NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD
RHODE ISLAND

COMPOSTING FACILITY

(No.)

CODE 317

DEFINITION

This is a treatment component of an agricultural waste management system or comprehensive nutrient management plan (CNMP) for the biological stabilization of organic material.

PURPOSES

To produce a biologically stabilized humus-like material using organic wastes from agricultural operations in a manner that reduces the risk of pollution of surface and ground water.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where:

- Organic waste material is generated by agricultural production or processing;
- Composting is needed to manage and utilize the waste organic material in an environmentally sound manner
- A composting facility is a component of a planned agricultural waste management system or CNMP;
- An overall agricultural waste management system plan or comprehensive nutrient management plan (CNMP) that accounts for the end use of the composted material has been developed in accordance with NRCS standards and permitted by the responsible state agency and,
- A composting facility can be constructed, operated and maintained without polluting air and/or water resources.

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.

Safety and Biosecurity. 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. Composting site locations shall be selected considering proximity to urban, suburban and rural populations, transportation availability and other infrastructure. Site selections shall also consider groundwater, surface water, soils and geology, topography, landscape screening, wind direction, and other physical conditions.

Soils, Geology, Liners, Leachate Collection and Transfer. Locate composting facilities on soils having very slow to slow permeability (permeability rate less than 1.0 x 10-4 cm/sec.) to minimize infiltration of dissolved substances (leachate) into the groundwater. In the absence of suitable soils, impermeable liners as called for in Rhode Island waste storage facility Standard No. 313 shall be used. In addition, a collection and transfer system may be needed as called for in Rhode Island silage leachate collection and transfer Standard No. 765. Compost pads shall be a minimum of two feet above the seasonal high groundwater table and a minimum of four feet above bedrock unless impervious barriers or liners are installed. All compost facilities shall require analysis of deep (8+) test pits prior to final site approval.

Runoff, Drainage, Flooding. Divert surface runoff from outside drainage areas around the compost facility. Collect runoff from the compost facility and utilize or dispose of it in accordance with the approved operations plan. 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. Minimize the movement of organic material, soluble substances, and substances attached to solids carried by runoff. Compost pads shall be either concrete, soil cement, or compacted well graded gravel or crushed stone, and designed with slopes of 1% or less but not so flat as to cause ponding. If compacted gravel is used as a pad, a top layer of sand may be installed to avoid gravel-sized particles in the final compost product. Surrounding topography shall be 4% or less. If located on a floodplain, the composting facility shall be protected from flooding due to at least a 25- year frequency event. Subsurface drainage may be required to lower groundwater levels upgradient from and under compost pads.

Separation Distances. Locate compost facilities considering prevailing winds and landscape elements such as building arrangement, landforms, and vegetation to minimize odors and protect the visual resources. In addition, the following separation distances apply to compost sites: Residences and businesses – 300 feet; Property line – 200 feet; Surface water body – 250 feet; Private well or spring – 250 feet; public well – 500 feet.

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.

Where animal mortality is 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 bulking agents and / or amendments and dead animal carcasses are placed. A secondary composting unit may be necessary to complete the composting process. Refer to guidance from the Connecticut Department of Environmental Protection or the Rhode Island Department of Environmental Management, the Connecticut Department of Agriculture, the University of Connecticut, Cooperative Extension System, or the University of Rhode Island, Cooperative Extension System.

Pile configuration and row spacing for turning and windrowing machinery may also influence the facility size. A separate area for final compost processing and storage may also be needed.

Facility Types. 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.

Composting operations covered in this standard include aerated windrows, static piles, and in-vessel.

- **Aerated windrows** are suited to large volumes of organic material that are managed by power equipment used to periodically turn the composting material. Periodic turning re-aerates the windrows, promoting the composting process.

- **Static piles** are initially mixed to a homogeneous condition and not turned again throughout the composting process. Static pile material must have proper moisture content and bulk density to facilitate air movement throughout the pile. Forced air may be necessary to facilitate the composting process.

- **In-vessel composting** in an enclosed structure is carried out on blended organic materials under conditions where temperature and airflow 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.

- **Other** types of composting operation processes include the **"Passively Aerated Windrow System" (PAWS)** and the **"Ag Bag"** composting system.

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, pH, and temperature conditions for a specified period of time with oxygen levels that are adequate to support aerobic organisms. Correct proportions of the various compost ingredients are essential to minimize odors and to avoid attracting flies, rodents, birds, and other animals.

