NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTIVE STANDARD

COMPOSTING FACILITY

(No.)
CODE 317

DEFINITION

A facility to process raw manure or other raw organic by-products into biologically stable organic material.

PURPOSE

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;
- A composting facility can be constructed, operated and maintained without polluting air and/or water resources;
- There is a need to improve air quality by reducing the emissions of odorous gases; and,
- The facility is operated as a component of an agricultural management system.

GENERAL CRITERIA

References - All references herein to FOTG Standards are in reference to NRCS Louisiana Conservation Practice Standards.

Federal, State, and Local laws - All state and local laws, rules and regulations concerning composting shall be adhered to. The producer shall be responsible for securing any necessary permits to install 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.

Location - Composting facilities shall be located as near the source as practical, with consideration of neighboring dwellings, prevailing winds and ultimate disposal of the compost to minimize the impact of odors. Buffer areas, vegetative screens, and natural landscape features can be used to minimize the effects of odors. The facility shall be placed a minimum of 100 feet from wells, springs, streams, and ponds, and no closer to dwellings than any of the production units or 300 feet, whichever is closer.

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. Runoff from outside drainage areas shall be diverted away from the facility. The composting facility shall be located outside natural drainage ways and above the floodplain unless protected from inundation or damage from a 25-year frequency flood event.

Types - Four types of composting operations are covered in this standard—aerated windrows, static piles, in-vessel, and rotary drum. Aerated windrows are more suited to large volumes of organic material that are managed by power equipment used to turn the composting material periodically. Periodic turning re-aerates the windrows, promoting the composting process.

Organic material in static piles is initially mixed to a homogeneous condition and not turned again throughout the composting process.

Static pile material must have the proper moisture content and bulk density to facilitate the composting process.

In-vessel composting in a totally enclosed structure is carried out on a blended organic material under conditions where temperature and air flow are strictly controlled. In-vessel composting also includes naturally aerated processes where organic materials are layered in the vessel in a specified sequence. Layered, in-vessel materials are usually turned once to facilitate the process. Vessel dimensions must be consistent with equipment to be used for management of compost. The use of commercially supplied composters must be warranted for the intended life of the structure.

Rotary drum composting can be a portable or stationary system. On initial start-up, the unit is filled to one-fourth capacity with pine shavings, pine sawdust, or other carbonaceous materials. Dead birds are added and the drum rotated until the contents are thoroughly mixed. To maintain the moisture content at the desired level, shaving or sawdust is added as needed.

Rotation of the drum aids in aeration of the material and facilitates the composting process. After the composting process is completed, the finished product can be land applied directly from the composting unit.

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.

DESIGN CRITERIA

Soils - Locate composting facilities on soils having slow to moderate permeability to minimize seepage of dissolved substances into the soil profile and movement toward groundwater. Evaluate site paving needs in terms of effects of equipment operation on trafficability, soil compaction, and potential for contamination from compost and petrol products.

Runoff - Divert surface runoff from outside drainage areas around the compost facility. Collect runoff from the compost facility and utilize or dispose of it properly. Evaluate the effects of changed infiltration conditions on groundwater recharge, and evaluate changes in volumes and rates of runoff

caused by the location of the operation. Properly manage movement of organic material, soluble substances, and substances attached to solids carried by runoff.

Materials - Material and structural design of in-vessel facilities and drum composting units shall conform to the requirements of FOTG Standard 313, Waste Storage Facility. Details of material requirements must be determined by the engineer on a case by case basis. In-vessel and drum composters can vary considerably and perform well; however, all must have certain common features:

A. Roof:
All composters must be protected from precipitation by a roof.

B. Concrete Floor:
All composting shall be performed over concrete floor. This is critical to all-weather operations and prevents contamination of the surrounding area. All bins of the two stage type and mini composters shall be underlain by a concrete slab; however the litter storage areas may be placed on compacted earth. Commercially supplied compost units shall be placed over a minimum 4 inch thick concrete slab. The slab shall extend a minimum of 4 feet past the front and back and sides of the unit.

C. Deterioration-Resistant Materials:
Pressure-treated lumber shall be used in composter construction. All fasteners shall be galvanized or stainless steel. Commercially supplied units shall utilize polyethylene mesh or other similar corrosion resistant materials.
Rotary drum composters will be constructed of carbon steel materials and protected from corrosion with coatings as recommended by the manufacturer.

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 the higher range of C:N for organic materials that decompose at a high rate (or are highly unstable) with 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, 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 two (2) weeks. A chemical neutralizing agent should be used if structural components do not provide adequate odor reduction.

Facility Size - Where 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 into which alternate layers of low moisture content manure (unusual poultry manure), carbon source material (straw is common), and dead animal carcasses are placed. A secondary composting unit is often necessary to complete the composting process.

Composting sizing shall be based on requirements found in the Agricultural Waste Management Field Handbook, Chapter 10.

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. 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 deleterious substances.

Pile Configuration - Compost piles for windrowed and static piles shall be triangular to parabolic in cross-sectional form with a base width to height ratio about 2 to 1. Increased surface area favorably affects evaporation and natural aeration and increases the area exposed to infiltration from precipitation in uncovered stacks. Aligning piles north to south and maintaining moderate side slopes maximizes solar warming. Windrows shall be aligned to avoid accumulation of precipitation.

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. Stability can be obtained in about 21-28 days but can require up to 60 days to produce the desired quality. Longer periods may be required when composting large animals such as sows or boars. Visual inspection and temperature measurements will provide needed evaluation of compost status.

Storage - Although the compost can be directly land applied after the composting process is complete, it is recommended that the material be stored under cover and be allowed to cure for at least 30 days. During this process, the compost can dry further, allowing greater ease in spreading. The material in dry storage shall not be piled higher than 7 feet to reduce potential for spontaneous combustion. In addition, it shall not come in contact with any litter stored in the same facility.

