

## CHAPTER 8

# Dead Animal Disposal

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### DEAD ANIMAL DISPOSAL - GENERAL

Managing dead animals in livestock and poultry growing situations is continually a greater challenge. Animal carcasses left to decay naturally above ground or in shallow pits or ditches pose risks to surface and ground water as well as endanger the health of domestic livestock, pets, and wildlife. Additionally, land spreading of farm hospital pen wastes and fetal membranes may endanger the biosecurity of the herd (Bonhotal, et. al., 2002). Today's environmental climate calls for proper and environmentally sound methods of dead animal disposal. Several disposal options are available. Those that are allowed by the South Carolina Department of Health and Environmental Control are rendering, burial, composting, incineration, and landfilling.

#### Rendering

Rendering is typically the method of choice for large animals such as a dairy cow. However, the availability of rendering plants makes this option difficult in many portions of South Carolina.



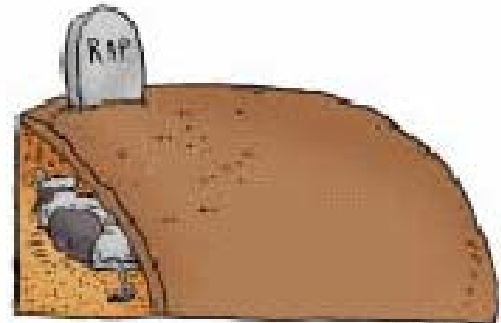
Source: Bonhotal et. al., 2002

The major concern in using rendering for dead animal disposal system is biosecurity. If the plant offers pickup, the truck which collects the dead animals on each farm can potentially transport disease from one farm to the next. Conversely, if many people take their dead animals to the plant, there is the potential for disease transfer. Although specific measures are taken to prevent disease transmission, it is still a concern to overcome when using this system.

#### Burial

Burial has long been the common on-farm approach to disposing of dead animals. This is a viable alternative. An adult dairy cow burial requires a hole approximately 2 feet x 7 feet x 8 feet deep (Gamroth, 2003). The bottom of the hole must be dry. There must be

at least a 2 foot separation between the bottom of the trench and groundwater. The pits should also have a berm to divert rainfall and runoff from the site. The soil should be able to infiltrate any rainfall that fall directly into the pit. It is recommended that the animal should be covered with hydrated lime for pathogen reduction . The site should be capped with at least 4 feet of soil mounded up of soil so that precipitation is not allowed to collect in the pit. Also, the area should be grassed to prevent erosion. The burial area should be monitored so that these conditions remain after settling of decomposing carcasses and capping material.



Source: Bonhotal et. al., 2002

These recommendations should help prevent burial pits from filling with water and carcasses floating to the surface. Water in the pit may be very bacteria-laden and may be a hazard to both animal and human health. There is also high potential for ground water contamination from both bacteria and nutrients.

Vectors (dogs, rats, snakes, flies, etc.) are potential problems in a burial situation. If a producer chooses this method for disposal of dead animals, the carcasses must be covered daily to reduce vectors in and around the trench or pit.

Regulation 61-43 allows burial of dead animals based upon the following conditions;

1. Proximity to the 100-year floodplain
2. Soil type
3. Depth to the seasonal high water table
4. Dead animals may not be placed in areas where the seasonal high water table is within 1.5 feet of the ground surface.
5. No burial site should be flooded with surface water.
6. Animals within a burial site must be covered daily with sufficient cover to prohibit exhumation from feral animals (dogs, coyotes, etc.)
7. When the burial site is full, the area should be capped and grassed to prevent erosion.
8. Other factors that the Department may see as relevant.

## Composting

Composting is an aerobic biodegradation process used to decompose organic material.

When disposing of dead animals composting is essentially above ground burial in a biofilter with pathogen kill by high temperature. It is an especially good method in areas where water table limitations prevent digging burial pits. Additionally, it transforms a waste product (manure and dead animals) into a useful soil amendment. For details on composting of dead animals refer to the fact sheet devoted to that topic.



Source: Bonhotal et. al., 2002

## Incineration

Incineration is a viable alternative in dead animal disposal of smaller animals. A dairy may be able to dispose of small calves through incineration; however, the cost of natural gas to burn larger animals would likely be cost prohibitive. Additionally, most incinerators are not constructed to handle carcasses as large as a dairy cow. If an incinerator is chosen to be used on a farm the following minimum criteria must be met.