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. Aligning piles north to south and maintaining moderate side slopes provides more uniform solar warming. Windrows should be aligned to avoid accumulation of precipitation. Use of geotextiles specifically designed for covering compost piles shall be encouraged.

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

Carbon Source. A dependable source of carbonaceous material must be available. The material should have an appropriate carbon content and high carbon to nitrogen ratio (C:N). Wood chips, sawdust, peanut hulls, straw, corncobs, bark, peat moss, and well-bedded horse manure are good sources of carbon. When selecting a carbon source consider its availability to microbes (i.e., sawdust is more available than bark).

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

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. Correct proportions of ingredients are essential to minimize odors and discourage vectors.

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.

pH. To avoid excessive ammonia losses and to control other odors, the initial pH of the blended materials should be as close to neutral as possible, but no higher than 8.5. Where odors do not present a problem, pH may be as high as 9.0. Adding extra carbon sources may lower pH and adding lime may raise pH. At the end of the composting process, pH should be near neutral or 7.0.

Bulking Materials. Bulking materials may be added to enhance airflow within the composting material. Piles that are too large or compact will inhibit the composting process. Some carbonaceous materials such as wood chips and bark can be used as bulking agents. Where it is desirable to salvage carbonaceous material, provisions for removing the material, such as screening, shall be made. Bulking materials may also be non-biodegradable. If a non-biodegradable material is used, provision shall be made for its salvage.

Moisture. Large amounts of water are required during the composting process because operating temperatures drive off water via evaporation and microbes utilize moisture for their metabolic processes. 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 shall be free of harmful substances. A good source of moisture is the recycled runoff and leachate from the compost pad. 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$_o$F for at least 5 days as an average throughout the compost mass. 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 the composting 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.

Oxygen. Heat generated by the process causes piles to dehydrate. As the process proceeds, material consolidates which reduces the volume of voids through which air flows. Materials selected for the composting mix must provide for adequate air movement. Available oxygen should not be less than 5 percent measured on a total volume of voids basis. Periodic pile turning with maintenance of proper moisture levels will normally provide adequate aeration.

Oxygen levels must be maintained at about 5 percent to minimize nitrogen loss by denitrification and pH must be kept 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 requirements of this standard.

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.

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. Visual inspection and temperature measurements may provide needed evaluation of compost status. If compost is to be sold commercially, certain testing procedures to determine compost maturity, soluble salts and ammonium nitrogen may be required.

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.

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 monitoring the temperature of the composting material.

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.

Storage. Provide properly designed pads or other storage facilities sized for the appropriate storage period. If used, storage structural components shall meet the requirements of Connecticut/Rhode Island practice Standard, "Waste Storage Facility," No. 313.

Use of Finished Compost. Land application of finished compost shall be in accordance with the current Rhode Island Conservation Practice Standards for Nutrient Management (Code 590) and Waste Utilization (Code 633).

Economics. Benefits associated with the ultimate use of the composed material should be compared to the capital expenditure and operating costs of the composting operations. In addition to cost return, benefits may include environmental protection, improved handling, disposal of dead poultry and other farm animal carcasses, odor control, reduced need for storage volume, production of an organic soil amendment and disposal cost savings.

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.

For uniformity of solar warming, align piles north south and provide moderate pile 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.

PLANS AND SPECIFICATIONS

Plans and specifications for composting facility shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. To the extent practical, specifications shall conform to National Engineering Handbook, Parts 642 and 643 (formerly NEH-20). A written operation and maintenance plan shall be developed with full knowledge and input of the owner-operator and included with the documents provided to the owner-operator.

As-Built Drawings. As built drawings shall be prepared showing all pertinent elements and elevations as actually installed. Copies of those as-built drawings shall be provided to the owner / operator upon construction completion.

OPERATION AND MAINTENANCE

General. Develop an operation and maintenance plan that is consistent with the purposes of this practice, and the life of the composting facility. Recipe ingredients, mixing, and layer sequencing shall be outlined in the O&M plan.

Safety provisions for operation of the composting facility shall be implemented.

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 to prevent microbe die-off.

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

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 cropland. Composted materials that are prepared for the retail market will require testing for labeling purposes, if sold as a fertilizer. If sold as a soil amendment, testing may not be required.

Record Keeping. If sold as a commercial product, record keeping shall be in accordance with federal, state, and local requirements for compost packaging and marketing. If used on-site, record keeping shall be in accordance with the CNMP and / or agricultural waste management system plan.

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