source.

Later, a new recipe using finished compost in place of the carbon source (straw) and raw caged layer manure was tried. Using the recycled finished compost, the primary composting bins reduced fly problems and eased handling because the finished compost was already on-site and does not have to be collected from the layer buildings. Tables 1 and 2 show the ratios of ingredients used in the composting trials. These ingredient ratios resulted in composting temperatures in the 140- to 160-degrees F range in both primary and secondary bins, and finished compost was a dark, dry material with a slight musty odor and very little evidence of feathers or bone.

Table 1. Ingredient ratios using straw and caged layer manure.

Ingredient	Parts by weight[1]
Caged layer manure	1
Hen carcasses	1
Straw or fescue hay	0.25

[1]Ingredients should be provided in this ratio within each repeated layer in the primary bin.

Table 2. Ingredient ratios using recycled compost to replace caged layer waste.

Ingredient	Parts by weight[1]
Hen carcasses	1
Recycled compost	1.5
Water	0.25

[1]Ingredients should be provided in this ratio within each repeated layer in the primary bin.

The actual weight of ingredient used in each layer in the primary bin will depend somewhat on bin size and the weight of the carcasses being composted. Based on an average carcass weight of 3 pounds and the bin size used in this experiment, about 50 dead birds, or 150 pounds of carcasses, were added in each layer. When straw or fescue hay was used as an ingredient, it was most effective to layer half the straw requirement above and below the carcass layer. Based on a 150-pound carcass layer, the straw requirement in these trials was 40 pounds of straw (150 x 0.25 = 40). Figure 4 is a schematic drawing of the layering scheme used in the trials with straw. Primary bins in all trials were started with a base layer of 6 inches of oak sawdust followed by a one-bale layer of straw. When the primary bins were full, they were "capped-off" with another 6-inch layer of sawdust. With these bin sizes and layering schemes, 17 to 18 layers were required to fill the bin, with 800 to 900 bird carcasses composted in each filling of a primary bin. Normal mortality resulted in filling one primary bin in about one week.

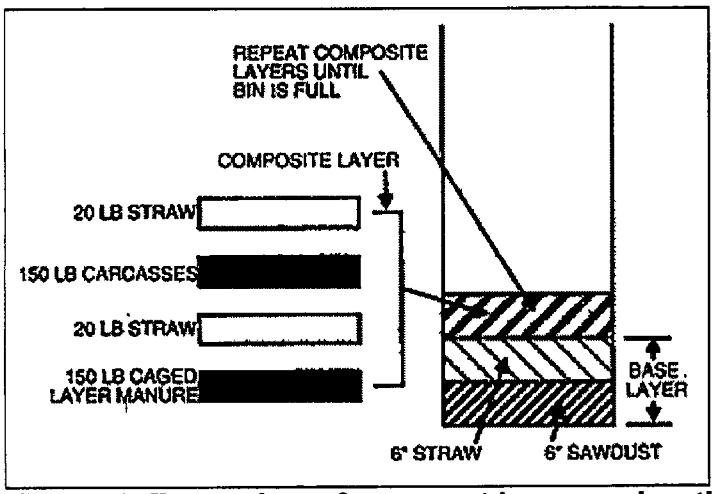

Figure 4. Formation of compost layers using the straw recipe.

When straw was used as an ingredient, it was taken from small square bales. In the trial using fescue hay in place of straw, the fescue hay was "unwound" from a large round bale and placed directly into the primary bins. While the fescue hay trials composted equally as well as the trials using straw, the long fiber lengths of the fescue hay severely hindered bin cleaning when primary composting was completed. Therefore, if hay is used in place of straw, small square bales or round bales that are coarsely ground or shredded with a tub grinder should be used.

Figure 5 is a schematic drawing of the layering scheme using recycled compost in place of caged layer manure and straw. The finished compost in these trials was quite dry, necessitating the addition of water as noted in Table 2. Care should be taken in adding water so that the composting mixture does not become too wet. Water can be added to the layers with a pressured garden hose. However, a hand sprinkler will more accurately apply the required amount of water on each successive layer.

In these trials, primary bins were composted 15 to 20 days before moving the material to the secondary bins. Table 3 shows average values of the chemical content of finished compost in these trials.

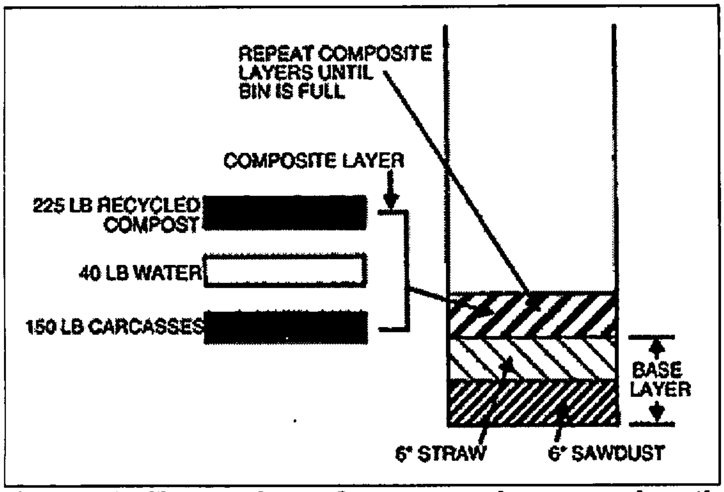

Figure 5. Formation of compost layers using the recycled compost recipe.

Table 3. Analyses of finished compost.

Fertilizer nutrient	Content
Dry matter (percent)	61.4
Nitrogen (lbs./ton)	64.3
Crude protein (percent)	20.0
P_2O_5 (lbs./ton)	69.8
K_2O (lbs./ton)	12.1

Summary

As of January 1992, the composter at the Agri-Foods facility had been operating for 16 months. During this time, 39,552 hen mortalities were composted. The composting process worked well in both winter and summer. An egg layer operation can successfully initiate composting as a means of managing dead birds by using the ingredient ratios with straw or hay as noted in Table 1. Once a supply of secondary compost is generated, this compost can be recycled as an ingredient to replace both manure and straw as noted by the recipe in Table 2. Water may need to be added because of the dry nature of recycled compost. Refer to MU publication WQ205, *Composting Poultry Carcasses in Missouri*, for detailed information on poultry composter design, construction and management.

To order, request WQ211, *Composting Layer Mortalities: Agri-Foods Composter* (free).

B W Organics, Inc.
Rt. 8, Box 729 / CR 2300
Sulphur Springs, Texas 75482

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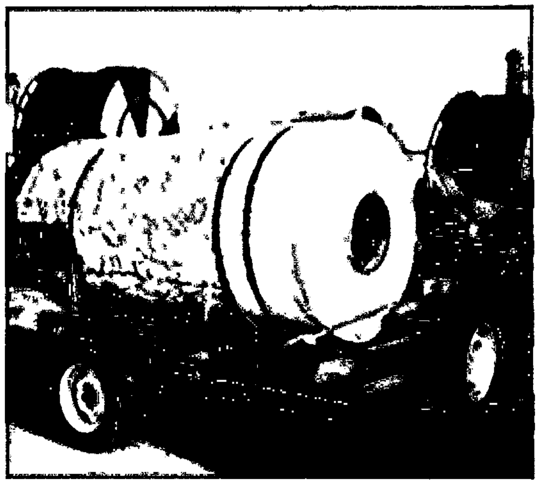
bworganics@neto.com



MODEL 408 CAP. 3 CU YDS

Features:

A 5 ft. by 7 ft all steel trailer frame
Four all steel 1,500# rotor casters
A #100 chain power driven unit w/ duel sprockets
1/4 inch steel drum 4 ft in dia. by 8 ft long
Two steel channel frames plus one power driven channel frame
Three slide gate unloading doors

A commercial in-vessel composter measuring 6 ft in dia. by 16 ft. long is manufactured and is being installed to process 25% mortality and 75% chicken litter to be tested and used as a cattle feed supplement. The preliminary research has been done on a university test model sized in-vessel composter. The results may open many doors for new uses of recycled waste streams.

Advantages of In-Vessel Composting:

Waste is retained on-farm until composted, eliminating the need to transport raw waste, on highways to a composting yard.
Composting can be completed rapidly, resulting in product stabilization/sanitation in 3-6 days.
While in the composter, raw wastes are isolated from the environment until the composting process is complete.
The site manager has precise control of moisture, temperature and aeration during the composting process.
The raw waste loses all offensive odors within 24 hours of composter start-up.
In-vessel composting can maintain a rapid decomposition process year-round regardless of the external ambient conditions.

MOST IMPORTANT

The product from all types of in-vessel composters can be used for:
Improvement of organic matter content and fertility of soil.
As peat moss substitute in greenhouse and landscape applications.

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John Willis
Bernie Beers

Design/Mfg. Organic Composters

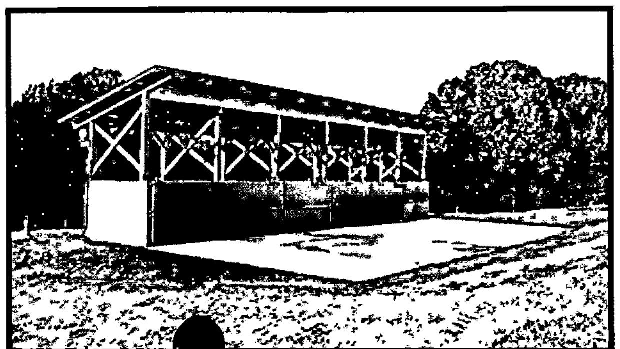
Poultry Mortality Composting made simple with Mountain Organic Materials' Forced Aeration design.

"After years of research and technology development, we've designed and built a poultry mortality composting system specifically for you, the grower. Each component from the compressor to the leachate control system, and from the door to the floor, was designed with your unique environment in mind. We understand mortality management is not your top priority, but designing and building a simple solution to that problem became our top priority…and still is. On behalf of the growers, suppliers, NRCS personnel and others who contributed their time and their unique perspectives, we are proud to present MOM's forced aeration mortality composting bin system for your review. Take a few minutes and kick the tires, check out the unique features that we've included and let us know when we can build one for you."

Sincerely,

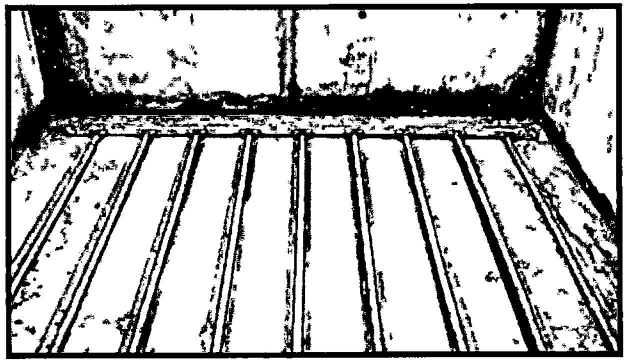
Keith Warren, President

Mountain Organic Materials, LLC

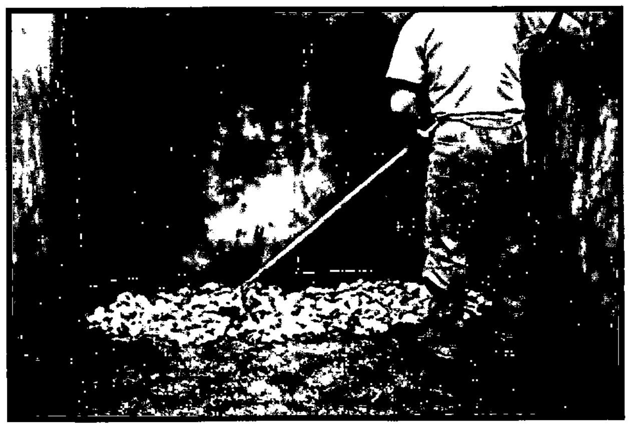


Here are just a few of the design features.

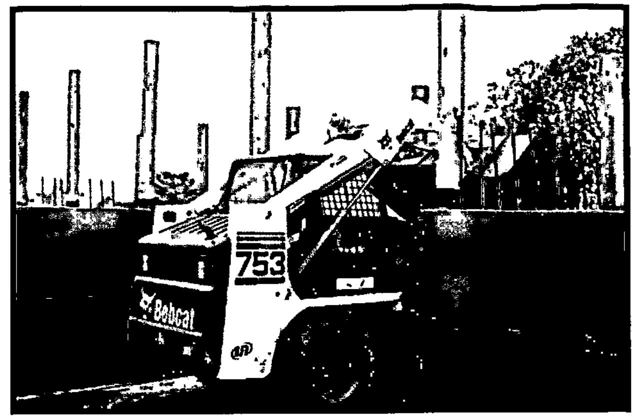
Since composting is a biological process where microorganisms are performing all the work, keeping them "happy" is important. They need a balanced diet of carbon (wood) and nitrogen (litter), a 45-55% moisture content environment, and just the right amount of oxygen.



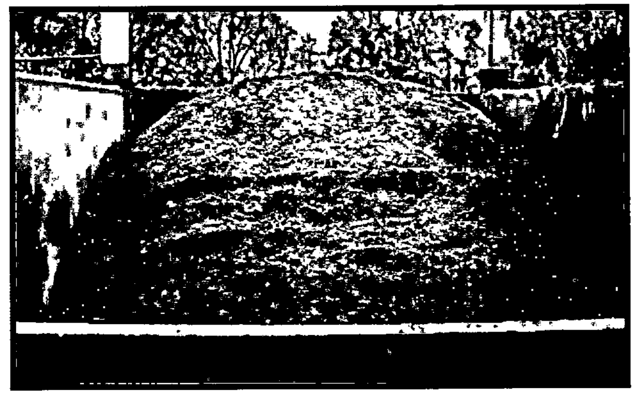
PVC Aeration Pipes, above, bring fresh oxygen to the microorganisms at just the right times to maintain optimum biological decomposition at all times.



Layering of mortalities and covering with a composting mix each day is fast and simple.



Door Openings are 7'6", so access with a front-end loader or skid steer loader is fast and efficient.



Doors are split design for no mess loading and unloading. One or two bins per system are designated for mixture storage but also serve as additional composting capacity during high mortality situations.

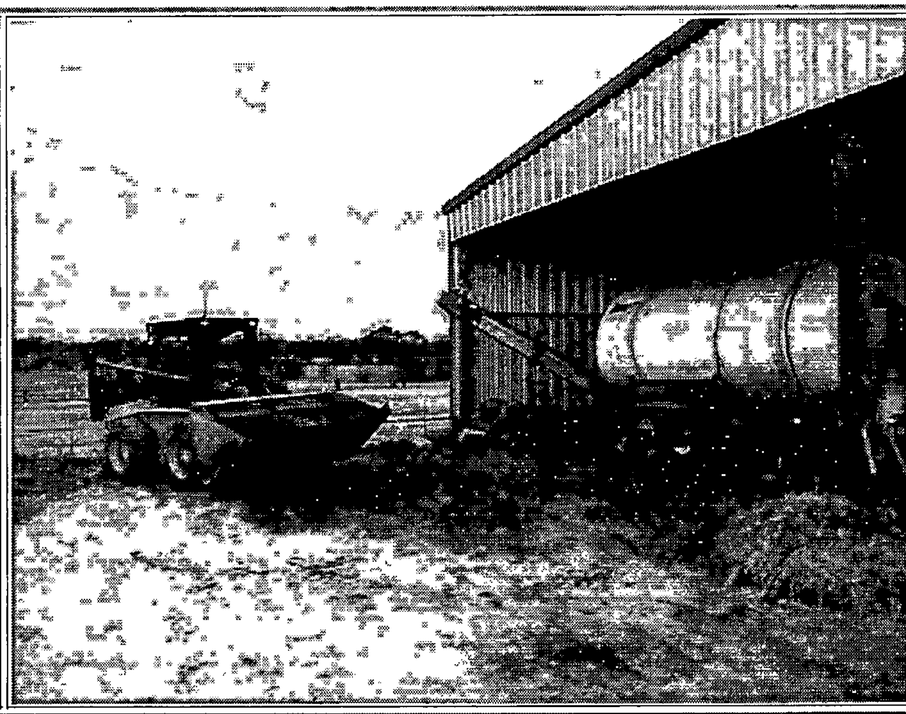
"Our forced aerated composting bin system (FACBS) has received North Carolina NRCS approval for federal cost share assistance through the Environmental Quality Incentives Program. Contact your local NRCS personnel or myself for more information."

Keith Warren

In-Vessel Composting of Poultry Mortality

FY98 CWA Section 319(h) Project

(project continuing through 2001)



Page last updated on June 12, 2000

UNDER CONSTRUCTION

This is an implementation/demonstration project funded through the Texas State Soil and Water Conservation Board and managed by the Department of Agricultural Sciences at Texas A&M University-Commerce. Day-to-day operations are provided by Mr. Wilbur Wilhite, Wilhite Farms, Mt. Vernon, Texas (click here for a map to the project site).

The Situation The Process
Status of the Project Feeding Trials
Animal handling and data collection protocol

SITUATION

Current Texas broiler production approaches 400 million birds annually. The industry suffers an annual death loss of an estimated 20 million birds in production facilities and produces over 400,000 tons of litter that require disposal.

Natural mortality (dead birds) poses microbial risks to watersheds, and the carcasses create disposal challenges in all production regions due to lack of readily available, environmentally friendly, low management disposal techniques. The mortality, which may average up to 5% of total production, is currently being disposed of by incineration (photo 1, photo 2), rendering or static bin composting (photo 1, photo 2). The passage of Senate Bill No. 1910 in Texas in 1997 restricted mass burial as a disposal alternative for carcasses.

Current carcass disposal options can be problematic under some circumstances due either to high costs, extensive carcass handling, labor and management requirements, microbial contamination risks to the watershed, or a combination of these factors.

THE PROCESS

Mortality is collected daily and loaded into a horizontal, single auger feed mixer equipped with knives to macerate carcasses and mix with the selected bulking agent (sawdust, hay, or cotton gin trash). The blended compost mass is then loaded (photo 1, photo 2) into an in-vessel composter measuring 6 ft. in diameter and 16 ft. long, and turning at 4 revolutions per hour. Composting temperatures in excess of 140 degrees F inside the in-vessel composter are sustainable for three days or more.

As product needs to be unloaded from the composter to make room for continued daily additions, the compost is transferred to static bins to mature for a minimum of three weeks prior to use.

Although annual clean-out litter works well as a bulking agent for in-vessel composting of poultry mortality, cake (material removed from production houses between each flock of birds using a housekeeper) does not work well as a bulking agent. Cake is composed primarily of manure and spilled feed and typically contains little bedding material. Without bedding material (ex. sawdust or rice hulls), the texture of cake-out material is too fine to provide the required porosity/oxygenation necessary to sustain rapid, thermophilic composting.

The following ratio of compost components (by weight) have been found to work well using in-vessel composting procedures as described above:

25% mortality / 75% sawdust (if sawdust contains 30% moisture)
50% mortality / 50% sawdust (if sawdust contains 15% or less moisture)
75% mortality / 25% cotton gin trash (if gin trash contains 10% or less moisture)
75% mortality / 25% hay (if hay contains 10% or less moisture)

As moisture level of the above bulking agents increase, the quantity of carcasses must be reduced to prevent compost blends from becoming too wet and creating anaerobic conditions.

STATUS OF THE PROJECT

Composting of poultry mortality from Wilhite Farms' broiler production houses (photo 1, photo 2) began full-scale in the fall of 1999. Three compost formulations containing mortality and sawdust, mortality and hay, and mortality and cotton gin trash have been developed for use at the Wilhite Farms demonstration site.

Beef cattle feeding trials utilizing mortality composted with sawdust, "cake-out" litter, and corn were initiated in June, 2000.

Project supervised by:

Don Cawthon
Department of Agricultural Sciences
Texas A&M University-Commerce
Commerce, TX 75429

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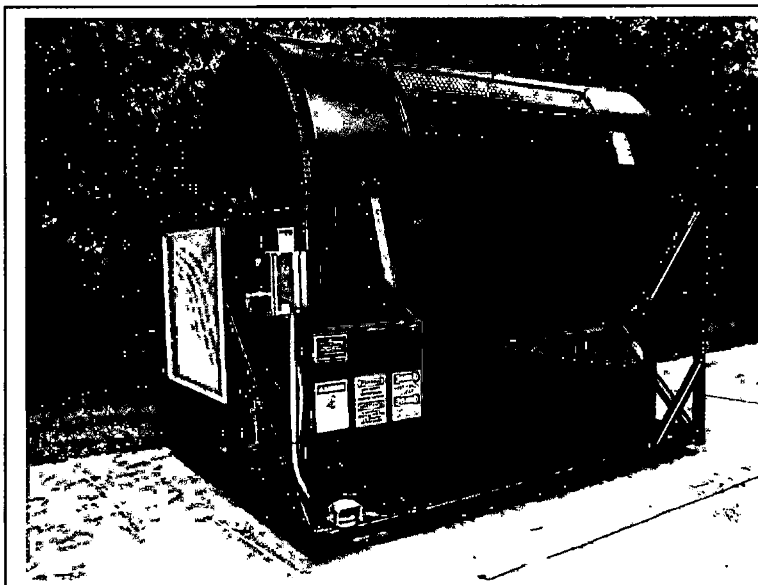
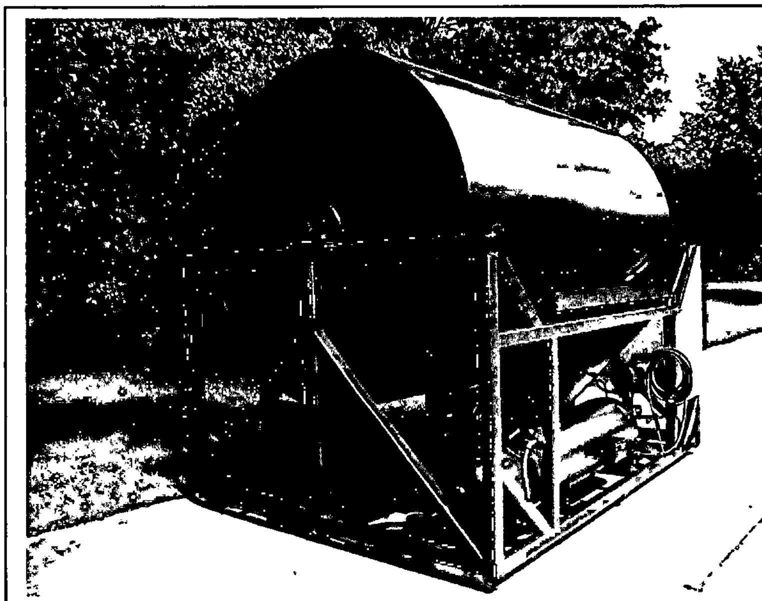
Fabrication

a division of Industrial Piping, Inc.

DRUM DEVIL COMPOSTER
MODEL CC3000A

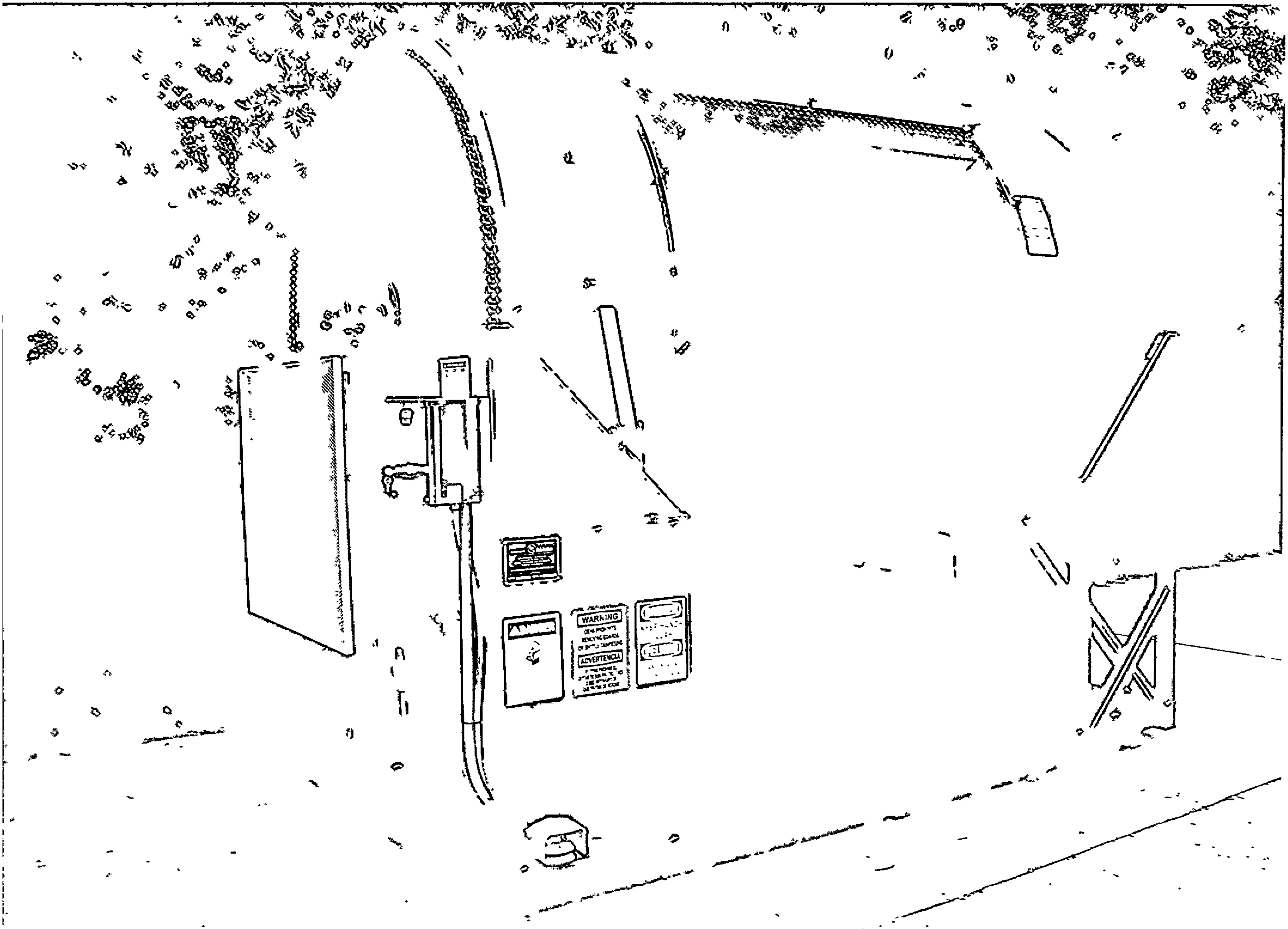
- [illegible]
- [illegible]
- [illegible]
- Dimensions [illegible] Long [illegible] lbs
- Electrical [illegible]
- [illegible] integrated automatic aeration system
- [illegible]



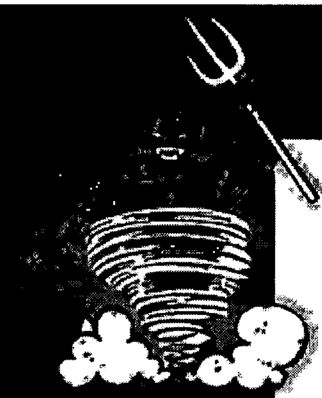


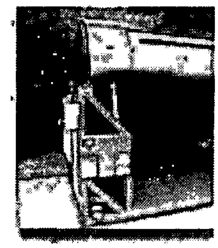
CONTACT MIKE ROBERTS: 1-800/951-0988 Ext. 241

800 Culp Road | P.O. Box 518 | Pineville, NC 28134 | 704/588-1100 TEL | 704/588-5614 FAX


WARNING
ADVERTENCIA

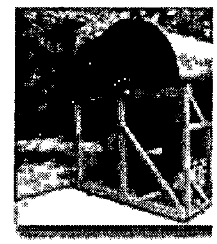
DrumDevil™
Mortality Composting



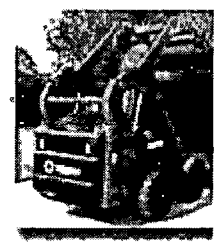


The DrumDevil™ is a rotary compost machine designed for the disposal of mortalities from commercial confined animal feedout operations (CAFO).

The DrumDevil™ system is the product of years of effort applying the principles of the developing science of composting combined with extensive field trials and testing. The DrumDevil™ rotary composting machine provides the most economical and environmentally friendly solution to the problems presented by animal mortalities in farming today. The DrumDevil™ system eliminates risks associated with infection of animal populations and contamination of the environment.



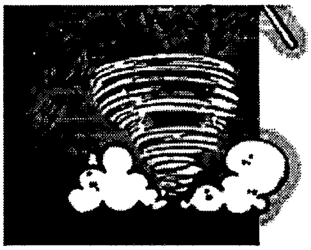
The DrumDevil™ design makes it easy to clean and easy to use. Every feature of the machine is planned to enhance safety and minimize labor to operate the DrumDevil™. Its heavy-duty construction ensures the DrumDevil™ gives the grower years of trouble-free service.



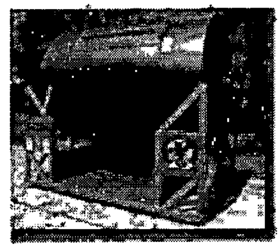
There are two models of the DrumDevil™, the standard **Model CC3000** and the aeration **Model CC3000A**.

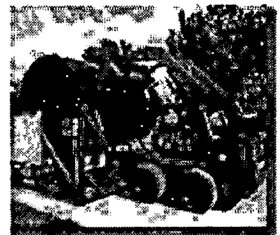
Manufactured by: IPI Fabrication **for:** Commercial Composting

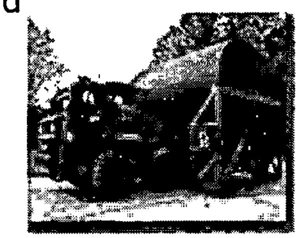
DrumDevil™
Mortality Composting



The DrumDevil™ Composting Process







Composting is a natural biological process that utilizes microorganisms to decompose the remains of dead plants and animals. Composting will occur naturally if the microbes are provided with a favorable environment that is conductive to their growth and reproduction.

With a favorable environment, the composting process is carried out with little to no odor or fly problems. The process results in composting temperatures of 140-170 degrees F, which kills diseases and pathogens that are commonly found in the remains of dead animals from livestock production operations.

A favorable environment for composting must include the following conditions:

- Energy source containing carbon
- Nutrient source containing nitrogen
- Bulk density of 800-900 pounds per cubic yard
- Carbon to nitrogen ratio (C:N) of 30:1
- Moisture content of 40-60 percent
- Oxygen content of 5-15 percent

The DrumDevil™ Composting Machine is designed to provide a favorable composting environment. It accelerates the composting process and minimizes the grower's management time. The DrumDevil™ makes the composting process quick, easy and, above all, economical.

For more information about the DrumDevil™ system and its composting process, please contact us.

Manufactured by: IPI Fabrication for: Commercial Composting

Virginia Tech
VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Virginia Cooperative Extension
Knowledge for the CommonWealth

VIRGINIA STATE UNIVERSITY

Composting Dead Poultry

Author: Eldridge R. Collins, Jr., Extension Agricultural Engineer

Publication Number 442-037, November 1996

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.

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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.

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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.

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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.

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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.

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 composterdesigned 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 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.

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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 usually 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."

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Dead Bird Compost as Fertilizer and Soil Conditioner

Compost will be highly variable in nutrient content depending upon the amount and compassion 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.

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Summary

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

NRCS Natural Resources Conservation Service

118 Academy Drive,
Suite D
Barnesville, Ga. 30204
770-358-0787, Ext. 3

DEAD POULTRY COMPOSTING FACILITY CONSTRUCTION SPECIFICATIONS

Permit Requirements - Federal, State and Local Laws: All methods for the disposal of dead animal carcasses require permits from Georgia Department of Agriculture. The design of poultry mortality composting facility will adhere to all state and local laws, rules, and regulations. The producer/landowner will be responsible for securing necessary permits to install the composting facility and for maintaining, operating and managing the composter.

A permit is required from the state veterinarian before construction of the facility. The following information must be submitted to obtain individual permits for the composter.

1) Owner's name and address
2) Exact location; longitude and latitude as well as map
3) Size and type of poultry operation
4) Construction plans (drawings) for composter
5) Any existing disposal permit number(s)

Submit information to:
State Veterinarian
Asst. Commissioner of Animal Industry
Georgia Department of Agriculture
Capitol Square
19 Martin Luther King, Jr. Drive
Atlanta, Georgia 30334-4201

Locate composting buildings where movement of any odors toward neighbors will be minimized. Buffer areas, vegetative screens, and natural landscape features can help minimize the effects of odors.

Grading and shaping of the site shall consist of removal and disposal of all grass, roots, stumps and other vegetation and shaping of the ground surface to the dimensions, neat lines and grades as shown on the drawings. Any fill material shall be placed in 9" maximum layers and compacted by 3 passes of heavy grading equipment over the entire layer prior to placement of another layer. The entire foundation shall be uniformly compacted whether or not fill is required.

Timber fabrication and installation shall be constructed on a firm foundation to the lines and grades shown on the plans. Dimensions and spacings shown on the plans and drawings are minimum requirements for the 25-year wind and snow loads or state and local building code, whichever is more stringent. These dimensions and spacings may be altered if the result is a stronger structure, with prior approval of the engineer. In no case will the dimensions and spacings be modified in a way which would reduce the strength of the structure. All framing shall be true and exact. Timber shall be accurately cut and assembled to a close fit. Appropriate bracing for safety and structural stability during construction shall be used.

Wood and Timber - All material shall be sound wood, free from decay, and new. All lumber shall be Southern Yellow Pine (SYP) No. 2 or better. Post shall be SYP no. 2SR grade or better. All timber beams shall be dense, structural quality, and graded in accordance with the Standard Grading Rules for Southern Pine Lumber. Unless otherwise specified, all timber and lumber shall be furnished in American Standard dressed sizes.

All structural timber, posts, and lumber, except roof girders, purlins, trusses, knee braces, and attic bracing shall be pressure treated. The minimum net retention of the preservative, chromated copper arsenate, shall be 0.4

Reinforcement steel and welded wire fabric shall be suspended off the ground and other concrete contact surfaces by using scotches of concrete bricks, concrete blocks, wire stands or other approved method prior to the placing of concrete. During concrete placement welded wire reinforcement shall be pulled into the middle of the concrete. Welded wire fabric shall be spliced by overlapping a minimum of one full mesh plus 2 in. or 6 in., whichever is greater.

The Concrete mix shall contain no less than six bags of cement per cubic yard. The water content shall not exceed 6 gallons per bag of cement in the mixture. Any mix selected shall have a designed minimum 28 day compressive strength of 3,500 pounds per square inch (psi). The concrete shall contain a standard known brand of Portland cement with washed sand and gravel. Clean water shall be used in the mix. Calcium Chloride and other chemical admixtures for concrete will not be accepted unless expressly specified in the drawings or specifications. Plasticizing and water reducing/set retarding admixtures may be used if used as recommended by the manufacturer.

Concrete Consistency - The amount of water used in the concrete shall be the minimum necessary to obtain the required workability. The consistency of the concrete shall be such that it can be worked readily into the corners and angles of the forms and around reinforcement but without permitting the materials to segregate or excess free water to collect on the surface. The slump shall be between 2 and 5 in. as tested by "The test for Slump for Portland Cement Concrete", ASTM Specification C-143.

Fiber Reinforced Concrete - Fiber shall consist of 3/4" length virgin homopolymer polypropylene fibers, either the collated fibrillated type or the monofilament type. The minimum rate of application is 1.5 lbs. of fiber per cubic yard of concrete.

The addition of fiber to a concrete mix may cause an apparent reduction slump. However, no additional water shall be added to the mix to improve workability. If needed, a suitable plasticizer should be added to the concrete mix, not to exceed manufacturer's recommendations.

Timing and Temperature Concrete shall be placed within 1 1/2 hours after introduction of water to the cement and aggregates. Concrete shall not be placed when the outside temperature is expected to fall below 40° F at the time the concrete is delivered and placed at the work site. Concrete shall not be exposed to freezing temperatures during the curing period. Concrete, when

deposited in the forms during hot weather, will have a temperature not greater than 90° F at the time of placement. Ice may be used as a portion of the mixing water to control temperature provided all ice is melted in the mixing process. When the outside temperature reaches or exceeds 90°F, the concrete shall be placed <u>within 45 min. after batching</u>.

Conveying and Placing - No concrete shall be placed until the approving official has given approval of the in-place subgrade, forms, reinforcing steel, and any other items involved or affected by the concrete placement.

Concrete shall be conveyed from mixer to forms as rapidly as practicable by methods which will prevent segregation or loss of ingredients.

The graded and compacted earth for floor slabs shall be level or graded as shown on the plans. The concrete thickness and surface uniformity shall be controlled by the use of screeds.

Unless otherwise authorized, all concrete shall be placed upon clean, damp surfaces free from frost, ice, standing and running water, and never upon soft mud, dried porous earth, or fill that does not meet specified compaction requirements. Soft mud or other unacceptable foundation material shall be removed and replaced with gravel or other approved material.