Requirements for incinerator disposal systems as given in R. 61-43 are:

1. The emission of particulate matter must be less than one pound per hour at the maximum rated capacity.
2. The incinerator must be a package incinerator and have a rated capacity of 500 pounds per hour or smaller, and it must burn virgin fuel only.
3. The incinerator cannot exceed an opacity limit of 10 percent.

Incinerators that meet the above requirements are purchased as package incineration units. "Home-made" incinerators are not recommended and will be required to obtain air quality permits.

Incineration is discussed in greater detail in the Fact Sheet "Dead Animal Disposal – Incineration".

## Landfilling

Depositing dead animals in the local landfill is a practice that has been used by some producers for many years. This option is most commonly used for carcass disposal due either to the occasional death of a large animal or to the catastrophic death of many animals. A landfill that accepts dead animals must have approval from SCDHEC. If landfilling is the chosen method of dead animal disposal, the producer should check to confirm that the local landfill receives these animals.

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Several methods for disposing of dead animals are available. Currently, in South Carolina burial in earthen pits and trenches is the most common method used. Many producers are switching methods to composting and/or incineration. Rendering is also a viable option in which the dead animal is processed for further use; however, there are few rendering plants operating in South Carolina and transportation to the plants can be costly.

For more information on disposing of dead animals contact your local USDA-Natural Resources Conservation Service office or the local Clemson University Cooperative Extension Office.

## DEAD ANIMAL DISPOSAL - COMPOSTING

Managing dead animals from a livestock production facility in an environmentally sound manner is very important to producers. Composting has become the method of choice for many livestock and poultry producers. Disposal of dead animals through composting began with poultry in the late 1980's. The first unit in South Carolina was installed in 1992. The first dead swine composter in South Carolina was installed in 1994. Since this time research has been conducted to show the efficacy of composting for disposing of carcasses of larger livestock and exotic animals (Keener, et.al., 2000).

Composting is the aerobic decomposition and stabilization of organic matter under conditions which allow development of thermophilic temperatures as a result of biologically produced heat. It is a natural process that is enhanced and accelerated by the mixing of organic waste with other ingredients in a prescribed manner for optimum microbial growth. Composting dead animals may best be described as “*above ground burial in a biofilter with pathogen kill by high temperature*” (Keener and Elwell, 2000)

Composting is accomplished by mixing an energy and structural component (carbonaceous material), a nutrient source (nitrogenous material) [C/N 25-40:1], water (40-60%), and porosity (30-50%) in a prescribed manner to meet aerobic microbial metabolic requirements. Temperature (110-150 F) is considered the yardstick of composting. The process is carried out under specific moisture and temperature conditions for a specified period of time. The larger the animal the longer the period of time required for animal decay. The composting process may become inhibited when moisture falls below approximately 40 percent. Correct proportions of the various compost ingredients are essential to minimize odors and to avoid attracting flies, rodents, and other small animals. The final product is sufficiently stable for storage, land application, or marketing without adverse environmental effects. The material improves soil fertility, tilth, and water holding capacity. Composting reduces the bulk organic material to be spread; improves its handling properties; can destroy weed seeds and pathogens; and is proven to be an effective disposal method of dead animals. Control of C:N ratio, water, and porosity are important in dead animal composting. However, the reality is that composting dead animals provides an inconsistent mix. Thus, the approach must be slightly different. (Keener and Elwell, 2000)

A typical compost mix with the C:N ratios adjusted might consist of a mixture as given in Table 1. However, when composting dead animals all of the variables do not always optimize and a mix as given in Table 2 might be more realistic.

**Table 1. Mix for composting dead swine with broiler litter using sawdust / straw as a carbon source and bulking agent.**

Ingredient	Weight ratio	Volume ratio
Sawdust/straw	1.0/0.3	3.0/1.0
Litter	2.0	4.0
Water	0.7	0.5
Carcasses	1.0	1.0

**Table 2. Mix for composting dead swine with sawdust.**

Ingredient	Weight ratio	Volume ratio
Sawdust	1.5	5.5
Carcass	1.0	1.0
Water	added as needed to maintain a damp sponge	

### Site Considerations

Composting facilities shall be located as near the source of organic waste as practical. Composting operations shall be located where movement of any odors toward neighbors will be minimized. Setback distances should be in accordance to the South Carolina Department of Health and Environmental Control (SCDHEC) specifications. Typically for composting structures it will be equal to the setback(s) for the facility.



