Natural Resources Conservation Service
Conservation Practice Standard

COMPOSTING FACILITY
(No.)
CODE 317

DEFINITION

A structure or device to contain and facilitate the controlled aerobic decomposition of manure or other organic material by micro-organisms into a biologically stable organic material that is suitable for use as a soil amendment.

PURPOSE

To reduce the pollution potential and improve the handling characteristics of organic waste solids; and produce a soil amendment that adds organic matter and beneficial organisms, provides slow-release plant-available nutrients, and improves soil condition.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where: (1) organic waste material is generated by agricultural production or processing; (2) a composting facility is a component of a planned waste management system; (3) a facility can be constructed, operated and maintained without polluting air and/or water resources; and, (4) the compost can be applied to the land or marketed to the public.

CRITERIA

Laws and regulations. All federal, state, and local laws, rules and regulations shall be adhered to strictly. The operator will be responsible for securing the necessary permits to install the required structures and for properly managing the unit on a daily basis.

Safety. Incorporate safety and personal protection features and practices into the facility and its operation as appropriate to minimize the occurrence of equipment and biosecurity hazards during the composting process.

Facility Siting. Locate composting facilities on soils having low permeability or on concrete/liner material that will minimize seepage of dissolved substances into the soil profile and movement toward groundwater. The floor of the composting facility shall be at least two feet above the seasonal high water table.

The facility should not be located on a flood plain unless protected from inundation or damage from a 25-year flood event.

Divert all surface runoff from outside drainage areas away from the compost facility. Direct contaminated runoff from the composting operation to an appropriate storage or treatment facility for further management.

Locate composting operations 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.

A poultry composting facility shall be located at least 150 feet from the property line and at least 600 feet from the nearest un-owned occupied dwelling. A swine composting facility shall be located at least 300 feet from the property line and at least 1,000 feet from the nearest un-owned occupied dwelling.

The composting facility should be located as near to the waste source as practical.

Locate so that water is available to the facility during dry periods to ensure proper moisture and acceptable curing times to meet the management goals.

Facility Type. The two main types of composting operations covered in this standard are static pile/bin composter and rotary drum. Select the type of composting facility based on availability of raw materials, equipment, labor, time, and land available.

For facilities that are organic producers or that sell compost to organic producers, ensure that the treated lumber used in the stacking facility meets the requirements for organic production. It may be best to have the producer consult with

the State Department of Agriculture and Commerce or designated organic certifier as to the use and acceptability of treated lumber for litter and compost storage.

Facility Size. Where poultry, swine, and other small farm animals are composted, establish the size of the composter units on the basis of locally determined animal loss rates. Composting facilities for the purpose of processing animal carcasses are to include a primary composting unit. A secondary composting unit is often necessary to complete the composting process.

a. Composting volume. The total composting volume required for a poultry operation may be estimated by the following formula:

$$\text{Volume (cu. ft.)} = \frac{\text{No. birds in flock} \times W_b \times M}{\text{flock life (days)}}$$

W_b = average market weight of bird (pounds)

M = mortality rate (% loss expressed as decimal)

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.

b. Mortality rate. 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, 10 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 animals to determine first stage volume requirements:

Table 1: First Stage Composter Design Factors

Animal Type	Loss Rate %	Flock Life (wks)	Cycles Per Year	Average Market Weight (lbs)
Broiler	5	6-7	5.5-6	5-7
Pullets	4	20-25	2	6.0
Laying Hens	14	60-65	0.9	4.5
Breeders	12	40-45	1.1	8-10
Swine Nursery	4	--	--	32
Sow Herd	3	--	--	375
Finishing Hog	3	--	--	150

Facility Operation.

Moisture. The moisture content of the blended material at start-up of the composting process should be approximately 60 percent (wet weight basis) and maintained between 40 and 60 percent during the composting process. The composting process may become inhibited when moisture falls below approximately 40 percent. Water used for moisture control must be free of harmful substances. Do not over water or compact compost mix to avoid high temperatures and possible combustion.

Composting period. The time needed for completion of the 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. Visual inspection and temperature measurements will provide needed evaluation of compost status.

Storage. Provide properly designed storage facilities sized for the appropriate storage period. Protect composted material from the weather (wind and rain) by roofs or other suitable covers. Storage of the compost mix should not exceed a height of 6 feet to reduce compaction and potential for spontaneous combustion. Structures must meet the requirements of NRCS Conservation Practice Standard 313-Waste Storage Facility.

Primary composting must be operated under roof cover and on a concrete floor. The floor

area not under the primary compost bins may be left as soil.

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 should be between 25:1 and 40:1. Use of the higher range of C:N for organic materials that decompose at a high rate (or are highly unstable) will risk associated high odor production.

Where more than two ingredients are to be blended, the two main ingredients are to be used in the analysis for the desired C:N and mixed accordingly. Adding up to 50 percent by weight of other ingredients to improve workability and air movement is permissible as long as the C:N of the added ingredient does not exceed the target C:N of the compost.