Concrete shall be deposited as close as possible to its final position in the forms. Concrete shall be thoroughly consolidated by rodding or mechanically vibrating the concrete in place or by hand-spading and tamping to remove air voids.

USDA NRCS Natural Resources Conservation Service

POULTRY COMPOSTING FACILITY

A facility for the biological stabilization of waste organic material.

PURPOSE – To treat waste organic material biologically by producing a humus-like material that can be recycled as a soil amendment and fertilizer substitute or otherwise utilized in compliance with all laws, rules and regulations.

CONDITIONS WHERE PRACTICE APPLIES
This practice applies where:
1. Waste organic material is generated by agricultural production or processing;
2. Composting is needed to manage the waste organic material properly;
3. An overall waste management system has been planned that accounts for the end use of the composed material.

PROCESS – Composting is accomplished by mixing an energy source (carbonaceous material) with a nutrient source (nitrogenous material) in a prescribed manner to meet aerobic microbial metabolic requirements. The process is carried out under specific moisture and temperature conditions for a specified period of time. Correct proportions of the various compost ingredients are essential to minimize odors and to avoid attracting flies, rodents, and other small animals.

CARBON SOURCE – A dependable source of carbonaceous material must be available. The material should have a high content and high carbon to nitrogen ratio (C:N). Wood chips, sawdust, peanut hulls, straw, corn cobs, bark, peat moss, and well bedded horse manure are good source of carbon.

MOISTURE CONTROL – Large amounts of water evaporate during the composting process because operating temperatures drive off water. A source of water must be available for compost pile moisture control from start-up through completion. Proper moisture facilitates the composting process and helps control odors.

EQUIPMENT NEEDS – Appropriate equipment must be available for initial mixing, turning, and hauling composted material and carbonaceous material. Appropriate long stem thermometers should be available for managing the compost material.

BULKING MATERIALS – Bulking materials may be added to enhance air flow within the composting material. Piles that are too compact will inhibit the composting process. The carbonaceous material can be considered as a bulking agent. Where it is desirable to salvage carbonaceous material, provisions for removing the material, such as screen, must be made.

MANAGEMENT – Composting operations require close management. Management capabilities of the operator and availability of labor should be assessed as part of the planning and implement process.

ECONOMICS – Benefits associated with the ultimate use of the composted material should be compared to the capitol expenditure and operating costs of the composting operations. In addition to cost return, benefits can include environmental protection, improved handling, disposal of dead poultry and other farm animal carcass, odor control, and reduced need for storage volume.

CARBON NITROGEN RATIO – Calculate the amounts of the various ingredients to establish the desired carbon-nitrogen ratio (C:N) of the mix to be composted. The C:N for organic materials that decompose at a high rate (or are highly unstable) with associated high odor production. When more air nitrogen immobilization. Phosphorus losses will be minimized when composting process is managed. Plans consider the effects of use and management of nutrients on the quality of surface water and groundwater as related to human and livestock consumption.

TESTING NEEDS – Test compost material for carbon, nitrogen, moisture, and pH if compost fails to reach desired temperature or if odor problems develop. The finished compost material should be periodically tested for constituents that could cause plant phytotoxicity as the result of application to crops.

DEAD POULTRY COMPOSTING FACILITY GUIDELINES

PLANNING CONSIDERATION FOR DEAD POULTRY COMPOSTING FACILITY

1. Composting facilities should be located as near to the source of birds as practical;
2. All runoff should be diverted from the facility;
3. The composter will not be designed to process bird mortality from other farms;
4. The composting unit may be a separate unit or may be attached or integrated into the design of a manure dry stack structure;
5. Poultry mortality shall be loaded into the composter daily;
6. **Facility shall be 50 feet from any well.**

FEDERAL, STATE, AND LOCAL LAWS – Those designing dead poultry composting facilities will strictly adhere to all state and local laws, rules, and regulations. The poultry producer will be responsible for securing the necessary permits to install the required structures and for properly managing the unit on a daily basis. A permit number is required for the composting facility.

CARBON-NITROGEN RATION – Composting is enhancing the opportunity for natural processes and organisms to break down dead poultry into a useable material. Mixing of select materials in the right proportions will speed the composting process without offensive odors. As part of the two-stage composting process, the following materials and proportions should be used:

MATERIALS	BY VOLUME	BY WEIGHT	C:N RATIO
Dead Birds	1.0	1.0	5
Chicken Litter	1.5	1.2	15
Straw or Hay	1.0	0.1	85
Water	0 to 0.33	0 to 0.5	*

*As needed to maintain proper moisture content. A mixture that is too wet will not function properly. Do not add water initially.

See Figure 1 for layering detail.

Both primary and secondary composting should be operated under roof cover and on a concrete floor. The area provided should be adequate for both states of composting as well as area for straw and manure material used in the composting layers.

STRUCTURE DESIGN – Material and structural design of the composting facility shall conform to the requirements of NRCS, Standard 317, Composting Facility and to the specifications outlined in the design – ENG – 317. Details of material requirements must be determined by the Engineer on a case by case basis.

Composters can vary considerably and perform well, however, all good composters have a certain amount of common features:

spaces provide oxygen for the process. If for some reason the process is not working satisfactorily, determine if too much or too little water was added and make the necessary adjustments. Also layers of straw or some other carbon source may be required, providing layers of manure, straw, and carcasses.

MONITORING TEMPERATURES – Temperatures in the composting bin must be monitored daily. A 36-inch probe-type thermometer with a rigid protective covering for the probe should be used to monitor temperatures within the pile. The temperature begins rising after about five days and peaks in about 7-10 days at 140-160 degrees Fahrenheit. It may be possible for the temperature to rise above the normal range and create conditions suitable for spontaneous combustion. However, this is highly unlikely because temperatures are monitored daily and any unusual extremes should be detected early and the pile is not generally deep enough to create conditions typically found in manure stacks which spontaneously combust. If temperatures exceed 160 degrees F, the material should be removed from the bin, spread on the ground away from buildings, and saturated with water to prevent spontaneous combustion.

If temperatures of 130 degrees F are not achieved during the composting process, the resulting compost shall be incorporated into the soil immediately after land application.

LOADING THE SECONDARY COMPOSTER – Once the temperature peaks and begins to drop in the top layer of first stage composter, move the entire bin contents to the second stage unit. Stage 2 of the composter may be a series of bins equivalent in size and number to the first stage bins. It may also be a single large bin capable of handling all of the material from the first stage bins. Unloading and loading shall be done in a manner that assures maximum mixing of the composted material.

Removing the material from the first stage composter achieves two important results. It improves the homogeneity of the mass and provides aeration needed to reactivate the bacteria. If a front end loader is used to move the material, the bucket can be raised high enough to allow the material to drop into the secondary unit and, thus, provide the necessary aeration an mixing. The temperature in the new cell will begin in approximately 7-10 days. The temperature in Stage 2 should be monitored as in the primary stage.

STORING THE COMPOST – Although the compost can be directly land applied after second stage composting, it is recommended that the material be stored under cover and be allowed to "rest" for at least 30 days. The material in dry storage should not be piled higher than 7 feet to reduce the potential of spontaneous combustion. In addition, it should not come in contact with any manure stored in the same facility. Storage will allow the compost to dry, allowing greater ease in handling.

TOTAL NITROGEN	ORGANIC NITROGEN	P	K
40	(lbs. per ton of compost) 28	20	25

In the absence of local laboratory analysis, the above nutrient content may be used to determine the land application rates. The nutrient requirements for any particular crop should be based on a current soil test.

Since 70 percent of local laboratory analysis, the above nutrient content may be used to determine the land application rates. The nutrient requirements for any particular crop should be based on a current soil test.

Since 70 percent of the total nitrogen in dead bird compost is in organic form, the compost will act as a slow release fertilizer. (The nitrogen in broiler litter is mostly mineralized N and will be available more readily than N in compost.) This characteristic of compost allows better utilization of the nitrogen by the crop and also reduces the potential for movement to ground and surface waters. Utilization of compost material for land application should consider prevailing winds, neighboring dwellings, and visual effects.

DEAD POULTRY COMPOSTING OEPERATION AND MAINTENANCE

Operation of the Compost System - Efficient and rapid composting requires careful control of the carbon-nitrogen (C:N) ratio of the composting material, percent moisture content, and the internal temperature of the compost stack. The stack consists of a nitrogen source (protein synthesis), a carbon source (energy and structural component), water and oxygen.

The composting process uses a mixture of poultry manure, poultry carcasses, oxygen and water. Wheat straw, peanut hulls, cotton seed hulls, etc. may be used to provide a source of carbon. The components of the mixture should be proportioned to ensure proper growth of the bacteria needed for decomposition. The mixture must be loose enough to permit oxygen penetration. In general terms, the C:N ratio of the original mix in the primary composter needs to be in the range of 10-15:1.

For proper composting to occur, it is of utmost importance to properly layer birds and other materials in the mixture as detailed in this plan.

Records - The Operator will maintain a daily record of materials used in the composting process, any problems that arise (such as odor, unusual high or low temperature readings), water additions, dates the composted material is moved to the secondary compost bins, dates the composting process is complete, etc. See attached Daily Record Sheets.

Methods of Composting - There are two composting methods available: the "original" method and the new "Hot Litter" method. Either method may be used, however proper composting is required.

Original Composting Method - For the primary (first stage) composting, the material is placed in bins in layers according to the following sequence:

1. One foot of dry manure or cake should be placed on the floor of the bin and raked level. Level the material in this and each subsequent layer to obtain the maximum storage volume, to keep carcasses away from the walls, and to optimize the compost process.

2. **A single layer thickness of carcasses is added.** Place the layer of carcasses 9 inches from the edge of the bin. A 9 inch layer of dry manure (preferably cake material) is placed on top of the carcasses and should completely cover the carcasses on the sides of the bin as well.

3. This completes the first batch.

4. The second and subsequent batches are alternate layers of carcasses and 9 inch layers of manure.

5. Add a 12 inch cap layer of manure on top of the final layer of carcasses. The finished height of the compost in the bin should be no greater than 5 feet.

6. Check the temperature of the initial layers to be sure 140° F is attained.

7. The addition of water is required if there is not enough water in the birds and manure. If the manure layer is dry, add water sparingly by spraying the carcasses. Be careful not to add too much water.

8. Partial layers of exposed birds shall be covered with manure that day and the remaining portion of the layer continued the next day.

typically found in manure stacks which spontaneously combust. If the temperature is 160° F and rising, spontaneous combustion may occur. Continually monitor the temperature and if 190° F is reached, the material should be removed from the bin, spread on the ground in an area away from buildings, and saturated with water to prevent spontaneous combustion.

If temperatures do not reach 140° F, adjustments must be made in the process to achieve proper composting in the next batch. Adjusting the moisture content, more or less water, or adjusting the carbon-nitrogen ratio are two of the easiest adjustments that radically affect the process.

A 36-inch long probe-type dial thermometer is required to check the temperature of the compost mixture. The temperature range is 0° to 200° F. The 5/16 inch diameter stem is recommended. Known sources include: Ben Meadows Co. 1-800-241-6401, Forestry Suppliers, Inc. 1-800-647-5368, and Professional Supply/Source, Inc. 1-800-234-4884.

Aeration and Moving the Compost Mixture to Secondary Treatment - The purpose of moving the product from primary treatment to secondary is to mix and aerate the compost so that a more complete breakdown of the carcasses occurs. The compost mixture should "cascade" from the loader bucket to provide good turning and aeration as it is deposited in the secondary treatment area. moving aerates the mixture and revives the bacteria, allowing them to begin another cycle of heating. Delayed movement, poor aeration, poor mixing or improper moisture will cause the compost not to re-heat properly.

When turning the mixture into the secondary bin, any large bones or other carcass parts found in the mix shall be removed and placed in a primary bin for recomposting. Large bones may clog spreader equipment.

Carefully analyze the need for water as the compost mixture is moved into the secondary bin(s) for another heating cycle. After the temperature determined by daily monitoring drops about 20° F (10-14 days) the compost should be moved to a storage area to await its use as a fertilizer.

Recomposting of the Mixture - When a bin fails to achieve proper temperatures, the entire mixture needs to be recomposted. Recomposting of an entire bin is best accomplished by correcting the cause of the low temperatures (drying the mixture, moistening the mixture, adding or changing carbon source, adjusting nitrogen source). The mixture should be placed in a primary bin for ease of monitoring temperatures. The temperature of recomposting should be monitored just as initial composting. When the 140° F or higher temperature is reached and drops, the mixture should be turned into a secondary bin for further treatment.

Trouble Shooting - The following list of problems and solutions was prepared by Dr. Stan Savage, Extension Poultry Scientist, University of Georgia.

Indications of composting improperly:

1. Temperature not rising to or above 135° F.
   a) Moisture levels are wrong
   b) Dead litter (low initial bacteria count)
   c) Lack of oxygen
2. Temperature rising above 160° F.
   a) Everything correct but too much oxygen in the compost. Be careful: spontaneous combustion can occur at a temperature slightly above 160° F.
3. Fly problems and possibly maggots.
   a) Composting too slow to start. Temperature too low (95°-100° F for fly production.)
   b) Refer to number 1.
4. Weeping - Moisture loss out the sides of the composter.
   a) Too much moisture in compost

SOURCES OF THERMOMETERS

FOR

DEAD BIRD COMPOSTING FACILITIES

(This is a list of companies manufacturing a 36" thermometer adequate for monitoring the temperature in dead bird compost primary and secondary cells. The required operating temperature range is from 130 to 160 degrees Fahrenheit.)

Ben Meadows Company
3589 Broad Street
Atlanta (Chamblee) GA 30341
Toll Free: 1-800-241-6401
Fax: 1-800-628-2068

Reotemp Instrument Corporation
11568 Sorrento Valley Road, Suite 10
San Diego CA 92121
Phone: 1-619-481-7737

W. H. Cooke & Company Incorporated
2926 Industrial park Drive
P. O. Box 263
Finksburg, Maryland 21048-0263
Toll Free: 1-800-772-5151
Phone: 1-301-833-8200
Fax: 1-301-833-8204

____

(Name of Farm)

OPERATION AND MAINTENANCE
DEAD BIRD COMPOSTER

DAILY RECORD SHEET

DATE	BIN #	TEMP.	REMARKS

ENVIRONMENTAL QUALITY INCENTIVES PROGRAM

EQIP OVERVIEW

The Environmental Quality Incentives Program (EQIP) is a voluntary conservation program administered by the USDA Natural Resources Conservation Service (NRCS). EQIP supports production agriculture and environmental quality as compatible goals. Through EQIP, farmers may receive financial and technical help with structural and management conservation practices on agricultural land. EQIP was reauthorized in the 2002 Farm Bill.

If selected for the program, farmers will develop a conservation plan, if they don't already have one, for the acreage affected by their EQIP practices. Conservation practices must meet NRCS technical standards. Farmers may elect to receive technical assistance from NRCS Conservationists, or they may use an approved third-party provider, if available, for approved conservation practices.

EQIP contracts provide incentive payments and cost-share payments for implementing conservation practices. These contracts are for 2 to 10 years allowing farmers to implement conservation practices as they can financially incorporate them into their farming operation.

HOW EQIP WORKS IN GEORGIA

NRCS will evaluate each EQIP application, with higher priority given to applications that use cost-effective conservation practices, address local priorities, and provide the most environmental benefit. Georgia will use a statewide Environmental Benefits Index (EBI) ranking worksheet to evaluate the applications. The EBI ranking worksheet will rank applications within each statewide resource concern with the exception of wildlife habitat, which is applicable to all resource concerns. To view Georgia 2004 EQIP ranking go to www.ga.nrcs.usda.gov/programs/eqip/eqip2004.html

Georgia's statewide resource concerns are:

- Reduced soil erosion and sedimentation, and improved soil quality
- Improved water quality through implementation of animal waste systems
- Protection of water sources through water conservation measures
- Increased wildlife habitat for all species

Conservation practices that address these resource concerns are eligible for financial assistance.

In the general sign-up, Georgia has set a 50% cost-share limit for all structural practices. Incentive payments may be made to encourage a farmer to adopt land management practices, such as residue management, prescribed grazing and comprehensive nutrient management.

WINDROW COMPOSTING POULTRY AND HATCHERY WASTE

Calvin J. Kuska
Kuska/Associates
8547 E. Arapahoe Road, Suite J-221
Greenwood Village, CO 80112

Composting is that ounce of prevention worth its pound of cure for the agricultural producer or processor of animal products. The degradation of water qualities, both rural and urban, along with the bacterial, nutrient and chemical contamination of water supply sources is becoming such a concern that problems will soon be regulated on a watershed rather than an individual site basis.

The problem by-products which are generated in the production of animals include manures, refused or spoiled feeds, mortalities, predatory animals, wash waters, wet or soiled, paper products, process sludges, hatchery egg trays, rotten eggs, throw-away organic items, etc. Anything that originated from the soil can and is being composted. In many areas of the World, we are helping farmers introduce to these streams urban source-separated organic wastes from lawn services, grocery stores and restaurants, wood products manufacturers, junk mail and other items to add to their recipe siding the composting process.

CRYPTOSPORIDIUM--A NEW SUPER BUG

The issue of nonpoint source pollution will be vital in the reauthorization of the Clean Water Act and the Resource Conservation and Recovery Act, because there have been too many notorious instances of bacterial pollution of public system drinking water like that in Washington, D.C. and Milwaukee. After one year there is so much concern about water safety in Milwaukee that 15% of 800,000 people required earlier to boil water for safety are still doing it, and 38% reportedly are purchasing expensive bottled water. Over 100 persons have died and 400,000 reported illness due to a waterborne parasite. Cryptosporidium, which is carried by human and animal wastes.

Ironically, the State of Wisconsin prepared an extensive study outlining the impact of livestock manures on water quality in the State in the early 1980's, but the Governor refused to release the report since it would impact the "America's Dairyland" license plate. As a result no preventative action or educational programs were undertaken, so the problem years later has become severe in nature.

Today, Wisconsin has undertaken the leadership for a nation-wide Farm *A* Syst program to preserve groundwater quality and protect farms from liability. The program is designed more to assess the problems facing agriculture than direct and educate about desirable type methods presently available for prevention. In the U.S. General Accounting Office's most recent report to Congress on Food and Agriculture issues, they state that "polluted runoff from agriculture affects 50 to 70% of the nation's monitored waters. Although the 1985 and 1990 farm bills created environmental and conservation initiatives, many challenges lie ahead because the initial lives are still in transition. Thus, new approaches that combine education, research, technical assistance, technological innovation, and regulation will be needed to sustain agricultural and environmental goals simultaneously."

SOIL IS NOT LIVING FILTER

The subsurface or land was traditionally viewed as having an almost limitless capacity to absorb, filter and attenuate waste materials entering it. So tenaciously was this belief held by the scientific and engineering communities that mountains of evidence to the contrary had to be amassed before this concept was finally discredited. One example of research, "The Effect of Farm Liquid Waste Application on Receiving Water Quality", conducted in Huron and Perth Counties, Ontario on five different soil types, found that bacteria at 11 liquid manure spreading sites can travel through the soil column and reach the tile water within a short period of time. In one case, that time period was as low as 20 minutes. Researchers of this study referenced other studies by Evans and Owens in 1972 and Patterson et al. in 1974, who both found tile drain water to be polluted a short time after the application of liquid manure.

The State of Washington Department of Ecology Shellfish Unit reported in January 1992 that failing septic systems and animal waste, respectively, causes 82% and 75% of the shellfish harvest restrictions in the Puget Sound. The basin encompasses 119 watersheds and involves more than 500 jurisdictions and agencies.

The sterilizing heat of up to 160 degrees F. kills weed seeds in the feed and beddings as well as any disease organisms which would require corrective actions. Recently a Nebraska farmer, who had land disposed manures for years, justified the purchase of composting machinery on the yearly costs associated with herbicides to eradicate weeds incoming in the hay and grains. The State of Maine and Province of Prince Edward Island banned diseased seed potatoes from landfilling or ocean dumping, and composting was the only acceptable practice. After composting, the potato-based compost was sold back to the potato farmers certified-safe for use on their farms.

TECHNIQUES OF COMPOSTING

The transformation of organic waste streams can be accomplished in one of two manners: aerobic or anaerobic. The end products from anaerobic decomposition can result in serious nuisance conditions, especially organic fatty acids, aldehydes, alcohols, hydrogen sulfide, etc.

Aerobic decomposition by micro-organisms leads to the formation of oxidized end products such as carbon dioxide, water, sulfates, etc. Generally these compounds are considered to be stable and relatively non-offensive. Although no biological process is odor-free, the aerobic composting process when properly managed will have a musky, sweetish odor which is not offensive to the operator or outsiders.

Open windrow composting is the most prevalent technology used on the farm level up to and including large-scale programs on a corporate, municipal and even a county and regional basis. The open windrow process is being used in both wet and dry climates, at mountain altitudes or at sea level with year around success regardless of the temperature.

The primary factors affecting composting rates are those that influence biological activities. The key elements are the moisture content of the stream, the carbon to nitrogen ratio also referred to as the browns and greens, and the aeration of the mass of the matter in the windrow.

Moisture

Moisture contents plays a very important role, and a starting level of 60-70% moisture is necessary for microbial activity. Large amounts of heat are generated during decomposition, and unless sufficient water is available, the compost windrow will tend to dry out, dropping activity to

The nutrients in the compost normally include nitrogen, potassium, phosphorus, sulfur, calcium, magnesium, boron, zinc, manganese, copper, iron and one barely recognized nutrient, humic acid, which can account for one-fourth of the compost's nutrient value.

Some Benefits of Compost Application

Improvement of soil structure. . . release of natural nutrients in the soil to the plant. . . increased movement, availability and retention of moisture up to two-thirds. . . promotion of greater bacterial action in the soil. . . helps rid the soil of excessive salt build-up. . . detoxifies soils that have been subject to heavy chemical applications . . . allows for increased root development to improve water and nutrient uptake. . . aids in maintaining proper soil pH. . . encourages the return of earthworms and micro-life. . . mature compost aids in speedier and higher seed germination. . . improves cation exchange capacity. . . acts as a root stimulant for bare root stock. . . facilitates safe, natural and non-toxic microbial action which is non-polluting and sustainable for years to come. . . increases yields after improving soil from chemical dependency. . . less expensive than escalating agrochemicals. . . helps drain boggy soils and hold water in sandy conditions, and. . . allows farmers and gardeners to provide greater health assurances to family and friends by eliminating chemical fertilizers and pesticides.

Values of Compost Products Today

The market for compost products of all types is increasing at the rate of 5% per year, and many of the large chemical fertilizer companies are either entering the marketplace or are conducting research on time-release, biologically friendly microbial fertilizers and friendly fluids for pest management.

We have surveyed the compost market from coast to coast, and we have been instrumental in a campaign to make environmental groups, Ducks Unlimited, State governments and regulatory personnel aware that peat from endangered wetlands is the largest dollar volume soil amendment sold across the U.S. Imported Canadian peat, a premium product with no nutrient values, sells at retail for up to $650 per ton.

We have recently informed state purchasing agencies that the mulch used for hydroseeding along highways is made from virgin timber, and it sells in the range of $250 to $350 per ton. Compost, on the other hand, has natural fertility and has proven to yield germination rates in excess of 90%, and

Broiler grower Billy Hixon shows off the freezers on his farm where he stores dead chickens until they are taken to a rendering plant. PHOTO: JOHN LEIDNER

Frozen CHICKEN

Here's a different twist on recycling poultry carcasses.

Broiler growers Bill Hixon and his son Billy of Pike County, Ala., have adopted a fairly new method of dealing with dead chickens. They freeze their dead birds.

Chickens die every day, and picking up dead birds is a daily chore and one of the biggest labor costs on modern broiler farms. While no one wants dead chickens, death losses of 3 to 5% are typical during growouts that last from six to eight weeks.

Dead-bird disposal ranks second only to litter management as an environmental concern for broiler growers. Freezers, meanwhile, allow for the conversion of what could be an environmental threat into a valuable source of protein.

Freezing is just one of several disposal methods. Burial poses contamination risks, and as a result it is prohibited in some states. Incineration can be expensive with the initial investment in the incinerator and additional costs for fuel. Some growers have even taken up alligator farming, because gators will eat dead chickens.

Composting is the disposal method that seems to be in vogue today. This process yields a useful soil amendment byproduct, but it can be labor intensive. "Composting works, but it also would take 30 minutes to an hour of our time each day," says Billy.

Dead-bird disposal ranks second only to litter management as an environmental concern for broiler growers.

He and his father like freezing, because their only labor involves picking up the birds from the house floors and depositing the carcasses in the freezers.

Once the dead chickens are frozen, carcass quality is maintained. When the freezer is filled, a truck comes and hauls the birds to a rendering plant. There the dead chickens are combined with other ingredients to produce high-protein animal feed products.

The use of freezers may be limited by a lack of rendering plants in an area and by the willingness of these plants to handle the carcasses. That hasn't been a concern for the Hixons. In addition to southeast Alabama, freezers are used on broiler farms in Arkansas, Oklahoma and other states.

In a typical program, the integrator furnishes the freezers and the grower is responsible for providing electricity to operate them, according to a report from Arkansas Extension.

The Hixons grow broilers for the Charoen Pokphand Group, a company based in Thailand that has extensive operations in Taiwan and elsewhere in Asia. Billy says the company moved to their area several years ago and encouraged the use of freezers on growout farms.

Each freezer costs about $2,000. On the Hixon farm, the free-standing freezer units hold between 600 and 1,000 pounds of dead birds.

In several states, the Natural Resources Conservation Service has developed standards for using freezers as part of an overall conservation system to prevent pollution of water and soil resources. A few of those standards are listed below.

- Freezer capacity should match expected mortality and the vendor's schedule for removing carcasses.
- Freezers should be capable of maintaining carcasses at temperatures of 28°F or lower.
- Freezers should be located with traffic patterns in mind and with ample turning and loading areas.
- Freezers also should be located 150 or more feet from the poultry houses to minimize disease transfer.
- Growers should have plans for other methods of disposal to cover incidents of catastrophic losses should they occur.

Freezers should operate for 10 years or more with no harmful environmental or health impacts. In addition to reducing the threats to water quality, using freezers minimizes unpleasant odors around broiler farms. Indeed, the only time one notices a foul smell from dead birds on the Hixon farm is when the freezer doors are opened.

By JOHN LEIDNER

Cooperative Extension Service
The University of Georgia College of Agricultural and Environmental Sciences
PDF

Poultry Mortality Composting Management Guide

Casey W. Ritz, Extension Poultry Scientist
John W. Worley, Extension Engineer

Disposal of dead birds can be a problem for poultry growers. Typical methods of mortality disposal include burial, incineration, rendering, and composting. Many states have banned the use of burial pits that historically have been used to dispose of dead birds. Incineration can be costly and raise air quality concerns, and the decreasing number of renderers further complicates disposal.

Composting is considered a positive alternative method of processing dead birds in an environmentally sound manner. Composting is the most widespread method used in states that have banned pits, and is considered by many as the best alternative for mortality management, though more labor intensive than other methods. The composting process converts dead birds into a useful, inoffensive, stable end product that can be field-applied for crop use and soil improvement. This relatively inexpensive method of using dead birds has gained wide acceptance throughout the poultry industry. Availability of cost-share funds to offset composter facility construction costs has contributed to the increase in the use of this mortality disposal method.

Principles of Composting

Composting is a natural, biological process by which organic material is broken down and decomposed into a stable end product. The composting process is carried out by bacteria, fungi and other microorganisms which digest the organic material and reduce it to humus. The principles of composting are quite simple — provide the microorganisms with an environment conducive to their growth — a balanced diet, water and oxygen.

The essential elements for the microorganisms involved in composting are carbon (C), nitrogen (N), oxygen (O_2) and moisture (H_2O). If any of these elements are lacking, or if they are not provided in the proper proportion to one another, the microorganisms will not flourish and generate adequate heat for decomposition. These nutrients are best supplied from an ingredient profile that has a carbon to nitrogen ratio of approximately 30:1. Birds have a C:N ratio of 5:1, litter ranges from 7:1 to 25:1, straw 80:1, peanut hulls 50:1, and wood shavings are 300-700:1. A good carbon source will perform two functions: provide carbon and act as a bulking agent that creates pores within the pile, allowing oxygen to flow through the material. If 2 parts by volume of litter and 1 volume of dead birds along with adequate bulking agent is contained in the litter or added prior to the carcasses, the C:N ratio should be adequate for the composting process to proceed.

The microorganisms best at composting are aerobic; that is, they require oxygen to live. During the composting process oxygen is used up quickly by microorganisms inside the compost pile. Aerating the compost by turning re-supplies it with oxygen and allows the microorganisms to continue the composting process at a rapid rate.

Water is essential to the growth of all living organisms. Composting microorganisms thrive best in moist conditions. Desirable moisture levels in the composting materials should be 40 to 60 percent. Too much water can cause the compost pile to become soggy and anaerobic; too little water will prevent microorganisms from reproducing to adequately high numbers. The amount of water needed depends on the size of birds being composted and the moisture content of the litter and/or carbon bulking material. As a rule of thumb regarding proper moisture content, well-watered compost when squeezed into a ball will not drip water and will retain its shape when released.

Composter Construction and Layout

When siting a composter, choose a well-drained, graded and elevated location so ground water and surface runoff cannot enter the facility. The composter must also be located and graded such that it is accessible year round.

The size of a composter is typically based on the size of the poultry operation. For every 1 pound of dead bird, 1 cubic foot of primary compost space is needed. An equal amount of space is required for the secondary stage. The National Resource Conservation Service (NRCS) has standard designs and cost-share programs for composters of various sizes. Growers interested in composting and cost-share opportunities should contact their local NRCS office for funding information and design approval.

A typical poultry mortality composter consists of various sized bins constructed of treated lumber set on a concrete slab with a roof overhead. The roof helps maintain appropriate moisture levels within the compost. The concrete slab helps prevent leaching of nutrients into the soil, prevents vermin and pests from burrowing under the compost, and makes cleanup of the facility easier.

Typically the bins are constructed large enough to accommodate the equipment used to handle the material. Therefore, the width of the small bin composter must allow the loader bucket to get into the bin. Normally these small bin composters will be 6-8 feet wide by 5 feet high and 5 feet deep. The depth of the bin may be limited to the reach capabilities of the front end loader in order to drop the composted material into the secondary bin, which may be located behind the primary bin. Moving the material from the primary bin to the secondary bin after 10 to 21 days is common for small bin type composters to mix in oxygen in the mass to promote additional heating. The oxygen is added to the mixture as it is moved from the primary bin to the secondary bin.

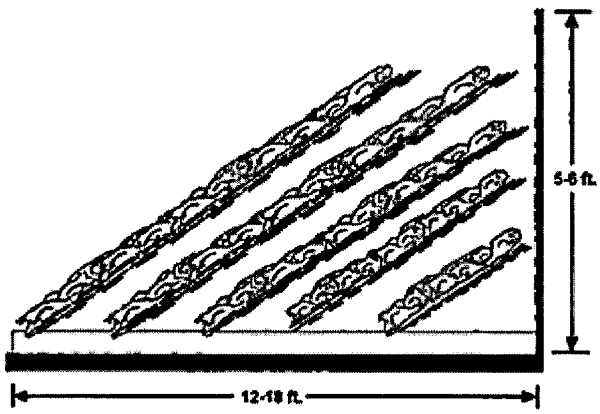
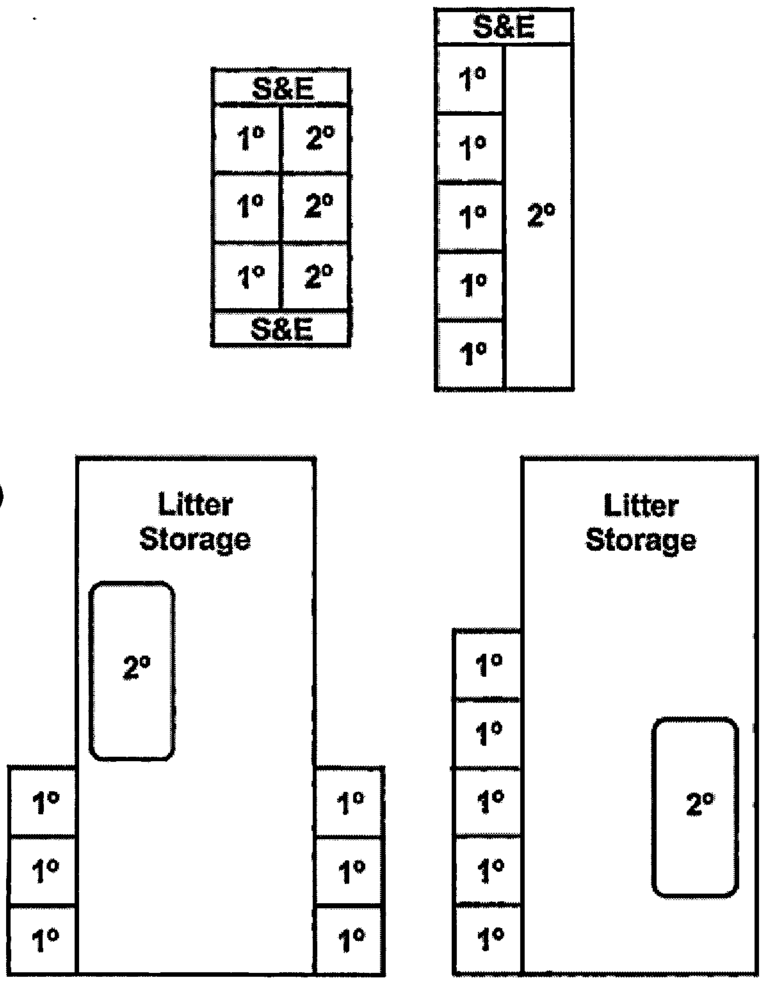


Figure 1. Bin composting on an angle can reduce time spent handling materials.

A modification to the small bin composter that is gaining in popularity is the use of a primary bin that is 5-10 feet deeper and with a front that is totally open. The compost material slopes back from the front of the composter at about a 45 degree angle (Figure 1). This design allows improved ingredient layering using a front end loader, so it requires less hand work. This modification can accommodate larger scale operations and material volumes. The primary and secondary bins are usually side by side or parallel to each other and built like a bunker silo. The big bin composter like the small bin type is filled to a height of 5 to 6 feet. Electrical power and a reliable water source are important necessities that should be made available at the composter to facilitate optimal year round composting. Example floor plans for stand alone composters and those integrated into a litter storage facility are shown in Figure 2.



Stand-alone composters with primary (1º), secondary (2º) and storage space (S&E) for bulk materials and equipment. Bin width and depth typically 6-8 feet.

Compost bins incorporated within a litter storage facility. Space for secondary compost is provided within the storage facility. Stack house width and length typically 40 x 100 feet, though based on specific storage needs.

Figure 2. Example composter floor plan designs.

Composter Operation and Management

The requirements for proper and complete decomposition of dead carcasses are reasonably simple and inexpensive. The materials needed (dead birds, litter, alternative carbon sources, water) are readily available on every poultry farm. Careful attention to proper management is essential for successful composting. Failure to manage the system will result in an odorous situation that attracts flies, scavengers and other vermin to the site. Proper management is vital for avoiding nuisance complaints.

Decomposition of the dead carcasses and litter depends upon microbial activity. The greater the microbial growth, the faster the carcasses decompose. Anything that slows down microbial growth lowers the temperature of the composting material and slows the composting process. The more rapid the microbial growth, the greater the heat output within the composting mass and the more rapidly the mass breaks down. The microorganisms responsible for composting are initially supplied by active or fresh litter material. The microbes in the litter used in the composting process need to be kept alive and in sufficient numbers so the composting process can begin immediately to break down the carcasses and the litter. Litter that is too dry and too long removed from the house will contain lower numbers of microorganisms and its use slows the process of carcass decomposition. Keeping a small amount of active compost on hand to seed new compost bins is an excellent compost management strategy and efficient way to use finished compost.

Oxygen is initially supplied when the carcasses and litter are placed within the composter. If all the necessary requirements for composting are in the correct proportion, composting will begin immediately with a corresponding rise in temperature of between 130 and 150 degrees F within a few days (Figure 3). As oxygen becomes limited, microbial growth will slow and the temperature of the mass will decrease. The composting process can be sustained at higher temperatures by using a bulking agent which creates air pockets in the compost pile and thus supplies more oxygen to the composting process. A coarse material, such as wood shavings, straw or peanut hulls will ensure more oxygen, allowing higher composting temperatures for an extended time before it begins to drop. Adding more litter or litter cake increases heating. If litter cake is used, little or no bulking agents are needed. Finished compost can be used as the bulking material in place of new carbon-containing material up to 50 percent of the mix. If the litter is too fine, oxygen will be limited to the microorganisms, slowing their growth. Slower microbial growth causes a lower composting temperature with slower digestion of the birds. At a temperature of 150 degrees F, the birds decompose about twice as fast as at 130 degrees F. If the temperature of the compost reaches only 130 degrees F, birds nearer the walls where it is cooler will decompose very slowly. Proper management and operation of the composter is relatively easy when the basic principles are followed. The amount of labor required to compost birds is reasonably low.

