NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

COMPOSTING FACILITY

(No.)

CODE 317

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DEFINITION

This is a treatment component of an agricultural management system for the biological stabilization of organic material.

The contents of this document implement experience factors important to the installation of this practice under the range of conditions found within Texas.

PURPOSES

To reduce the pollution potential of organic agricultural wastes to surface and ground water.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where:

- Organic waste material is generated by agricultural production or processing;
- A composting facility is a component of a planned agricultural waste management system; and,
- A composting facility can be constructed, operated and maintained without polluting air and/or water resources.
- *Does not apply to catastrophic poultry losses associated with atmospheric phenomena such as extremely high or low temperature, high winds, collapse of buildings, etc.*

CRITERIA

General Criteria Applicable To All Purposes

Laws and Regulations. The installation and operation of the composting facility shall comply with all federal, state, and local laws, rules, and regulations.

Permits. The producer will be responsible for securing all the necessary permits to install the required structures and for properly managing the unit on a daily basis.

Safety. Safety and personal protection features and practices shall be incorporated into the facility and its operation as appropriate to minimize the occurrence of equipment hazards and biological agents during the composting process.

Facility Siting. The bottom elevation of the composting facility shall be above the seasonal high water table and on soils with an acceptable permeability that does not allow materials to contaminate the ground water, and meets all applicable regulations, or the facility shall be installed on concrete slabs or other appropriate liners.

Ideally, compost facilities should be located outside of flood plains. However, if site restrictions require location within a floodplain, they shall be protected from inundation or damage from a 25-year flood event, or larger.

Locate compost facilities so prevailing winds and landscape elements such as building arrangement, landforms, and vegetation minimize odors and protect the visual resource.

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Composting Facilities should be located as near as practicable to the source of dead birds. The composting unit may be attached or integrated into the design of a manure dry stack structure.

The composter will not be designed to process bird mortality from other farms.

Direct surface runoff away from the compost facility. Direct contaminated runoff from compost facilities to an appropriate storage or treatment facility for further management.

Compost Mix. Develop a compost mix that encourages aerobic microbial decomposition and avoids nuisance odors.

Carbon-Nitrogen Ratio. The initial compost mix shall result in a Carbon to Nitrogen ratio between 25:1 and 40:1. Compost with a greater carbon to nitrogen ratio can be used if nitrogen immobilization is not a concern.

Carbon Source. A dependable source of carbonaceous material with a high carbon to nitrogen ratio (C: N) shall be stored and available to mix with nitrogen rich waste materials.

Bulking Materials. Add bulking materials to the mix as necessary to enhance aeration.

The bulking material may be the carbonaceous material used in the mix or a non-biodegradable material that is salvaged at the end of the compost period. If a non-biodegradable material is used, provision shall be made for its salvage.

Moisture Level. Provision may be made for maintaining adequate moisture in the compost mix throughout the compost period within the range of 40 to 65 percent (wet basis).

In high precipitation climatic regions, care shall be taken to prevent excess moisture from accumulating in the compost. Facility covers may be required to provide for a suitable product

Temperature of Compost Mix. Manage the compost to attain and then maintain the internal temperature for the duration required to meet management goals.

When the management goal is to reduce pathogens, the compost shall attain a temperature greater than 130°F for at least 5 days as an average throughout the compost mass.

This temperature and time criterion may be achieved during either primary or secondary composting stages or as the cumulative time of greater than 130°F in both stages.

Turning/Aeration. The frequency of turning/aeration shall be appropriate for the composting method used, and to attain the desired amount of moisture removal and temperature control while maintaining aerobic degradation.

Facility Type. Selection of the composting facility/method shall be based on the availability of raw material, the desired quality of final compost, equipment, labor, time, and land available.

Facility structural elements such as permanent bins, concrete slabs, and roofs shall meet the requirements of Conservation Practice Standard 313, Waste Storage Facility.

Facility Size. Size the compost facility to accommodate the amount of raw material planned for active composting plus space required for curing.

Dimensions selected for elements of the compost facility shall accommodate equipment used for loading, unloading, and aeration.

Sizing of facilities for composting dead animals shall be based on normal mortality loss records for the operation. Or, if not available, locally established mortality rates for the type of operation shall be used.

Compost Period. Continue the composting process long enough for the compost mix to reach the stability level where it can be safely stored without undesirable odors. It shall also possess the desired characteristics for its use, such as lack of noxious odor, desired moisture content, level of decomposition of original components and texture. The compost period shall involve primary and secondary composting as required to achieve these characteristics.

Test the finished compost as appropriate to assure that the required stabilization has been reached.

