NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE 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.

The material for composting may include livestock and poultry manure, dead animal carcasses, and food processing wastes where food is processed as part of normal farming operation.

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,
- Animal mortality management is a component of an agricultural management system.
- Municipal sludge, solid waste, and other non-farm type wastes are not included in this standard.

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.

The owner or operator shall be responsible for securing all required permits or approvals related to composting, and for operating and maintaining any components in accordance with applicable laws and regulations.

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. Locate composting facilities as near to the source as practical where prevailing winds, vegetative screening, buffer areas, natural landscape features, and building arrangements minimize odor and visual resource problems. Consideration shall be given to the effect on soil, plant, animal, air and water resources.

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 all weather trafficability, soil compaction and potential for contamination from compost and petroleum 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.

Ideally, compost facilities should be located outside of floodplains. However, if site restrictions require location within a floodplain, they shall be protected from inundation or damage from a 100-year frequency flood event, or larger.

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.

See National Engineering Handbook, Part 651 Agricultural Waste Management Field Handbook, Chapter 10 for design of each type of facility.

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 & Storage. 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. Additional information is available in Conservation Practice Standard 316, Animal Mortality Facility and Chapter 10, AWMFH.

Composting Method. Four types of composting operations are covered in this standard; windrows, static or aerated piles, in-vessel, and bin composting. 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 homogenous condition and not turned again throughout the composting process. Static pile material must have the proper moisture content and bulk density to facilitate air movement throughout the pile. Forced air (aerated static pile) might be necessary 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 specific sequence. Layered, in-vessel materials are usually turned once to facilitate the process. Vessel dimensions must be consistent with equipment to be used for the management of compost.

Composting bins may be used for both large and small volumes of organic waste, including animal mortalities.

Compost Mixes. Develop a compost mix (carbonaceous and nitrogenous materials) that encourages aerobic microbial decomposition (under specific moisture and temperature conditions) for a specified time and avoids nuisance odors and avoid attracting vectors (flies, rodents, and other small animals).

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 initial compost mix shall result in a carbon to nitrogen (C:N) ratio 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 or if nitrogen immobilization is not a concern.

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.

Nutrients & Odors 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 and nitrogen loss by ammoniafication. 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. Keeping the compost well aerated will also minimize nitrogen loss by denitrification. Phosphorus losses will be minimized when the composting process is managed according to the requirements of this standard. Determine the effects of use and management of nutrients on the quality of surface water and ground water as related to human and livestock consumption.

Carbon Source. A dependable source of carbonaceous material with a high C:N ratio shall be stored and available to mix with nitrogen rich waste materials. Wood chips, sawdust, peanut hulls, straw, corncobs, bark, peat moss, and well-bedded horse manure are good sources of carbon

Bulking Materials. Add bulking materials to the mix as necessary to enhance aeration. Piles that are too compact will inhibit the composting process.

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 Control. The moisture content of the blended material at start-up of the composting process should be approximately 60 percent (wet weight basis). 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). The composting process may become inhibited when the moisture content falls below approximately 40 percent. Proper moisture control facilitates the composting process and helps control odors.

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.

For the best results, operating temperature of the composting material should be 120ºF to 150ºF once the process has begun. It should reach operating temperature within 2-7 days and remain elevated for up to 14 days (above 130ºF) to facilitate efficient composting and pathogen removal. The material should remain at or above 105ºF for the remainder of the designated composting period.

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

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 pathogens and reduce the viability of weed seeds.

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. Materials selected for the composting mix should provide for adequate air movement throughout the composting process.

Pile Configuration. Compost piles for windrowed and static piles should be triangular to parabolic in cross-sectional form with a base width to height ratio of 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. Windrows should be aligned to avoid accumulation of precipitation.

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. Acceptable stability occurs when microbial activity diminishes to a low level. This stability can be obtained in 21-28 days but can require up to 60 days to produce the desired qualities. Composting of large carcasses may require 6 months or longer. Visual inspection and temperature measurements will provide needed evaluation of compost status. The compost period shall involve primary and secondary composting as required to achieve these characteristics.

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.

Use of Finished Compost. Land application of finished compost shall be in accordance with Nutrient Management (590) and Waste Utilization (633).

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.

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

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.

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

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.

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.

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

PLANS AND SPECIFICATIONS

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

The following list of Construction Specifications is intended as a guide to selecting the appropriate specifications for a specific project. The list includes most but may not contain all of the specifications that are needed for a specific project:

IA-1 Site Preparation
IA-3 Structural Removal
IA-5 Pollution Control
IA-6 Seeding and Mulching for Protective Cover
IA-11 Removal of Water
IA-21 Excavation
IA-23 Earthfill
IA-24 Drainfill
IA-26 Salvaging and Spreading Topsoil
IA-27 Diversions
IA-31 Concrete
IA-32 Concrete for Nonstructural Slabs
IA-45 Plastic (PVC, PE) Pipe
IA-81 Metal Fabrication and Installation
IA-83 Timber Fabrication and Installation
IA-92 Fences

OPERATION AND MAINTENANCE

The landowner/operator shall be provided a written operation and maintenance (O&M) plan for the composting component of the waste management system that is consistent with the purposes of this practice and the life of the composting facility. The O&M plan shall be developed with full understanding and input of owner-operator.

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^{o}F. Take action immediately to cool piles that have reached temperatures above 185^{o}F.

The O&M 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.

REFERENCES

National Engineering Handbook, Part 651 Agricultural Waste Management Field Handbook, Chapter 10.

Northeast Regional Agricultural Engineering Service, Cooperative Extension "On-Farm Composting Handbook", NRAES-54.