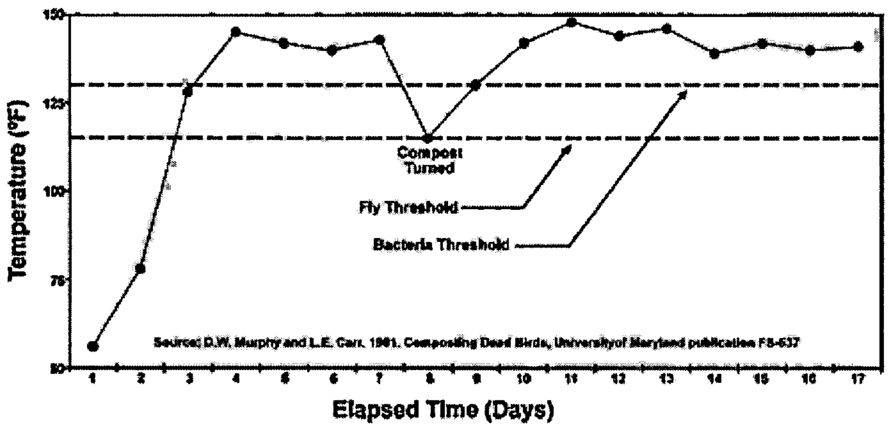


Figure 3. Typical temperature profile of a two-stage composter. Note the pest and microbial threshold limits.

Two-Stage System

In two-stage composting, the first stage generates heat and major tissue breakdown. The second stage after turning continues the process and homogenizes the material. Orderly loading of ingredients is necessary for efficient compost activity. Layer ingredients into the composter as illustrated in Figure 4.

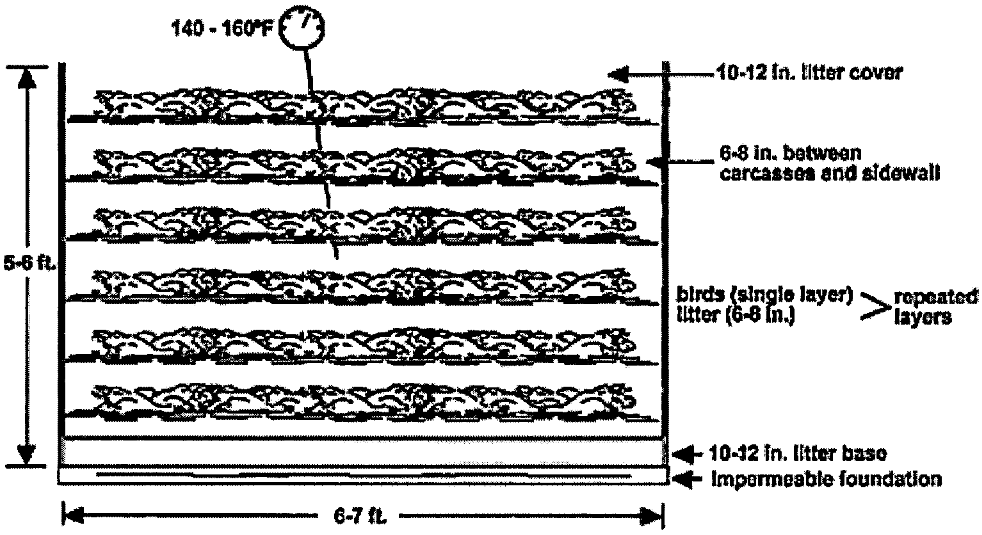


Figure 4. Mortality composter profile.

- Place an initial layer of 8 to 12 inches of fresh litter on the floor. This litter will supply bacteria to start the process and will also help absorb carcass fluids or excess water that may be added to the composter.
- Next add a thin layer of bulking material such as peanut hulls, coarse shavings or straw. Litter cake, if used in the composter, can replace the need for adding this layer of bulking material.
- Now add a layer of bird carcasses. Arrange the carcasses in a single layer side by side, touching each other. Place carcasses no closer than 6 inches from the walls of the composter. Carcasses placed too near the walls will not compost as rapidly due to lower temperatures there and may cause in odorous liquids to seep from the compost pile.
- A small amount of water may be needed after each carcass layer. Typically, thoroughly wetting the carcasses will add sufficient water to the mix to achieve the needed moisture level. If much water is needed, the litter is likely too dry and low in live bacteria. Using finished compost material or fresh litter directly out of the chicken house can prevent this situation.
- Next, add a layer of litter. This layer should be twice as thick (8-10 inches) as the layer of carcasses underneath. If only a partial layer is needed for a day's mortality, the portion used must still be covered with litter. The rest of that layer can be used with subsequent mortality.
- After completing the initial layer, add subsequent layers of carcasses, bulky ingredient and litter until a height not exceeding 5 to 6 feet is reached. The last layer will be a cap of 8-10 inches of litter. Compost piles limited to 5 to 6 ft in depth, with adequate porosity and moisture levels, do not pose a fire hazard. Keep in mind, however, the potential for spontaneous combustion as temperatures are monitored throughout the composting process. Excessive height can induce higher compost temperatures that exceed 170 degrees F and increase the chance of spontaneous combustion.
- Larger birds may require extra care during composting. Additional water or carbon material may need to be added to better facilitate the decomposition process and additional heating cycles may be needed to produce an acceptable end product.

Bin composters are designed to accommodate normal mortality. And while they may successfully handle above-average losses, they are not designed for catastrophic losses that can be caused by excessive heat, building collapse, highly pathogenic diseases, etc. Catastrophic losses can be successfully composted within carefully constructed and managed windrows. Information on composting catastrophic mortality can be obtained from the Cooperative Extension Service.

Problems with operation of the composter can be solved by reapplying the concepts of good compost management. (See **Troubleshooting Guide**.)

Temperature

Temperature in the range of 130 to 150 degrees F inside the compost pile is evidence that a composter is working well and that the composter environment is suitable. These high temperatures are produced by the biological activity of the microorganisms that are breaking down the organic material in the pile. High temperatures enhance the growth and reproduction of thermophilic (heat-loving) bacteria that are especially good at digesting organic material.

The heat produced by the microorganisms not only contributes to their own growth, but also speeds up the decomposition process and helps kill pathogenic microorganisms that may be present. For the composter to work properly, temperatures need to be higher than 130 degrees F. When oxygen becomes limited, the temperature of the compost will begin falling. By the time it drops to 130 degrees F (about 7 to 21 days after capping), the compost can be turned. Moving the material aerates the mixture and revives the microorganisms so another heat cycle can occur, leading to a more complete breakdown of the compost. The movement to a second cell will probably be necessary to get adequate decomposition if the birds exceed 4½ to 5 pounds.

The compost temperature should again rise to 150 degrees F within days. Delayed movement, poor aeration, poor mixing, or moisture above 60 percent or below 40 percent will prevent the mass from heating properly.

Once the temperature determined by daily monitoring drops from 150 to 130 degrees F (7 to 21 days), the product can be moved again to await its use as a fertilizer and soil amendment in the same manner as poultry litter. **Do not store finished compost with dry litter.** The interface between the moist and dry material is an ideal location for spontaneous combustion to occur.

Pests and Pathogens

Fly larvae, pathogenic bacteria and viruses are destroyed through the combined effects of time and temperature during composting. Typical temperatures achieved during composting exceed the human waste treatment requirements of the Environmental Protection Agency (130 degrees F for 15 days). Because biocidal temperatures are not reached at the outer edges of the primary compost bins, turning and mixing the compost at least once is needed to ensure the destruction of pathogens and nuisance insects. Monitoring compost temperatures and maintaining good management practices throughout the entire process helps ensure the elimination of insect larvae and pathogens in the final product.

Rodents, scavenging animals and other pests are seldom a problem with a properly managed composter. The solid construction and concrete floor of the composter will discourage ground level entry. Habitual raiders can be kept from the compost with fencing or some other building material. Trapping of pests may be appropriate where legal.

Compost Use

Well composted mortality can be used as a soil conditioner and nutrient source for crops just as fresh poultry litter. Compost is typically lower in nitrogen and slightly higher in phosphorus and potassium than manure and is thought to release nitrogen at a slower rate and over a longer period of time than fresh manure. The soil-amending and plant food properties of compost make it a valuable byproduct of poultry production. Marketing the compost can provide producers with an additional income stream to their agricultural operations.

Users of compost are encouraged to obtain a nutrient analysis of the product prior to its use. If analysis data is not obtained or is not available at time of use, the following average values may be used as a reasonable estimate of the available nutrient content of dead bird compost:

Total Nitrogen (N):	44 lbs/ton
Phosphorus (P_2O_5)	65 lbs/ton
Potassium (K_2O)	48 lbs/ton

We recommend that mortality compost not be spread on active pastureland or home gardens because of the potential for botulism poisoning in grazing animals or humans. Botulinum bacteria can survive for long periods of time, especially in bones. If bones have been successfully decomposed by the composting process, the threat of botulism is decreased. As a general rule, mortality compost should be spread on hay fields or cropland where grazing animals will have no opportunity to consume the material.

Innovations

Composting has proven to be an effective, environmentally sound method of dead bird disposal. Emerging technologies that enhance the composting process further promote and expand the use of composting as a mortality disposal method. Aerated-bed and in-vessel rotary drum composting units are at the leading edge of composting technology. These systems may decrease the time and daily management needed to compost material through controlled infusion of air and simplified aeration techniques. These new mechanized compost technologies can be initially cost-prohibitive. However, government cost-share programs are being made available that can offset the cost to the producer sufficiently to where the initial purchase cost of the technology is similar to two-stage bin composter construction.

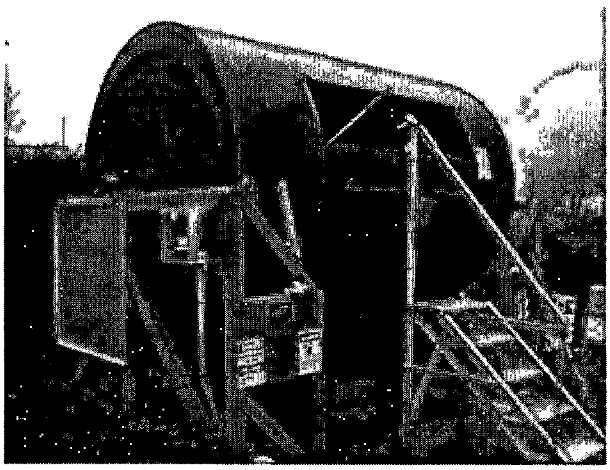


Figure 5. In-vessel rotary composter with forced air infusion capabilities. [Courtesy Industrial Piping, Inc.]

Enzyme and microbial products marketed as compost accelerants are also relatively new products that may be used to enhance the composting process, especially if the materials being composted do not have sufficient bacteria levels to initiate the process, such as with old litter or yard trimmings. These products require adequate moisture and appropriate ingredient materials in order to function properly, just as with normal composting procedures. Whether or not a product will improve the composting process depends very much on individual circumstances. The need or addition of such a products should be based on composting success or failures at a given location and with the use of the materials that are to be used on a daily basis.

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Obtaining a Composting Permit

In order to obtain a permit for composting poultry mortalities, Georgia growers must submit a written request to the State Veterinarian. The letter requesting the permit should state the name that is to appear on the certificate of compliance and describe the disposal method of choice. It must also include any existing pit numbers where applicable. If the farm is new, this should be stated at the time of the request. Requests for a dead bird disposal permit must be mailed to:

Georgia Department of Agriculture
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19 M.L. King Jr. Drive, Room 106
Atlanta, GA 30334

Land Application

Georgia does not require that mortality compost remain on the premises of the grower where the mortality originated. Well composted material can be transported and used off-site just as poultry house litter can. Though not defined in the regulation, in order to be "well composted," the material should have undergone at least two heat cycles and be devoid of undecomposed flesh.

Troubleshooting Guide for Carcass Composting

Problem/Symptom	Probable Cause	Suggestions
Improper temperature	Too dry (less than 40% moisture).	Add water.
	Too wet (more than 60% moisture).	Add bulking material and turn pile.
	Improper C:N ratio.	Evaluate bulking material and adjust as necessary.
	Improper mixing of ingredients.	Layer ingredients appropriately.
	Adverse Environment.	Ensure adequate cover.
-		
Failure to decompose	Improper C:N ratio	Evaluate bulking material and adjust as necessary.
	Carcasses layered too thickly.	Single layer the carcasses.
	Carcasses on outside edges.	Maintain 6-10 inches between carcasses and edges.
-		

Odor	Too wet.	Add bulking material and turn.
	Too low C:N ratio.	Evaluate bulking material and adjust as necessary.
	Inadequate cover over carcasses.	Cover with 10-12 inches of bulking material.
Flies	Inadequate cover over carcasses.	Cover with 10-12 inches of bulking material.
	Poor sanitation conditions.	Avoid leaching from pile.
	Too wet.	Turn pile and add bulking material.
	Failure to reach proper temperature.	Assess C:N ratio, layering.
Scavenging animals	Inadequate cover over carcasses.	Maintain 10-12 inch cover. Avoid initial entry with fence or barrier.

References and Resources

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Cooperative Extension Service to the exclusion of others.

Bulletin 1266/April, 2005

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, The University of Georgia College of Agricultural and Environmental Sciences and the U.S. Department of Agriculture cooperating.

Josef M. Broder, Interim Dean and Director

process oxygen is used up quickly by microorganisms inside the compost pile. Aerating the compost by turning re-supplies it with oxygen and allows the microorganisms to continue the composting process at a rapid rate.

Water is essential to the growth of all living organisms. Composting microorganisms thrive best in moist conditions. Desirable moisture levels in the composting materials should be 40 to 60 percent. Too much water can cause the compost pile to become soggy and anaerobic; too little water will prevent microorganisms from reproducing to adequately high numbers. The amount of water needed depends on the size of birds being composted and the moisture content of the litter and/or carbon bulking material. As a rule of thumb regarding proper moisture content, well-watered compost when squeezed into a ball will not drip water and will retain its shape when released.

Composter Construction and Layout

When siting a composter, choose a well-drained, graded and elevated location so ground water and surface runoff cannot enter the facility. The composter must also be located and graded such that it is accessible year round.

The size of a composter is typically based on the size of the poultry operation. For every 1 pound of dead bird, 1 cubic foot of primary compost space is needed. An equal amount of space is required for the secondary stage. The National Resource Conservation Service (NRCS) has standard designs and cost-share programs for composters of various sizes. Growers interested in composting and cost-share opportunities should contact their local NRCS office for funding information and design approval.

A typical poultry mortality composter consists of various sized bins constructed of treated lumber set on a concrete slab with a roof overhead. The roof helps maintain appropriate moisture levels within the compost. The concrete slab helps prevent leaching of nutrients into the soil, prevents vermin and pests from burrowing under the compost, and makes cleanup of the facility easier.

Typically the bins are constructed large enough to accommodate the equipment used to handle the material. Therefore, the width of the small bin composter must allow the loader bucket to get into the bin. Normally these small bin composters will be 6-8 feet wide by 5 feet high and 5 feet deep. The depth of the bin may be limited to the reach capabilities of the front end loader in order to drop the composted material into the secondary bin, which may be located behind the primary bin. Moving the material from the primary bin to the secondary bin after 10 to 21 days is common for small bin type composters to mix in oxygen in the mass to promote additional heating. The oxygen is added to the mixture as it is moved from the primary bin to the secondary bin.

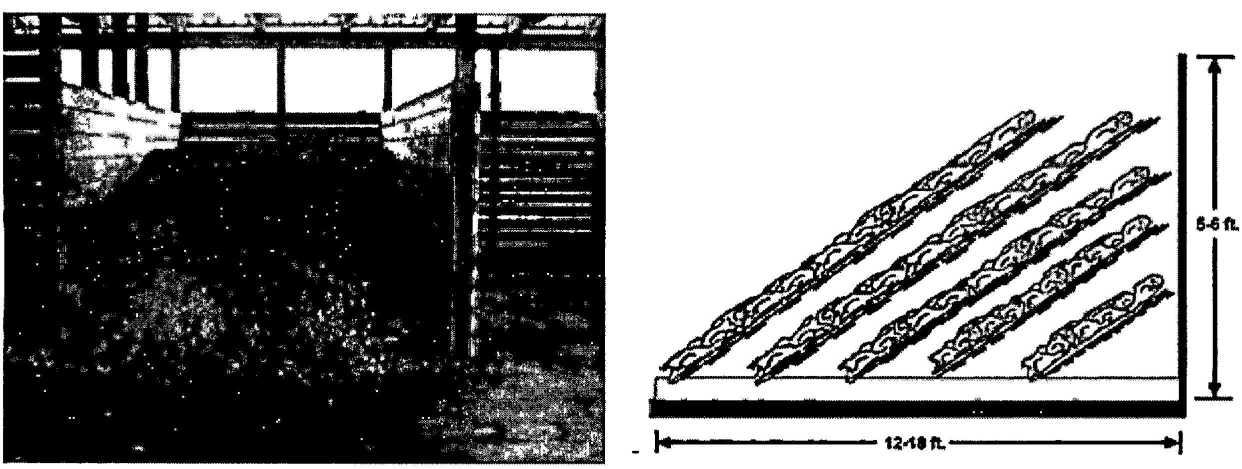
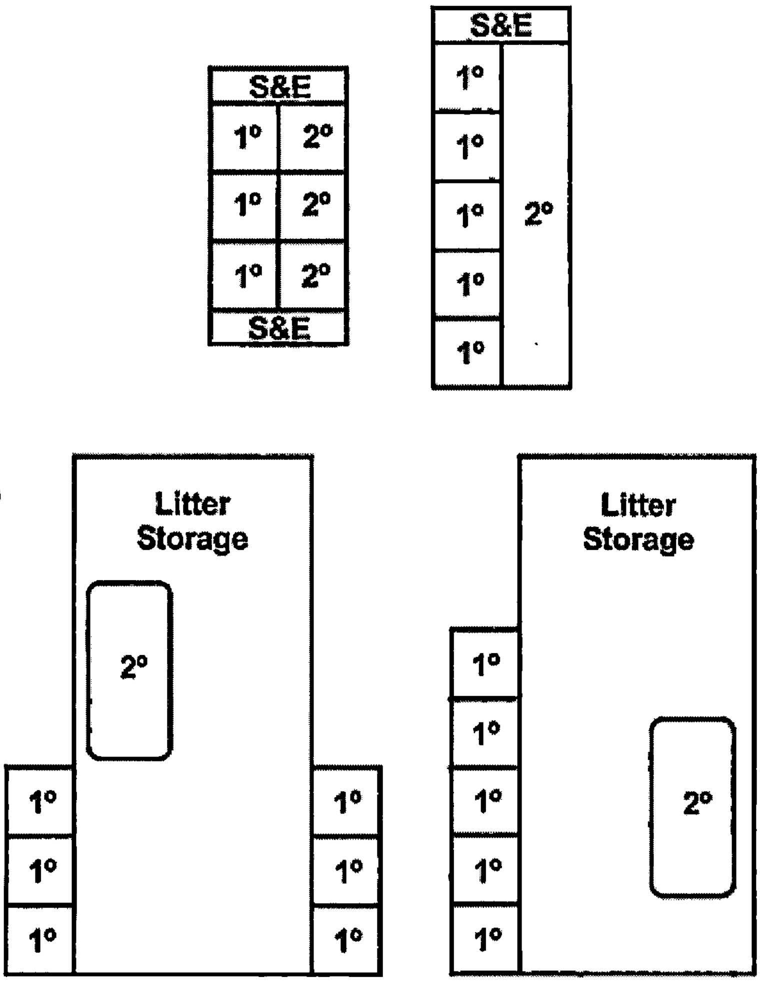


Figure 1. Bin composting on an angle can reduce time spent handling materials.

A modification to the small bin composter that is gaining in popularity is the use of a primary bin that is 5-10 feet deeper and with a front that is totally open. The compost material slopes back from the front of the composter at about a 45 degree angle (Figure 1). This design allows improved ingredient layering using a front end loader, so it requires less hand work. This modification can accommodate larger scale operations and material volumes. The primary and secondary bins are usually side by side or parallel to each other and built like a bunker silo. The big bin composter like the small bin type is filled to a height of 5 to 6 feet. Electrical power and a reliable water source are important necessities that should be made available at the composter to facilitate optimal year round composting. Example floor plans for stand alone composters and those integrated into a litter storage facility are shown in Figure 2.



Stand-alone composters with primary (1°), secondary (2°) and storage space - (S&E) for bulk materials and equipment. Bin width and depth typically 6-8 feet.

Compost bins incorporated within a litter storage facility. Space for secondary compost is provided within the storage facility. Stack house width and length typically 40 x 100 feet, though based on specific storage needs.

Figure 2. Example composter floor plan designs.

Composter Operation and Management

The requirements for proper and complete decomposition of dead carcasses are reasonably simple and inexpensive. The materials needed (dead birds, litter, alternative carbon sources, water) are readily available on every poultry farm. Careful attention to proper management is essential for successful composting. Failure to manage the system will result in an odorous situation that attracts flies, scavengers and other vermin to the site. Proper management is vital for avoiding nuisance complaints.

Decomposition of the dead carcasses and litter depends upon microbial activity. The greater the microbial growth, the faster the carcasses decompose. Anything that slows down microbial growth lowers the temperature of the composting material and slows the composting process. The more rapid the microbial growth, the greater the heat output within the composting mass and the more rapidly the mass breaks down. The microorganisms responsible for composting are initially supplied by active or fresh litter material. The microbes in the litter used in the composting process need to be kept alive and in sufficient numbers so the composting process can begin immediately to break down the carcasses and the litter. Litter that is too dry and too long removed from the house will contain lower numbers of microorganisms and its use slows the process of carcass decomposition. Keeping a small amount of active compost on hand to seed new compost bins is an excellent compost management strategy and efficient way to use finished compost.

Oxygen is initially supplied when the carcasses and litter are placed within the composter. If all the necessary requirements for composting are in the correct proportion, composting will begin immediately with a corresponding rise in temperature of between 130 and 150 degrees F within a few days (Figure 3). As oxygen becomes limited, microbial growth will slow and the temperature of the mass will decrease. The composting process can be sustained at higher temperatures by using a bulking agent which creates air pockets in the compost pile and thus supplies more oxygen to the composting process. A coarse material, such as wood shavings, straw or peanut hulls will ensure more oxygen, allowing higher composting temperatures for an extended time before it begins to drop. Adding more litter or litter cake increases heating. If litter cake is used, little or no bulking agents are needed. Finished compost can be used as the bulking material in place of new carbon-containing material up to 50 percent of the mix. If the litter is too fine, oxygen will be limited to the microorganisms, slowing their growth. Slower microbial growth causes a lower composting temperature with slower digestion of the birds. At a temperature of 150 degrees F, the birds decompose about twice as fast as at 130 degrees F. If the temperature of the compost reaches only 130 degrees F, birds nearer the walls where it is cooler will decompose very slowly. Proper management and operation of the composter is relatively easy when the basic principles are followed. The amount of labor required to compost birds is reasonably low.

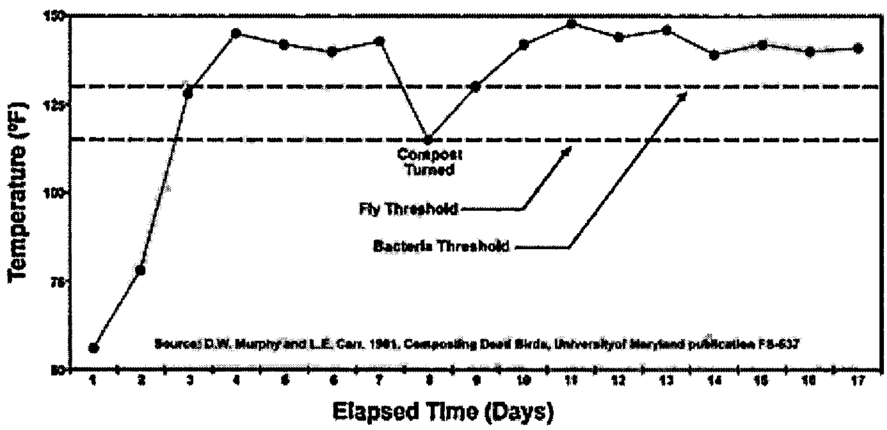


Figure 3. Typical temperature profile of a two-stage composter. Note the pest and microbial threshold limits.

Two-Stage System

In two-stage composting, the first stage generates heat and major tissue breakdown. The second stage after turning continues the process and homogenizes the material. Orderly loading of ingredients is necessary for efficient compost activity. Layer ingredients into the composter as illustrated in Figure 4.

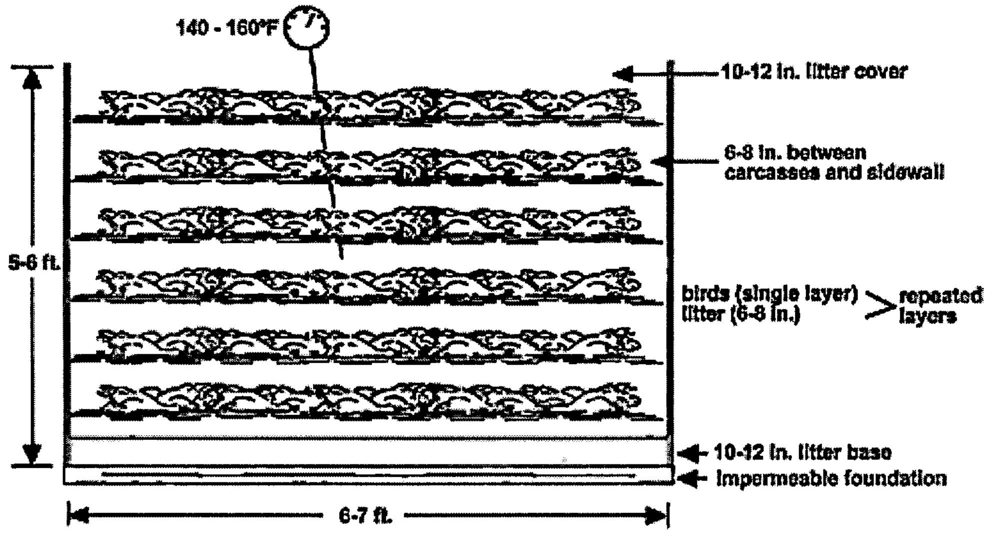


Figure 4. Mortality composter profile.

- Place an initial layer of 8 to 12 inches of fresh litter on the floor. This litter will supply bacteria to start the process and will also help absorb carcass fluids or excess water that may be added to the composter.
- Next add a thin layer of bulking material such as peanut hulls, coarse shavings or straw. Litter cake, if used in the composter, can replace the need for adding this layer of bulking material.
- Now add a layer of bird carcasses. Arrange the carcasses in a single layer side by side, touching each other. Place carcasses no closer than 6 inches from the walls of the composter. Carcasses placed too near the walls will not compost as rapidly due to lower temperatures there and may cause in odorous liquids to seep from the compost pile.
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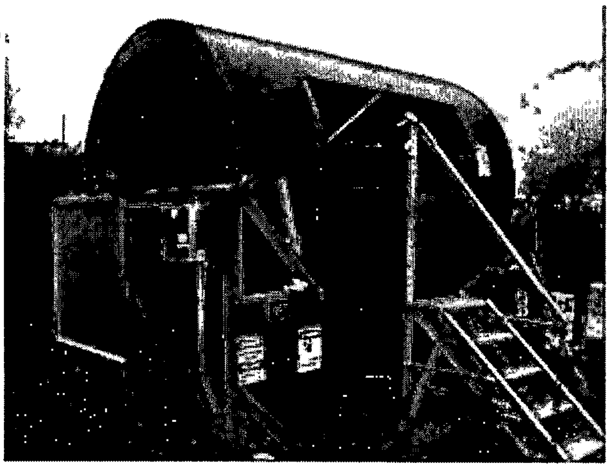

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Problem/Symptom	Probable Cause	Suggestions
Improper temperature	Too dry (less than 40% moisture).	Add water.
	Too wet (more than 60% moisture).	Add bulking material and turn pile.
	Improper C:N ratio.	Evaluate bulking material and adjust as necessary.
	Improper mixing of ingredients.	Layer ingredients appropriately.
	Adverse Environment.	Ensure adequate cover.
-		
Failure to decompose	Improper C:N ratio	Evaluate bulking material and adjust as necessary.
	Carcasses layered too thickly.	Single layer the carcasses.
	Carcasses on outside edges.	Maintain 6-10 inches between carcasses and edges.
-		

Odor	Too wet.	Add bulking material and turn.
	Too low C:N ratio.	Evaluate bulking material and adjust as necessary.
	Inadequate cover over carcasses.	Cover with 10-12 inches of bulking material.
Flies	Inadequate cover over carcasses.	Cover with 10-12 inches of bulking material.
	Poor sanitation conditions.	Avoid leaching from pile.
	Too wet.	Turn pile and add bulking material.
	Failure to reach proper temperature.	Assess C:N ratio, layering.
Scavenging animals	Inadequate cover over carcasses.	Maintain 10-12 inch cover. Avoid initial entry with fence or barrier.

References and Resources

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Cooperative Extension Service to the exclusion of others.

Bulletin 1266/April, 2005

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Josef M. Broder, Interim Dean and Director

Poultry Litter Management and Carcass Disposal Assessment

Why should I be concerned?

Some of the nutrients contained in poultry wastes are mobile and easily leached from litter and dead bird compost residues.

The litter from one 20,000-bird flock, finishing at 5 1/2 pounds per bird, contains about one ton of total nitrogen. If 10 percent of this amount is leached into the soil and converted into the nitrate form, 200 pounds of nitrate nitrogen is produced. What happens to the nitrogen after leaching depends on several factors, but it can result in the pollution of groundwater or surface water.

The manner in which litter is stored and land applied can make a big difference in its value as fertilizer. Unprotected litter and dead bird carcasses that are improperly handled may pollute farmstead water sources. They also pose a health threat to other animals.

The goal of ARKANSAS Farm*A*Syst is to help you protect your drinking water supply.

How will this work sheet help me protect my drinking water?

- It will take you step-by-step through your poultry litter management and carcass disposal practices.

- It will rank your activities according to how they might affect the groundwater that provides your drinking water supplies.

- It will provide you with easy-to-understand rankings that will help you analyze the "risk level" of your poultry litter management and carcass disposal practices.

- It will help you determine which of your practices are reasonably safe and effective, and which practices might require some modification to better protect your drinking water.

How do I complete the work sheet?

Follow the directions below.

Directions

1. Use a pencil. You may want to make changes.

2. For each category listed on the left that is appropriate to your farmstead, read across to the right and circle the statement that **best** describes your situation. **Skip and leave blank any areas that don't apply.**

3. Look above the description you circled to find the rank number (4, 3, 2, or 1) and enter that number on dashed line under **"YOUR RANK"** column.

4. Directions on overall scoring appear at the end of the work sheet.

LOW RISK (rank 4)	**LOW-MOD RISK (rank 3)**	**MOD-HIGH RISK (rank 2)**	**HIGH RISK (rank 1)**	**YOUR RANK**
Litter storage				
Litter is stored in a non-leaking stacking shed with a concrete floor.	Litter is temporarily stacked on a restrictive surface (concrete, 6-mil plastic, clay layer, etc.) at least 100 feet downslope from the well. Stacks are protected from rainwater by a 6-mil plastic cover. Surface water is diverted around the stacks.	Litter is routinely stacked at least 100 feet downslope from the well but is exposed to either rainwater or surface water.	Litter is stacked less than 100 feet from the well and is exposed to either rainwater or surface water.	
Carcass disposal				
All carcasses are collected and treated in a well-designed and functioning compost bin.	Carcasses are disposed of by an approved non-compost method according to guidelines provided by the Livestock and Poultry Commission.	Carcasses are disposed of in pits.	Carcasses are piled on the ground or thrown into a gully or ravine.	
LAND APPLICATION OF LITTER OR COMPOST RESIDUES				
Application rates				

Litter and compost residues are applied to fields at rates that are just high enough to meet crop nutrient requirements based on a nutrient management plan.	Litter and compost residues are applied to cropped fields at rates that do not exceed 2.5 tons/acre/ application, and do not exceed 5 tons/ acre/year. Soils in application areas are tested yearly for nitrogen, phosphorus, and potassium.	Litter and compost residues are applied to cropped fields at rates that do not exceed 2.5 tons/acre/ application, and do not exceed 5 tons/ acre/year. Soils in the application areas are not tested.	Litter and compost residues are applied to cropped lands at rates that exceed 2.5 tons/acre/application, or exceed 5 tons/acre/ year; or these wastes are applied to uncropped lands at any rate.	
Record keeping				
Good records kept on farm applications and wastes leaving farm through sales or giving away.	Fair records kept on farm applications and wastes leaving farm through sales or giving away.	Fair records kept on farm applications but no records on wastes leaving farm.	No records kept.	
Application timing				
According to accurate nutrient accounting or AWMP. Never apply on frozen or saturated soil.	Based on when crop is at growth stage that it usually needs fertilizing. Try to avoid applying in wet conditions.	Based on when can get around to it. Sometimes apply when soil is wet or frozen.	Based only on when litter is cleaned out of houses.	

Continue on next page...

Application areas				
All areas are more than 25 feet from rock outcrops, 100 feet from surface water sources, wells, dwellings, or sinkholes and have slopes of 15% or less. Or all areas are approved by a nutrient	Most areas are more than 25 feet from rock outcrops, 100 feet from surface water sources, wells, dwellings, or sinkholes and have slopes of 15% or less. Or most areas are	Several areas are less than 25 feet from rock outcrops, or less than 100 feet from surface water sources, wells, dwellings, or sinkholes, or have slopes greater than 15%.	Litter is nearly always spread over areas that are less than 25 feet from rock outcrops, or less than 100 feet from surface water sources, wells, dwellings, or sinkholes, or that have slopes greater than 15%.	

management plan.	approved by a nutrient management plan.			
Calibration				
Waste application equipment is calibrated to proper application rate before each application and checked at least once during the application period. Applications are made uniformly over the area.	Waste application equipment is calibrated before each application but not rechecked during the application period. No effort made to assure applying waste uniformly over the area.	Use custom waste hauler and applicator and assume they calibrate their equipment. Or calibrate your equipment only once a year.	Never calibrate waste application equipment or ask custom applicator about his calibration procedure.	
		RANKINGS TOTAL (Add up numbers in Your Rank column)		
		# OF AREAS RANKED (7 if ranked all)		
		Use these two numbers to calculate risk ranking.		

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THE USE OF ALKALINE HYDROLYSIS FOR THE PROCESSING AND DISPOSAL OF POULTRY CARCASSES

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Alkaline hydrolysis with heat has been used to solubilize and sterilize biological tissues including poultry carcasses. These results suggest alkaline hydrolysis may be a useful alternative to extant disposal methods such as rendering, incineration, composting, and burial.

ABSTRACT

It has previously been shown that alkaline hydrolysis reduces mammalian carcasses to a sterile solution of amino acids, peptides, nucleotides, and soaps that can be used as fertilizer, a carbon and nitrogen supplement for soil, or feedstock for methane-producing anaerobic fermenters. The technology has also been shown to destroy all index infectious agents including those known to cause transmissible spongiform encephalopathies.

Studies have been undertaken to evaluate various applications in the poultry industry including the disposal of poultry processing waste, disposal of carcasses from super-annuated layers, and disposal of male chicks from producers of layer pullets.

Studies undertaken at 100° C with male chicks one day post-hatching have shown complete destruction of the carcasses including beaks and feet. Studies on pure feather preparations from mature animals using 150° C hydrolysis temperatures have shown a pattern of amino acid residues similar to that found in hydrolyzate from mammalian carcasses. Preliminary results from studies currently underway in the United Kingdom on turkey waste carcasses--including feather, beak, and bone--also replicate results found with mammalian tissues, even with reduced temperatures and processing times.

METHODS

1. Alkaline Digestion of Feathers

Mature feathers (goose, chicken, duck) from old pillows were rehydrated and digested at 150° C with NaOH or CaO.

NaOH hydrolysis for 6 hours: 397 g of frozen rats, 30.3 g NaOH and 600 ml of water, were heated to 150° C for 6 hrs. This comprised 7.73% protein, 89.32% water, and 2.95% NaOH [molratio protein to alkali:10: 9.5].

CaO hydrolysis for 5 hours: 39.1 g dry feathers, 20.4 g CaO, and 500 ml water were heated to 150° C for 5 hrs. This comprised 6.99% protein, 89.37% water, and 3.65% CaO [molratio protein to alkali:10: 9.3].

Amino Analysis of the Feather Digest: Following alkaline hydrolysis, hydrolyzate samples were secondarily hydrolyzed with 6 M hydrochloric acid for 16 hrs at 110° C, dried, and derivatized with dabsylchloride. The dabsylamino acids were separated by reverse phase HPLC on C18 silica and quantitated by comparison to an amino acid standard run.