Odor. Select carbonaceous material that, when blended with the nitrogenous material, provides a balance of nutrients and porous texture for aeration. 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. However, strong ammonia and amine related odors will be present for up to the first 2 weeks.

ADDITIONAL CRITERIA FOR ROTARY DRUM COMPOSTING

The number of portable units required is determined by the product of mortality rate x average market weight of bird x number of birds in flock, divided by the capacity of the drum.

The following relationship is to be used as the **limiting factor** in the determination of the required number of rotary drum composting units:

$$\frac{M \times W_b \times \text{No. of birds in flock}}{\text{Total Capacity of Drum}} \leq \textbf{16 lbs/gal per unit}$$

M = mortality rate (% loss expressed as a decimal)

W_b = average market weight of birds in pounds

Capacity of Drum = 1700 gallons

Deviation from 16 lbs/gal per unit requires the approval of the State Agricultural Engineer.

The owner or operator shall be responsible for adhering to the procedures stated in the Operating and Composting Manual provided by the manufacturer. The drum should not be filled above approximately 75% of its total capacity in order to insure achieving a thorough or complete mixing of the content when the drum is rotated. The moisture content should be visually inspected daily. The temperature of the compost should be monitored daily during the composting period. Appropriate steps should be taken as needed to maintain the moisture content and temperature at the required levels.
Location of the portable unit with respect to property lines, dwellings, and water sources shall be in compliance with distances established for a conventional composting facility.

The owner or operator shall follow the maintenance instructions provided by the manufacturer in order to maintain the unit in good mechanical condition.

When using a compost recipe that consists of pine shaving or sawdust, a laboratory analysis of the nutrient content of the compost is recommended but not required prior to land application. Results of a laboratory analysis of compost produced using sawdust are shown in Table 1. These values are acceptable for use in the determination of land application rates.

Table 1 Nutrient Content of Compost (% by weight)

Nitrogen	1.1%
Available P_2O_5	0.8%
Potash (K_2O)	0.4%

Source: Laboratory analysis of composted material by Mississippi State Chemical Laboratory Analysis #22,568.

When materials other than sawdust or pine shavings are used in the compost recipe, a laboratory analysis is required prior to land application.

Use of Finished Compost. Land application of finished compost shall be in accordance with NRCS Conservation Practice Standard 590-Nutrient Management.

CONSIDERATIONS

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

A chemical neutralizing or other additive agent should be used if structural components do not provide adequate odor reduction.

ADDITIONAL CONSIDERATIONS FOR ROTARY DRUM COMPOSTING

1. Consideration should be given to protecting the compost within the unit from excess moisture during rainfall by providing some form of cover for the unit.

2. Consideration should be given to the type and availability of material to be used (sawdust, pine straw, poultry litter, etc.) in the composting recipe.

3. Consideration should be given to methods to be used to uniformly distribute the compost during land application.

PLANS AND SPECIFICATIONS

Prepare plans and specifications in accordance with the criteria of this standard and describe the requirements for applying the practice to achieve its intended use, including:

- Layout and location of livestock facilities, waste collection points, and/or waste transfer
- Size, type and number of animals or other sources of organic feedstock
- Grading plan showing excavation, fill, and drainage, as appropriate
- Size and capacity needed
- Design requirements and drawings
- Safety requirement for operation

Specifications for construction and installation of a composting facility shall use or be in conformance with requirements of the attached "Construction Specifications." Any variation from these specifications shall be approved by the area engineer.

OPERATION AND MAINTENANCE

Temperature. For best results, operating temperature of the composting material should be 130º F to 170º F once the process has begun. It should reach operating temperature within about 7 days and remain elevated for up to 14 days to facilitate efficient composting. The material should remain at or above 110º F for the remainder of the designated composting period. A 36-inch probe-type thermometer with rigid protective covering for the probe shall be used to monitor temperature within the pile. Closely monitor temperatures above 165^{o}F. Take action immediately to cool piles that have reached temperatures above 185^{o}F.

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. Compost managed at the required temperatures will favor destruction of any pathogens and weed seeds.

Aeration. Heat generated by the process causes piles 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.

Nutrients. Keep compost well aerated to minimize nitrogen loss by denitrification. Keep pH at neutral or slightly lower to avoid 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. Land application of compost shall be at recommended agronomic rates in accordance with Nutrient Management (590). Generally poultry is composted using poultry litter and swine is composted using saw dust. The nutrient content of this compost is approximated as follows:

Type	Total Nitrogen	P	K
	(Pounds per ton of compost)		
Poultry	40	20	25
Swine	20	0.9	5

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.

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. Make provision for the salvage of any non-biodegradable material used in the composting process.

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. Composted materials that are prepared for the retail market will require testing for labeling purposes.