Use of Finished Compost. Land application of finished compost shall be in accordance with

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Conservation Practice Standards 590, Nutrient Management, and 633, Waste Utilization.

Design criteria—Poultry Mortality

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*
Dead Birds	*1.0*	*1.0*
Poultry manure	*2.0*	*1.5*
Straw or Hay	*1.0*	*0.1*
Water	*0.2*	*0.3*

**See Figure 1 for layering details*

Both primary and secondary composting should be operated under roof cover and on a concrete floor. The area provided should be adequate for both stages of composting as well as area for straw and manure materials used in the composting layers. The floor area not under the compost bins may be left as soil if preferred. A water supply should be provided.

Composting Volume: *The total composting volume required for a farm may be estimated by the following formula:*

$$Volume = \frac{B \times M \times W \times VF}{T}$$

Where:

Volume = Volume required for each stage (cu.ft.)

B = Number of birds in flock

M = Mortality rate (percent loss expressed as a decimal)

W = Average market weight of bird in pounds

VF = Volume factor of 2.5 cu.ft./ lb. Of dead birds

T = Flock life, or number of days for animal to reach market weight

This volume formula will be appropriate for broilers, turkeys, layers, Cornish hens, etc. Each stage of the two-stage composting process must have this volume. The total calculated composting volume is divided by the volume of the individual composting bin to determine the number of bins required. A bin is typically 5 feet high, 8 feet wide, and 5 feet deep. However the width should be 2-3-feet wider than the loading and mixing bucket. The bin size for second stage composting should be the same as for the first stage or have area available of equal total volume. The following table provides suggested design factors for various types of birds to determine first stage volume requirements:

Table 1. Poultry data and first stage composter design factors

Poultry Type	*Loss Rate (%)*	*Flock Life (weeks)*	*Cycles Per yr*	*Average market wt. (pounds)*
Broiler	*4.5-5.5*	*6-7*	*5.5-6*	*4.2*
Roaster				
Females	*3*	*6*	*4*	*4.0*
Males	*8*	*10*	*4*	*7.5*
Laying hens	*14*	*60-65*	*0.9*	*4.5*
Breeders				
Hens	*10-12*	*60-65*	*0.9*	*7-8*
-Males	*20-25*	*40-45*	*1.1*	*10-12*
Turkeys				
-Females	*5-6*	*13-14*	*3*	*14*
-Lgt. Tom	*9*	*16-16.5*	*3*	*24*
Feather Production	*12*	*18-18.5*	*2.5*	*28-32*

**Loss rate of mortality based on the entire flock life*

Loading the Primary Composter:
For the primary (first stage) composting, the material is placed in bins in layers according to the following sequence (see Figure 1):

1. *One foot of dry manure should be placed on the floor of the bin. This manure is not part of the recipe.*

2. *A 6-inch layer of loose straw is placed on top of the manure to aid aeration under the carcasses.*

3. *A layer of carcasses is added. Place carcasses 6- inches or more from edge of bin. A 12-inch layer of manure is placed on top of carcasses.*

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4. *Water is added according to the recipe. This completes the first batch.*

5. *The second and each subsequent batch starts with a layer of straw, then a layer of carcasses, then a layer of manure, with each added in accordance with recipe proportions. Finally, the water is sprinkled over the top of each batch according to the recipe proportion. Place boards across front of bin to contain layer material.*

6. *Partial layers for small flocks and/or young birds shall be covered with manure that day with remaining portion of layer continued the next day.*

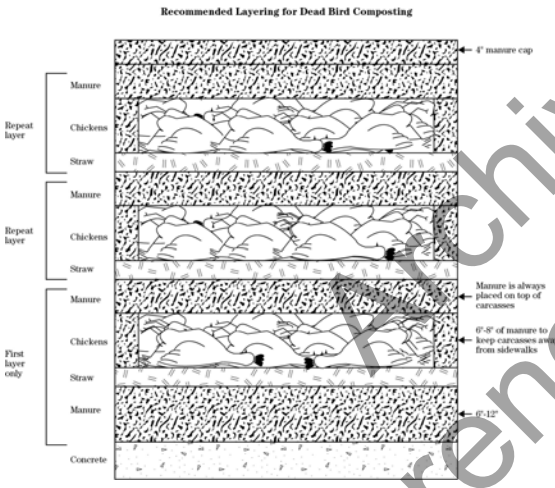

FIGURE 1. CROSS SECTIONAL DRAWING OF COMPOST BIN

Operation of Compost System:

The composting process uses a simple mixture of dry poultry manure, poultry carcasses, wheat straw, and water. (Other carbon sources such as peanut hulls, cottonseed hulls, etc. may be used in place of straw.) The components of the mixture must be added according to the proportions shown in table 2 to ensure proper growth of the bacteria and fungi needed for decomposition. It 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 10-15. This will provide finished compost at 20 days with a C: N ratio of 20-25.