2. Alkaline digestion of day-old chicks

7 pounds of first-day-post-hatching (less than 36 hour age) male chicks, each weighing 1 to 1.2 ounces, or approximately 100 male chicks, were placed in a Lab-5 alkaline hydrolysis chamber with a starting concentration of KOH of at least 21%. They were incubated for 3, 7, or 9 hours at 99° C. The capacity of the Lab 5 is 11 pounds (5 kg) but only 7 pounds of chicks could be packed in the chamber due to feather volume. The ratio of volumes of liquid to solid at the beginning of the run were 3.5:1. The temperature of 99° C was used to prevent foaming seen at 100° C.

3. Alkaline Digestion of Turkey Carcasses and Feathers in the United Kingdom

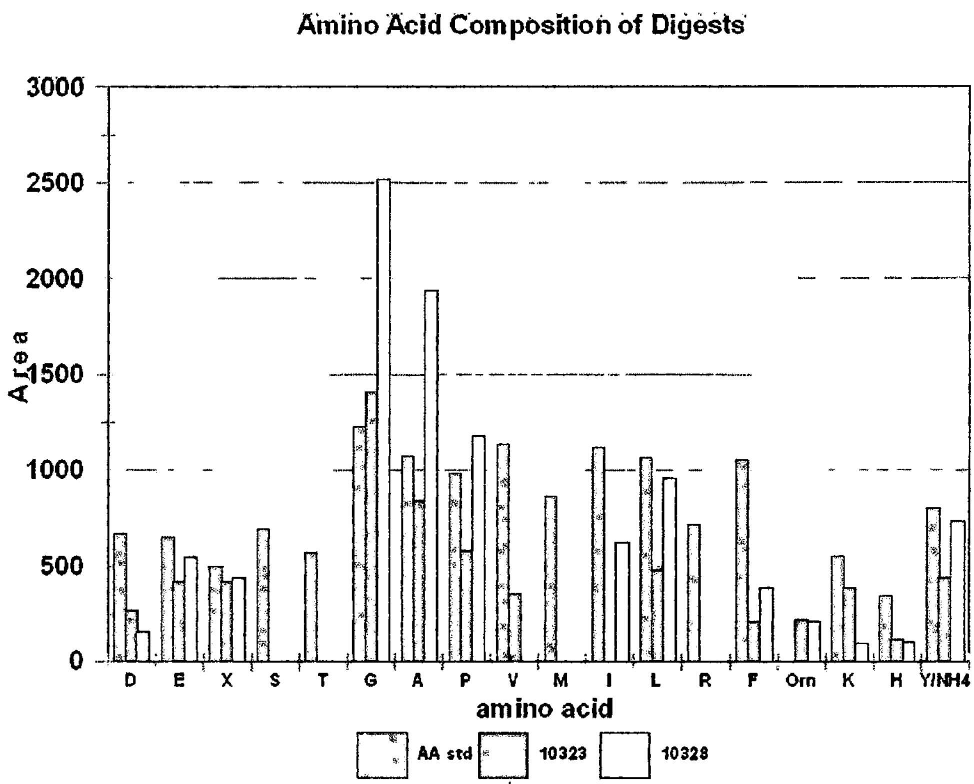
Whole mature turkey carcasses, with feet, were digested for 20 minutes at 200° F, 30 minutes at 200° F, or 40 minutes at 150° F. In parallel, a batch of turkey feathers only, no carcass, was digested for 20 minutes at 17% KOH at a feather:alkali fluid ratio of 1:1.

RESULTS

1. Alkaline Digestion of Feathers

The effect of the alkali on the amino acid composition of digest of mature feathers is shown in Figure 1.

Figure 1. Amino Acid Analysis of Feathers Digested by Alkaline Hydrolysis



Abbreviations: D, Aspartic Acid. E, Glutamic Acid. X, A Crosslink. S, Serine. T, Threonine. G, Glycine. A, Alanine. P, Proline. V, Valine. M, Methionine. I, Isoleucine. L, Leucine. R, Arginine. F, Phenylalanine. Orn, Ornithine. K, Lysine. H, Histidine. Y/NH4, Tyrosine/Ammonia. First bar (blue): Amino acid standard. Second bar (red): NaOH hydrolysis for 6 hours. Third bar (yellow): CaO hydrolysis for 5 hours.

The amino acids serine, threonine, cysteine, methionine and arginine are completely destroyed during the hot alkali treatment. In the case of arginine, its destruction product appears as the amino acid ornithine. The destruction of serine, threonine and cysteine is called ß-elimination; this reaction converts these amino acids into unsaturated derivatives such as dehydro-alanine and dehydro-butyrine. These unsaturated amino acids subsequently can react further with other amino acids to produce so-called crosslinks. This ß-elimination combined with the hydrolysis of peptide bonds in the proteins totally destroys all biological activity associated with proteins.

2. Alkaline digestion of day-old chicks

At 3 hours of hydrolysis, some carcass tissue remained, but not at the later timepoints, as in Table 1. After 7 or 9 hours, the remaining solids consisted of bone fragments with the appearance of flaking paint. The bone fragments could not be picked up when wet due to crumbling.

Table 1. Alkaline Hydrolysis of Day-Old Chicks

Time (hours)	Solid tissue	Suspended solids (mg/L)
3	Yes	n/a
7	No	6,400
9	No	4,670

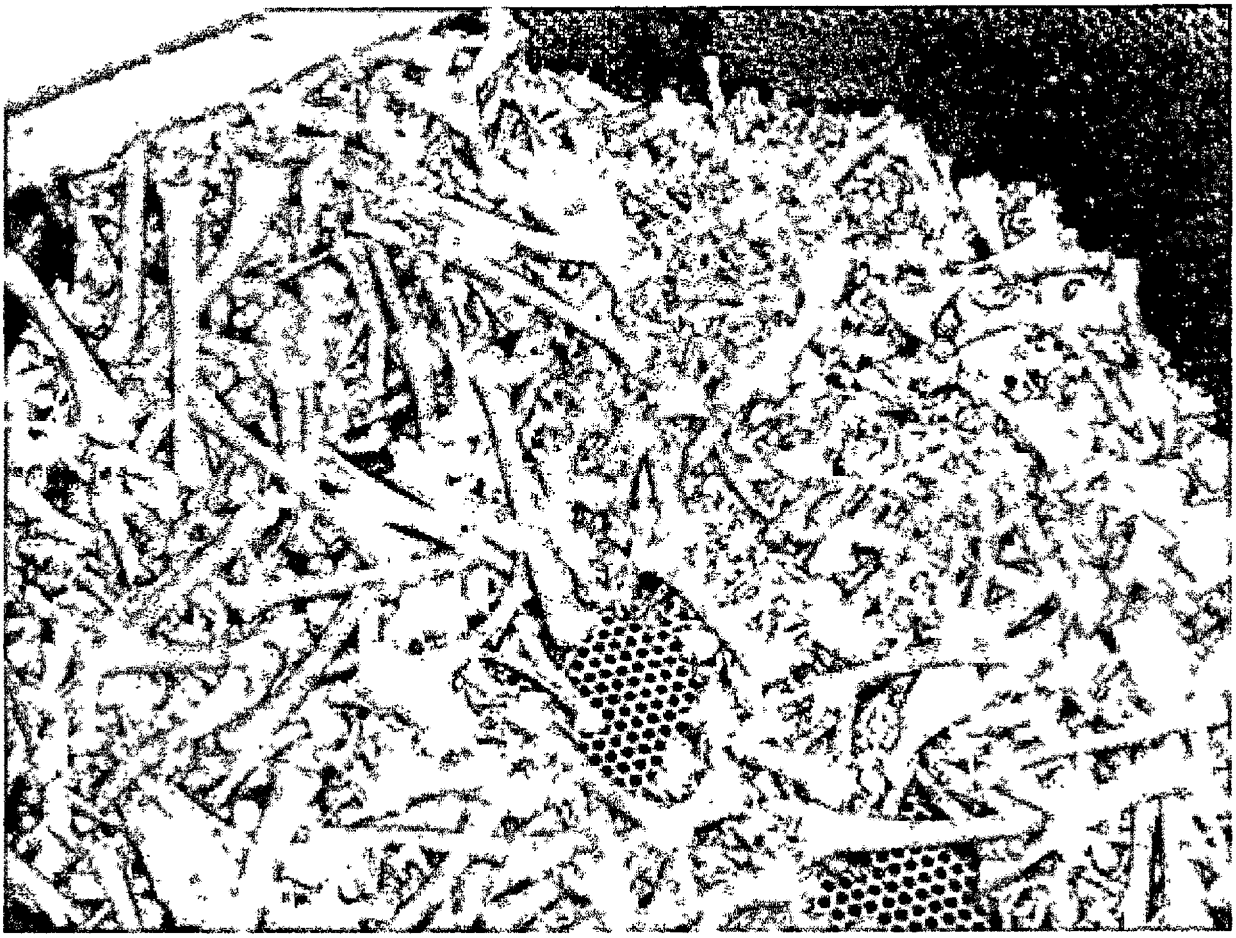
A previous assay of day-old chicks hydrolyzed for 18 hours in a Lab-5 showed complete hydrolysis. The hydrolyzate from that experiment is currently being analyzed for its value as a feedstock for anaerobic fermentation.

3. Alkaline Digestion of Turkey Carcasses and Feathers in the United Kingdom

The bones remaining as solids after alkaline hydrolysis were easily crushed by hand but had increasing amounts of red marrow present at decreasing time points.

Figure 2. Turkey carcasses before processing by alkaline hydrolysis.

Figure 3. Turkey carcasses after processing by alkaline hydrolysis for 20 minutes.



The feathers in the feather-only analysis were entirely hydrolyzed; no feathers were observable after 20 minutes in 17% KOH.

DISCUSSION

The primary components of animal tissues are water and proteins. Water constitutes from 65 to 80% of the weight of an animal, and protein averages 20% of the weight; fat can vary from 6 to 18 percent or higher. The primary effects of alkaline hydrolysis with 1 to 2 N NaOH or KOH on animal tissue are the breaking of amide (peptide) bonds of proteins, saponification of fats, and destruction of nucleotides.

The time required for hydrolysis varies by incubation temperature. Based on previous studies, with each 10° C increase, the time required for hydrolysis is halved. At 100° C, the approximate temperature attained at atmospheric pressure by commercially-available equipment (Agri-Lyzer™, WR2, Indianapolis, IN), a standard operating time of 16 hours is adequate for all tissues tested, as shown in Figure 4. The time required for dissolution of solid tissue is less.

Figure 4. Alkaline Hydrolysis of Rat Carcasses at 100° C.

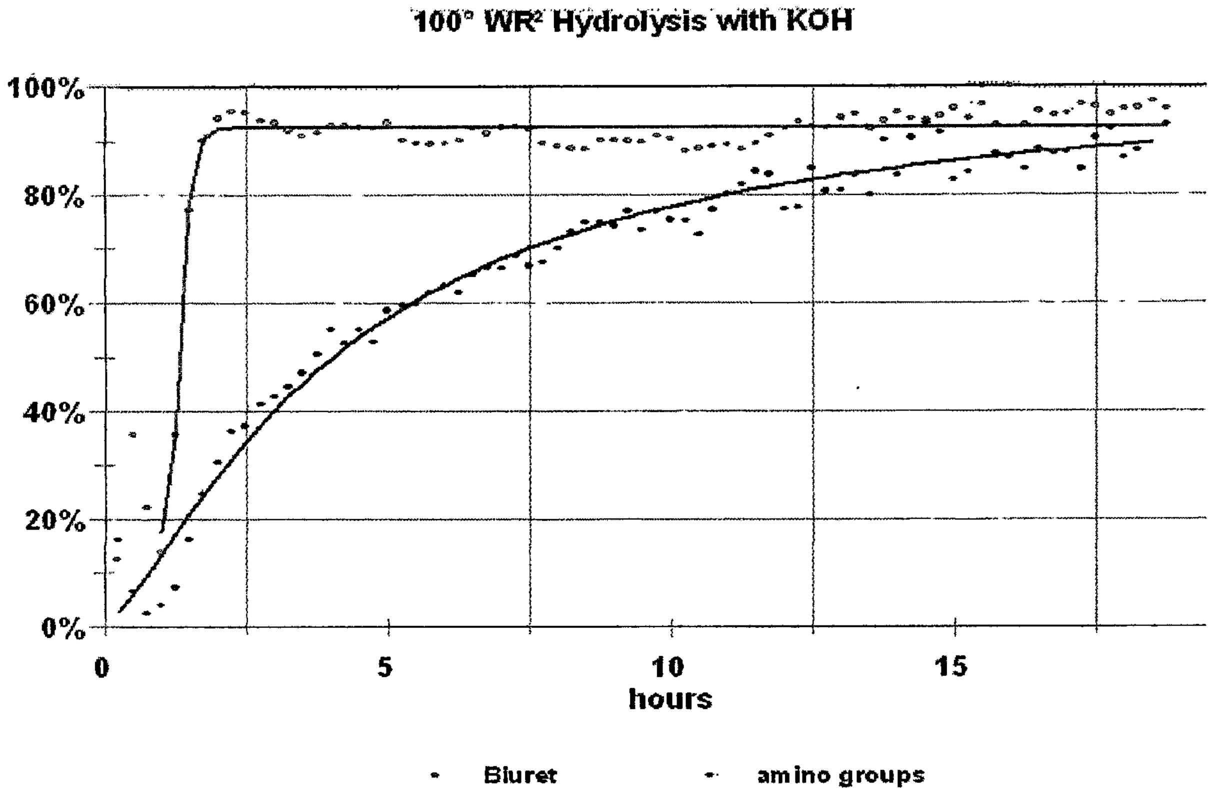


Figure 4. The hydrolyzate was monitored with the Biuret reaction for peptide content and amino groups [o-naphthoquinone sulfonic acid reaction] in KOH digest of rat tissues at 100° C. Complete solubilization occured after ~2.5 hrs [Biuet curve] followed by continuous hydrolysis and amino group release with more than doubling of amino groups between 2.5 and 18 hours.

The results of alkaline hydrolysis with 0.75 M final KOH on tissue at 100° C [212° F] demonstrated that hydrolysis of peptide bonds, ß-elimination of hydroxyl groups of serine and threonine, and the destruction of arginine with concomitant production of ornithine all occurred just as under the standard conditions of 3 hours at 150° C but take a longer time, i.e., 16 to 18 hours, at the lower temperature.

Utilization of the Hydrolyzate

The hydrolyzate resulting from alkaline hydrolysis at elevated temperature has a composition compatible with utilization as fertilizer or as feedstock for anaerobic fermentation, as shown in Table 2.

Table 2: Analysis of Hydrolyzate of Carcasses and Carcass Parts

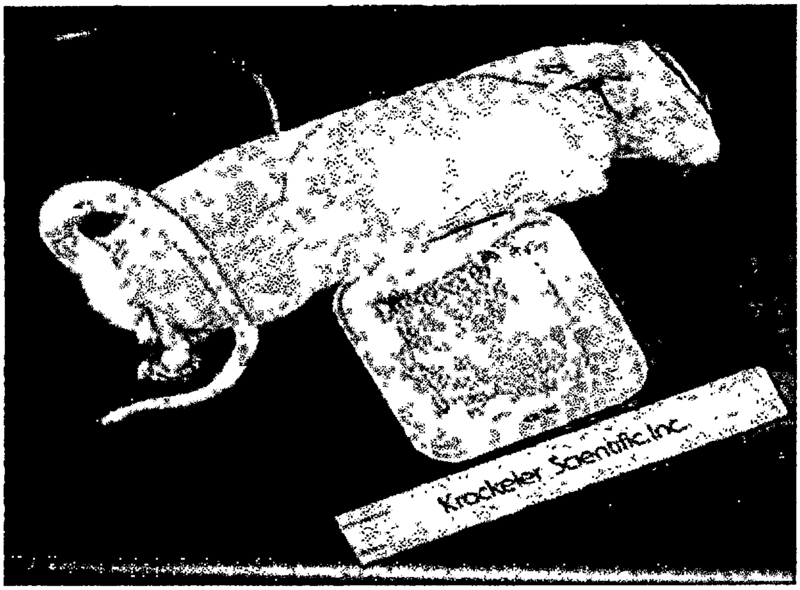
	Cow	Pig Heads	Hog	Horse
Carcass weight (kg)	447	119-123	n/a	1,281
Ending pH	13	9.2 to 11.3	11.2	11
Suspended solids (mg/L)	2,600	8.9 to 19.3	3,400	2,200
BOD (mg/L)	18,000	n/a	7,400	108,600
COD (mg/L)	21,000	122,600 to 163,000	136,600	165,000
Phosphorus (mg/L)	n/a	n/a	110	457
Potassium (mg/L)	n/a	0.24 to 2.7	n/a	n/a
Chloride (mg/L)	290	0 to 1.1	96	946
Ammonia (mg/L)	290	722 to 1,029	n/a	1,900
Total organic carbon (mg/kg)	n/a	n/a	32,000	43,600
Total Kjeldahl Nitrogen (mg/L)	n/a	n/a	440	13,000

Assay sources: Cow, University of Florida, August 2001. Pig heads, DeMulder, Doncaster, England, January to March 2002. Whole pigs, Burgess & Niple, Ohio, October 1999. Horses, FECL, September 1998.

There is variation between studies depending on a variety of factors including the ratio of carcass to alkali volume. Within one study the results are generally consistent. In one study using elk carcasses in October and November 2001 BODs ranged from 40,530 to 73,630, for example.

The quantitative amounts of individual amino acids may vary between poultry and bovine, equine, porcine, ovine, or rodent tissues, but the extent of hydrolysis is consistent. The solids remaining after hydrolysis are minimal, as shown in Figure 5.

Figure 5. A Rat with the Post-hydrolysis Solids of its Littermate



A 330 g rat and the powdered remains of one of its littermates after alkaline hydrolysis. Only 10 g of calcium phosphate derived from the hydroxyapatite of the bones and teeth of the digested rat are recovered. The bones and teeth, stripped of collagen, can be crushed into powder with minimal force.

The results of the studies on poultry carcasses indicate the process of alkaline hydrolysis is applicable to poultry disposal. Feathers are efficiently hydrolyzed. Hydrolysis of feathers in the strong alkali solution can be observed within minutes even in the absence of heat. Studies in the UK are determining whether reduced times of hydrolysis are adequate for processing of poultry waste intended for feedstock in anaerobic fermenters. In all cases tested so far, whether whole carcasses, pure feathers, or samples with added long bones, all of the tissue was destroyed.

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EVALUATION OF MORTALITY PROCESSING ALTERNATIVES

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Current U.S. broiler production approaches eight billion birds annually and the industry suffers a death loss of an estimated 400 million birds/400,000 tons each year (based on an approximated 5% mortality rate and 2.0 lb. average carcass weight as used by Blake *et al.*, 1990). These carcasses create disposal challenges in all production regions and can pose microbial risks to watersheds and contribute to air quality concerns. Commercial methods of mortality management can include burial, digestion, incineration, rendering, or composting. Use of these mortality management strategies varies by production region.

Since all of these strategies can be problematic due either to cost, extensive carcass handling, labor and management requirements, microbial contamination risks to the watershed, or a combination of these factors, widespread research and development activities are continuing to identify new, more efficient and more economical mortality management alternatives. Newer technologies under investigation and development often support stabilization of carcasses destined for nutrient recovery (i.e. rendering) or other value-added uses.

Several states now allow the use of mass burial procedures only for catastrophic loss events. Implementation of new, low management, environmentally friendly, on-farm management alternatives are needed to meet some of the challenges facing industry while protecting environmental quality.

SUMMARY OF TRADITIONAL MORTALITY MANAGEMENT OPTIONS

Mass Burial Pits

Mass burial pits have historically served as a basic means of carcass disposal. However, this method is quickly loosing favor in areas of concentrated production, more populated regions, or in environmentally at-risk watersheds due to potential problems associated with microbial contamination of groundwater. Alabama, Arkansas, Georgia, Texas and some other states have banned the use of mass burial pits except under conditions of a catastrophic loss.

Alabama

As of July 1, 2000, burial is no longer permitted as a method of disposal for poultry carcasses in Alabama except in the case of a catastrophic loss event (J.P. Blake, personal communication, July 24, 2000). As a result, incineration, composting and rendering are the only commercial options currently used in Alabama. Approximately 20% of the state's mortality is managed using incineration techniques, 70% by composting and 10% by rendering.

Composters have become widespread in the state and seem to be working well when managed properly. Only one integrator and one private company that services growers under contract to various integrators are utilizing rendering. Refrigeration is the means being used commercially to store carcasses on-farm while awaiting pickup and delivery to a rendering facility. No new technologies are being implemented on a commercial scale at this time, however field-testing of a fermentation system is underway.

Arkansas

Growers for one integrator utilize freezers for on-farm mortality storage prior to delivery to a rendering facility (S.E. Watkins, personal communication, July 31, 2000). Approximately 25% of the state's mortality is managed through rendering techniques, 30% are composted and about 45% are incinerated. Other mortality management strategies such as acidification are not being implemented commercially at this time.

Use of incinerators in Arkansas will probably remain popular in the future due to convenience, but fuel prices will have an obvious influence. Use of composting will likely increase if incineration looses favor due to cost. Some composting operations have experienced problems with wildlife attraction. This attraction could facilitate encroachment of diseases from the wild as well as promote spreading of diseases between producers. The use of burial pits became illegal in Arkansas in 1992.

Georgia

Poultry producers in Georgia can choose between several state-approved methods including pits (roughly 3 X 8 X 6 ft deep, unlined chambers), composting, incineration, rendering and digestion (D.P. Smith, personal communication, July 26, 2000). Approximately 90% of the producers utilize pits, especially as a backup to other options such as incinerators or composters. Five to 10% of growers use composting techniques (primarily static bin) while 10-15% use incinerators. Less than 5% utilize rendering options or on-farm digestion techniques. Digesters (basically sealed tank operations) are now being discontinued as an approved method by the Georgia Department of Agriculture due to operational problems.

Mass burial is used only for emergencies and alligator farms are being used on a trial/test permit basis at this time. The use of composting and incineration may increase slightly in the future, while rendering and digestion techniques will probably decrease.

Acidification For On-Farm Storage Prior to Rendering

This procedure is similar to the fermentation process except that sulfuric or phosphoric acid is added to carcasses (Blake, 1998). Nutrients are preserved, pathogens are inhibited and rendering yields acceptable quality feed ingredients.

Alkaline Storage Prior to Rendering

Poultry carcasses can be preserved for several months using alkaline hydroxides to increase the pH to 13.0 (Burgess and Carey, 1999b). Using a 10% solution of KOH, mortality from up to three flocks of broilers could be preserved by adjusting the pH to 13 between each flock. Feeding of the rendered product in broiler starter diets appeared feasible from preliminary trials (Burgess and Carey, 1999a). Also based upon preliminary studies, use of the remaining alkaline effluent as a soil amendment appears feasible (Burgess *et al.*, 1999).

Extrusion

Extrusion uses friction to generate the heat required to sterilize and dehydrate mortality and this process can be used as an option to rendering (Blake, 1998). Carcasses can be ground with other feed ingredients if desired prior to extruding.

Extrusion is currently considered an expensive alternative to rendering and is not suitable for on-farm use due to the cost of equipment.

Rotating Tank, In-Vessel Composting

Composting of poultry carcasses mixed with poultry litter using a rotating-tank in-vessel composter can decompose carcasses in three days and complete thermophilic stabilization of the compost mass in four to six days (Cawthon and Freeman, 1999). A compost containing 25% carcasses by weight was found to be free of coliform and salmonella bacteria as well as botulism spores and toxin. When analyzed as a feed, the compost contained 24.9% crude protein, 4.0% fat, 15.3% fiber, and 82% total digestible nutrients and could have value-added application as a ruminant livestock feed ingredient.

REFERENCES

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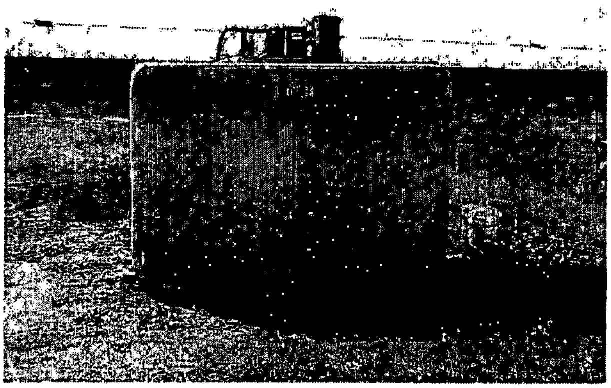
NATURAL RESOURCES CONSERVATION SERVICE
INTERIM CONSERVATION PRACTICE STANDARD

ANIMAL MORTALITY FREEZERS

(No.)
CODE 774



DEFINITION

A freezer unit capable of freezing and storing poultry carcasses or small animals until such time they can be moved off-site for recycling and/or rendering.

PURPOSE

This practice may be applied as part of a conservation management system to provide a suitable disposal method of dead poultry in order to prevent pollution of water and soil resources. This standard covers the planning and design of on farm freezers for the disposal of dead poultry or small animals encountered on farms as part of normal farming operations.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where current disposal practices of dead poultry or small animals are unsatisfactory and where there is a need to improve sanitation, reduce pollution, and/or recycle dead animals into a feed source. There must be a vender capable of safely collecting and transporting the carcasses from the farm to the recycling or rendering plant.

CRITERIA

General. All Federal, state, and local laws, rules, and regulations governing waste management, pollution abatement, and health and safety shall be strictly followed. The owner or operator shall be responsible for securing all required permits, approvals, and registration and for the operation of the unit in accordance with appropriate laws, rules, and regulations.

All methods for the disposal of animal mortality require permits from the Georgia Department of Agriculture. Prior to construction/placement of the mortality freezer the state veterinarian must issue a permit. The following information must be submitted to obtain the disposal permits.

1. Owner's name and address
2. Exact location: longitude and latitude
3. County map with site located
4. Size and type of operation
5. Construction plans (drawings)
6. Freezer capacity and manufacturer
7. Any existing disposal permit number(s)

Submit this information to

State Veterinarian
Asst. Commissioner of Animal Industry
Georgia Department of Agriculture
Capitol Square
19 Martin Luther King, Jr. Drive
Atlanta, Georgia, 30334-4201

Consideration should be given to the operating cost of the freezer unit. Local energy cost rates should be used to estimate these expenses.

Consideration should be given to economics, the overall waste management system plan, and safety and health factors.

PLANS AND SPECIFICATIONS

Plans and specifications shall be prepared in accordance with the criteria of this standard and shall describe the requirements for applying the practice to achieve its intended use.

The plans shall also include the number, size, location of mortality storage freezers, and foundation support for the freezer.

OPERATION AND MAINTENANCE

An operation and maintenance plan shall be developed that is consistent with the purposes of the practice, it's intended life, safety requirements and the criteria for its design.

Freezers must be operated properly to maximize equipment life and minimize potential problems. Temperatures should be monitored regularly to ensure proper freezing of carcasses.

The freezer must be loaded according to manufacturer's recommendations and not exceed the design capacity.

Freezers shall only be used only for the freezing of dead animals associated with the planned operation.

The freezer must be inspected periodically (e.g. after each transfer of the carcasses to trucks for transport off-site) to ensure that all components are operating as planned and in accordance with the manufacturer's recommendations. The inspection shall check for leaks and structural integrity of the freezer unit and proper freezing temperature.

The O&M plan shall include but not limited to the following.

- Name and telephone number of the vendor responsible for removing animal carcasses from the freezers to off-farm facilities.
- Schedule for removing animal carcasses from the freezer(s).
- Capacity of freezer.
- Maximum loading capacity of freezer(s).
- Freezer operating temperature.
- Method of mortality disposal for catastrophic losses
- Contact(s) and phone numbers of person(s) to contact in case of catastrophic losses.

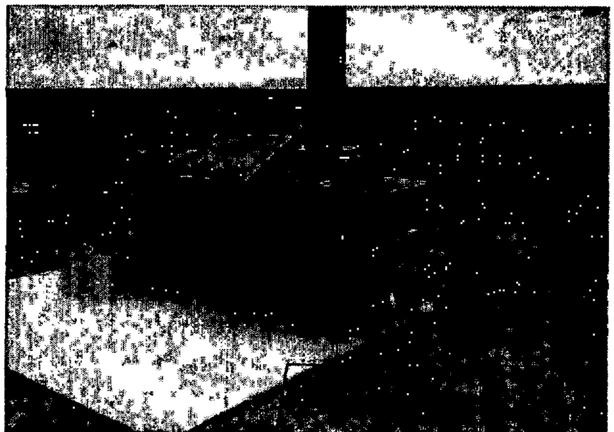
REFERENCES

NRCS conservation practice standards
Access Road, Code 560
Critical Area Planting, Code 342

NATURAL RESOURCES CONSERVATION SERVICE
INTERIM CONSERVATION PRACTICE STANDARD

INCINERATOR

(each)
CODE 769



DEFINITION

An incinerator used to dispose of dead poultry, suckling pigs, or other small animals.

PURPOSE

This practice may be applied as part of a conservation management system to provide a suitable disposal method of dead poultry or small animals to prevent pollution and improve environmental quality. This standard covers the planning and design of a manufactured incinerator for the disposal of dead poultry or small animals encountered on farms as part of normal farming operations.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where current disposal practices of dead poultry or small animals are unsatisfactory and where there is a need to improve sanitation, reduce pollution, or enhance the visual resource.

CRITERIA

General. All Federal, state, and local laws, rules, and regulations governing waste management, pollution abatement, and health and safety shall be strictly adhered to. The owner or operator shall be responsible for securing all required permits, approvals, and registration and for the operation of the unit in accordance with appropriate laws, rules, and regulations.

Incinerator owners or operators must obtain air construction and operating permits pursuant to Georgia Department Natural Resources, Environmental Protection Division, Rules for Air Quality Control, Chapter 391-3-1 (O.C.G.A. 12-9-1, Georgia Air Quality Act).

All methods for the disposal of animal mortality require permits from the Georgia Department of Agriculture. Prior to construction/placement of the mortality freezer the state veterinarian must issue a permit. The following information must be submitted to obtain the disposal permits.

1. Owner's name and address
2. Exact location: longitude and latitude
3. County map with site located
4. Size and type of operation
5. Construction plans (drawings)
6. Freezer capacity and manufacturer
7. Any existing disposal permit number(s)

Submit this information to

State Veterinarian
Asst. Commissioner of Animal Industry
Georgia Department of Agriculture
Capitol Square
19 Martin Luther King, Jr. Drive
Atlanta, Georgia, 30334-4201

Emissions. Incinerator particulate matter emissions, carbon monoxide (CO) emissions, and

Where air emissions are a concern, consideration should be given to alternate methods of disposal (composting, rendering, etc.).

Consideration should be given to the operating cost of the incinerator. Local fuel cost rates should be used to estimate these expenses.

Due consideration should be given to economics, the overall waste management system plan, and safety and health factors.

PLANS AND SPECIFICATIONS

Plans and specifications shall be prepared in accordance with the criteria of this standard and shall describe the requirements for applying the practice to achieve its intended use.

OPERATION AND MAINTENANCE

An operation and maintenance plan shall be developed that is consistent with the purposes of the practice, it's intended life, safety requirements, and the criteria for its design.

Incinerators shall only be used for the cremation of dead animals.

Incinerators must be operated properly to maximize equipment life and minimize emission problems. Any operator of an incinerator shall be trained and licensed by the manufacturer's representative or an equivalent organization using a state-approved training program. A licensed operator must be on-site when the incinerator is in operation.

The incinerator must be loaded according to manufacturer's recommendations. Ashes should be removed frequently to maximize combustion and prevent damage to equipment. Plans shall include methods for collecting and disposing of the ash material remaining after incineration. The plan shall include an ash collection box or bucket and disposal of the ash on the land or through a community trash disposal system.

The incinerator must be inspected periodically to ensure that all components are operating as planned and in accordance with the manufacturer's recommendations.

REFERENCES

Georgia Air Quality Act
Official Code of Georgia Annotated (O.C.G.A.) 12-9-1 --

Georgia Department of Natural Resources, Environmental Protection Division, Rules for Air Quality Control, Chapter 391-3-1

NRCS conservation practice standard Critical Area Planting, Code 342

API Proposal Materials

American Protein - Presentation
Truck Sanitation - wheelwells equiped with auto spray.
Freezer Sanitation → on-site

* Grower owns freezer(s) pays $50.00 per pickup ~ 7 per flock

Costs per lb mortality - projected
Inc 0.0571
Com 0.0583
1 unit Freeze 0.0441
2 unit freeze 0.0437

Saeplast Freezers
- Canadian Co.

Siting around freezer pad critical

Conasauga River - NRCS priority area
Armuchee Creek

American Proteins, Inc.
Projected Farm Mortality Disposal Cost

Investment -	Incineration	Composting	Freezing/ with 1 unit	Freezing/ with 2 units
Incinerator cost (Shenandoah A-6) - see note below	$ 3,000.00	$ -	$ -	$ -
Shed and base slab cost or composter	500.00	3,600.00	350.00	500.00
Freezer	-	-	1,900.00	3,800.00
Water service	-	150.00	-	-
Total Investment	$ 3,500.00	$ 3,750.00	$ 2,250.00	$ 4,300.00
Cost of operating -				
Annual Fixed Costs -				
Investment Depreciation (10 year life)	$ 350.00	$ 375.00	$ 225.00	$ 430.00
Interest (one half of investment at 10% interest)	175.00	187.50	112.50	215.00
Maintenance and repair	55.00	230.00	100.00	150.00
Insurance (at 0.5% of investment)	17.50	18.75	11.25	21.50
Annual Variable Costs -				
Fuel - 3,202 gallons at $.70 / gallon	2,241.40	-	-	-
Electricity	175.00	-	547.50	750.00
Labor (27.5 hrs / flock @ $6 / hr for 6 flocks)	990.00	-	-	-
Labor (277 hours @ $6 / hour)	-	1,662.00	-	-
Machinery (81 hours at $20 / hour)	-	1,620.00	-	-
Rendering Pick-up charges	-	-	2,100.00	1,500.00
Total Costs	$ 4,003.90	$ 4,093.25	$ 3,096.25	$ 3,066.50
cost per pound of mortality	$ 0.0572	$ 0.0584	$ 0.0442	$ 0.0438

In Texas, incineration investment has increased to approximately $10,000 due to requirements by state of an afterburner and an enclosed shed.
Alabama Cooperative Extension System references incineration cost as $.0890 per pound of mortality (ANR-955).

Assumptions Used -

Cost of Incineration and composting provided by Mr. Mike Lacy with the University of Georgia, Cooperative Extension Service from a presentation at the 1998 "National Poultry Waste Management Symposium". The cost were prepared by NC State University, Department of Poultry Science (by M.J. Wineland, T.A. Carter, K.E. Anderson).

Cost of Offal and Freezing option prepared by American Protein, Inc.

Costs are based on a four house farm grown to seven weeks of age with 6 cycles and assumes 70,176 pounds of mortality annually (11,696 per flock).

Labor cost for gathering farm mortality is not included in any of the cost presentations - the freezing / rendering option assumes that no additional time is involved in placing mortality in the freezer units.

Freezer capacity is rated at about 1,800 pounds for the smaller unit and about 2,800 for the larger unit.
Electricity cost per day is projected at $1.25 to $1.50 by manufacturer.
Freezing capacity per day is approximately 800 pounds in a 24 hour period.

The above cost assumptions are based on seven pick-ups per flock in column 3, or five per flock in column 4. Column 4 assumes two freezer units are in place, which should help to reduce the number of required pick-ups by API, allow for better freezing, and provide back-up for excessive mortality. Cost of $50 per pick up by API. Birds grown beyond seven weeks will require additional pick-ups by API.

API requires a five year agreement to commence service with growers.

ALABAMA COOPERATIVE Extension SYSTEM

ANR-923

ALABAMA A&M AND AUBURN UNIVERSITIES

Rendering—A Disposal Method for Dead Birds

Carcass disposal at the poultry farm is an important environmental issue. Some of the standard methods, such as burial and incineration, no longer meet the needs of operators. Prompted by recent water and air quality regulations, the poultry industry in Alabama is giving carcass disposal top priority by supporting efforts to promote and adopt alternative disposal methods. One environmentally sound alternative for the disposal of dead birds is conventional rendering. With today's technology it is possible to reclaim or recycle almost 100 percent of all inedible raw poultry material.

Rendering is a heating process that extracts usable ingredients, such as protein meals and fats. Rendering has been used for many years to convert the inedible results from the slaughtering process into meat meal, bone meal, and feather meal—all of which are highly valued as animal feed ingredients. Today, rendering plants supply 85 percent of all fats and oils used in the United States and export 35 percent of the fats and oils used worldwide. The rendering plant is a vital link between the poultry grower and industries which use fats and oils.

When properly handled, poultry mortalities that occur on the farm can also be recycled through the rendering process. As some of the roadblocks are removed through advanced technology and better understanding, rendering is becoming a more widely accepted practice for on-farm poultry mortality management. One concern is the spread of avian disease when dead birds are moved from farm to rendering plant. Proper equipment and techniques can minimize this problem.