**Figure 1. Poultry composting facility in Lexington County, South Carolina**

Site paving needs should be evaluated in terms of effects of equipment operation on trafficability, soil compaction, and potential for contamination from compost and petrol products. Special consideration should be given to designing high traffic areas in front of the

primary bins which must be used daily in all weather conditions. One alternative for supporting traffic may be the installation of a geotextile fabric with crusher run gravel on top.

Buffer area(s), vegetative screens, and natural landscape features can help minimize the effects of odors.

The facility should be located as near the source of organic material as practical with consideration given to:

- surface water and groundwater protection.
- biosecurity. To reduce the risk of the spread of disease.
- the location of neighboring dwellings and how they will be affected by prevailing winds.
- location of ingress and egress so as not to interfere with traffic flow or utilities.
- location of the access for easy loading and unloading of compost.

## **Facility Size**

The composting facility shall be designed to provide storage for the maximum length of time anticipated between emptying events or storage period. The size required for composting is based upon the size of the animal to be composted and the equipment being used. The larger the animal the more space required for composting. Additionally, equipment must be able to move in and out of the structure freely. The minimum storage period shall be based on the time required for the composting process and environmentally safe utilization considering the climate, crops, soil, equipment, and local, state, and Federal regulations.

Several methods have been developed for sizing composting facilities. Each of these methods requires larger areas as the size of the animal increases. Additionally, the type of mix may influence the size. For example, a swine composter may be designed using 10 cubic feet per pound of dead animal when balancing the C:N ratio while 20 cubic feet per pound of dead animal is used when the ratio is not balanced (USDA-NRCS, SC 2002). Table 3 gives general sizing criteria for sizing composting units for dairy operations.

**Table 3. Sizing guidelines for dairy carcass composting - primary bins. (Morse, et. al. 2001)**

Carcass Type	Average weight (lbs.)	Composting space per pound of dead animal (ft <sup>3</sup> )	Weight range for same composting space (lbs.)
Pre – wean	90	10	25 - 300
Heifers	600	15	300 - 750
Cows	1400	20	150 -1400

### **Composting Period**

Sufficient time shall be planned to complete the compost process. The time needed for completion of the composting process varies with the material and must continue until the material reaches a stability level at which it can be safely stored without creating undesirable odors and poor handling features. Acceptable stability occurs when microbial activity diminishes to a low level. Table 2 (Keener and Elwell, 2000) shows estimated time for complete composting based upon carcass size. Visual inspection and temperature measurements will provide needed evaluation of compost status.

**Table 4. Cycle times required for composting mortalities of various sizes. (Keener and Elwell, 2000)**

Mortality size (lbs.)	4	10	50	100	220	350	500	1000	1500
Primary stage (days)	10	16	35	50	75	95	115	160	195
Secondary stage (days)	10	10	12	15	25	30	40	55	65
Storage stage (days)	30	30	30	30	30	30	30	30	30

### **Composting Method and Loading**

The composting method must fit the individual farm operation. Several methods include aerated windrow, static pile and in-vessel (bin). Compost piles for windrowed and static piles should be triangular to parabolic in cross-sectional form with a base width to height ratio of approximately 2 to 1. The typical dead animal composter uses the in-vessel (bin) method. However, windrowing or a combination may be used.



A typical stage one composting bin is loaded using the following sequence and according to the prescribed mix in Table 2. The composting mix is a combination of carbon source and litter or other type of manure to maintain proper C:N ratio, moisture and porosity.