Once the weight of a day's poultry carcasses is determined, the other elements can be weighed out according to Table 2. The elements shou14 be weighed in appropriate containers until volume proportions can be determined and compared with the amounts contained in the bucket the front-end loader. Table 2 provides approximate proportions base on volume.

Ingredients:

Table 2. Recipe of material proportions for composting.

Ingredient	*Volumes*	*Weights*	*C:N Ratio*
Poultry Carcasses	*1.0*	*1.0*	*5*
Manure	*2.0*	*1.5*	*15*
Wheat Straw	*1.0*	*0.1*	*85*
*Water**	*0.2*	*0.3*	*0*

**More or less water may be added to ensure a mixture that is moist but not saturated. Adding the right amount of water may be critical to the success of the operation (about 1.0 gallon per every 30-35 pounds of dead birds) .A hose can be used to deliver the correct amount of water based on time to deliver the needed weight. The moisture content should be maintained at about 20 percent (should not be dusty or stick to shovel). Water shall be added daily with each new layer of dead birds.*

This is a vitally important part of the process, since a mixture that is too wet will not function properly.

Monitoring Temperatures:

A 36-inch probe-type thermometer with rigid protective covering for the probe should be used to monitor temperature within the pile. It may be possible for the temperature to rise above the normal range and create conditions suitable for spontaneous combustion. This can be avoided if (1) temperatures are monitored daily and any unusual extremes are detected early and (2) the pile kept at normal depths that do not create conditions typically found in manure stacks which spontaneously combust. If temperatures exceed the 160 F., the material

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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 of 130° F. are not achieved during the composting process, the resulting compost shall be incorporated immediately after land application.

***Loading the Secondary Composter**:*

Once the temperature peaks and begins to drop in the top layer of the first stage composter, move the entire contents of the bin 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 and mixing. The temperature in the new cell will begin to rise as bacterial activity is renewed and will peak in approximately 7-10 days. The temperature in Stage 2 should be monitored as in the primary stage.

Storinq 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 for 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.

***Land Applyinq the Compost**:*

Land application of compost shall be at recommended agronomic rates in accordance with NRCS Standard and Specifications for Waste Utilization. The nutrient content of the compost is approximated as follows:

Total Nitrogen	Organic Nitrogen	NH_4N	P_2O_5	K_2O
	(#/T compost)			
40	130	10	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 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 the 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 the compost material for land or other application should consider prevailing winds, neighboring dwellings, and visual effects.

Since dead bird compost is relatively moist as compared to dry broiler litter, care is needed in selecting land application equipment suitable for both dry litter and compost. Application equipment must be calibrated frequently to avoid over application.

CONSIDERATIONS

Develop an initial compost mix with a Carbon to Nitrogen ratio of at least 30:1 to reduce most offensive odors.

Minimize odors and nitrogen loss by selecting carbonaceous material that, when blended with the nitrogenous material; provides a balance of nutrients and porous texture for aeration.

Maximize solar warming by aligning piles north to south configured with moderate side slopes.

In humid areas, do not locate piles (windrows) across the slope to prevent ponding and sogginess.

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Protect compost facilities from the wind in cold climates. Wind protection may help prevent excess drying of the compost in dry climates.

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

Develop an operation and maintenance plan that is consistent with the purposes of this practice, and the life of the composting facility. Recipe ingredients and sequence that they are layered and mixed shall be given in the plan.

Safety requirements for operation of the composting facility shall be provided.

Manage the compost piles for temperature, odors, moisture, and oxygen, as appropriate. Make adjustments throughout the composting period to insure proper composting processes.

Closely monitor temperatures above 165°F. Take action immediately to cool piles that have reached temperatures above 185°F.

The operation and maintenance plan shall state that composting is a biological process. It requires a combination of art and science for success. Hence, the operation may need to undergo some trial and error in the start-up of a new composting facility

Compost structures should be inspected at least twice each year when the facility is empty. Replace deteriorated wooden parts or hardware. Patch concrete floors and curbs as necessary to assure water tightness. Roof structures should be examined for structural integrity and repaired as needed.

The access road to the composting area should be maintained as an all-weather road for use during adverse weather periods. Areas in the composting structure for storage of straw and manure used in the compost layering should be readily accessible from the access road entrance.

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APPROVAL AND CERTIFICATION

COMPOSTING FACILITY

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PRACTICE STANDARD APPROVED:

/s/ JOHN W. MUELLER	**6/12/02**
State Conservation Engineer	**Date**

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