The primary concern is proper maintenance of carcasses between death and delivery for processing. Poultry mortalities that are destined for a rendering plant must be held in a leak-proof, fly-proof container. Unless carcasses can be held in a way that retards decomposition, fresh mortalities should be sent to a rendering facility within 24 hours of death.

Freezing

Some producers are experimenting with freezing as a way to hold dead birds on the farm until they can be rendered. Custom-designed freezers preserve dead birds until they can be delivered to the rendering plant. These freezers are usually freestanding with self-contained refrigeration units designed to operate at temperatures between 10° and 20°F and accommodate 600 to 1,000 pounds of dead birds. Inside the freezer are specially designed boxes that hold the carcasses. The freezer unit never leaves the farm; only the container holding the dead birds is transported to the rendering plant or removed to be emptied into a collection vehicle. To minimize contamination these storage boxes are tightly sealed to prohibit the effects of weather and to prevent leakage.

Loading and unloading is easily accomplished through various door arrangements. Birds are added in a single layer to ensure that all the carcasses freeze properly. Stacking or overloading prevents complete freezing of carcasses and should be avoided. Beyond placing carcasses in the freezer as they are collected daily, there is little labor involved. Processing can take place at the end of each growing cycle or as needed.

Freezer units work off energy efficient circuit boxes with an operating cost of about $1.50 per day. So far, the cost of freezing as a collection method is related to the cost of energy; its potential for generating income is not yet known. Ideally, freezer units will have no environmental or health impacts and will operate for 10 years.

Transfer of pathogens or harmful microorganisms between farms may be a problem with this method of collection. However, freezing is useful as a way to reduce or eliminate pollution and improve conditions on the farm. Additional research will more fully explore this management option and any problems with transfer of pathogens between farms.

Fermentation

Fermentation may also become a more widespread method for holding poultry carcasses for up to 3 months until their valuable nutrient components can be recovered by rendering. Fermentation is a biologically secure and environmentally safe procedure.

Fermentation mixes dead birds (which have been ground into 1-inch particles) with a fermentable carbohydrate source, such as sugar, whey, ground corn, or molasses. Fermentation reduces the pH level so that pathogenic microorganisms are inactivated and the organic materials are preserved.

Fermentation for the long-term storage of poultry carcasses prior to rendering has proven effective in field trials conducted by Auburn University in cooperation with the Alabama Poultry Industry. The methods employed have produced an environmentally and biologically safe material that can easily be converted into a usable, highly valued feed ingredient.

Fermentation preserves tissue so that it can be safely transported to a rendering plant for recovery of nutrients and recycled into usable foodstuffs or animal feed. The acidic pH (4.0 to 5.0) makes the fermented mixture essentially pathogen free.

Acid Preservation

Another way to preserve dead birds for future rendering is acidification. This technique has been a widespread practice in preserving foodstuff for years. The procedure is similar to the fermentation process except that propionic, phosphoric, or sulfuric acid is added to carcasses. Sulfuric acid may be preferred because it retards spoilage and is relatively low in cost.

To be prepared for storage, carcasses may be punctured with a blunt metal rod instead of being placed in a grinder. They must be stored in airtight, plastic containers to protect the mixture as well as the environment. Carcasses are separated from the acid solution without the accumulation of sludge in the holding container.

Transportation cost to haul the acidified product to the rendering plant is often only 10 percent of that for moving frozen mortalities. Even more important, however, is the fact that these processes eliminate the potential for transmitting pathogenic microorganisms into the rendered products or environment. Accurate costs of fermentation and preservation are still limited because most of the work has been through research. However, estimated costs range from three to four cents per pound of dead birds.

Advantages Of Rendering

As a management technique, preparing carcasses for rendering has many advantages over other disposal methods. Perhaps the greatest benefit is the eventual removal of all mortalities from the farm. New techniques that maximize safety and minimize the expense of delivering poultry mortalities to rendering plants are being used by producers and buyers of poultry products. Removal of carcasses from the farm eliminates environmental pollution related to other methods of disposal. As concerns for nutrient losses, water quality, and recycling for profit increase, the choice to render dead birds will become more advantageous.

A valid concern with storage for rendering is the possibility of disease being carried between poultry farms and rendering plant by vehicles and containers used to convey dead birds. Appropriate management and handling techniques can address this concern. Poultry producers can contact renderers in their area to determine the holding and transportation methods that have been successfully used.

As Alabama's poultry industry expands, the occurrence of mortalities will increase. Growers should determine the method of disposal most compatible with their management ability, environmental conditions, and financial situation. An effective way to resolve environmental concerns and at the same time end up with a valuable by-product is through rendering.

ALABAMA COOPERATIVE Extension SYSTEM

ANR-923

This publication was prepared by John P. Blake, *Extension Poultry Scientist,* Associate Professor, Poultry Science; and James O. Donald, *Extension Agricultural Engineer,* Professor, Agricultural Engineering.

For more information, call your county Extension office. Look in your telephone directory under your county's name to find the number.

ACES, 6M, New 4:95, ANR-923

Gator Aides Chicken Farmers or Sweet Home Alligator Camilla, Georgia

Alligator farming has grown in the South in the past six years because of the realizations of what alligators could do for chicken farmers. Alligators have proved to be chicken-disposal machines. Between 5 and 6 percent of chickens raised for slaughter die of natural causes, yet disposal of the dead chickens is tightly regulated by most states. Most poultry farmers use mass grave sites or incinerators. It is not feasible for many smaller farmers to truck dead chickens to an approved burial site or incinerator. The dead birds must be disposed of quickly and few farmers have enough each day to fill up a truck. Generally, any vehicle carrying dead birds must be leak-proof and driven by someone with a license to carry dead birds, (Editors note: That would be the Dead Birds Driver's License :-)). This can be expensive. Alligator farming has been a good move for chicken farmer, Mark Glass. Glass began raising alligators in 1995 at his farm near Camilla, Georgia, about 250 miles south of Atlanta. He has about 10,000 of the reptiles and harvests about 4,000 a year, making him a minor in the player industry. He also has about 500,000 chickens. Glass initially kept his alligators in an outdoor pond, but they didn't grow as fast as he wanted. As a result, he built four enclosed, heated buildings for them. Giving them a 90 degree environment, ground up chicken with a dry animal feed plus vitamins, Glass' alligators reach the four foot harvest size in about eighteen months. That's quite fast compared to the three to six years it takes wild alligators to reach a similar size. Alligators are prized not only for their appetite for chicken, but also for their marketable meat and hide. A four-foot alligator yields four to five pounds of meat that sells for about $6.00 a pound. The hide of a four-foot alligator will sell for about $80.00 as well. So far, Glass says, he has used all his earnings from the alligator farm to expand and upgrade his operation. With all the benefits of alligator farming, Glass points out there are risks involved as well. "If you are in the alligator business, you're going to get bitten," he said. "I got bitten by a 4.5 footer. I was lucky. He didn't like the taste of me and he let me go. If he had held on, I would have been in trouble."

Editors note:Although these projects are motivated by the profit value, it should be noted that when a farm-raised animal is available the wild population receives less pressure.
Abstracted by Ken Shaw from an AP article that appeared 12-2-00 in the Register Guard.

UNIVERSITY OF FLORIDA
EXTENSION
Institute of Food and Agricultural Sciences

Options for Dead Bird Disposal[1]

B. L. Damron[2]

Disposal of dead birds on the farm continues to be a challenge from the standpoints of cost, environmental safety, biosecurity and practicality. While we, hopefully, have to deal with only a relatively small amount each day, disposal or preservation must also occur daily in order to meet the above challenges. Based on 1999 Florida agricultural statistics from the Florida Department of Agriculture, the layer industry could generate 2.14 million pounds of carcasses annually while broiler concerns might have to dispose of about 10.2 million pounds.

Burial

Burial has been the method of choice for years because of its low cost and convenience. A deep pit with inside framing and a tight-fitting cover can be constructed, or an open trench prepared by a backhoe can be progressively filled as birds die. Some growers use a transplanting auger to dig smaller round holes for disposal. In order to control odors and flies, and discourage scavengers, a covering of at least two feet of earth must be maintained. Of course, all of these methods should be sited on high ground where the groundwater level is well below the bottom of the excavation. The disposal cost associated with burial pits has been estimated to be 3.68 cents per pound for a broiler flock of 100,000. Disposal in a municipal or commercial landfill is also an option when the operators will permit carcass burial. This route is usually reserved for larger or emergency disposal needs because of tipping and transportation costs.

Incineration

Incineration is probably the most biologically safe method of disposal. It creates only a small amount of benign waste that can be easily disposed of and does not attract pests. It is also a serviceable option where a high water table or soil type precludes excavation. But there are concerns about odors, particulate emissions, slow through-put and costs. Here, a 100,000 broiler flock would incur a cost of 8.92 cents/pound. There has been some revival of interest in this method because of design improvements that have lowered fuel costs by more than half.

Composting

Composting has emerged as an environmentally safe disposal alternative. This method enables on-farm conversion of dead birds into a humus-like soil amendment. Adding water to alternating layers

1. This document is Fact Sheet AN-126, one of a series of the Animal Sciences Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Original publication date May 2002. Revised []. Reviewed []. Visit the EDIS Web Site at http://edis.ifas.ufl.edu.
2. B. L. Damron, Poultry Nutrition Professor, Department of Animal Sciences, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL, 32611.

of straw, carcasses and manure in bins placed on a roofed concrete slab starts the process. The suggested by-weight ratios of these various components are: 1 part carcass, 2 parts poultry litter, 0.1 part straw and 0.25 part water. The thermophilic bacteria then go to work using the nitrogen, carbon and fat from litter and dead birds, to digest them at temperatures of 130-150°F. Most large farms use a two-stage process, wherein, after a couple of weeks when the temperature has decreased, the material is turned into a second bin to aerate the compost. Heating and further decomposition occurs over the next week to produce a compost that can be applied to crops or pastures. Smaller farms without a loader could consider using mini-composters (4 ft x 4 ft x 4 ft boxes with removable side panels). As many units as are needed to accommodate a flock are placed in a concrete-floored shed and filled using the proportions previously mentioned. In small-scale composting, achieving the desired 50-60% moisture level in the bin is much more important than in larger two-stage operations. After the temperature has peaked above 130°F and begins to decrease, the compost can be moved to storage or applied to the soil.

While composting is effective, it requires a loader (two-stage), time and attention to detail. Also there is still a substantial volume of material to be transported away. The average composition of broiler compost has been found to be: 28% moisture, 1.9% nitrogen, 2.3% P_2O_5, and 1.6% K_2O. The cost of large-bin composting on a broiler farm has been reported at 4.88 cents/pound for a flock of 100 thousand. A similar calculation for a small-bin operation yielded 3.50 cents/pound of mortality.

Rendering

The rendering option allows removal of carcasses from the farm and eliminates environmental pollution possibilities while recycling a troublesome waste material into a good feed ingredient. Renderers have been cooking, hydrolyzing and pressing processing plant wastes into by-product meal, feather meal and fat for years. The three major concerns related to this method of disposal are biosecurity, proper feather breakdown and a suitable on-farm storage method to reduce transportation cost.

Dr. John Brown, while at Dekalb Research, offered some recommendations in that area, starting with a farm having a written biosecurity plan that is reviewed often to emphasize its importance. The storage and pickup container should be secure against animal invasion and located at least 100 yards from houses. Carcasses should be taken to the storage site at the end of the day by an employee not returning to farm buildings that day. Brown also suggests that money spent on biosecurity should be viewed as an investment in future profitability.

A rendered carcass meal has been produced and tested in feeding trials with broilers here at the University of Florida. The full-fat processing yield was 41% and use of the material at up to 12% of the diet supported equal or improved feed efficiency. Neither meat flavor nor texture were affected by the inclusion of the meal in the diet. Feather hydrolization did not appear to be a problem and the meal contained 55.7% protein, 2.03% sulfur amino acids, 3.15% lysine, 3.73% calcium, 1.47% total phosphorus and 0.41% fiber.

Preservation by Freezing

Freezing was one of the initial preservation methods tried. One broiler company developed special weather-proof units that could be handled with a forklift. The freezer unit never leaves the farm. The bird container is either hauled away or emptied at the farm in order to transport the contents to a rendering facility. The cost of using refrigeration in a 100,000-bird broiler operation has been estimated at 11.41 cents/lb.

Preservation by Lactic Acid Fermentation

Lactic acid fermentation has also been widely tested as a preservation method for holding carcasses up to three months before rendering. Carcasses need to be ground, thoroughly mixed with the correct amount of a fermentable carbohydrate such as molasses, corn meal or dried whey, and brought to 60-70% moisture. The lactic acid bacteria present in the gut then start to convert the energy source to lactic acid. As the conversion proceeds (in the absence of oxygen), the pH is naturally lowered after five to seven days to between 3 and 4.5 where spoilage bacteria cannot survive. This process does take some attention to detail in terms of accurate measurements of raw materials and thorough mixing. Another prerequisite is a rendering facility that will accept the product. Either the renderer or the producer must also have equipment for transporting the tanks of fermented product. In economic evaluations this method compared favorably with a per-pound cost of 4.55 cents when employed on a 100,000-broiler farm.

Preservation by Acidification

Another way to preserve dead birds for future rendering is acidification. In this method, the carcasses are not ground but punctured with a blunt metal rod and submerged in an air-tight vat of sulfuric acid. This procedure also has the advantage of destroying disease organisms and harmful bacteria. No full-scale economic data could be located on this preservation alternative but is was estimated to be three to four cents per pound.

Other Methods

Some other, less tested methods of disposal have been mentioned in the popular press and in personal contacts. One of these is the construction of a dead bird digester. Concrete tanks are placed in the ground, partially filled with water and bacteria added. Dead birds are chopped into the tanks where they are digested away. Field reports on this method vary widely from good results to ineffectiveness. A variation of this procedure has been tried in houses with lagoons. Dead birds were ground into the lagoon and the naturally occurring bacteria allowed to carry out the digestion. The additional organic load to the system was not reported to be a problem. Garbage-feeding operations in which food wastes are collected and cooked for livestock feeding have also been mentioned as outlets for mortality. For commercially permitted producers, alligator feeding is also a disposal alternative.

Unfortunately, there is no simple or single answer to mortality or other waste disposal challenges. Each operation must determine the method most suitable to their management ability, environmental conditions and financial parameters.

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Dead Bird

ARBOR ACRI

Arbor Acres Broiler Management Manu

Dead Bird Disposal

Objective: Dispose of dead birds in a manner that avoids contamination of the environment, prevents cross contamination with other poultry, and is not a nuisance neighbors.

Disposal Methods

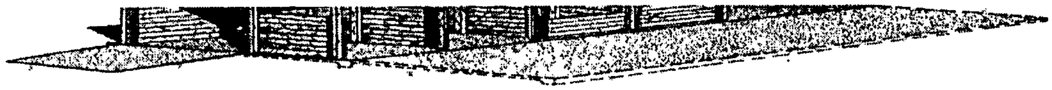
Disposal Pits

- *Burying in pits is a traditional method of disposal.*
- *Advantages: Disposal pits are inexpensive to dig and tend to produce a l amount of odor.*
- *Disadvantages: Disposal pits can be a reservoir for diseases and they re adequate drainage.*
- *Ground water contamination is becoming a greater concern and in som disposal pits are illegal.*

Incineration

- *Incineration is another traditional method of disposal.*
- *Advantages: Incineration does not contaminate ground water or cause contamination with other birds where grounds are properly maintaine very little by-product (ash) to remove from the farm.*
- *Disadvantages: This method of disposal tends to be more expensive and produce air pollution. In many areas, air pollution regulations have bee established limiting incinerator use.*
- *If incinerators are used, ensure that there is sufficient capacity for futu*
- *When operating, be sure carcasses are completely burned to a white asl*

Poultry Carcass Compost Facility



Composting

- *Composting has become one of the preferred alternatives for on-farm di*

- *Advantages: it is economical and if designed and managed properly, wi contaminate the ground water or air.*

- *Constructing a composter:*

  1. Build a 2.5 m. (8-ft.) high building with 3.7 m² (40-ft.²) of floor space p birds broiler capacity. The building should have a concrete floor and roo protects the compost from rain.

  2. Divide the building into a minimum of two bins with no more than 3.4 ft.²) per bin.

  3. The sidewalls should be constructed of 5.1cm. x 20.3 cm. (2"x 8") plan hold the weight of the compost and also allow air into the compost for ae fermentation.

- *Operating the composter:*

  1. Place a 30 cm. (12-inch) layer of litter on the bottom of the composter.

  2. Dig a 13 cm. (5 inch) trough in the litter and add 8 cm. (3 inch) of clean in the trough.

  3. Place the birds on the shavings along the trough so that they are touchi keep them at least 15cm. (6 inches) away from the edges of the composte

  4. Mist the birds with water and cover with 13cm. (5 inches) of one-part f and one part dry litter.

  5. The composter requires no further treatment and the composting proc should be completed within thirty days.

- *Under normal conditions the temperature of the compost should increa and reach a peak operating temperature of 57-66° C (135-150° F) within four days. Because insects, bacteria and other pathogens are killed at temperatures above 46° C (115° F), 55° C (131° F) and 60° C (140° F) respe composting effectively destroys these organisms.*

- *The product from the composter can be used as a soil amendment or fer Most producers will remove compost from the farm at the same time of removal.*

Rendering

- *Some producers dispose of dead birds by hauling them to a rendering pl*

- ***Advantages:** There is no on-farm disposal of dead birds, it requires mini capital investment and causes minimal environmental contamination. T product from dead birds can be used as a feed ingredient.*

- ***Disadvantages:** It requires freezer units to keep the birds from decompo during storage while they await transport to the rendering plant. In ad very extreme biosecurity measures must be in place to prevent the trans personnel from tracking diseases from the rendering plant or other farn farm.*

[Home] [Brd TOC] [CLS FS TOC] [Bro TOC] [Met TOC] [US TOC]

ON-LINE PUBLICATIONS BY TOPIC

MORTALITY MANAGEMENT

OVERVIEW

PDF	**An Economic Evaluation of Dead-Bird Disposal Systems** (Auburn University)	HTML
PDF	**Dead Bird Disposal** (Oklahoma State University)	
PDF	**Dead Poultry Disposal** (Texas A&M)	
PDF	**Best Environmental Management Practices - Mortality Management** (Michigan State University)	
	Poultry Best Management Practices - Mortality Management (Louisiana State University)	HTML
	Proper Disposal of Dead Poultry (North Carolina State University)	HTML
PDF	**Proper Disposal of Dead Poultry** (Canada Plan Service)	
	Virginia Farmstead Assessment System: Poultry Litter Management and Carcass Disposal (Virginia Tech)	HTML
PDF	**Disposal of Poultry Carcasses in Arkansas** (University of Arkansas)	HTML
PDF	**Poultry Mortality Disposal Guidelines for Alberta** (Alberta Agriculture, Food and Rural Development)	HTML
PDF	**Best Environmental Management Practices: Mortality Management** (Purdue University)	

- Catastrophic losses -

PDF	**Catastrophic Poultry Mortality Loss: Handling and Disposal Alternatives** (Oklahoma State University)	HTML
PDF	**Catastrophic Animal Mortality Management (Burial Method)** (USDA/NRCS)	

PDF	**Guidelines for In-House Composting of Catastrophic Poultry Mortality** (University of Maryland)	HTML
PDF	**A Guide to Composting Flood-Related Animal Moralities** (North Carolina Department of Environment and Natural Resources)	

- Software available-

Software available for download - Poultry Mortality Calculator: Mortality Economic Analysis (MEAN) Program (Alberta Agriculture, Food and Rural Development)	HTML
Mortality Economic Analysis (MEAN) Program Help Guide (Alberta Agriculture, Food and Rural Development)	HTML

COMPOSTING

PDF	**Composting Animal Mortalities** (Minnesota Department of Agriculture)	
	Composting Layer Mortalities (University of Missouri)	HTML
PDF	**Mini-Composters in Poultry Production** (Auburn University)	HTML
PDF	**Frequently Asked Questions About On-Farm Poultry Carcass Composting** (Auburn University)	HTML
	Composting Poultry Mortalities (University of Georgia)	HTML
	Composting Dead Poultry (Virginia Tech)	HTML
PDF	**Basic Concepts for Composting Poultry Mortalities** (University of Florida)	HTML
	Dead Bird Composter Requirements from the MBAH (Mississippi State University)	HTML
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1992 Proceedings - Nat. Poult. Waste Man. Symp.
ed. JP Blake, JO Donald, PH Patterson Auburn, Al

COMPARISON OF MORTALITY DISPOSAL SYSTEMS

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Every turkey and broiler production facility is faced with the reality of farm mortality. A flock of 30,000 turkeys averaging 0.5% mortality each week (9% total mortality), will produce approximately 13.9 tons of carcasses during an eighteen week growing period. For a flock of 50,000 broilers grown to 49 days of age that averages 0.1% daily mortality (4.9% total mortality), then approximately 2.4 tons of mortality will occur (Blake <u>et</u> <u>al</u>., 1990). These losses represent a tremendous amount of organic matter.

As the poultry industry expands, so also will the amount of on-farm generated wastes. Therefore, the poultry industry must aggressively pursue efforts to protect the environment while maintaining a good public image.

METHODS OF DISPOSAL

Burial

Burial is the original method of disposal which is usually the most convenient.

Burial involves several variations which may include pits, Utah "cookers", sanitary landfills and inverted feedbins. A properly constructed disposal pit is convenient, sanitary, and a practical method for handling poultry mortalities. Disposal pits have been used with varying degrees of success by the poultry grower. An "approved" burial pit can be fabricated from concrete block, monolithic concrete, or treated wood (Sweeten and Thornberry, 1984; Collins and Weaver, 1974). Pre-cast open-bottom septic tanks can be delivered to the site and offer the best way of developing a concrete disposal pit at relatively low cost. The cover is made of reinforced concrete with a drop chute of PVC pipe at the center that is capped off with a tightly fitted cover.

hulls, or rich hulls is first placed on the concrete floor of the bin. A layer of straw is added to aid in aeration and supply an adequate source of carbon. Then, a single layer of carcasses is placed into the bin and water is added to maintain a moist, but not saturated condition. Finally, the layer of carcasses is covered with manure for subsequent layering. As mortality proceeds, successive layers of manure cake, straw, carcasses, and water are layered into the primary bin. Once full, a final cover of manure is placed over the carcasses.

Temperature of the compost increases rapidly as bacterial action progresses, rising above 130 F within 5 to 10 days. The increase in temperature has two important effects: 1) it hastens decomposition and 2) it kills microorganisms, weed seeds, and fly larvae. Temperature begins to decrease in the primary bin 14 to 21 days later. At this point, material is moved to the secondary bins, aerated in the process, and allowed to proceed through a second temperature rise. After the second heating cycle, composted material can be safely stored until needed for land application.

For composting to be a viable method for the disposal of poultry farm mortalities, it is paramount that the compost process completely inactivates pathogenic (avian and human) microorganisms prior to land application. Studies by Murphy (1990), Conner and Blake (1990), and Conner et al. (1991 a,c) indicated that two-stage composting effectively inactivates poultry-associated bacterial pathogens. Aeration of the compost, simply turning of the pile from the primary to secondary bin to produce a second heat cycle, ensures effective inactivation of human and avian pathogenic microorganisms.

When properly managed, composting is a biosecure, relatively inexpensive, and environmentally sound method for the disposal of poultry carcasses. Its use is becoming more widespread as an alternative method for the disposal of poultry carcasses.

Rendering

Rendering is one of the best means for converting farm mortalities into a valued biologically safe protein by-product meal. Unfortunately, the spread of pathogenic microorganisms during routine pickup and transportation to a rendering facility presents a substantial threat. Removing poultry carcasses from the farm is most acceptable for the environment, and a valuable feed ingredient results.

Central Pick-up: One of the major concerns with this method is the possibility of disease transmission. Sound biosecurity at disposal sites is essential to prevent disease transmission. Central carcass disposal sites have been placed initiated and continue on-farm until carcass amounts are sufficient to warrant the cost of transport.

Disposal facilities have been constructed on two Alabama broiler farms to demonstrate the feasibility of on-farm endogenous fermentation of poultry carcasses (Blake and Donald, 1992). A prototype grinding unit was specifically designed to allow for the simultaneous addition of the carbohydrate source during grinding (Autiomatic Model 601, Dixie Grinders, Inc., Guntersville, AL). On a daily basis, broiler mortality is ground and ground corn (20%) was utilized as the carbohydrate source. The mixture (mortality and carbohydrate) was directly fed into sealed storage tanks (approximate capacity 1600 lbs).

Weekly pH measurements were obtained from the fermentation tank(s) at approximately 12 inches below the surface. All pH values of the ferment decreased below 5.0 within a 10-day period. Resulting ferment obtained at the end of a typical 7-week growout cycle was subjected to conventional rendering.

Unlike routine pickup of "fresh" mortalities, fermentation and subsequent storage of poultry carcasses reduces transportation costs by 90% and eliminates the potential for transmission of pathogenic microorganisms through poultry via rendered products.

Extrusion: Extrusion technology utilizes the principle of friction as a means of creating heat, shear, and pressure. The material to be extruded is fed into a barrel and forced by means of a screw against a series of baffle-like restrictions causing the material to flow back against itself. Due to the forces of friction and pressure within the barrel, product is cooked to a preselected temperature of 115 to 155 C in less than 30 seconds. Upon exiting the extruder, a rapid drop in pressure allows for the evaporation of 12 to 15% of the moisture.

Haque et al. (1987) successfully incorporated whole ground hens into an extruded broiler diet. Feathers, whole carcasses, processing plant wastes and hatchery wastes have each been extruded into acceptable feed ingredients (Tadtiyanant et al., 1989; Miller et al., 1990; Blake et al, 1990). Poultry feeding trials indicate that extrusion of poultry carcasses is a viable alternative to conventional by-product rendering.

Microbiological studies conducted to determine the ability of bacteria, molds, and viruses to survive the extrusion process have also been conducted (Reynolds, 1990; Blake et al., 1990). In all cases, the extrusion process effectively inactivated these microorganisms and extruded products would not pose a potential disease transmission problem.

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ALABAMA COOPERATIVE Extension SYSTEM

Frequently Asked Questions About On-Farm Poultry Carcass Composting

ANR-980, Reprinted Feb 1996. **John P. Blake,** *Extension Poultry Scientist,* Associate Professor, Poultry Science; and **James O. Donald,** *Extension Agricultural Engineer,* Professor, Agricultural Engineering

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What is essential during the poultry carcass composting cycle?

For the cycle to work properly, temperatures in excess of 130 degrees F must be achieved and maintained for approximately 14 to 21 days. Exposure of carcasses to these temperature conditions requires a minimum of two 10- to 14-day composting cycles.

Are special ingredients required for composting?

The process described does not employ inoculants, chemicals, or other commercial additives. These may (or may not) improve the operation of a composter. The simple process and materials discussed will produce the required decomposition of carcasses.

Do composters produce an odor?

Except when moving compost, there should be no objectionable odor from the composter. Movement of compost from the primary to the secondary bin releases some odor. The odor is not that of decomposing carcasses, and it abates quickly after moving is completed.

Are flies a problem?

Fly breeding has not been a problem with composters. If the composter is operating properly, temperatures in excess of 130 degrees F generated throughout primary and secondary masses are sufficient to kill maggots already in carcasses when they are placed into the composter. Covering the birds in primary bins with dry manure discourages flies.

Do composters fail, and why?

Occasionally, composters fail to reach an adequate temperature, or they may produce odors and seepage. Composting is a biological process that depends on providing nutrients in an environment favorable for microbiological decomposition. Common mistakes are failure to provide all the materials needed for food and aeration or sloppy loading of primary bins so that materials are not "sandwiched."

Too much water is also a common problem. Saturated compost piles are anaerobic and will not support the desired aerobic, thermophilic bacterial growth required for rapid, odorless decomposition of carcasses.

Compost materials can be amended. When primary compost is turned, dry manure or straw can be added to compost that is "too wet," water can be added to compost that is "too dry," and improperly mixed materials can be remixed. A little experience and perseverance usually give good results in a short time.

Are composters biologically safe?

1. Mode of operation: Composters are intended to deal with normal mortality on the farm. It is not recommended that carcasses be transported from the farm where they originate, either to another poultry farm or to a central processing facility.
2. Managing the process: Sloppy loading (piling carcasses against sidewalls), careless layering of materials, and taking shortcuts such as skipping the second stage of composting will defeat the effectiveness as well as the safety of the method and should be avoided.
3. Structural design: Treated lumber, concrete, and a roof are all important biosecurity features of the composter and should not be compromised for the sake of economy. These combined features contain and maintain the compost mixture, and they minimize area contamination with manure, tissue, etc. Finally, they absolutely exclude vermin scavengers.
4. Research conducted in the Department of Poultry Science at Auburn University shows that conditions produced within a typical two-stage composter result in a decline of coliform bacteria to undetectable levels during the compost cycle. Findings indicate that composting effectively inactivates enteric bacteria.

Do large carcasses decompose?

Whole birds compost well, but long bones, keels, etc. do survive the process. Large turkeys compost just as well as broilers.

Are the roof and concrete floors needed?

A roof is necessary to ensure all-weather operation and to control moisture content of the compost. Concrete prevents soil contamination, excludes vermin, and most importantly, provides a good working surface for manure handling equipment.

What should be used as compost media if broiler litter is unavailable?

Several alternate carbon (bulking) ingredients can be used successfully, singly, or in combination. These may include, but are not limited to, corn stover, soybean pods and trash, poor quality hay, sawdust, grass clippings, leaves, "cake" (the wet compact crust that forms around feeders and waterers), or manure without litter that is found in layer operations and slatted-floor breeder houses. Substitution of carbon and nitrogen sources does require some analysis, recalculation of mix proportions, and on-site experimentation to ensure that mixtures provide C:N ratios between 20 and 35 and that sufficient moisture and bulking are provided to support vigorous aerobic fermentation.

Can poultry compost be recycled back into the primary compost bins?

Up to one-half of the manure and one-half of the straw used in primary composting can be substituted with recycled compost. Recycled compost produces a rapid start-up in primary boxes, and increased recycling produces a stable end product. Recycling also reduces material costs.

What are the costs of composting?

After construction costs are fulfilled, operational costs fall into two major categories--labor and materials. Labor required is approximately 1/2 hour per day, at whatever the prevailing rate may be. Material costs (straw, etc.) vary from nothing, where materials are available on the farm or are provided by a second party, to $0.004 per pound of carcass disposed of, where wheat straw costs $1.50 per bale and is used at the rate of 0.1 pound per pound of carcass.

This publication is based on a University of Maryland Cooperative Extension Service Fact Sheet entitled "Frequently Asked Questions" by Dennis W. Murphy. Appreciation is extended to them for permission to reprint.

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Livestock Mortalities:

Editor's Note – The following is the executive summary of a report conducted by Sparks Companies in March 2002. The full report is available from the National Renderers Association at (703) 683-0155, or by e-mail at renderers@nationalrenderers.com.

The market for U.S. meat and meat-based products requires the annual slaughter of roughly 139 million head of cattle, calves, sheep, hogs, and other livestock, as well as 36 billion pounds of poultry. But despite the best efforts of farm managers, veterinarians, and drug companies, millions of livestock succumb to disease or accidents that prevent their usage for human consumption. While the proportion is very modest, the sheer size of the U.S. livestock sector results in the generation of several billion pounds of livestock mortalities annually, creating a disposal challenge for farmers, ranchers, and meatpackers. Disposing of these mortalities is complicated because of the need to minimize adverse environmental consequences, such as the spread of human and animal disease or the pollution of ground or surface water. Renderers play an important role in this process by providing an environmentally friendly disposal option and transforming this potentially harmful material into various useful and valuable compounds.

But the continuing role that renderers play in mortality disposal could be in jeopardy. The outbreak of bovine spongiform encephalopathy (BSE) in Europe in the mid-1980s has forced many nations, including the United States, to erect various safeguards to prevent similar outbreaks within their own borders. By all accounts, these measures have succeeded in preventing the introduction of BSE to the North American continent, where no indigenous case has ever been detected. And a recent analysis conducted by Harvard University's Center for Risk Analysis finds that the United States is highly resistant to BSE outbreaks. Nevertheless, attention has recently focused on ways to enhance existing safeguards, possibly including tight restrictions or a total ban on the process of rendering livestock mortalities. However, such an action could have substantial adverse economic and environmental consequences that must be fully weighed against the potential to further reduce the near-zero risk of BSE entering the North American livestock sector.

Livestock Mortalities in the United States

Nearly three billion pounds of mammalian livestock mortalities was generated in 2000, plus another 346 million pounds of poultry mortalities (see Table 1). Ruminants (cattle, sheep, lamb, and goats) combine to account for about 22 percent of all mammalian livestock that die prior to slaughter each year (the balance being swine), but because cattle are so large and heavy, the volume (weight) of ruminant mortalities accounts for about 67 percent the total death loss each year. Beef cattle alone account for the largest proportion of mammalian livestock mortalities requiring disposal, at nearly 50 percent (by weight). The distribution of livestock mortalities by species has important implications, especially since ruminants tend to be a central focus of most regulations concerning the rendering industry and BSE.

In terms of cattle mortalities in particular, those over the age of 24 months account for less than 23 percent of cattle deaths, but since cattle gain weight rapidly as they age, these older, large animals account for more than 51 percent (996.1 million pounds) of the dead cattle that occur annually. This distribution has important environmental

Table 1. Livestock Mortalities in the United States, 2000

	Farm Mortalities		Percent of Farm Mortalities			
			Total		Mammalian	
Species	Number	Weight	Number	Weight	Number	Weight
	1,000	*1,000 lbs*			*Percent*	
Dairy Cattle	804.0	449,227.3	0.8	13.5	3.5	15.1
Beef Cattle	3,327.8	1,482,952.5	3.2	44.6	14.5	49.8
Hogs	17,927.7	981,655.2	17.0	29.5	78.3	33.0
Sheep	281.5	21,957.0	0.3	0.7	1.2	0.7
Lambs	486.2	37,923.6	0.5	1.1	2.1	1.3
Goats	65.0	4,225.0	0.1	0.1	0.3	0.1
Total Mammalian	**22,892.2**	**2,977,940.6**	**21.7**	**89.6**	**100.0**	**100.0**
Chicken	50,507.0	154,950.7	47.9	4.7		
Turkey	31,946.5	191,679.0	30.3	5.8		
Grand Total	**105,345.7**	**3,324,570.4**	**100.0**	**100.0**	**100.0**	**100.0**

Livestock *Continued from page 21*

including logistic factors, and the quantity of mortality, location of production facilities, soil type, topography, amount of labor available, and access to equipment. The estimated cost of alternative disposal methods for each operation will be driven largely by the producers' attitude toward environmental issues, as well as management preferences and government regulations.

For many producers, paying a modest fee to have a renderer remove dead carcasses is likely preferred to finding alternative on-farm disposal methods, which is fortuitous given the potential for environmental damage if this material is disposed of improperly. And, the rendering industry is well equipped to safely and efficiently handle the volume of mortalities produced using its existing infrastructure.

However, new restrictions could result in large increases in renderer collection fees, or even the elimination of this option altogether. Producers would then respond by re-evaluating their costs and deciding which other livestock mortality disposal method is most cost effective. Of course, some methods could result in costs that are not solely incurred by the livestock producer, but instead by society as a whole through environmental degradation, groundwater pollution, or the spreading of disease.

As the relative costs of "approved" methods of disposal increase, so does the likelihood that producers could turn to "unapproved" methods at greater risk to the environment. Furthermore, small operations will likely be at a disadvantage to adopting capital-intensive methods such as composting and incineration, putting them at a competitive disadvantage to large animal enterprises. Therefore, it is incumbent on regulators to carefully weigh the potential benefits of new restrictions on livestock mortality disposal against the full costs that could result, including the greater likelihood for the use of disposal methods that are unapproved and which could threaten to harm society or the environment. ❖

Editorial *Continued from page 5*

the California Milk Advisory Board, which sponsors the ads, is speaking out against the claim, as are some of the state's dairymen.

They say cows today have it much better than cows in the old days that roamed the range, even being provided comfort stalls. Besides, they add, it's also bad for business if dairymen allow their animals to live in filth.

Insisting that cows are treated well during their lives, one dairyman even plugged the value of cows once the animal is no longer around.

"Afterwards, they continue to make people's existence better because they are used to make other products people need."

That should make us all happy. ❖

Mark Your Calendar

✓ The **American Feed Industry Association's (AFIA's) Feed Ingredient Institute** is being conducted June 17-20, 2002, at the Holiday Inn O'Hare, Rosemont, IL. The seminar covers virtually every aspect of the feed industry and is an educational opportunity for anyone in feed manufacturing or industry suppliers. For program details and registration, contact AFIA at (703) 524-0810, or visit www.afia.org.

✓ The **Northwest Poultry Council's (NWPC's) Second Annual Convention and Membership Meeting** will be held June 25-27, 2002, at the Inn at the Mountain in Welches, OR. Contact NWPC at (503) 227-1728.