**Figure 2. Loading a dairy cow into a composting facility in Lewis County, NY. ( Bonhotal, et. al., 2002)**

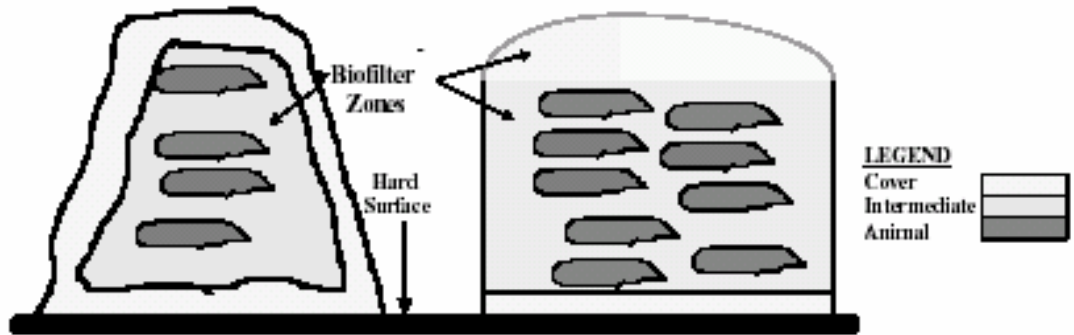
The recommended loading sequence for both methods is (Henry, 1994; Keener and Elwell, 2000)

1. One (1) foot of bulking agent such as sawdust is placed on the floor of the bin to soak up excess moisture. This is not part of the recipe in Table 2. If any liquid seeps out of the compost mixture additional sawdust should be place to soak up the liquid.
2. A uniform layer of carcasses is added on top of this bottom layer with a minimum of 12 inches of compost mix added next to the sidewalls to keep the carcasses away from the sidewalls. Carcasses should be lanced or cut so that no gaseous buildup occurs. Gaseous buildup could result in explosion.
3. A minimum of 12 inches of compost mix should cover the layer of carcasses. This layer serves as both an insulator to maintain heat and a biofilter to reduce odors.



Source: Bonhotal et. al., 2002

4. When adding additional layers a minimum of 6 inches should be maintained between carcass layers. Hollow out a place of the previous top layer and place new carcasses into the stack.
5. Cover the new layer with a minimum of 12 inches of material.
6. When the loading of the primary bin is completed a 12-inch cap of compost mix should be added to the top of the compost mix.



**Figure 3. Cross-sectional views of dead animal composting in a windrow or bin facility. (Keener and Elwell, 2000)**



**Figure 4. Composting bin for a 650 pound boar in Dorchester County, SC. The picture shows the layering of sawdust, broiler litter, and carcass.**

## Moisture

A water source must be available for compost pile moisture control from start-up through completion. The moisture content of the blended material at start-up of the composting process should be approximately 55 percent (wet weight basis) and maintained between 40 and 60 percent during the composting process.

Proper moisture content is critical in a carcass composting process and varies greatly with carcass species and size. Water is also a by-product of aerobic decomposition of animal and poultry carcasses. Moisture is important in initiating the composting process. Learning to control moisture is a trial and error process for each size and species of carcass. For poultry, a good rule of thumb for moisture is to spray the carcasses with a light mist roughly equivalent to an autumn morning dew. The composting of large swine carcasses requires a larger quantity of water to initiate the process. A longer period of time is required before by-product water is released by the swine carcass. Initial moisture application for swine varies from 0.25 to 0.65 pounds of water per pound of carcass depending upon carcass size. A 350 pound animal requiring approximately 0.5 pounds of water per pound of carcass would require an initial addition of 175 pounds or 21 gallons of water.

### **Carbon-Nitrogen (C:N) Ratio**

The amounts of the various ingredients shall be calculated to establish the C:N ratio of the mix to be composted. For composting typical organic matter or typical manure, the C:N ratio should be between 25:1 and 40:1. However, for composting dead animals the C:N ratio should be in the range of 10:1 to 20:1. Typical C:N ratios for composting amendments are found in the USDA-NRCS Agricultural Waste Management Field Handbook or the On-Farm Composting Handbook by the Northeast Regional Agricultural Engineering Service (NRAES). Organic materials with higher C:N ratios should be used for materials that decompose at a high rate (or are highly unstable) and result in greater odor production.

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

### **Porosity, Aeration, and Oxygen**

Aerobic composting consumes large amounts of oxygen. The porosity of the mix is critical to maintain adequate gaseous exchange sites. Adequate aeration may be achieved when the porosity of the mix ranges from 30 to 50 percent (Keener and Elwell, 2000). Thus, aeration in the process is critical. Aeration also removes excess heat generated by microorganisms, gases within the material, and excess moisture. Proper aeration may be achieved by passive air exchange, forcing air through the material, mechanical turning, or a combination of any of these methods.