Compost recipe. 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 for composting operations should be used:

Materials	By Volume	By Weight
Dead birds	1.0	1.0
Poultry litter	2.0	1.5
Dead swine	1.0	1.0
Saw dust	5.0	1.6

Loading the primary composter. For the primary (first stage) composting, the material is placed in bins in layers according to the following sequence:

a. One foot of dry litter or saw dust should be placed on the floor of the bin.

b. A layer of carcasses is added. Place carcasses 6-12-inches from edge of bin. A 12-inch layer of litter or saw dust is placed on top of carcasses.

c. Water is added if needed.

d. The second and each subsequent layer starts with an increment of carcasses, then an increment of litter or saw dust, with each added in accordance with recipe proportions. Place boards across front of bin to contain layer material.

e. Partial layers for small animals shall be covered with litter or saw dust that day with remaining portion of layer continued the next day.

Monitoring. The operation and maintenance plan shall state that composting is a biological process that needs monitoring and management throughout the composting period to insure proper composting processes. The operation may need to undergo some trial and error in the start-up of a new composting facility. Manage the compost piles for temperature, odors, moisture, and oxygen, as appropriate. Test the finished compost as appropriate to assure that the required decomposition has been reached.

Maintaining the Structures. The compost structure should be inspected at least twice each year when the facility is empty. Deteriorated wooden parts or hardware should be replaced. Concrete floors and curbs should be patched as necessary to assure water tightness. Roof structures should be examined for structural integrity and repaired as needed.

Access road to the composting area should be maintained as an all-weather road for use during adverse weather periods. Road should be free of potholes, crowned in the middle, and have drainage provided on each edge. Areas in the composting structure for storage of litter or sawdust used in the compost layering should be readily accessible from the access road entrance.

REFERENCES

USDA, NRCS. 2000. National Engineering Handbook, Part 637, Chapter 2, Composting. Washington, D.C.

NRCS Conservation Practice Standards:

313 – Waste Storage Facility

590 – Nutrient Management

342 – Critical Area Planting

Natural Resources Conservation Service
Construction Specifications

COMPOSTING FACILITY

1. SCOPE

Work shall consist of constructing the composting facility and include site preparation, concrete, water line, and building material to the location and elevations shown on the drawings or as staked in the field.

2. SITE PREPARATION

The building site shall be cleared to the extent needed. All logs, stumps roots, sod, and other material shall be removed from area within six (6) feet of the concrete floor.

The area shall be shaped, graded, and filled, if necessary, to provide a slope away from building for drainage. Any fill material used shall be free from all sod, roots, frozen soil, stones over 6 inches in diameter, and other objectionable material. Fill material shall be compacted with at least one pass of construction equipment over entire surface of each layer placed. Layers should be less than 9 inches thick.

3. CONCRETE

Design mix. The concrete mixture shall be no less than five bags per yard mix. The water content shall not exceed 6 gallons per bag of cement. Any mix selected shall have a designed minimum 28 day compressive strength of 3,000 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.

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 fiber, 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.

4. STEEL REINFORCEMENT

Reinforcement steel and welded wire fabric shall be new, clean, and free of oil, grease, paints, and flaky rust. Steel bars for concrete reinforcement shall be deformed billet-steel bars, conforming to ASTM Specification A-615, Grade 40 to 60. Welded wire fabric shall conform to the requirements of ASTM Specification A-185.

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 or pieces of blocks, wire stands, or other approved method prior to the placing of concrete. Scotches of stones, wood materials, earth, earth clods, clay bricks, scrap metal and other unapproved materials are not acceptable. 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.

5. WOOD AND TIMBER

All material shall be full section sound wood, free from decay, and of new quality. All timber beams shall be dense, structural quality, and graded in accordance with the Standard Grading Rules for Southern Pine Lumber.

All structural timber, posts, poles and lumber, except roof girders, rafters, purlins, trusses, knee braces, and attic bracing shall be pressure treated. Treated timber and lumber shall be impregnated with the specified type and quantity of preservative and conform to Federal Specification TT-W-571. The minimum net retention of the common

preservative, chromated copper arsenate, shall be 0.4 lbs/cf (pcf) for dimension lumber used above ground and 0.6 pcf for structural posts or timbers in contact with the ground. Posts or timbers encased in concrete should not be considered in contact with the ground.

Roof truss design and support shall be in accordance with local government codes and follow manufacturer's standard dimensions. Roof truss shall be securely attached to the support posts.

Posts and poles shall be set plumb and to the depths shown on the drawings. Backfill around post/poles shall be concrete as shown on the drawings or shall be hand tamped earth if allowed on the drawings. Posts/poles shall be temporarily braced until girders, plates or other members are installed to maintain plumb alignment.

6. VEGETATION

A protective cover of vegetation shall be established on all exposed surfaces of fills, borrow areas, or other disturbed areas. Newly vegetated areas shall be fenced where necessary to protect the vegetations. The establishment of vegetation shall be in accordance with Conservation Practice Standard 342 - Critical Area Planting.

7. CONSTRUCTION DETAILS

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