✓ The **Southwest Meat Association's (SMA's) 46th Annual Convention and Suppliers' Showcase** is July 17-20, 2002, at the Hyatt Tamaya Resort and Spa, Santa Ana Pueblo, NM. Registration packets are available from SMA at (979) 846-9011.

✓ A joint meeting of the **American Dairy Science Association (ADSA), American Society of Animal Science,** and the **Canadian Society of Animal Science,** will be held July 21-25, 2002, in Quebec City, Canada. The **Fats and Proteins Research Foundation (FPRF)** is a partial sponsor of a symposium held on July 22, titled "Transmissible Spongiform Encephalopathies: Impact on Animal Agriculture and Food Safety." FPRF will also be an exhibitor at the meeting. For more information, log onto www.fass.org/meetings, or call ADSA at (217) 356-3182.

✓ The **American Association of Meat Processors (AAMP)** will hold their annual convention July 25-28, 2002, in Reno, NV. Call AAMP's toll free convention line at (877) 877-0168, or e-mail aamp@aamp.com.

✓ The **2002 Southern Feed and Grain Convention** will be held at the Hilton Sandestin Beach Resort, Destin, FL, July 28-30, 2002. This is the second annual convention co-sponsored by the Alabama, Mississippi, and Tennessee Feed and Grain Associations. For registration, contact Ray Wilson at (615) 459-7930, or by e-mail at tfga-rwbw@comcast.net, or Jim Bell at (901) 521-4500, or e-mail jimbell@eurofins.com.

✓ The **Association of American Feed Control Officials** is holding their annual meeting August 3-5, 2002, in Kansas City, MO. For more information, log onto www.aafco.org, or call Sharon Senesac at (765) 385-1029.

✓ The **Advanced Short Course in Feed Microscopy with Emphasis on Animal Protein Products and Introduction to Extruded Feed** is being held August 15-17, 2002, at Northern Crops Institute, North Dakota State University, Fargo, ND. Contact the American Oil Chemists Society at (217) 359-2344, or log onto www.feedcourse.aocs.org. ❖

periods of the broiler growout. The EOD period generally lasts from day 7 to day 14 or 16. This program allows birds to start well (first week) and then controls growth for a short period, followed by many weeks for compensatory gain. The research completed at Auburn showed that 6-pound broilers could recover in live performance and WOG yield from EOD feeding to 14 days, but not beyond (16 or 18 days in this case). This would allow 4 days off feed between 7 and 14 days of age. Body weights were reduced from 30 to 40 percent in birds fed EOD, depending on the length of the program.

Neither chilled carcass weight (4.10 lb.) nor yield (71.1%) were reduced by EOD feeding to 14 days. Total feed costs per live pound were reduced by EOD feeding (15.0 vs. 14.4 cents/live lb.) as was total feed cost on a dressed weight basis (21.6 vs. 21.2 cents/dressed lb.). Current research is examining white meat yield with programs of this type to make sure that fillet and tender yields are not suffering with early feed restriction.

This technique may be used to reduce early growth if late mortality is a problem. EOD feeding would be most useful if lighting or nutrition programs are not feasible or are not reducing late mortality to the desired level. EOD feeding will be economically favorable only if the birds have enough time (and feed nutrients) to show compensatory growth through the remainder of the growout. For this reason, companies growing a small broiler need to approach feed restriction programs, of any type, cautiously.

Reference:

Dozier, III, W.A., R.J. Lien, J.B. Hess, S.F. Bilgili, R.W. Gordon, C.P. Laster and S.L. Vieira, 2002. Effects of early skip-a-day feed removal on broiler live performance and carcass yield. J. Appl. Poult. Res. 11:297-303.

This information was provided by Roger Lien and Joe Hess of the Poultry Science Department at Auburn University.

How Good Is Your Dead Poultry Compost?

Composting dead poultry has been adopted statewide as an environmentally safe disposal method. The use of pits has been prohibited since July 1, 2000. As a result, composting is the method of choice for approximately 60% of the state's broiler producers. Incineration and rendering account for the remaining 35 and 5%, respectively. A considerable amount of research has been conducted during the past decade to support the use of composting as an environmentally safe method for the disposal of dead poultry. When properly conducted, disease-causing organisms do not survive the composting process, and the composted material can be easily applied to crop or pastureland as a soil amendment.

Occasionally, composters fail to reach an adequate temperature, or there may be a production of odor or seepage from the bins. Keep in mind that composting is a biological process that depends on providing nutrients to an environment that supports microbial decomposition. A common mistake is to fail to provide the necessary nutrients that are basically derived from the main components of the composting recipe. The recipe states that two-part litter, one-part dead poultry, and approximately one-quarter part water is all that is necessary to achieve adequate composting temperatures resulting in carcass decomposition. Since the composting process is an aerobic process, it also depends on adequate amounts of oxygen to support microbial growth. For the composting cycle to work properly, temperatures in excess of 130 degrees F must be achieved and maintained for a minimum of 5 days to ensure pathogen inactivation.

Failures can be encountered when the composting bins are improperly loaded. Carcasses should be equally distributed when layered into the composting bin. This may require the use of a rake to evenly distribute the carcasses into a single layer. This is especially true for large carcasses. Sloppy loading of the primary bin that results in sandwiching of the carcasses will produce a dense anaerobic mass that will not compost. Anaerobic conditions exist when the supporting bacteria are starved for oxygen allowing non-oxygen-requiring bacteria to dominate, resulting in a putrefied, bad-smelling mass. Keeping the carcasses approximately 6 inches away from the sidewalls of the bin also effectively eliminates fly infiltration.

Lack of or excessive addition of water is a common problem. Unfortunately, it is difficult to tell the producer the exact amount of water that needs to be added that will result in adequate composting since overall moisture content of litter varies farm-to-farm. Too much water will result in seepage and in temperatures below 130 degrees F. Saturated piles may become anaerobic, and noxious odors and fly problems may result. To correct this problem, compost materials can be amended, and dry litter can be added

THE UNIVERSITY OF TENNESSEE
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Agricultural and Biosystems Engineering

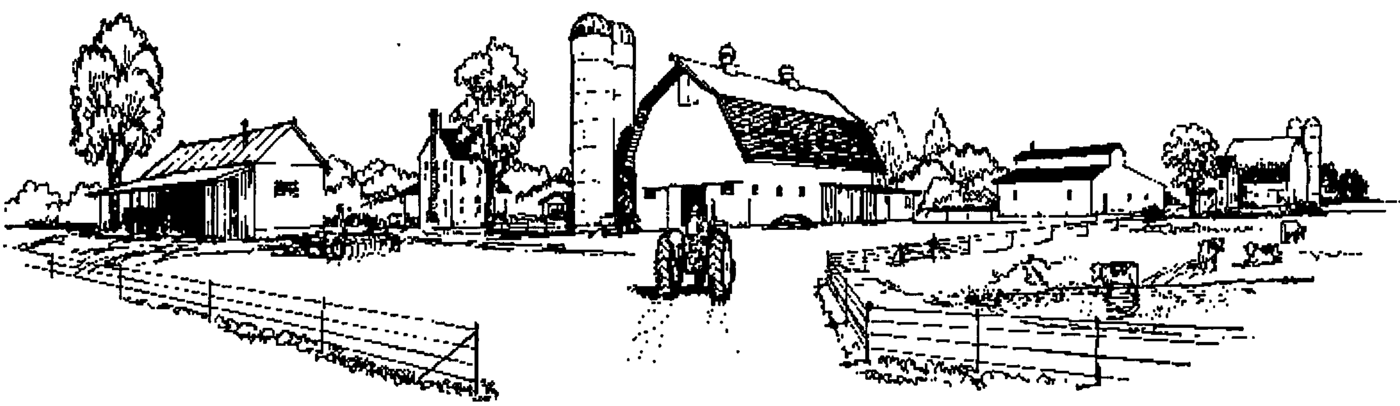
USING INCINERATORS FOR POULTRY MORTALITY MANAGEMENT

Robert T. Burns
Associate Professor
Agricultural and Biosystems Engineering Department

Mortality Management Options

Commercial poultry producers are faced with mortality management on a daily basis. There are a several options available for handling poultry mortalities. In Tennessee composting, rendering, incineration, disposal in a Class I landfill and on-site burial are accepted by the Tennessee Department of Environment and Conservation as dead animal disposal methods. The mortality management method that best suits a given broiler farm will depend on the available labor, land area, farm location and management level available on the farm.

The majority of broiler mortalities in Tennessee are managed using dead-bird composters or burial. While on-site burial is currently legal in Tennessee, it is the least desirable mortality management option due to the increased potential for ground-water contamination compared to the other available options. On-site composting of poultry mortalities has become a very successful option for producers and is highly encouraged. Incineration is also a viable option, and has several advantages over other disposal methods.



INCINERATION

Incineration was commonly used on many poultry farms until the energy shortage of the 1970's. When energy costs increased many producers stopped incinerating mortalities. Currently manufactured livestock incinerators are more fuel efficient than many of those offered several years ago. The increased fuel efficiency of many newer incinerators makes them an economically viable alternative to composting systems.

Incineration has both advantages and disadvantages when compared to other mortality management methods. The primary advantage of incineration is producer convenience. A properly sized incinerator can reduce daily mortalities to a comparatively small amount of ash in a few hours. Incineration provides a higher level of bio-security than other mortality management options. Carcasses that could potentially spread disease or attract insect pests or vermin are quickly reduced to ash during the incineration process. Improperly designed or operated incinerators can cause odor and particulate air pollution problems.

INCINERATOR SELECTION

Commercially constructed incinerators should be used for the incineration of poultry carcasses for mortality management. While home-made units may prove serviceable, they usually lack the design needed to ensure a clean burn. The following items should be considered when selecting an incinerator for poultry mortality management; capacity, burner size, fuel type, controls, door size, and overall sturdiness. A typical commercial livestock incinerator with automatic controls and a counter-weighted door is shown in figure 1. When considering needed incinerator capacity, remember that required incinerator capacity will increase during a broiler grow-out cycle. Figure 2 indicates a typical mass of mortalities in pounds that would be generated on a week-by week basis during a seven-week broiler grow-out cycle. As the bird size increases during the grow-out, so does the weekly mass of mortality carcasses to be handled. Note that while the mortalities run around 100 pounds per week in the beginning of the grow-out, they reach 1200 pounds per week during the last week. Poultry producers should have an alternative plan for handling a catastrophic loss of birds in the event of a power or ventilation failure or during periods of excessive heat. It is not practical to size an incinerator to handle a large and sudden loss of birds.

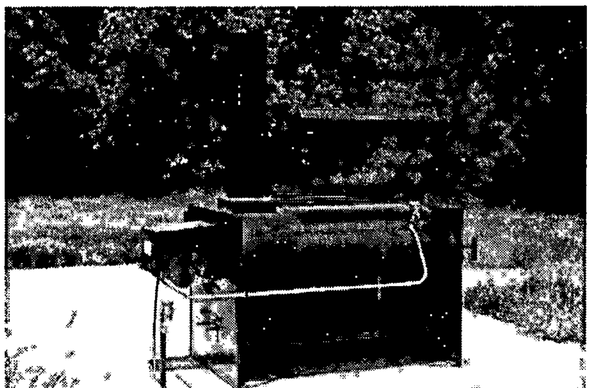


Figure 1. Commercial Livestock Incinerator

Incinerators are available with single or dual burner systems. The dual burner systems usually use the first burner for the primary carcass incineration and use the second burner in the incinerator stack in an afterburner mode to provide a cleaner burn. Incinerators with over 400,000 Btu / hour total burner capacity require permitting in Tennessee. To calculate total burner capacity, the Btu / hour rate of both burners must be added together. Incinerators are available that operate on propane and diesel. A well designed unit using either fuel type can do a good job. As such fuel selection is primarily determined by the operators preference and fuel availability. Incinerators are available with or without automatic controls. Most operators highly favor units with automatic ignition and timer mechanisms. This allows the operator to load the incinerator and set a timer that will ignite the unit and provide a timed burn. Automatic controls reduce the amount of time required to manage the incineration process and as such are very desirable. Make sure that the loading doors are of ample size to allow easy loading of large carcasses and removal of ash. Also look for doors that are counter-weighted or spring assisted to make opening and closing easy.

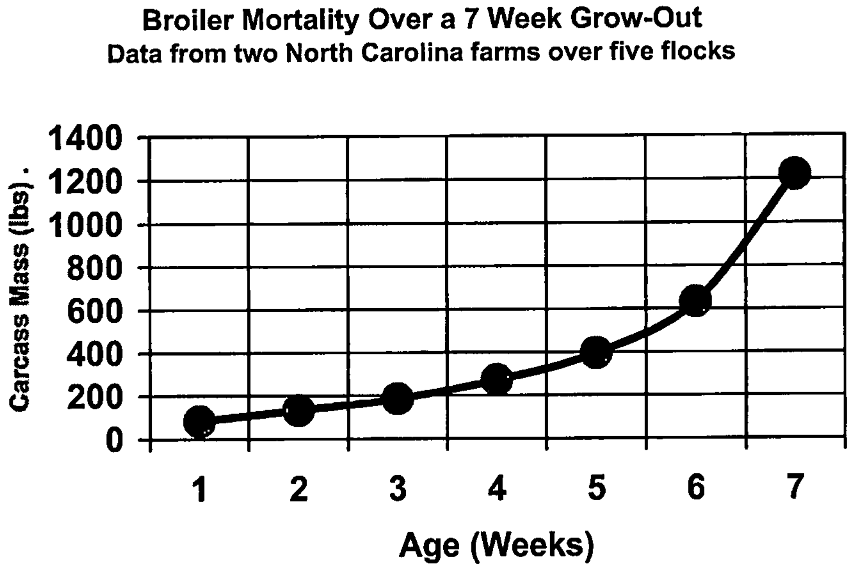


Figure 2. Broiler Mortalities over Grow-Out

PERMIT REQUIREMENTS

Tennessee regulations exempt incinerators used to burn livestock and poultry operation mortalities from air pollution control permitting unless they meet one of the following conditions;

1) The incinerator has a manufacturer's rated capacity greater than 500 pounds per hour.
2) The incinerator has a total burner rating greater than 400,000 Btu per hour.
3) The incinerator is charged with materials other than livestock or poultry carcasses.
4) The unit is used commercially.

Incinerators used to burn poultry mortalities that do not meet the conditions listed above are exempt from air pollution permitting in Tennessee.

OPERATING COST

The cost to operate an incinerator will fluctuate with fuel prices. Assuming a propane cost of $0.75 per gallon, the cost to burn 100 pounds of poultry broiler carcasses will range from $3 to $5 in fuel, averaging $4 per 100 pounds. Smaller birds require more propone to incinerate than larger birds, due to the increasing amounts of carcass fat in the larger birds. Table 1 shows the pounds of carcass burned per gallon of propane as determined from a study conducted by the North Carolina State University.

Table 1. Incinerator Efficiency*

Species	Lbs of Carcass / Gallon of Propane	Cost per 100 lbs carcass @ $ 0.75 / gallon propane
3 week old broiler	15.4	$ 4.87
7 week old broiler	25.1	$ 2.98
Broiler breeder	28.0	$ 2.67
Commercial layer	31.1	$ 2.41
Turkey	27.7	$ 2.71

*Shenandoah A-10 Incinerator used for test by NCSU.

Table 2 provides an estimate of fuel cost to operate an incinerator at propane costs varying from $0.65 to $0.95 per gallon for a single 24,500 bird broiler house over one flock. These cost estimates are based on an average of 20 pounds of carcass incinerated per gallon of propane.

Table 2. Estimated Fuel Cost per House per Flock
(Assuming 3000 pounds mortalities / 24,500 bird house / flock)

Propane cost / gallon	Cost / 100 lbs Carcass	Fuel Cost (house / flock)
$ 0.65	$ 3.2	$ 96
$ 0.75	$ 3.7	$ 111
$ 0.85	$ 4.2	$ 126
$ 0.95	$ 4.7	$ 141

ASH DISPOSAL

Ash from the incineration of poultry mortalities is a concentrated source of phosphorus and potassium. Table 3 shows the typical nutrient content in ash generated from poultry broiler mortalities. It is important to recognize that if mismanaged, this phosphorous rich ash could cause surface water degradation. Ash should be land applied in areas where run-off potential is very low.

Table 3. Typical Nutrient Content of Poultry Carcass Ash	
Nitrogen	20 lbs / ton
Phosphorus (P_2O_5)	650 lbs / ton
Potassium (K_2O)	175 lbs / ton

SUMMARY

- When selecting an incinerator, look for a sturdy unit of adequate capacity to handle the mortalities generated at the end of a grow-out cycle.
- Look for a unit with automatic ignition and a timer mechanism to reduce your management time.
- Choose a location for the incinerator that is typically downwind from any nearby residences and your buildings.
- Remember that ash contains nutrients and must be handled in an appropriate manner.
- Permits from the Tennessee Division of Air Pollution Control are required for incinerators under some conditions.
- Have a separate mortality management plan in place to handle a catastrophic loss.

More information on livestock incinerators may be obtained from the following vendors:

Burn-Easy Animal Carcass Incinerators
R&K Incinerator Co.
Rt. 4 6125 West 100 South
Decatur, IN 46733
1-800-233-1163 (219)-565-3214 Fax (219)-565-3149

Larry Lewis Livestock Incinerator
P.O. Box 112
Cedar, Iowa 52543
Sales (515)-933-4762 Service 1-800-933-4761

National Incinerator Incorporated
P.O. Box 266
Boaz, AL 35957
(205)-589-6720 Fax (205)-589-2326

References:

A Cost Comparison of Composting and Incineration Methods for Mortality Disposal. Poultry Science Facts #25. North Carolina State University

Installation and Use of Incinerators. Alabama Cooperative Extension System Bulletin ANR-981. Auburn University.

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Agricultural Extension Service
Charles L. Norman, Dean

ALABAMA COOPERATIVE Extension SYSTEM

Installation And Use Of Incinerators

ANR-981, Reprinted Nov 1995. **James O. Donald,** *Extension Agricultural Engineer,* Professor, Agricultural Engineering; and **John P. Blake,** *Extension Poultry Scientist,* Associate Professor, Poultry Science

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Every day the poultry grower is faced with the responsibility of disposing of dead birds. Mortality losses due to congenital defects, disease, or accident occur daily. In a flock of 100,000 broilers grown to 49 days of age, approximately 5,000 will be lost. That is an average loss of 0.1 percent each day.

Dumping carcasses into ditches, streams, and fields is not only unacceptable but also illegal. Proper disposal methods will reduce nuisance complaints from neighbors as well as safeguard the environment and reduce chances of disease transmission.

Methods suitable for the proper disposal of poultry farm mortalities are burial, incineration, composting, and rendering. Incineration is often the chosen alternative in areas where drainage is so poor that pits are not acceptable or where rocky soil makes digging expensive. Recognized as one of the most biologically safe methods of disposal, incineration curtails the spread of disease and does not create water pollution problems. The comparatively small amount of waste by-products (ash) does not attract insects or scavengers and can be disposed of easily. The main environmental concern is the emission of particulates that may be generated during the burning process.

Types Of Incinerators

Proper and acceptable cremation of dead birds is not obtained by merely drenching the carcasses with a flammable fluid and then igniting the stack. Not only is such an approach usually incomplete, but the resulting odors may prompt nuisance complaints. Homemade incinerators, usually constructed from 55-gallon barrels or other drums, are unsatisfactory because they do not meet current air pollution controls.

Commercial incinerators are the best equipment to ensure proper burn and to avoid creating pollution. The Alabama Department of Environmental Management requires the use of Class 4 incinerators for disposing of poultry mortalities. Units are available with oil or gas burners. Smoke discharge stacks may be fitted with afterburning devices which make use of high heat levels for near complete gas combustion.

When purchasing an incinerator consider the following points:

- *Sturdiness:* The unit should be able to operate under heavy loading conditions and withstand high operating temperatures.
- *Automatic Controls:* A unit that can be loaded, ignited, and allowed to run on a timer is a real convenience.

Capacity: The poultry grower must estimate the expected daily mortality rate and consider bird size when calculating the incinerator capacity needed. The incinerator should be able to accommodate normal daily mortality. When heavy, unexpected losses occur, alternative methods of disposal should be considered. Selecting an appropriately sized unit will avoid overloading and ensure proper operation for a longer period of time. Manufacturers of commercial incinerators typically establish a burn rate for their units. This information can help in deciding the size unit to purchase.

Location Of Unit

Placing the incinerator unit in an appropriate location will promote convenient use and avoid potential problems. The unit should be down wind from poultry houses, farm residences, and neighbors. Exposure to the destructive elements of nature can greatly reduce the life of the unit. It is wise to place the incinerator on a concrete slab under a shelter to extend the life of the unit. Because of the intense heat that is generated, clearance between the discharge stack and any wooden structure or trees must be maintained. To promote daily use, location of incinerators should be convenient to the poultry houses as possible.

Cost Of Operation

Some considerations in cost of operating incinerators include the rate of burn and price of fuel. Recent data obtained from broiler operators in Alabama indicated an average burn rate of about 65 pounds per hour. Incineration costs can vary depending on weight, moisture, and fat content of carcasses and the loading capacity of the unit. As the bird's age and carcass size increase, several loads may be required in order to cremate a day's mortality. In addition to the initial purchase cost of an incinerator, growers can expect to spend approximately $3.50 to cremate 100 pounds of carcasses, assuming fuel costs are $0.61 per gallon. As fuel prices increase, so will the cost of incineration.

Certain maintenance costs are involved with incinerators. Expendable parts and grates need to be replaced every 2 or 3 years. The entire unit may require complete refurbishment or replacement every 5 to 7 years.

Conclusion

Incineration of poultry farm mortalities is an acceptable method of disposal. However, a greater number of nuisance complaints are generated by this method than by any other means of disposal. It is imperative that the grower follow recommended procedures for locating and operating the unit. The poultry grower is also encouraged to calculate carefully the cost of operation prior to purchase of an incinerator.

For more information, contact your county Extension office. Look in your telephone directory under your county's name to find the number.

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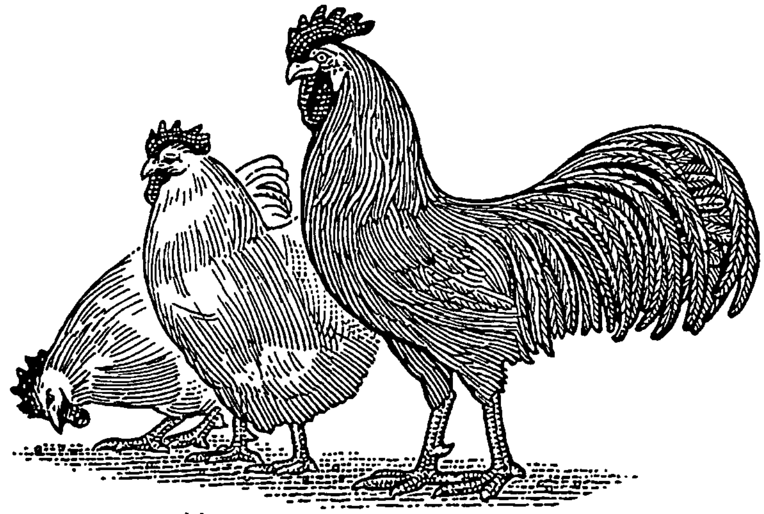
CURRENT CONCEPTS IN Broiler Production FALL 2002

Incineration for Disposal of Poultry Mortalities



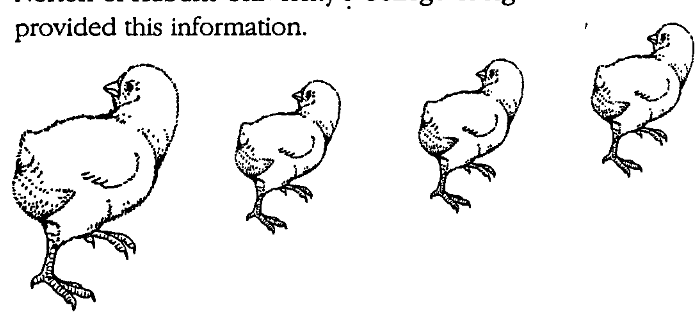
Alternative methods for disposing poultry mortalities have been explored for many years. Older methods of disposal, such as pit burial, chemical and biological digesting, and composting, have come under increasing scrutiny and regulatory pressure. Recent advances in refractory materials and better engineering have contributed greatly to improvements in incinerator efficiency. This study was designed to measure the efficiency and operational costs of several incinerators in poultry farm settings. One broiler breeder farm with two houses and two broiler farms, each with four houses, in north Alabama were selected for the study. Each grower agreed to pick up, count, and weigh the mortalities daily and to keep detailed records of all fuel usage and any additional maintenance expenses.

Farm #1, a breeder flock, had an average mortality weight of 5.82 pounds over the four-quarter test period and averaged 19.83 pounds of mortalities per gallon of fuel. Farm #2, a broiler farm, had an average mortality weight of 2.08 pounds over the 6-flock test period and averaged 24.98 pounds of mortalities per gallon. Farm #3, a broiler farm, had an average mortality weight of 0.93 pounds over the test period and averaged 49.89 pounds of mortalities per gallon.

Operational costs were calculated, based on $.85 per gallon for propane and $.98 per gallon of diesel. Farm #1 averaged 4.26 cents per pound with a range of 3.55 to 4.72, Farm #2 averaged 3.59 cents per pound with a range of 2.69 to 4.01, and Farm #3 averaged 1.99 cents per pound with a range of 1.83 to 2.07. While these differences in efficiency and cost represent wide variability in specific model design and operation, it is apparent that recent technological advances make possible incineration costs that are quite attractive relative to traditional alternatives.

In this study, a major reason in differences was observed to be in cull management of broiler chicks during the first week of growout. Microbiological samples of residual materials remaining after incineration were examined and were found to be virtually devoid of detectable levels of bacteria. Incineration is shown to be a very cost-effective, environmentally friendly method of disposal.

Gene Simpson, John Blake, Jim Donald, and Robert Norton of Auburn University's College of Agriculture provided this information.



AUNotes From Joe Hess, *Extension Poultry Scientist*

Poultry Science Department efforts in the areas of food safety and poultry product quality continue to increase under the guidance of the Poultry Science Peaks of Excellence Program. The department recently recruited Dr. Shelly McKee, a poultry products specialist formerly at the University of Nebraska, to enhance efforts in this area. In addition, two slots are being advertised for food safety microbiologists (one from the peaks program and one to replace Dr. Conner). When these positions are filled, Auburn poultry science will be in position to work with other departments on campus to greatly increase our efforts in the poultry products area. We hope that the industry continues to play an active part in shaping these programs so that our efforts are applicable to field needs and situations. Significant progress has been made on the new Poultry Science Building this summer due to an abundance of bluebird days. Check our Web site for updated pictures.

Irradiation of Poultry Meat

Irradiation of poultry meat was approved in 1992 by the USDA as an effective way to pasteurize the product in order to reduce bacterial contamination and provide a more wholesome product (Lutter, 1999); however, the poultry industry has been slow to adopt this technology. Carrotop Foods has been marketing irradiated chicken for several years with great success, which indicates that the public is willing to buy irradiated products. In fact, the public has been, unknowingly, buying irradiated spices for years. Many nursing homes and hospitals also use irradiated poultry.

Millions of cases of illness could be avoided by using this technology on meat (Lutter, 1999). People will be receiving a safer, longer-lasting product at a minimum increase in cost: a win-win situation. In addition, by investing in this technology, a company can recoup the original cost through longer shelf life and a higher quality product.

Four main pathologic bacteria of primary concern are associated with poultry: *Listeria, Campylobacter, E. coli*, and *Salmonella*. These bacteria, plus spoilage organisms, are effectively reduced by irradiation (Jay, 2000). This is accomplished through irradiation breaking down bacterial DNA, rendering it unable to reproduce (Jay, 2000). Decontamination of food by irradiation is safe, efficient, environmentally clean, and energy efficient. The food never becomes radioactive and is essentially the same as nonirradiated food after the process is over (Farkas, 1998). The use of this technology could become an important tool for the poultry industry.

Bibliography

Farkas, J. Irradiation as a method for decontamination food. A review. International Journal of Food Microbiology. 44(3)189-204, 1998.

Jay, James. Modern Food Microbiology, sixth edition. 2000.

Lutter, Randall. Food Irradiation. The Neglected Solution to Food-Borne Illness Science. 286:2275-2276, 1999.

Robert Voitle of Auburn University's Poultry Science Department provided this information.

Research Shorts

Recent Research of Interest to Poultry Managers

Miles, D.M., S.L. Branton, B.D. Lott, and J.D. Simmons, 2002. Quantified detriment of ammonia to broilers. Poultry Science 80 (Suppl. 1): 54.

Broilers in chambers showed the following reductions in body weight compared to broilers held without ammonia; 25 ppm – 1.7 percent reduction after 3 weeks, 50 ppm – 12.3 percent reduction after 4 weeks, 75ppm – 22.6 percent reduction after 4 weeks. Chamber trials do not reflect field situations, but they do give a glimpse into how ammonia levels may affect bird performance.

Timmons, J.R., J.M. Harter-Dennis, and A.E. Sefton, 2002. Effect of a high coefficient of variation of inorganic phosphorus consumption on 0- to 20-day-old male broilers. Poultry Science 80(Suppl. 1): 71.

Broilers were fed two times their phosphorus needs every other day versus the correct amount every day. It was found that broilers could do reasonably well in bone mineralization and growth, if this nutrient was not provided as we would want. This information is of interest in light of feed mixability and phytase inclusion questions.

Lien, R.J., J.B. Hess, and W.D. Berry, 2002. Influence of peak and post-peak feed allotments on broiler breeder egg production. Poultry Science 80(Suppl. 1): 3.

Cobb breeder hens were peaked on high (36.2 lbs/100 hens/day) or low (33.8 lbs/100 hens/day) feeding programs. Two pounds of feed were removed over a 2-week period post peak from each group, and relative feed removal for the rest of the production period was similar (23.3 percent). Birds on the high-feeding program produced 13 more eggs per hen than those on the low-feeding program, with much of the loss coming between 55 and 65 weeks.

Berrang, M.E., J.K. Northcutt, D.L. Fletcher, and N.A. Cox, 2002. Role of transport coop fecal contamination in the transfer of *Campylobacter* to carcasses of previously negative broilers. Poultry Science 80(Suppl. 1): 47.

Campylobacter-negative broilers were held in transport coops for 2, 4, or 6 hours after removal of Campy-positive broilers. Sampling after processing revealed more than 50 percent *Campylobacter*-positive birds in all three samplings, indicating that transport coop cleanliness can have an important role in *Campylobacter* contamination of previously clean birds.

In-Vessel Composting of Un-Separated Hatchery Waste

Don Cawthon
Department of Agricultural Sciences
Texas A&M University-Commerce
Commerce, Texas

Hatchery waste is the result of broken and/or unhatched eggs at facilities designed to produce young chicks for stocking broiler production houses. The waste consists of unhatched chicks, membranes, embryonic fluids and egg shell.

One disposal option for this waste product involves the loading and transport of the material to a facility that separates the liquids from the solids using centrifugal force. The liquid is refrigerated and transported by tanker truck to a pet food manufacturing plant. The solids (chicks, membranes, egg shell) are landfilled.

This project evaluated the capability of in-vessel composting techniques to decompose and stabilize the un-separated waste material obtained directly from the hatchery. The waste was collected in an open-topped tank in Pittsburg, Texas and transported to Texas A&M University-Commerce for mixing and loading into research-size in-vessel composters.

Due to the high moisture content (~80%) of the waste product, wood products were used to serve as absorbents and bulking agents as outlined in the table below:

Overall Waste/Wood (V/V)	Volume of Hatchery Waste	Volume of Fine Sawdust	Volume of Coarse Shavings	Moisture Content
3:1	2	3	3	45%
4:1	1.5	4.5	1.5	45%

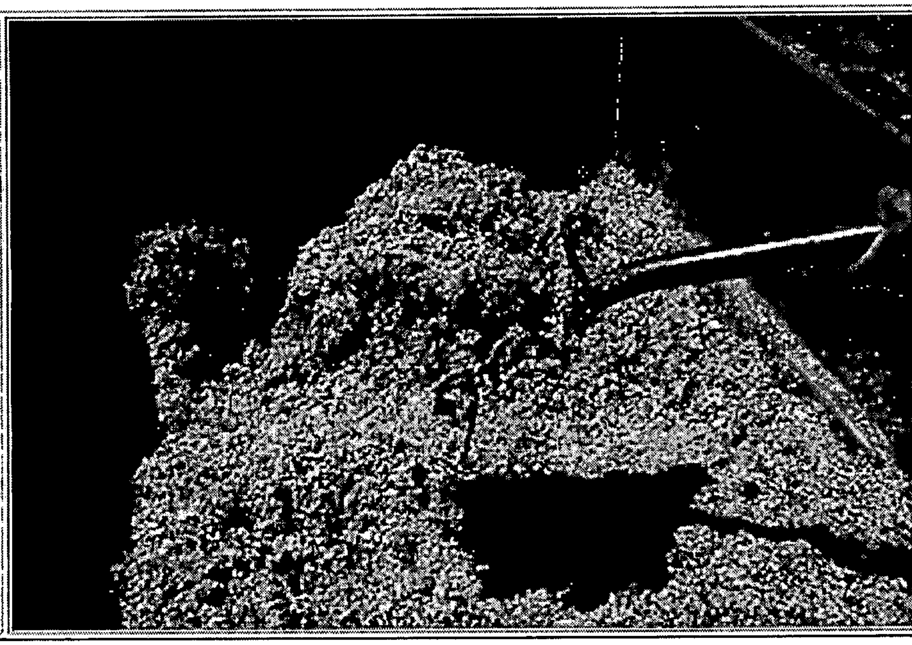
Temperatures of the above blends during the composting process can be seen here.

Following is the nutritional content of the compost from the 3:1 blend when analyzed as a soil and as a tissue.

Soil Test			Tissue & Forage Test		
Component	Mean	Range	Component	Mean	Range
pH	6.7	6.6-6.8	Crude Protein (%)	14	12.6-15.5
NO_3 (ppm)	14.8	14-16	ADF	40.5	39.6-43.7
EC (dSm^{-1})	2.46	2.4-2.5	N (%)	2.34	2.02-2.48
P (ppm)	826	807-860	P (%)	0.41	
K (ppm)	1450	1380-1570	K (%)	0.54	
Ca (ppm)	21,200	17,800-28,500	Ca (%)	8.2	
Mg (ppm)	398	347-482	Mg (%)	0.16	
S (ppm)	241	228-260	S (%)	0.3	
Na (ppm)	836	796-911	Na (ppm)	3025	
			Fe (ppm)	1785	
			Mn (ppm)	83.4	
			Zn (ppm)	79.3	
			Cu (ppm)	88.4	

Page created August 17, 1998.

In-Vessel Composting of Separated Hatchery Waste



Don Cawthon
Department of Agricultural Sciences
Texas A&M University-Commerce
Commerce, Texas

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One disposal option for this waste product involves the loading and transport of the material to a facility that separates the liquids from the solids using centrifugal force. The liquid is refrigerated and transported by tanker truck to a pet food manufacturing plant. The solids (chicks, membranes, egg shell) are landfilled.

This project evaluated the capability of in-vessel composting techniques to decompose and stabilize the separated waste material obtained from a centrifugal seperator. The waste was collected in an open-topped tank in Pittsburg, Texas and transported to Texas A&M University-Commerce for mixing and loading into research-size in-vessel composters. Hatchery waste was composted with either wood products or poultry litter as the bulking agents.

Composting using wood products as the bulking agent:

Wood products were used to serve as absorbents and bulking agents as outlined in the table below:

Volume of Hatchery Waste	Volume of Fine Sawdust	Resulting Moisture Content
2	1	27%

Temperatures of the above blends during the composting process can be seen here.

Following is the nutritional content of the compost from the 2:1 blend when analyzed as a soil and as a tissue.

Soil Test			Tissue & Forage Test		
Component	Mean	Range	Component	Mean	Range
pH	7.8	7.8-7.8	Crude Protein (%)	8.3	6.0-9.8
NO_3 (ppm)	7	7-7	ADF	19.2	15.0-20.8
EC (dSm^{-1})	2.09	1.89-2.35	N (%)	1.32	0.95-1.57
P (ppm)	1360	1330-1420	P (%)	0.57	0.42-0.68
K (ppm)	1310	1280-1370	K (%)		
Ca (ppm)	158000	144,000-184,000	Ca (%)	23	21-24
Mg (ppm)	1765	1670-1830	Mg (%)	0.27	0.25-0.28
S (ppm)	286	272-307	S (%)	0.22	0.19-0.30
Na (ppm)	1311	1297-1317	Na (ppm)	1581	1454-1778
			Fe (ppm)	2019	1120-3799
			Mn (ppm)	29	25-33
			Zn (ppm)	34	33-36
			Cu (ppm)	40	29-49

Composting using poultry litter as the bulking agent:

Poultry litter was used to serve as an absorbent and bulking agent as outlined in the table below:

Volume of Hatchery Waste	Volume of Poultry Litter	Resulting Moisture Content
2	1	27%

Temperatures of the above blends during the composting process can be seen here.