Bulking materials should be added to provide the porosity, structure, and texture to enhance air flow within the composting material. Piles that are too compact will inhibit the composting process. Good results are usually obtained when the bulking agent has particle sizes ranging from 1/8 to 2 inches in diameter. 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 screening, must be made.

Heat generated by the process causes the compost pile to dehydrate. As the process proceeds, material consolidates, and the volume of voids through which air flows decreases. Materials selected for the composting mix should provide for adequate air movement throughout the composting process. Periodically turning the pile and maintaining proper moisture levels for windrows and static piles will normally provide adequate aeration.

Proper aeration minimizes nitrogen loss by denitrification. Maintaining the pH at neutral (7.0) or slightly lower avoids nitrogen loss by ammonification. High amounts of available carbon will aid nitrogen immobilization. Phosphorus losses will be minimized when the composting process is managed according to the requirements of this standard.

Increased surface area favorably affects evaporation and natural aeration and increases the area exposed to infiltration from precipitation in uncovered stacks. Aligning uncovered stacks north to south and maintaining moderate side slopes maximizes solar warming. Windrows should be aligned to avoid accumulation of precipitation.

## **Temperature**

Temperature is the primary indicator to determine if the composting process is working properly. A minimum temperature of 130°F shall be reached during the composting process. A temperature of 140°F is optimum; however, temperatures may range up to 160° F. If the minimum temperature is not reached, the resulting compost shall be incorporated immediately after land application or recomposted by turning and adding moisture as needed. Compost managed at the required temperatures will favor destruction of any pathogens and weed seeds.

A good carcass compost should heat up to the 110 – 150°F range within a few days. Failure of the compost material to heat up properly normally results from two causes. First, the nitrogen source is inadequate (example - wet or leached litter). A pound of commercial fertilizer spread over a carcass layer will usually solve this problem. Secondly, composting fails when too much water has been added and the compost pile becomes anaerobic. An anaerobic compost bin is characterized by temperatures less than 120°F, offensive odors, and black, oozing compound flowing from the bottom of the compost bin.



**Figure 5. Typical thermometer for monitoring compost.**

It is possible, though unlikely, for the temperature to rise above the normal range and create conditions suitable for spontaneous combustion. If temperature rises above 170°F, the material should be removed from the bin and cooled. If temperature falls significantly during the composting period and odors develop, or if material does not reach operating temperature, investigate piles for moisture content, porosity, and thoroughness of mixing. Figure 5 shows a typical thermometer for monitoring compost.

## **Land Application of the Compost**

Land application of compost shall be based upon the compost and soil analysis, as well as crop nutrient requirements (based on crop yield). The compost should be applied to the land at recommended agronomic rates. The compost should be analyzed to determine the nutrient content.

## **Water Quality Considerations**

Composting of waste organic materials should improve water quality by eliminating alternative methods of disposal which could pollute ground and surface water. Soil amended with compost will have an increased available moisture content, which will result in some additional storage of water in the soil profile resulting in less leaching. The

compost material must be properly managed to prevent movement of soluble substances and of items attached to solids carried by water runoff. Caution must be taken to prevent spreading compost near surface waters because high organic matter content and an increase nutrient loading could cause eutrophication of the water bodies.

## **Odor Considerations**

The most effective odor control is the use of adequate cover of sawdust as a biofilter as previously described.

When mixing materials, select carbonaceous material that, when blended with the nitrogenous material, will result in the desired pH. The blended material should have a pH at or slightly below neutral for best odor control. Where odors do not present a problem, pH of 8 to 9 is acceptable, but strong ammonia and amine related odors will be present for up to the first 2 weeks.

Another method of minimizing odor is to design a mix that results in desired C:N ratios as given above. When the C:N ratio is very low, 10:1 or less, a loss of nitrogen generally occurs through rapid decomposition and volatilization of ammonia.

## **Management**

The composting process must be managed properly in order to achieve good results. It is a biological process that can have excellent results or can be a catastrophe. Temperature is the primary indicator that the process is working. If adequate temperatures are not achieved the process must be evaluated to correct the problem.

Loading the composter with the correct materials at the proper ratios is critical. The addition of water is the most crucial. Inadequate water will slow the process, while too much water will fill the pore space and will not allow air to permeate throughout the pile, resulting in an anaerobic condition. Odor is generally a good indicator of anaerobic conditions.

Other troubleshooting methods are to 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.