ADDITIONAL CRITERIA FOR ROTARY DRUM COMPOSTING

Design - The number of portable or stationary 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

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

Process - Rotary drum composting uses a drum partially filled with composting material that can be rotated by mechanical means. As organic material is added to the drum, the drum is rotated to mix the new ingredients and add oxygen to the existing ingredients. This results in a faster composting process than with other methods. Due to the short cycle time required when used for production poultry, it is critical that the compost mix be managed for optimum temperatures. This may require keeping a pile of material "hot" for use in the drum. This may be done by mixing various carbonaceous and bulking materials at the proper moisture in a pile outside the drum so that it preheats to 130^{o} F or more before being added to the drum composter.

Operation - The rotary drum composter shall be operated in accordance with the manufacturer's instructions. On initial start-up, the drum is filled to one-fourth capacity with carbonaceous material. Mortalities and an approximately equal volume of carbonaceous material are added and the drum rotated until the contents are thoroughly mixed. The drum should not be filled above approximately 75% of its total capacity in order to ensure 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. For best results, temperatures inside a rotary drum composter should be maintained above 130^{o} F during the composting process.

Location - The location of the drum composting unit with respect to property lines, dwellings, and water sources shall be in compliance with distances established for a conventional composting facility previously stated in this standard.

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

Safety - Features such as motor guards, lock out switches, etc., shall be provided with drum composters, as appropriate, to maximize operator personal safety, and to minimize the occurrence of equipment hazards.

CONSIDERATIONS

Carbon Source - A dependable source of carbonaceous material should be available. The material should have a high carbon 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 sources of carbon. Two materials may have the same carbon to nitrogen ratio (C:N) but may vary significantly in "readily available" carbon. Rice hulls are an excellent source of readily available carbon while most straw sources are not. Chopped wheat straw is minimally acceptable while most straw hay and prairie hay do not give satisfactory results.

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 composting 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 screening, 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 implementing process. Poultry composters typically require 15-35 minutes of labor per day. Swine mortality is more infrequent but will require 30-60 minutes to initiate processing of a large animal.

Economics - Benefits associated with the ultimate use of the composted material should be compared to the capital expenditure and operating cost 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.

ADDITIONAL CONSIDERATIONS FOR ROTARY DRUM COMPOSTING

- 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.

- Consideration should be given to the equipment required to operate the portable unit during spreading (land application) of the compost.

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

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

- Consideration should be given to provisions for handling mortality in the event there are problems with the drum composter unit.

PLANS AND SPECIFICATIONS

Plans and specifications for composting facilities shall be in keeping with this and other referenced standards. They shall describe all the requirements for applying the practices to achieve its intended purposes and shall include a written operation and maintenance plan for the composting component of the comprehensive waste management plan.

OPERATION AND MAINTENANCE

Commercially Supplied Composters - The manufacturer of the composter shall supply to the producer a written operation and maintenance plan which shall be followed. The units should as a minimum be completely cleaned out and the compost process be restarted at least biannually. Also the regular addition of fresh litter to the composting unit is essential for successful management.

Structure Maintenance - The compost structure, wooden bins and rotary drum should be inspected at least twice each year when the facility is empty. Replace deteriorated 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. Rotary drum composter shall be maintained in accordance with the manufacturer's recommendations.

Temperature - Good carcass compost should heat up to the 140° F range within a few days. Failure of the compost material to heat 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, the compost 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 a black oozing compound flowing from the bottom of the compost bin.

For best results, operating temperature of the composting material should be 130° F to 170° 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 110° F for the remainder of the designated composting period.

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, nitrogen content of litter, and thoroughness of mixing. Compost managed at the required temperatures will favor destruction of any pathogens and weed seeds. A dry cover layer of 4" to 6" is needed to provide insulation to maintain adequate temperature within the compost pile.

Closely monitor temperatures above 165^{o} F. Take immediate action to cool compost mixes that have reached temperatures above 185^{o} F.

Moisture - Proper moisture content is critical in the composting process and varies greatly with the product being composted. Minor amounts of initial moisture are important in initiating the process. However, the number one source of failure in aerobic carcass composting is too much moisture either from excess application by the operator or failure to exclude outside rainfall. Learning to control moisture is a trial and error process. For poultry, a good rule of thumb for moisture is to spray the carcasses with a light mist roughly equivalent to autumn morning dew. Further addition of water is almost never needed in poultry composting. The composting of large swine carcasses requires a larger quantity of water to initiate the process. This is due in part because it takes a longer period of time before by-product water is released by the swine carcass. Initial moisture application for swine varies from 0.03 to 0.08 gallons of water per pound of carcass depending on carcass size. A 350 pound sow requiring approximately 0.06 gallons of water per pound of carcass would require an initial addition of 21 gallons of water.

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. Periodically turning the pile and maintaining proper moisture levels for windrows and static piles will normally provide adequate aeration.

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. Include compost nutrients in nutrient management of nutrients on the quality of surface water and ground water 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 and to determine the available nitrogen (N), phosphorus (P), and potassium (K) content. Composted materials that are prepared for the retail market will require testing for labeling purposes.

Land Application - Land application of compost shall be in accordance with FOTG Standard 633, Waste Utilization, Exhibit 2, Agricultural Waste Land Applications Guidelines and FOTG Standard 590, Nutrient Management. Compost should be applied to the land at recommended agronomic rates. The nutrient requirements for any particular crop should be based on a current soil test.

REFERENCES

NEH, Part 651, Agricultural Waste Management Field Handbook, Chapter 10
NRCS Louisiana Conservation Practice Standards
Nutrient Management – Code 590
Waste Storage Facility – Code 313
Waste Utilization – Code 633