Following is the nutritional content of the compost from the 2:1 blend when analyzed as a soil and as a tissue.

Soil Test			Tissue & Forage Test		
Component	Mean	Range	Component	Mean	Range
pH	6.9	6.8-6.9	Crude Protein (%)	6.3	5.9-6.7
NO_3 (ppm)	57	53-60	ADF	15.3	13.6-16.4
EC (dSm^{-1})	5.96	5.73-6.21	N (%)	1.01	0.94-1.07
P (ppm)	3044	2215-3940	P (%)	0.50	0.48-0.53
K (ppm)	5023	4750-5180	K (%)	0.67	0.66-0.68
Ca (ppm)	165,000	161,000-169,000	Ca (%)	24.5	24.0-25.0
Mg (ppm)	3583	3540-3640	Mg (%)	0.4	0.4-0.4
S (ppm)	1120	1040-1230	S (%)	0.26	0.25-0.26
Na (ppm)	2379	2282-2438	Na (ppm)	2414	2386-2452
			Fe (ppm)	2989	2403-3843
			Mn (ppm)	103	99-111
			Zn (ppm)	137	131-144
			Cu (ppm)	129	122-136

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USDA United States Department of Agriculture

FY2016 HPAI Response

Mortality Composting Protocol for Avian Influenza Infected Flocks

February 5, 2016

Please note: These procedures may be revised as the situation develops.

EXECUTIVE SUMMARY OF THE METHOD

Composting is a biological heating process that results in the natural degradation of organic resources (such as poultry carcasses) by microorganisms. Composting has been successfully used throughout the United States for nearly two decades to control outbreaks of low pathogenicity avian influenza (LPAI) and highly pathogenic avian influenza (HPAI). Composting can be effective with most bird types and poultry house designs.

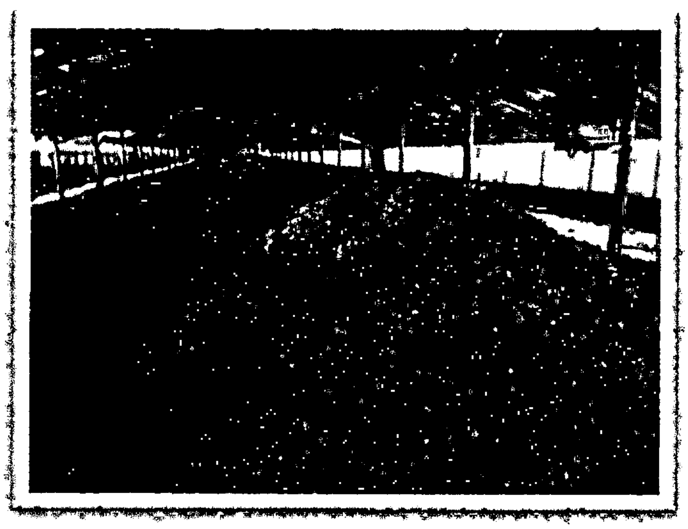
Microbial activity within a well-constructed compost pile can generate and maintain temperatures sufficient to inactivate the avian influenza virus. The effectiveness of this virus inactivation process can be assessed by evaluating compost temperatures and the shape of the time and temperature curve, visual observation of carcass decomposition, and the homogeneity of the compost mix.

Successful mortality composting requires the following:

1. **A qualified composting expert to guide windrow construction.**
2. **Trained equipment operators.**
3. **Sufficient carbon, water, and space.**

If any of these components is lacking, composting is NOT recommended.

Prepared by members of the USDA Composting Technical Committee: Lori P. Miller, Gary A. Flory, Robert W. Peer, Eric S. Bendfeldt, Mark L. Hutchinson, Mark A. King, Bill Seekins, George W. Malone, Joshua B. Payne, Jerry Floren, Edward Malek, Mary Schwarz, and Jean Bonhotal



Completed windrow (photo by Gary Flory)

KEY ELEMENTS FOR SUCCESSFUL COMPOSTING

The role of the Subject Matter Expert (SME) is to ensure that these key elements are followed in the construction of compost windrows:

1. Windrows (typically 6 to 8 feet high and 12 to 15 feet wide) are constructed on an adequate and uniform base layer (10 to 15 inches thick) of a sufficiently porous and absorbent carbon material.
2. The base layer and windrow are not compacted with equipment.
3. Good carcass to carbon contact is ensured by creating a core with a minimum 1:1 mix, by volume, of carcasses, carbon, and other infected material (manure, egg shells, feed, etc.). DO NOT GRIND/CRUSH/MACERATE THE CARCASSES DURING CONSTRUCTION!
4. Windrows should be constructed to ensure adequate distribution of moisture throughout; the windrows are capped with carbon material (8 to 12 inches thick) to ensure that no carcasses are exposed and to minimize odor.
5. Windrow dimensions, including the base and cap, may be reduced for smaller carcasses.

Pay loader used for clearing the base (photo by Josh Payne)

LABOR, EQUIPMENT, AND SUPPLIES

- Skilled equipment operators and general laborers;
- skid loader(s), pay loaders, dump trucks, rakes, and scoops;
- sawdust, litter, wood shavings, corn stover, active compost, seed and nut hulls, woodchips, or other carbon material; and
- compost thermometers (36" or 48" stem length).

PROTOCOL

Prior to Windrow Construction

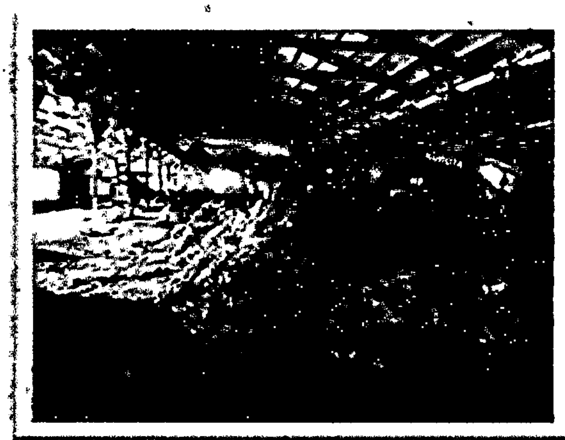
- Evaluate barn configuration to determine if space is adequate for windrow(s) construction within the poultry barns. If not, assess other on-site structures or outside compost sites.
  - To assess outside sites, see Appendix A.
- Evaluate type and quantity of infected materials to be composted:
  - Carcass: type, size, number and condition
  - In-barn manure/litter: volume, moisture content, density

Windrow Base Construction

Clearing the base (photo by Gary Flory)

- Before in-house composting, clear carcasses and litter from the windrow location(s) of the poultry house to create a 12–15 foot wide work area for construction of the windrow base(s). Distribute the material from on either side of the pathway. (See Appendix C for in-house variations.)
- Before outside composting, an adequate site must be identified (see Appendix A). Site modifications and approval from State and local agencies may be required.
- Using the largest loader possible, begin building the windrow base.
- The windrow base should be 12–15 feet wide with a depth of 10 to 15 inches. (Note: base will compress over time.)
  - Carbon material for the base should be porous and bulky enough to allow adequate air flow into and through the windrow. Ideal materials for the base include bark mulch or coarse wood chips. Other acceptable materials include: straw, wood shavings, active compost, small grain hulls, and corn stover. Also, coarse woody material in excess of 2 inches in size should be avoided to ensure that the resulting compost can be land applied as a soil amendment.
  - If these materials are not available, poultry litter may be used for the windrow base if it is sufficiently dry, porous, and bulky.
  - To maintain the base's porosity and to avoid compaction, do not drive equipment on the base.

Construction of the Core



Constructing the core (photo by Bob Peer)

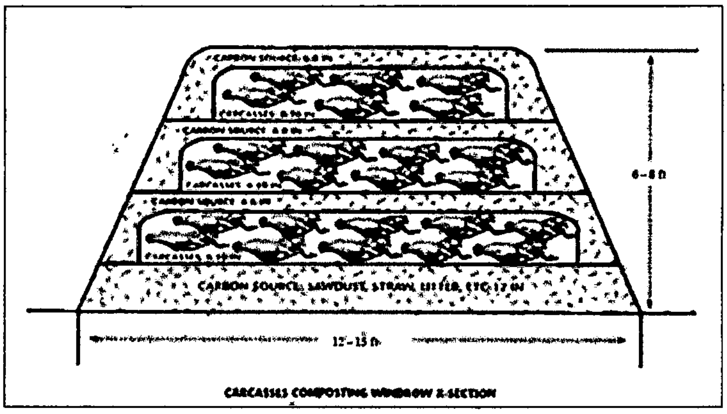
- The windrow core should consist of a uniform mix of carcasses and litter. The easiest way to get a uniform mix throughout the windrow is to scoop litter and birds together in each bucket load and add it to the windrow in a manner that thoroughly mixes the contents of the bucket. If additional carbon material is needed, the material should support heat generation (i.e., composting). Suitable materials include fresh wood shavings, active compost, poultry litter, straw, corn stover, and small grain hulls. In many instances this material may need to be blended with the existing litter and carcasses to be suitable.

Layering Method

Layering method (photo by Mary Schwarz)

As an alternative to the core construction method described previously, the windrow core can be constructed by layering carcasses and carbon material. Base and cap construction is the same as in the standard protocol. Following base construction, proceed in the following manner:

- Add a 12–15 inch layer of litter and birds, then cover with a 12–15 inch layer of wood chips or other carbon source.
- Add another layer of litter and birds until the windrow is two or three layers high and as long as needed.
- Cover the windrow with an 8–12 inch layer of wood chips or other carbon sources. The finished pile should be 6 to 8 feet high.



The SME may choose to use either or both of these construction techniques depending on site conditions.

Approval of Windrow Design

SMEs should evaluate the windrows to ensure that they have been constructed consistently with this protocol. Approval will be documented on the Compost Approval Checklist in Appendix G.

Temperature Monitoring

Once the windrow construction has been approved by the SME, daily temperature monitoring can begin following the standard temperature monitoring SOP found in Appendix D. Temperature data should be collected on the temperature log included in Appendix E or in a comparable electronic document. The health and safety of the individual conducting the temperature monitoring should be protected by following the ammonia safety procedures outlined in Appendix F.

TROUBLESHOOTING

The table below describes some of the most common composting problems and possible solutions.

Problem	Issue	Solution
Excessive flies or odor	Exposed carcasses	Add additional cap material
Leachate from windrow	Mixture too wet	Add additional carbon material, mix and cap
Temperature does not reach 131 °F	Mixture too dry (< 40% moisture)	Add water to pile, mix if necessary
Temperature does not reach 131 °F	Mixture too wet (> 60 % moisture)	Add additional carbon material, mix if necessary
Temperature drops early	Not enough oxygen	Aerate or mix pile

- not be located on a flood plain,
- be constructed or designated for the current emergency,
- have (or construct) diversion ditches, terraces, or berms to direct surface water flows and storm water away from active compost piles. (Note that if piles are located between production houses, then roof and surface drainage should be directed away from the compost area), and
- the edges of the identified site should have these following minimum setbacks, including:
  - 200 feet from a water supply well used for drinking;
  - 200 feet from water bodies, including: ponds, lakes, streams, rivers;
  - 200 feet from a nearby residence (not owned by the premises);
  - 50 feet from a drainage swale that leads to a water body (see above); and
  - 25 feet from a drainage swale that does not lead to a water body.

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Method 2. Volume Based Estimate

a. Assume bulk density of litter is 30 pounds/cubic foot or approximately 800 pounds/cubic yard. This means the following:
   i. Each 20 pound bird requires 30 pounds or 1 cubic foot of carbon material
   ii. Each 40 pound bird requires 60 pound or 2 cubic feet of carbon material.

b. To calculate total carbon material needs, perform the following calculations:
   i. Multiply number of 20 pound birds by 1 to get cubic feet then divide by 27 for cubic yards.
   ii. Multiply number of 40 pound birds by 2 to get cubic feet then divide by 27 for cubic yards.

c. To estimate additional volume needed, subtract the total volume of litter in the building (see above) from the total volume of carbon material required.

Method 3. Computerized Estimator

a. First, use the Spartan Emergency Animal Tissue Composting Planner v1.03 to estimate the total amount of amendment needed.

b. Then use the Spartan Compost Recipe Optimizer v1.04 to estimate the amounts/proportions of amendments needed; given the availability of amendments (poultry manure, poultry litter, sawdust, bark, etc.).

c. Go to this site: http://msue.anr.msu.edu/program/info/managing_animal_mortalities and then select "Composting Tools."

Turkey Breeder Houses

- Although designs of turkey breeder houses may vary, generally the nests and other equipment can be moved to the center and sides of the house to make space for the construction of two windrows.
- Because of limited operating space, windrows may need to be shorter (5 feet tall) and narrower (10 feet wide). This will allow the loader operator to construct the windrow core and place the cap from one side of the windrow.
- Eggs and feed should be evenly distributed onto the core of the windrow.
- Eggs should be broken with the loader bucket to facilitate decomposition and inactivation of virus.

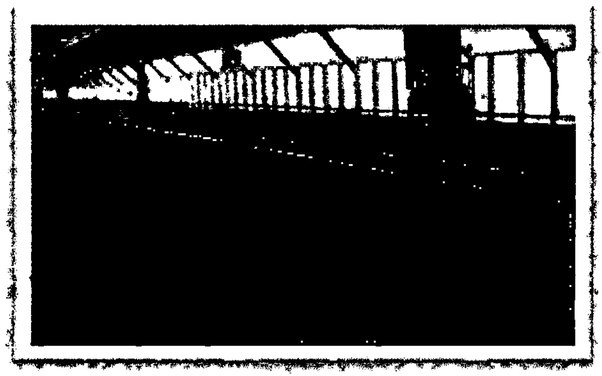
Windrow in a turkey breeder house (photo by Gary Flory)

Breeder Turkey Toms

- Breeder toms can weigh between 60 and 80 pounds.
- Due to their size, more carbon material may be required to maintain good carcass to carbon contact.
- Handling and placing the carcasses in the windrow may be difficult due to their size and the tendency of the carcasses to roll to the edge of the windrow. Additional labor may be necessary to appropriately position the carcasses on the windrow.
- Additional capping material may be needed to ensure that all carcasses are adequately covered.

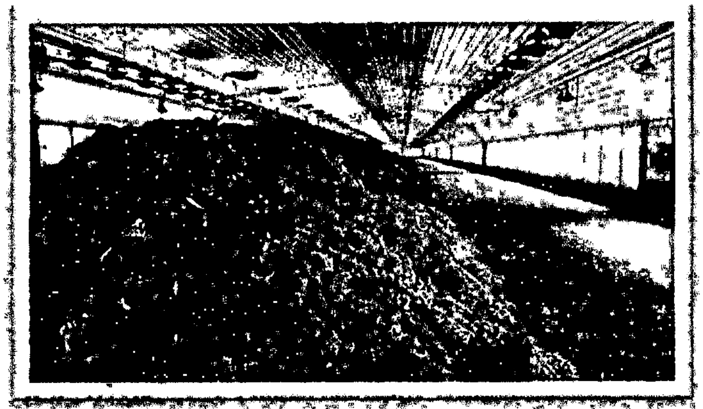
Broiler-Breeder Houses with a Center Scratch Area

- Slats and nests need to be moved outside the house after depopulation.
- Carcasses and litter in scratch area should be scooped up with a loader(s) and dumped onto the middle of the manure which was under the slats. Place equal amount of carcasses on both manure piles.
- Dump any feed onto the manure.
- Bring in carbon material to build a base 10 inches deep and 12 foot wide in the scratch area. Ensure that the base does not touch the wooden slat supports.



Typical broiler-breeder house with center scratch area (photo by Bob Peer)

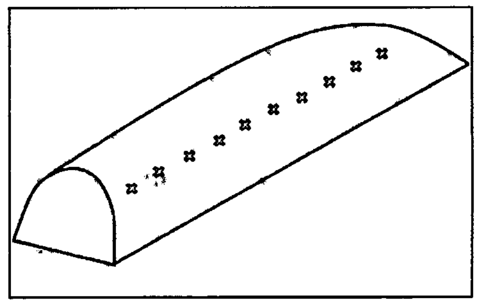
- In the center of the house, construct a 12–15 feet wide base that is 10–15 inches deep.
- Combine both capped windrows onto the base, mixing litter, carcasses, and added carbon material.
- Cap the final windrow with 8–12 inches of suitable carbon material.



Final windrow (photo by Josh Payne)

APPENDIX D TEMPERATURE MONITORING PROCEDURE

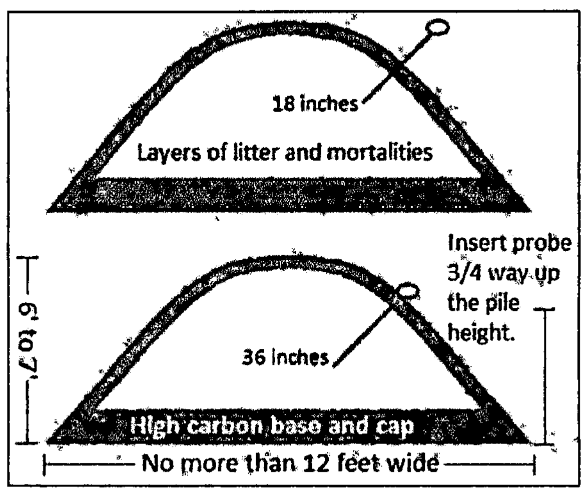
Monitor temperatures of the windrow daily at a minimum of 10 locations flagged by the SME. The temperature monitoring locations should be spaced equidistantly the length of each windrow. Take two temperature readings at each flagged location within a foot of the flag; one reading at a depth of 18 inches and another reading at a depth of 36 inches. To ensure consistent temperature monitoring to the same depth, mark the thermometer probe at 18 inches and 36 inches. Place the temperature probe ¾ of the way up the windrow at a 45 degree angle. Ideally, temperatures should be monitored by a single individual for consistency. Temperature probes should be calibrated before use.



Example temperature monitoring locations

Instructions

- Turn on fans or open the doors and curtains to all the houses containing compost piles to allow them to air out and to maximize ventilation.
- USE THE BUDDY SYSTEM. Entering a barn with active compost or dead birds requires a two person team.
- Place the stem of the thermometer approximately 18 inches and then 36 inches into the compost pile half way up the pile at a 45 degree angle.



- Leave the thermometer at each depth and point for at least 60 seconds.

APPENDIX E TEMPERATURE MONITORING LOG SHEET

COMPOSTING TEMPERATURE LOG			
County:	Site Number:		
Street address, city, state:			
Farm Name:			
House/Windrow Number:	Date Started:	Date Finished:	Date Turned:

Use the cells below to record the temperatures each day at 18 inches and at 36 inches.

Date	Depth	Flag #1	Flag #2	Flag #3	Flag #4	Flag #5	Flag #6	Flag #7	Flag #8	Flag #9	Flag#10	Avg
	18"											
	36"											
	18"											
	36"											
	18"											
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APPENDIX G COMPOST APPROVAL CHECKLISTS

INITIAL COMPOST WINDROW CONSTRUCTION CHECKLIST

Farm Name:		**County:**	
Farm Address:			
Farm Contact:		**Contact Phone:**	
Date Windrows Started:		**Date Windrows Completed:**	
Windrow #:		**Premises County & #:**	
Who constructed windrow?		**Contact Info:**	

	WINDROW DESIGN	***Yes***	***No***	***N/A***	***Comments/Description***
1	Height between 6 and 8 feet.				
2	Width between 10 and 15 feet				
3	Base between 8 and 12 inches				
3	Dome shaped without significant irregularities				
4	No soft tissue visible on the surface of the windrow				
5	A minimum of 6 inches of carbon cover material				
6	Photos taken				
7	Sketch of flag locations with dimensions attached,				

Recommendations:

☐ I have observed the windrows at this site and in my professional judgment they have been constructed consistent with the criteria outlined in the Mortality Composting Protocol for Avian Influenza Infected Flocks.

☐ I have observed the windrows at this site and in my professional judgment they have **NOT** been constructed consistent with the criteria outlined in the Mortality Composting Protocol for Avian Influenza Infected Flocks. The following corrective actions are recommended:

____

____

____

Signature of Composting SME: ____________________ Date: __________

Print name of Composting SME: ____________________________

\- -

The corrective actions recommended above were completed on: ________________

☐ I have observed the windrows at this site and in my professional judgment they have **NOT** been constructed consistent with the criteria outlined in the Mortality Composting Protocol for Avian Influenza Infected Flocks. The windrows should be evaluated by a composting Subject Matter Expert to recommend corrective actions if necessary.

☐ Windrow temperatures have **NOT** reached the average temperature of 131 °F for a minimum of 72 hours. The windrows should be evaluated by a composting Subject Matter Expert to recommend corrective actions if necessary.

Signature of State Animal Health
Official, APHIS Official or IMT Official: ____________________ Date: __________

Print name of signing official: ______________________________

- -

Phase 1 Recommendations of Subject Matter Expert:

☐ I have observed the windrows at this site and based on their construction and my review of the temperature logs, the windrows have performed in a manner demonstrated to inactive the avian influenza virus. The 14-day initial composting cycle is complete.

☐ I have observed the windrows at this site and based on their construction and my review of the temperature logs, the windrows have **NOT** performed in a manner demonstrated to inactive the avian influenza virus. The following corrective actions are recommended:

____

____

Date of windrow evaluation: ______________________________

Signature of Composting SME: ____________________ Date: __________

Print name of Composting SME: ______________________________

- -

The corrective actions recommended above were completed on: ______________

Phase 1 was complete on: ______________________________

Signature of Composting SME: ____________________ Date: __________

☐ I have observed the windrows at this site and in my professional judgment they have **NOT** been constructed consistent with the criteria outlined in the Mortality Composting Protocol for Avian Influenza Infected Flocks. The windrows should be evaluated by a composting Subject Matter Expert to recommend corrective actions if necessary.

☐ Windrow temperatures have **NOT** reached the average temperature of 131 °F for a minimum of 72 hours during the second composting phase. The windrows should be evaluated by a composting Subject Matter Expert to recommend corrective actions if necessary.

Signature of State Animal Health
Official, APHIS Official or IMT Official: ______________________ Date: ______________

Print name of signing official: ____

Phase 2 Recommendations of Subject Matter Expert:

☐ I have observed the windrows at this site and based on their construction and my review of the temperature logs, the windrows have performed in a manner demonstrated to inactive the avian influenza virus. The windrows may be moved without restriction on the premises or may leave the premises with appropriate permits.

☐ I have observed the windrows at this site and based on their construction and my review of the temperature logs, the windrows have **NOT** performed in a manner demonstrated to inactive the avian influenza virus. The following corrective actions are recommended:

____

____

Date of windrow evaluation: ____

Signature of Composting SME: ____________________________ Date: ____________

Print name of Composting SME: ____

The corrective actions recommended above were completed on: ______________________

Phase 2 was complete on: ____

Signature of Composting SME: ____________________________ Date: ____________

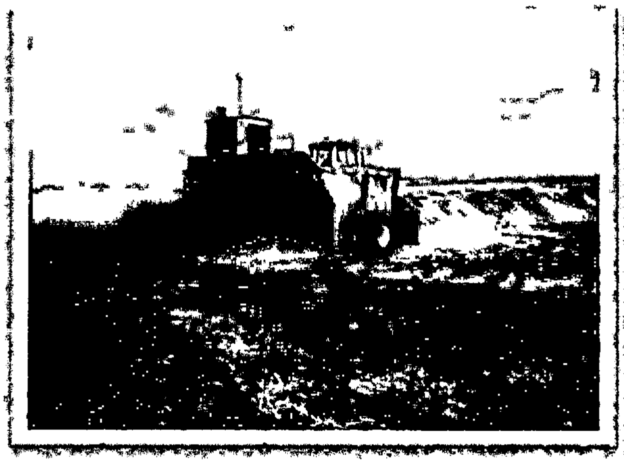
b. Requires 2 passes for larger windrows.

Brown Bear compost turner (photo by Gary Flory)

Brown Bear compost turner (photo by Bob Peer)

4. Straddle-type windrow turner (tractor pulled).
   a. Windrows should be constructed far enough apart to allow the tractor and turner to operate (width of tractor approximately 10 to 12 feet).
   b. Mixes material well.
   c. Need a large unit to turn 12–15 foot windrows (at least 14 foot wide)—the "toe" of the windrows can be removed by a loader to reduce the width of larger windrows.

Self-propelled compost turner
(photo by Gary Flory)



Tractor-pulled compost turner
(photo by Mark King)

Material	Type of value	% N (dry weight)	C:N ratio (weight to weight)	Moisture content % (wet weight)	Bulk density (pounds per cubic yard)
Fish wastes (gurry, racks, and so on)	Range	6.5–14.2	2.6–5.0	50–81	—
	Average	10.6	3.6	76	—
Mixed slaughterhouse waste	Typical	7–10	2–4	—	—
Mussel wastes	Typical	3.6	2.2	63	—
Poultry carcasses	Typical	2.4[b]	5	65	—
Paunch manure	Typical	1.8	20–30	80–85	1,460
Shrimp wastes	Typical	9.5	3.4	78	—
Manures					
Broiler litter	Range	1.6–3.9	12–15[a]	22–46	756–1,026
	Average	2.7	14 a	37	864
Cattle	Range	1.5–4.2	11–30	67–87	1,323–1,674
	Average	2.4	19	81	1,458
Dairy tie stall	Typical	2.7	18	79	—
Dairy free stall	Typical	3.7	13	83	—
Horse-general	Range	1.4–2.3	22–50	59–79	1,215–1,620
	Average	1.6	30	72	1,379
Horse-race track	Range	0.8–1.7	29–56	52–67	—
	Average	1.2	41	63	—
Laying hens	Range	4–10	3–10	62–75	1,377–1,620
	Average	8.0	6	69	1,479
Sheep	Range	1.3–3.9	13–20	60–75	—
	Average	2.7	16	69	—
Swine	Range	1.9–4.3	9–19	65–91	—
	Average	3.1	14	80	—
Turkey litter	Average	2.6	16 a	26	783
Municipal wastes					
Garbage (food waste)	Typical	1.9–2.9	14–16	69	—
Night soil	Typical	5.5–6.5	6–10	—	—

Material	Type of value	% N (dry weight)	C:N ratio (weight to weight)	Moisture content % (wet weight)	Bulk density (pounds per cubic yard)
Paper fiber sludge	Typical	—	250	66	1140
Paper mill sludge	Typical	0.56	54	81	—
Paper pulp	Typical	0.59	90	82	1403
Sawdust	Range	0.06–0.8	200–750	19–65	350–450
	Average	0.24	442	39	410
Telephone books	Typical	0.7	772	6	250
Wood chips	Typical	—	—	—	445–620
Wood-hardwoods	Range	0.06–0.11	451–819	—	—
(chips, shavings, and so on)	Average	0.09	560	—	—
Wood-softwoods	Range	0.04–0.23	212–1,313	—	—
(chips, shavings, and so on)	Average	0.09	641	—	—
Yard wastes and other vegetation					
Grass clippings	Range	2.0–6.0	9–25	—	—
	Average	3.4	17	82	—
Loose	Typical	—	—	—	300–400
Compacted	Typical	—	—	—	500–800
Leaves	Range	0.5–1.3	40–80	—	—
	Average	0.9	54	38	—
Loose and dry	Typical	—	—	—	100–300
Compacted and moist	Typical	—	—	—	400–500
Seaweed	Range	1.2–3.0	5–27	—	—
	Average	1.9	17	53	—
Shrub trimmings	Typical	1.0	53	15	429
Tree trimmings	Typical	3.1	16	70	1,296
Water hyacinth-fresh	Typical	—	20–30	93	405

[a] Estimated from ash or volatile solids data.
[b] Mostly organic nitrogen.

USDA United States Department of Agriculture

FY 2016 HPAI Response
Job Aid: Overview of the HPAI Composting Process
January 12, 2016

Note: The purpose of this document is to provide a summary of the USDA APHIS *Mortality Composting Protocol for Avian Influenza Infected Flocks* and is not a substitute for that document. All appendices referenced below can be found in that Protocol located at www.aphis.usda.gov/fadprep.

CONDUCTING THE FARM ASSESSMENT

In order to plan for windrow construction at the affected premises, a Farm Assessment is required. The Farm Assessment may be provided by the Site Manager or may be developed by a composting subject matter expert (SME) recognized by APHIS. The following components found within the assessment must be completed.

- Evaluate the barn configuration to determine if space is adequate for windrow(s) construction within the poultry barns. If not, assess other on-site structures or outside compost sites (*see Appendix A*).
- Evaluate the type and quantity of infected materials to be composted, including
  - carcass: type, size, number, and condition;
  - in-barn manure/litter: volume, moisture content, and density;
  - stored manure/litter: volume, moisture content, and density;
  - routine mortality method, location, and physical condition of mortalities;
  - feed: quantity and location;
  - eggs: quantity and condition;
  - clean bedding; and
  - paper products.
- Calculate the amount of carbon needed for composting (*see Appendix B*).
- Evaluate premises for supplemental water and include the source and application method.
- Evaluate on farm equipment availability and determine any supplemental equipment needs.
- Ensure all overhead line and poultry house equipment are removed or out of the way. Be sure all loose cords cables or hoses are secured so that they will not become entangled by equipment.
- Ensure ventilation is balanced to reduce the risk of disease transmission while maintaining air quality for worker safety.

ARRANGING FOR NECESSARY EQUIPMENT

Following a Farm Assessment, the SME coordinates with the Site Manager and requests additional resources from the Incident Management Team (IMT) Logistics Branch. The resource list includes, but is not limited to:

- skilled equipment operators and general laborers;
- skid loader(s), pay loaders, dump trucks, rakes, and scoops;
- sawdust, litter, wood shavings, active compost, woodchips, or other carbon material; and
- compost thermometers (36" or 48" stem length).

CONSTRUCTING COMPOST WINDROWS

When constructing compost windrows, the SME should ensure that the following key elements are incorporated into the construction of the compost windrows:

- windows formed outside of poultry houses are sited in consultation with State and local officials to minimize environmental impacts;
- windrows (finished dimensions not to exceed 6 to 7 feet high and 12 to 15 feet wide) are constructed on adequate and uniform base layer (10 to 12 inches thick) of sufficiently porous carbon material;

USDA United States Department of Agriculture

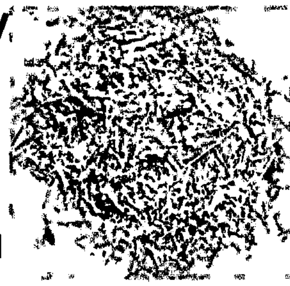
HPAI Outbreak

Mortality Composting: Carbon Sources for Windrow Construction

Please note: These procedures may be revised as the situation develops; *This is a list of generally acceptable carbon sources for windrow composting of HPAI related mortalities. The carbon source resource needs for the premises, i.e. quantity and type, should be determined by a compost SME and will depend on site-specific (typically poultry house-specific) conditions and circumstances.*

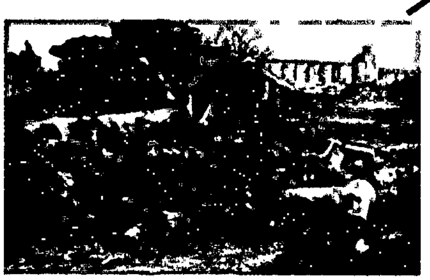
Suitable carbon sources:

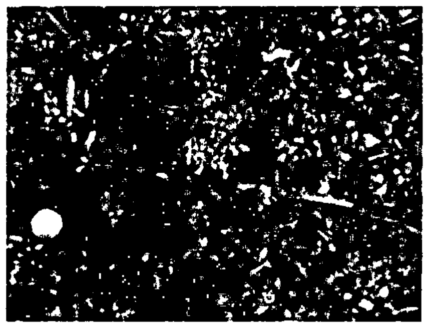
- Wood chips about 2" or less in size
- Wood Shavings
- Yard/brush trimmings 2" or less in size
- Partially composted leaf and yard waste (still hot)
- Sawdust (not used alone)
- Chopped Hay/Straw
- Chopped Corn Stover
- Oat/Sunflower Hulls
- Manure with Incident Command approval
- Ground pallets (2" or less) if fasteners have been removed
- Other material listed in APHIS Composting Protocol or as recommended by APHIS-recognized Subject Matter Expert and approved for use on agricultural land by the state



Materials not suitable within a carbon source:

- Rocks
- Glass
- Plastic
- Large logs/branches
- Grass clippings >5%
- Ground construction and demolition debris (CDD)
- Regulated pests (Emerald Ash borer, etc.)
- Rubber
- Metal/baling wire
- Chemicals
- Concrete
- Painted/pressure treated wood
- Soil/sand
- Carbon source with free liquid or excessive leachate





Photos from top to bottom and left to right: Wood chips, chopped corn stover, Oat hulls, Mixed wood with logs/large lumber pieces, Wood chips with rocks/gravel, Mixed wood with lumber and debris, Construction Demolition Debris.

USDA United States Department of Agriculture

FY2016 HPAI Response

Mortality Composting:
Carbon Sources for Windrow Construction
March 10, 2016

Please note: These procedures may be revised as the situation develops; *This is a list of generally acceptable carbon sources for windrow composting of HPAI related mortalities. The carbon source resource needs for the premises, i.e. quantity and type, should be determined by a compost SME and will depend on site-specific (typically poultry house-specific) conditions and circumstances.*

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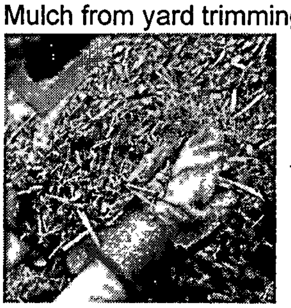
- Sawdust (not used alone)
- Chopped hay/straw
- Chopped corn stover
- Oat/Sunflower hulls
- Manure (if approved by Incident Command)
- Ground pallets (2” or less) if fasteners have been removed
- Other material listed in APHIS Composting Protocol or as recommended by APHIS-recognized Subject Matter Expert and approved for use on agricultural land by the state

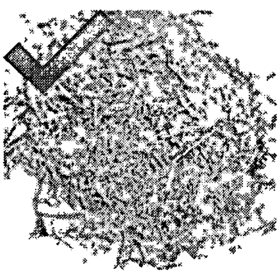
Materials <u>not</u> suitable within a carbon source:

- Rocks
- Glass
- Plastic
- Large logs/branches
- Grass clippings >5%
- Ground construction and demolition debris (CDD)
- Regulated pests (Emerald ash borer, etc.)
- Rubber
- Metal/baling wire
- Chemicals
- Concrete
- Painted/pressure treated wood
- Soil/sand
- Carbon source with free liquid or excessive leachate

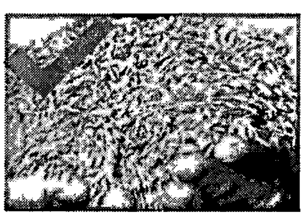
Mulch from yard trimmings/waste



Wood chips

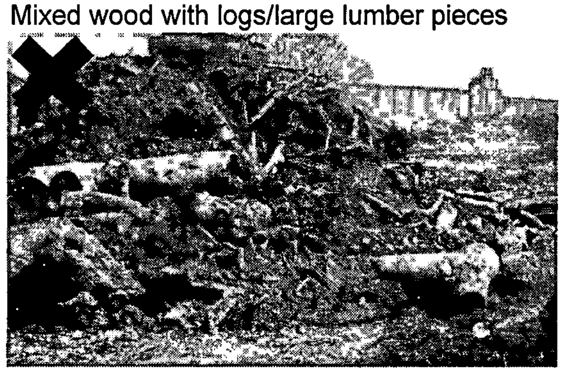


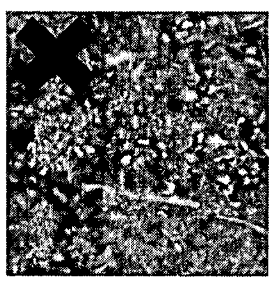
Chopped corn stover



Oat hulls

Mixed wood with logs/large lumber pieces





Wood chips with rocks/gravel

Construction demolition debris

FY2016 HPAI Response
Cleaning & Disinfection Basics (Virus Elimination)
February 19, 2016

Please note: These procedures may be revised as the situation continues to change.

GENERAL GUIDANCE

All previously highly pathogenic avian influenza (HPAI) Infected Premises must be *both* CLEANED and DISINFECTED. Cleaning and disinfection practices during an outbreak should focus on virus elimination in a cost effective manner.

While traditionally wet cleaning and disinfection has been performed in many incidents, dry cleaning and eliminating the virus through either heating of houses or fumigation is a preferred approach during a widespread HPAI outbreak. Any method(s) selected should consider the characteristics of the premises/houses and other factors which may impact the effectiveness of the virus elimination activities.

DEFINITIONS

Cleaning: The removal of gross contamination, organic material, and debris from the premises or respective structures, via mechanical means like sweeping (dry cleaning) and/or the use of water and soap or detergent (wet cleaning). The goal is to minimize the remaining organic material so disinfection can be effective.