## **Biosecurity.**

Anyone working on or about an animal production facility shall follow biosecurity techniques to prevent the spread of diseases. If possible, entry into poultry houses or other animal production facilities should be avoided. However, if entry is necessary, the farm operator's permission is required.

In order for proper pathogen kill to occur in the composting process, it is necessary to maintain a temperature of 135 degrees F for a minimum of three days within the active composting area. Other than testing, monitoring temperatures is a good indicator of pathogen kill.



Source: Bonhotal et. al., 2002

Animals showing signs of a neurological disease must be reported to authorities and disposed of in the manner they recommend. It is not clear whether prions, the agent that causes Bovine Spongiform Encephalitis (Mad Cow Disease) would be destroyed in the composting process. Animals that show signs of a neurological disease should not be composted. Quarantined animals that die should not be composted. (Bonhotal, et. al. 2002.)

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## DEAD ANIMAL DISPOSAL - INCINERATION

Managing dead animals in livestock and poultry growing situations is continually a greater challenge. Today's environmental climate calls for proper and environmentally sound methods of disposing of dead animals. Incineration is a suitable method to dispose of small animals to prevent pollution and improve environmental quality.

Many farms currently incinerate as the preferred method of dead animal disposal. Incinerators must either be permitted by the South Carolina Health and Environmental Control (SCDHEC), Bureau of Air Quality or qualify for an exemption. Typically, incinerators installed for dead animal disposal qualify for an exemption and do not require a permit. However, if a problem exists SCDHEC may require a permit.

Three criteria must be met in order for a incinerator to qualify for an exemption from an air quality permit.

1. The emission of particulate matter must be less than one pound per hour at the maximum rated capacity.
2. The incinerator must be a package incinerator and have a rated capacity of 500 pounds per hour or smaller, and it must burn virgin fuel only.
3. The incinerator cannot exceed an opacity limit of 10 percent.

### Incinerator Capacity

Incinerator capacity will be based on average daily weight of dead animals anticipated. The following table lists factors to use in determining dead animal weight per day:

Table 1. Daily loss factors for determining incinerator capacity for dead animal disposal.

<u>Type Animal</u>	<u>Daily Loss Factor</u> (lb/day/animal)
Chickens:	
Broilers	0.0024
Laying Hens	0.0015
Breeding Hens	0.0019
Breeder, Male	0.0082
Turkeys:	
Hen	0.0081
Tom	0.0318
Swine:	
Suckling Pigs	0.042 (per sow)

Examples of calculations for determining incinerator capacity required for broilers and small swine.

Example 1:

Capacity of broiler houses: 36,000

Average daily weight of dead birds:

$$36,000 \times 0.0024 = 86.4 \text{ lbs/day}$$

Incinerator capacity:

Minimum 86.4 lbs.

Example 2:

Size of swine unit: 500 sows (total on farm)

Average daily weight of dead suckling pigs:

$$500 \times 0.042 = 21 \text{ lbs/day}$$

Incinerator capacity:

Minimum 21 lbs.

## **Collection of Incinerator By-Product (Ash)**

All incineration disposal of dead animals shall have a plan for collecting and disposing of the ash material remaining after incineration. The plan should include an ash collection box or bucket and disposal of the ash on the land or through a community trash disposal system. If land application is used, allow one-half acre for each 60,000 broilers; 30,000 layers; and 100 sows or hogs.

## **Location of Incinerators**

Wells, springs, or surface water courses shall be protected from any incinerator by-product. An incinerator shall be located at least 20 ft. from any building to prevent spontaneous combustion. The incinerator shall be located on a concrete slab.

Consideration should be given to enclosing the incinerator in a block house structure with a roof or roof protection to extend the life of the unit.

## **OPERATIONS AND MAINTENANCE**

Operation of the incinerator shall be as specified in the owner's manual. Improper loading may result in the production of heavy black smoke and objectionable odor. Operation of the incinerator according to the manufacturer's recommended practice should result in little to no smoke or objectionable odor.

The use of the incinerator to dispose of waste oil, hazardous waste, or any other waste chemical is prohibited. The use of the incinerator will be limited to dead animal disposal only unless otherwise approved by SCDHEC's Bureau of Air Quality.

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For more information on the sizing and selection of incinerators for dead animal disposal contact your local USDA - Natural Resources Conservation Service office or your local Clemson University Cooperative Extension office.