Disinfection: Methods used on surfaces to destroy or eliminate HPAI through physical (e.g., heat) or chemical (e.g., disinfectant) means. A combination of methods may be required.

Virus Elimination: Cleaning and disinfection measures conducted with the primary purpose to destroy or eliminate all avian influenza virus on the premises as cost effectively as possible.

OPTIONS

For premises that can be cleaned and disinfected (most premises):

Step 1 CLEANING OPTIONS

Dry Cleaning
Timing & method of dry cleaning must not aerosolize virus.

and/or

Wet Cleaning

Step 2 DISINFECTION OPTIONS

Drying & Heating (100-120 °F for 7 days total)
At least three days must be consecutive days drying and heating at specified temperature; heating to 100-120 °F must occur for seven days total.

and/or as needed

Wet Disinfection with EPA Approved Antimicrobial

and/or as needed

Fumigation with EPA Registered Sterilant for Porous and Non-Porous Surfaces or Alternative Science-Based Methods

NOTE: A premises may require a *combination* of methods, but *at least one* choice must be selected from Step 1 and Step 2. The cleaning and disinfection options selected and implemented *must* be included as part of the approved cleaning and disinfection plan and approved by State Animal Health Officials and APHIS for reimbursement.

USDA United States Department of Agriculture

Highly Pathogenic Avian Influenza

A Guide To Help You Understand the Response Process

Detect
You see unusual signs of illness or sudden deaths in your flock. You report it to your private or State veterinarian. Samples are taken and tested. You find out your flock is positive for HPAI.

Quarantine
USDA and State personnel come to your farm. We assign you a caseworker, who will be your main point of contact onsite, answer your questions, and guide you through the needed paperwork. We will also place your operation under quarantine, meaning only authorized workers are allowed in and out, and movement restrictions for poultry, poultry products, and equipment go into effect. We contact neighboring poultry farms and start testing their birds to see if they've been affected, too.

Appraise
We work with you to create a flock inventory. This lists how many birds you have, what species they are, their age, and other key details that will help us give you 100 percent of fair market value for your birds.

Depopulate
Infected flocks are depopulated as quickly as possible—ideally within 24 hours of the first HPAI detection—to get rid of the virus.

Compensate
You receive your first indemnity payment early on in the response process. We also pay you a standard amount for virus elimination activities (cleanup work).

Manage Disposal
USDA will help you dispose of the dead birds safely. Disposal methods include composting, burial, incineration, rendering, or landfilling. The options you'll have depend on several things: what type of farm you have, the specific conditions there, State and local laws, and what you prefer.

Eliminate Virus
The next step is to wipe out all traces of the virus at your property. To kill the virus, thoroughly clean and disinfect the barn, equipment, and all affected areas of your farm. You can do this work yourself or hire contractors to handle it.

Test
As soon as you're ready, let your caseworker know you're finished with cleanup. Your site must then stay empty for at least 21 days. During this time, we'll return to collect and test environmental samples. We need to confirm that your property is completely virus-free.

Restock
Once USDA and the State both approve, you can restock your facilities and start production again. State officials will release your farm from quarantine after all required testing and waiting periods are done.

Maintain Biosecurity
After restocking, you'll need to continue maintaining the highest biosecurity standards to keep the virus from coming back. For biosecurity tips, go to www.aphis.usda.gov/publications and download the factsheet "Prevent Avian Influenza at Your Farm."

How Long Does the Process Take?
Ideally, this entire process could be completed in as soon as 60–120 days. However, the timeframe varies depending on many things (for example, flock size, depopulation and disposal methods used, test results, farm's location). We're committed to restoring production as fast as we can while also protecting poultry health.

Questions?
Talk with your caseworker or the State or Federal officials responding to the disease event in your area.

For general information and contacts, visit:

www.usda.gov/avian_influenza.html

www.aphis.usda.gov/fadprep

Animal and Plant Health Inspection Service • APHIS 91-85-005 • Issued September 2015

USDA United States Department of Agriculture

FY2016 HPAI Response

Landfill Disposal Guidance—Recommended Waste Acceptance Practices for Landfills

January 15, 2016

BACKGROUND

Highly pathogenic avian influenza (HPAI), commonly known as bird flu, is a foreign animal disease caused by influenza A viruses. These viruses are found naturally in wild bird populations. Wild birds act as reservoirs, circulating these viruses between each other, sometimes with no clinical signs. However, HPAI can be transmitted to domestic chickens and turkeys, which may result in an outbreak. The USDA is the lead federal agency in responding to foreign animal diseases, such as HPAI.

PURPOSE

The intent of this guidance is to provide recommended waste acceptance practices for landfill disposal of HPAI infected carcasses. In an outbreak, all carcasses must be disposed of in a timely, biosecure, aesthetically acceptable, and environmentally responsible manner. Permitted landfills are an important option for disposal during an outbreak. These landfills must have necessary environmental controls to manage carcasses. In addition, strict biosecurity procedures must be followed during transportation and disposal.

PROTECTION OF LANDFILL OPERATORS

While the Centers for Disease Control and Prevention (CDC) has determined that risk for human infection from the 2014–2015 HPAI outbreak strains is low (see the *CDC Interim Guidance for Landfill Workers in the United States Disposing of Poultry Carcasses During Outbreaks of HPAI)*, the CDC does recommend landfill operators take appropriate precautions for those involved in disposal operations. If landfills are used to dispose of carcasses during an HPAI outbreak, landfill operators should follow CDC's guidelines, which are available here or by visiting www.aphis.usda.gov/fadprep.

GENERAL LANDFILLING PROCESS

All HPAI landfill operations will be supervised by personnel from USDA or State Departments of Agriculture. Contractors can be hired through the USDA to provide roll offs and other equipment at farms, CDL truck drivers (to transport roll offs to and from landfills), and personnel to perform cleaning and disinfection (C&D) of all conveyances. Contracted workers may also instruct truck drivers onsite, under the direction of landfill management.

The landfill will determine the amount of carcasses and waste materials they will accept from an infected farm. Waste materials may include manure, eggs, litter, left over feed, egg flats, pallets, used PPE, and C&D supplies. The landfill will also control the frequency of deliveries. Communication will be established between landfill management, State or Federal site managers and/or case managers at an infected premises, and the USDA APHIS contracting office. Deliveries to and from the landfill are coordinated in advance between the landfill and the State or Federal site manager on an infected premises.

10. The USDA contractor or subcontractor drives the truck to the landfill and prepares to dump where directed by landfill staff or designee.
11. The USDA contractor uses heavy equipment to open roll-off gate.
12. The truck driver tips load where directed.
13. The landfill staff or designee covers waste material and manages leachate in accordance with permit conditions.
14. The USDA contractor or subcontractor drives the truck to the C&D station for washing prior to leaving landfill.
15. The USDA contractor or subcontractor disposes of C&D wash water in accordance with the landfill and State requirements (likely at the municipal waste water treatment plant).
16. USDA APHIS pays the contractor and landfill when their invoices are approved.

FOR FURTHER INFORMATION

Please see the following websites for further information concerning HPAI:

- FAD PReP Material and References
- USDA Avian Influenza.

USDA United States Department of Agriculture

January 13, 2016

Policy and Approach to HPAI Vaccination

The current Animal and Plant Health Inspection Service (APHIS) policy for avian influenza (AI) vaccination, as described in VS Memorandum 565.12, allows "H5 and H7 vaccines to be used as a tool for combating any potential outbreak of highly pathogenic avian influenza (HPAI) in the United States." AI vaccines may be prepared from any serotype, including H5 and H7, and may be recommended for use in chickens or turkeys subject to the requirements and restrictions specified in VS Memorandum 800.85v2. The memorandum allows H5 and H7 vaccines to only be used under the supervision or control of USDA-APHIS-Veterinary Services (VS) as part of an official USDA animal disease control program. The VS Center for Veterinary Biologics (CVB) implements the provisions of the Virus-Serum-Toxin Act to ensure that veterinary biologics available for the diagnosis, prevention, and treatment of animal disease are pure, safe, potent, and effective.

APHIS supports that vaccination should be available as part of a science-based influenza control strategy that includes: (1) enhanced biosecurity; (2) an eradication plan; (3) controlled vaccination for flocks deemed to be at risk; (4) suitable monitoring of all flocks at risk and of all vaccinated flocks; and (5) a repopulation plan. The management of AI must continue to be based on sound scientific principles. However, innovative strategies will be required to eliminate these persistent and adaptive viruses.

Assumptions to be Used Throughout this Policy/Approach:

The use of vaccine will be through USDA supervision and will only be distributed under the approval of each State Veterinarian. USDA will cover the cost of purchasing vaccine. USDA will not incur the costs associated with administering the vaccine. Vaccine will be used as part of disease suppression (i.e., preventing further spread) and eradication. In certain unique economically significant circumstances, it may be used as a protective effort to maintain production. The use of a vaccine strategy in an outbreak situation does not mitigate the need for increased biosecurity efforts. All HPAI testing will be done at a National Animal Health Laboratory Network (NAHLN) Laboratory and National Veterinary Services Laboratories (NVSL). VS will provide recommendations for use of specific vaccines in line with testing and surveillance methods. Vaccinated birds will be identified, and vaccinated flocks will be monitored. Vaccinated birds will not move outside of the vaccination area (those States or regions where vaccine is used under this strategy). Products from vaccinated birds may be moved outside of the vaccination area, but must not be exported. Poultry from outside States will be allowed to transit the vaccination area in accordance with all other procedures for transiting a control area.

Factors and Triggers Preceding Vaccination:

Vaccination may be considered as part of a suppression or eradication strategy in an outbreak. Certain unique circumstances may call for protective vaccination. The factors or triggers to consider for any decision to vaccinate include the following:

- Probability that the disease cannot be rapidly contained frequently, and offered a clear benefit in reducing the number of depopulated flocks when compared to scenarios not incorporating vaccination into control strategies. Additionally, earlier start times for vaccination relative to first detection of HPAI resulted in shorter outbreaks with fewer infected flocks. Economic modeling estimates indicated the benefits of reduced spread due to vaccination in the uniformly dense populations of commercial poultry simulated in the epidemiological model may offset the costs of heightened trade restrictions under vaccination.

2. Conversely, simulating disease spread in regions characterized by pockets of, or lower commercial poultry population density, generated less predictable results. The number of infected flocks was typically lower, unless disease spread into a cluster of farms within the densely populated area. Consequently, disease spread in these less densely populated production areas may be staggered with a difficult to predict rise in the number of infected flocks, complicating the triggering of vaccination and reducing the effectiveness of reactive vaccination as a control and prevention strategy.

Approval of Vaccine Use:

The APHIS Administrator or his designee will approve the potential use of vaccines based on several criteria, including the status of HPAI detections, vaccine efficacy, and the availability of doses. A suppression/eradication vaccination strategy would be applied only under the supervision of the active incident command in that area. The incident command (including State, Industry, and Federal involvement) team would be responsible for developing and forwarding the plan for vaccination use, reporting vaccine use, permitting movements, and monitoring activities as part of their regular reporting. If vaccinated birds remained alive after the active incident was resolved (for example, a breeder flock in the vaccination zone), the State Veterinarian will be responsible for monitoring and routine reporting on the flock.

In those unique situations where protective vaccination is used, the State Veterinarian would be required to develop a plan for vaccine use within their State (including poults/pullets shipped to their State) to include regular reports on vaccine use, monitoring activities, and movement permits. The State will submit this plan to USDA (Assistant Director in conjunction with National Poultry Improvement Plan (NPIP) office) for review.

Oversight of Vaccination:

USDA would require a memorandum of understanding (MOU) with the States using vaccines and their poultry producers. The MOU would include adherence to an approved State eradication plan using vaccination as a tool to eventually ensure that HPAI virus has been eliminated from each individual poultry premises. The MOU would include the following requirements:

- Maintain accurate records of all commercial vaccine purchased and used;
- Monitor and confirm to USDA that vaccine use is strictly limited to the defined vaccination zone as outlined in the national strategy;
- Monitor and confirm that the accepted vaccination protocol is being followed;
- Ensure that there is active monitoring of vaccinated poultry through diagnostic testing of vaccinates or sentinel birds and dead bird surveillance;
- Allow USDA to review and have access to all production and mortality records;

assays, rRT-PCR monitoring of non-vaccinated sentinel birds maintained in the same environment, or by dead bird surveillance of other birds in the same environment.

Surveillance Requirements in Vaccinated Flocks:

Specific surveillance protocols would be developed and modified in accordance with the vaccine that is in use. The guidelines included in this document are general suggestions, based on what we know of vaccine possibilities, and would be targeted to the specific vaccine chosen for any vaccination effort. This document will be updated as needed.

For the current rHVT vaccine, the DIVA strategy will not only discriminate between infected and vaccinated birds, but also will help identify vaccinated birds that become infected with avian influenza. A strategy would be to use agar gel immunodiffusion (AGID) or hemaglutination inhibition (HI) assay for examination of an immune response to field strain virus exposure and/or a reverse transcriptase polymerase chain reaction (rRT-PCR) based approach utilizing the standard matrix AI assay for the direct detection of active AI virus in tissues or swabs. Both of these tests will be negative in rHVT vaccinated, unexposed chickens. However, this approach is muddied by the use of conventional inactivated swine lineage H1 and H3 vaccination in turkeys, as these vaccinates will have positive AGID or HI results. Accordingly, all vaccinated turkey poults will be required to have periodic oropharyngeal samples obtained and tested via rRT-PCR per the MOU with the controlled States. Birds presumptive positive via the matrix rRT-PCR test and found to be presumptive positive for H5 must have samples forwarded to NVSL for confirmation of H-type and determination of pathogenicity status. Any birds found to be positive for HPAI must be immediately quarantined depopulated and indemnified and the premises must undergo the full cleaning and disinfection process outlined in the Red Book.

Surveillance Protocol for Turkeys:

Vaccinated turkeys will be sampled routinely. The house will be sampled once a week, with rRT-PCR tests, until the birds are 6 weeks of age. Subsequently, rRT-PCR testing by house will be done every 3 weeks for the life of the flock when over 6 weeks of age. Immediate testing will be conducted whenever triggering events of mortality or reduced egg production occur as described in the draft Secure Turkey Supply Plan for monitoring within the control zone. This could be incorporated into regular serological monitoring generally conducted every 3-4 weeks on breeding stock post-vaccination. Use of sentinels is discouraged. Unvaccinated birds would represent a multiplication risk that could overwhelm induced immunity in vaccinated stock thereby defeating the purpose of vaccination. Turkey breeders in production are handled individually at least weekly for artificial insemination and any HPAI present should manifest quickly, especially if breeder toms supplying semen to those flocks are affected. Weekly testing of breeder toms in production should be considered.

Surveillance Protocol for Table Egg Layers:

Surveillance would be through serological testing of vaccinates and dead bird surveillance using rRT-PCR followed by confirmatory testing at NVSL.

- Pullet house (vaccinates and dead bird tested)
    - 80-100 birds/house

egg-type and meat type chicken breeders must test negative to all subtypes of AI to maintain their official certification as an **Avian Influenza Clean** flock. Therefore, if birds are vaccinated for and test negative on an NPIP-approved test cleared for use with vaccinates, their certifications will be maintained. However, if a flock is infected and tests positive for AI, certification will be lost. In order for any NPIP participating hatchery to maintain their NPIP certifications, they must only accept hatching eggs that are derived from NPIP flocks that have tested negative to AI. NPIP hatcheries that accept hatching eggs from NPIP participant flocks that have been vaccinated and test negative will maintain their certification; NPIP hatcheries that accept hatching eggs from flocks that are infected and have tested positive will lose their certification.

NPIP regulations permit the use of vaccination in poultry if the following principles are fully met:

- If vaccine is used, methods must be used to distinguish vaccinated birds from birds that are both vaccinated and infected.
- If vaccination is considered as an option, a written plan for use must be in place with proper controls and provisions for APHIS approval of any use of vaccine. The plan will define procedures to prevent the spread of HPAI by vaccination teams. Surveillance must continue to assess vaccination effectiveness and detect any antigenic change. The vaccinated premises will be subject to risk assessments, surveillance requirements, and biosecurity procedures. Considerations must be given to any national or OIE standards or conditions for movement as well. The requirement for a written plan is addressed through the MOU which is required for use of vaccination, as detailed earlier in this document.

Interstate Movement Requirements and Impacts:

Interstate movement of birds that are not vaccinated should not be affected. NPIP status of non-vaccinated flocks should not be affected by the use of vaccine, and therefore should not impact interstate movements. Movement of vaccinated birds will not be allowed outside of the vaccination area, unless done in a controlled and permitted manner to slaughter. The movement of hatching eggs/day-old chicks derived from vaccinated breeder flocks should not be restricted, nor should these be considered vaccinates. However, these shipments should be permitted and tracked so that any subsequent positive test results could be appropriately interpreted.

HPAI Virus Elimination: Flat Rate Payments

January 8, 2016

Introduction

Eliminating highly pathogenic avian influenza (HPAI) virus from affected premises is a crucial step toward resuming operations. In the past, the standard process involved reimbursing producers and contractors for work done, which sometimes resulted in lengthy delays in payments due to the need for cooperative compliance agreements (CCAs).

To streamline the process, APHIS is moving to a flat-rate payment for virus elimination activities. Invoices and CCAs will no longer be needed; payment will be on a per-bird basis. This approach will also allow for some cost sharing by producers and will help ensure that APHIS isn't covering routine or deferred maintenance and biosecurity under virus elimination payments. In addition, APHIS will make payments in two installments — another revision that will get funds to producers more quickly.

What costs were included in calculating the flat rates?

During the 2015 HPAI outbreak, APHIS determined that dry cleaning and heating barns for virus elimination is the most cost effective means of virus elimination, although we recognize that other methods may be equally suitable in a given set of circumstances. We used heat disinfection as the basis to calculate the flat rate.

The critical activities in virus elimination include barn preparation, a cleaning step, and a disinfection step. APHIS broke down the data into these types of activities and calculated flat rates based on those that would be performed in a future outbreak.

Activities included in the calculation of the flat rates:

- Barn preparation – Labor, equipment, and supplies to prepare the barns for virus elimination.
- Dry cleaning – Labor and equipment to remove gross organic material that remains after disposal efforts; labor and supplies for disassembly, cleaning, and reassembly of equipment such as waterers or egg conveyors; and cleaning and disinfecting equipment used for other activities (e.g., payloaders).
- Heating – Labor, equipment, and utilities to heat barns to between 100F and 120F for 7 days, with at least three of those days being consecutive.

Activities not included in the calculation of the flat rates:

- Costs of routine or deferred maintenance. This includes activities such as mowing around barns and fixing holes in barns and in fan screens.
- Biosecurity practices such as insecticide and rodenticide application, as well as clerical and accountant time.

How are flat rates calculated and paid?

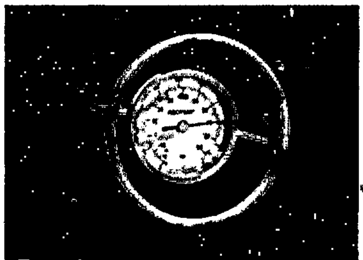
To calculate the flat rates, virus elimination costs per farm were summed across all farms, stratified by farm type: caged layers and turkeys. This total was divided by the number of birds depopulated for each farm, again stratified by farm type. Since we have found dry cleaning and heating to be the most cost-effective virus elimination method, we used that as the basis for the calculation. Producers have the responsibility of conducting or contracting for the covered activities and may choose to use any effective virus elimination method with the funds provided. Because there are no virus elimination activities associated with lying fallow, producers who choose this approach rather than cleaning to eliminate virus will not be offered funding.

APHIS plans to make two payments direct to the producer/owner, each for 50% of the total calculated value. The initial payment is to be requested via a VS 1-23 form and is paid after the flock plan is completed. A second (final) VS 1-23 will be signed and paid after laboratory testing of environmental samples is completed with negative results reported.

APHIS will continue to provide oversight to meet our responsibility of ensuring that the HPAI virus is quickly contained and fully eliminated.

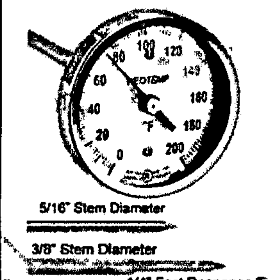
APPENDIX J
Calibrating Compost Thermometers

Routine calibration of compost thermometers maintains equipment accuracy.



The purpose of windrow composting of HPAI related poultry carcass mortality is inactivation of avian influenza virus. Compost pile temperature measurements are a critical indicator of effectiveness of the compost process for virus inactivation. Temperature monitoring is performed by a compost subject matter expert (SME), regulatory monitoring staff, contractors, or farm personnel. Accurately monitoring temperatures daily is vital to ensure that compost windrows meet time and temperature requirements set forth by USDA-APHIS. *These time and temperature requirements must be met to release quarantine on the infected premises.*

The calibration process described below is appropriate for most commercially available dial-type compost thermometers. The most common compost thermometers in use for HPAI response are 36" or 48" length bimetal dial industrial compost thermometers (such as the $^{5}/_{16}$" stem heavy duty, or $^{3}/_{8}$" stem with ¼" fast response tip super duty) manufactured by Reotemp Instruments.



When to calibrate the compost thermometer?

<u>The thermometer should be calibrated, at a minimum, weekly.</u>
Calibration should also be performed if any of the following occurs:

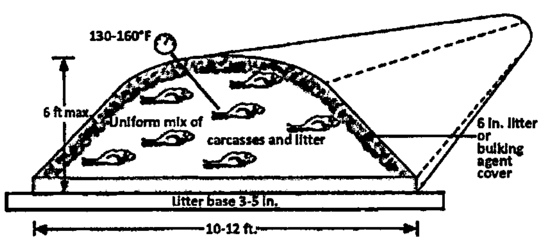
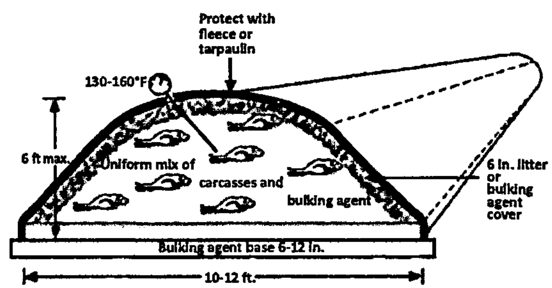
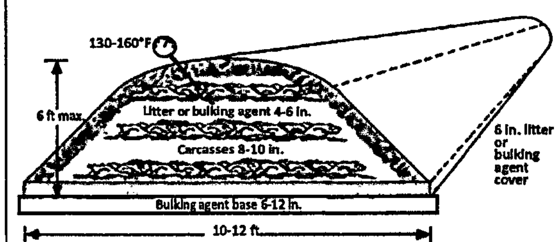
- It is dropped on a hard surface or subjected to severe shock,
- It is subjected to forces causing excessive pressure or bending of the stem,
- It is subjected to prolonged vibration,
- It is exposed to extreme temperatures outside the range of the dial, or
- The calibration screw on the back of the dial is turned accidentally.

<u>Note:</u> *if the stem is bent or the dial becomes un-sealed or broken the thermometer may no longer be accurate. It is recommended that the Reotemp thermometers be fitted with a metal probe handle for better handling and to protect the dial.*

Safety: The pointed stem of the thermometer is very sharp. Take care when handling and use a protective sheath when thermometer is not in use.

Poultry Mass Mortality Composting Options

Select a composting option that matches the nature and extent of losses, resources available and farm situation.

Method:	In-House Windrow	Outside Windrow	In-Shed Windrow
Situation:	Catastrophic loss where repopulation schedule permits and removal of dead from poultry house poses an environmental or disease risk.	Catastrophic loss where in-house is not an option and there is a desire to repopulate the house quickly.	Elevated mortality that exceeds the routine compost bin capacity.
Procedures:	Place a uniform mixture of carcass and litter on a base layer of litter and cover windrow with litter or other bulking agents (i.e. sawdust, woodchips). Requires 0.8 inches of litter per pound of meat per square foot. Excluding base and cover on a volume basis, this equals 1 part carcass to 2 parts litter. After ~14 days, turn windrow in-house or relocate and cover with bulking agent. Composting usually complete < 28 days. 	At an approved site, place a uniform mixture, by volume of 1 part carcass to 2 parts bulking agent on a carbon base layer, cover with bulking agent and protect windrow with compost fleece or tarpaulin. Turn and recover windrow at ~14 days. If circumstances warrant, turning may be delayed and compost allowed to age for ~28 days. 	When composting small volumes of mortality inside sheds, place carcasses on a layer of bulking agent, cover with bulking agent and repeat this layering process. Turning windrow at ~14 days (and re-covering with bulking agent) is essential since carcass decomposition can sometimes be slower in this layering procedure. Composting usually complete in ~28 days. 

Consult your poultry company before selecting a compost method. For more assistance contact your local USDA - NRCS office, Conservation District or Cooperative Extension Service. A detailed presentation is available at the following website: http://www.poultryextension.udel.edu

Every farm needs a mass mortality plan!

Prepared by Bud Malone, University of Delaware
Funded by USDA, Conservation Innovation Grant.
The University of Delaware and USDA are
equal opportunity providers and employers.

Agricultural Innovations Practical applications for sustainable agriculture | **Fact Sheet**

Sustainable Agriculture Research & Education

In-House Composting in High-Rise, Caged Layer Facilities

Richard T. Koenig
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Utah State University Extension, Provo

Bruce E. Miller
Utah State University, Logan

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Utah State University Extension, Tooele


County Extension Agent Dean Miner sifts through composted poultry manure.
Photo by Gary Neuenswander

Inside this fact sheet:

SARE Agricultural Innovations are based on knowledge gained from SARE-funded projects. Written for farmers and agricultural educators, these peer reviewed fact sheets provide practical, hands-on information to integrate well-researched sustainable strategies into farming and ranching systems. The articles are written by project coordinators and published by SARE.

GEOGRAPHIC RANGE:

Continental U.S. and areas with similar climate and high-rise, caged layer poultry production systems. This SARE research was conducted in the western U.S., but similar research has been done in Pennsylvania, Maryland and Georgia.

Introduction

Manure handling, storage, and disposal are common problems facing poultry producers in the United States. Fly and odor control, urban encroachment, a limited nearby land base for manure disposal, and increased regulatory pressures necessitate the development of alternatives to traditional scrape and haul systems.

One alternative for high-rise layer facilities is to compost manure inside of the buildings housing laying hens. Research showed that the addition of a carbon source coupled with frequent aeration of compost in a layer house produced temperatures high enough to inhibit fly reproduction in the material.

In-house composting offers promising solutions to common problems faced by egg producers. Since manure can be treated within the layer facility, odors associated with manure disturbance and handling when cleaning out a building are reduced. Fly control is achieved with heat, thereby reducing the need for pesticides. In addition, a more uniform and marketable compost product is produced, which greatly reduces the need for a nearby agricultural land base for manure disposal. Research conducted by others [1] also has shown that the final weight and volume of material produced are at least 35% lower after in-house composting compared to traditional systems where poultry manure accumulates undisturbed.

This article summarizes the in-house composting process and relevant research findings from a Western SARE pro

(Introduction continued on page 2)

ishing can occur outdoors in a conventional composting system, or partially composted material can be land-applied without finishing. Practitioners should check with state and local officials regarding regulations on composting facilities and compost quality standards before marketing the products of this process as compost.

An essential component of in-house composting is the negative pressure ventilation system that vents ammonia and other gasses from the composting area. This reduces the exposure of poultry and employees to potentially toxic gasses produced during composting. High concentrations of harmful gasses may still be present in the composting area, so employees working there should be equipped with appropriate monitoring and respiratory safety devices. Also, practitioners should be aware of impending air quality rules designed to regulate ammonia emissions from poultry farms. Careful attention to composting conditions, particularly the carbon to nitrogen (C:N) ratio of the material, can limit ammonia emissions. There is also some evidence (cited later) that chemical amendments can be used to reduce ammonia volatilized from composting manure.

Managing Compost Inside Poultry Facilities

Details on composting processes and methods are outside the scope of this article but are presented elsewhere in comprehensive manuals [3]. Two of the most important factors for successful in-house composting are the appropriate C:N ratio and moisture content of the material. Carbon to nitrogen ratio should be in the range of 20:1 to 40:1, with moisture contents in the range of 40 to 65% by weight. Practitioners are encouraged to purchase a comprehensive reference on composting methods, and to periodically have samples of material analyzed to compare results to desired ranges and make adjustments as necessary.

Carbon requirements

Initial research showed that high composting temperatures could be achieved in-house using relatively low rates of carbon material (200 to 600 lbs per 1,000 square feet of floor area, [4, 5]) (Figure 2). The resulting C:N ratio of the compost, however, was approximately 10:1, much lower than recommended for optimum composting. Composting with a low C:N ratio contributes to high rates of ammonia gas evolution and atmospheric ammonia concentrations inside the layer facility. While using less carbon extends the length of time compost can accumulate before the volume exceeds the capacity of the turner, the resulting high rates of ammonia volatilization are not sustainable from an air quality perspective.

Increasing the amount of carbon used to produce a target C:N ratio of 20:1 to 40:1 will reduce ammonia volatilization. Formulae are available to calculate the exact amount of carbon necessary to achieve a target C:N ratio, knowing the characteristics of the manure and carbon source material [3]. Higher C:N ratio carbon sources are desirable, as they reduce the total amount of carbon required. Depending on the source, from 1/3 to 2 pounds of carbon per pound of manure would be required for an optimum C:N ratio with in-house composting.

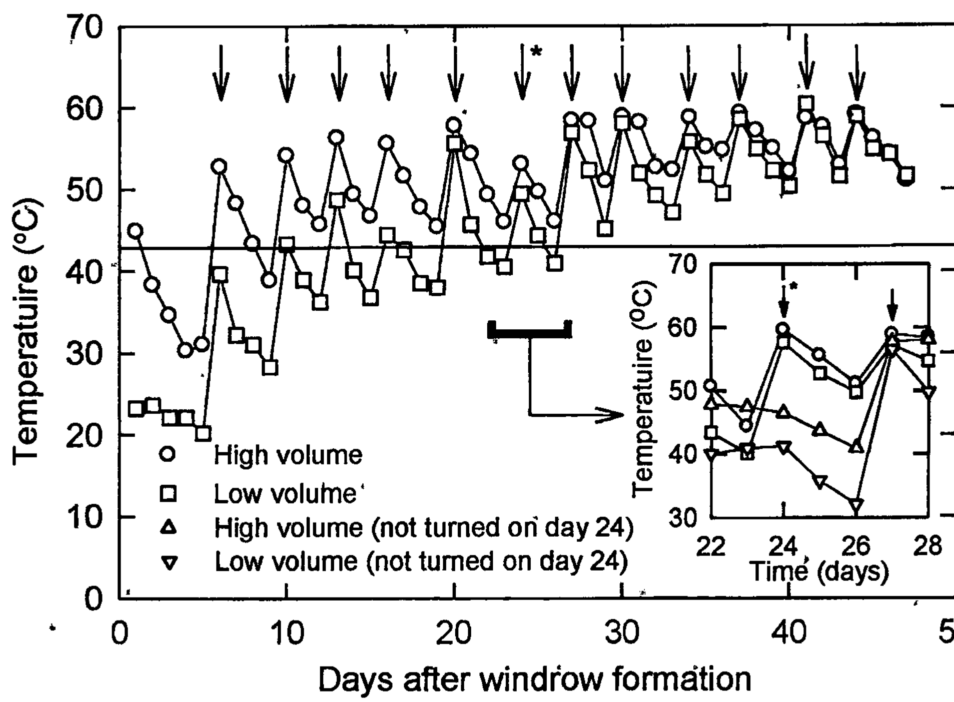

Figure 2. Daily compost temperatures measured during a seven-week in-house cycle. The treatments consisted of high and low initial volumes of composting material. Arrows indicate when compost was turned. The horizontal line represents the lethal limit for fly larvae (43 oC = approximately 110° F). The * indicates when certain replications of the treatments were not turned on day 24. Data from Miner et al. (2001) [5].

tion of higher rates of carbon during winter are recommended to accelerate drying and promote higher material temperatures.

Fly control

The farmer cooperators on this SARE research project were able to discontinue using a feed-based larvicide and shift to topical applications of an insecticide when needed as long as the material was managed appropriately to maintain high temperatures. Fly outbreaks, though infrequent, did occur when equipment broke down and turning schedules could not be maintained. Similar success in controlling flies with in-house composting has been reported by other researchers [7].

Ammonia volatilization and control

One of the main challenges with in-house composting is the accumulation of high levels of ammonia and other gasses inside layer houses and venting of these gasses from the facility. Active biological decomposition coupled with the low carbon to nitrogen ratio and frequent turning of the material contributes to higher ammonia levels than in high-rise layer facilities where manure accumulates in static beds. Monitoring showed that atmospheric ammonia in the composting area peaked well above safe levels for humans and poultry when the compost was being turned (Figure 3). Atmospheric ammonia was also higher in winter when fan use to cool buildings was reduced. Ammonia concentrations in the cage area were less than 50% of the concentrations in the composting area due to air flow patterns created by operation of the ventilation system [8].

There are several options to manage atmospheric ammonia during in-house composting. Practices that conserve nitrogen and reduce ammonia volatilization are the most desirable and environmentally sustainable solutions. Using rates of carbon calculated to maintain optimum C:N ratios will increase ammonia assimilation by microorganisms and reduce ammonia volatilization. Chemical amendments such as aluminum sulfate also have the potential to reduce ammonia volatilization from in-house compost [9], but more research remains to be done in this area. To reduce exposure in the short term, facility personnel where this research was conducted would over-ride the automated fan system for 15 to 30 minutes to vent ammonia when compost was being turned. It is recommended that facilities using in-house composting invest in ammonia gas sensors

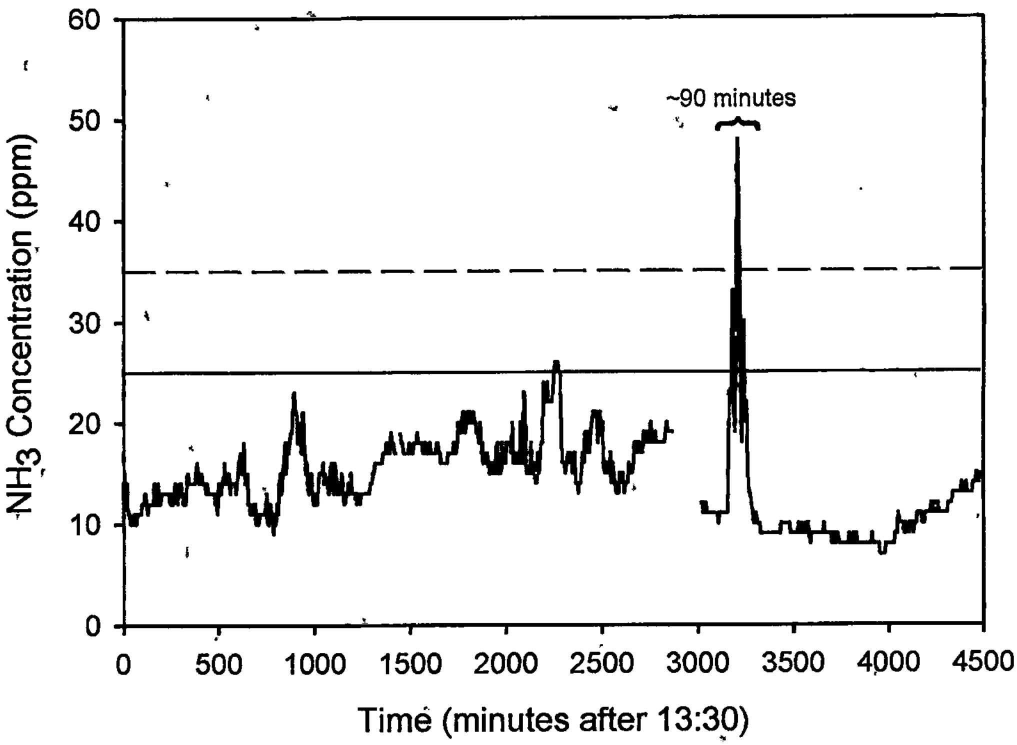

Figure 3. Ammonia concentrations over time in the manure storage area of a high-rise layer structure during in-house composting. The peak concentration occurred during a compost turning event. The — line indicates the 8 hour human health exposure limit. The — — line indicates the 10 minute human health exposure limit. Data are from Koenig et al. (in press) [9].

to prevent exposure of workers and poultry to high levels of atmospheric ammonia. In light of impending air quality regulations, practitioners of in-house composting also are cautioned to adopt practices that reduce ammonia emissions from poultry facilities.

Economic Evaluation

Cooperators on this project reported cost savings associated with reduced pesticide use for fly control, removal of less material from the buildings at cleanout, and the pro-compost turning event and lasted for less than 60 minutes. Ammonia levels also increased over time as compost volumes increased. In a series of laboratory and limited in-house trials, process controls and chemical amendments such as aluminum sulfate showed potential to reduce ammonia volatilization from composting poultry manure.

This fact sheet is based on a SARE-funded project. For more information, please visit www.sare.org > Project Reports > Search the database for project # SW00-040

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