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COMPOSTING FACILITY GUIDANCE

This guidance is not a rule. It has been prepared to give the reader information, in plain language, about how the Division of Waste Management and Radiation Control expects to interpret R315-312 of the Utah Administrative Code. In the event questions arise regarding the matters discussed in this guidance, the text of the rule will govern.

Introduction

Although permits are not required for composting facilities, R315-312-2(1) of the Utah Administrative Code requires that a plan of operation be submitted to the Director of the Division of Waste Management and Radiation Control. This plan must demonstrate that the facility has the operation plans and procedures in place to meet the requirements of the rule. In general, an operations plan should cover all of the areas listed below. Where specific areas of the rule apply the rule is listed.

Composting is the transformation of organic material (plant matter) through controlled aerobic decomposition into a soil-like material. Invertebrates (insects and earthworms), and microorganisms (bacteria and fungi) help in transforming the material into compost. Composting is a natural form of recycling, which continually occurs in nature.

Yard waste, paper waste, and food wastes make up approximately 60% of the waste stream in the United States. Composting of part of these waste streams would reduce the amount of Municipal Solid Waste (MSW) requiring disposal, while providing a nutrient-rich soil amendment. Many landfill owners in Utah operate compost facilities to take advantage of the reduction in waste volume and associated savings in landfill space that removal of compostable waste can provide.

When planning a compost operation there are many factors that must be considered. Although this document is not intended as a guide on how to plan and operated a compost facility, some of the factors related to planning and operation are discussed as they may relate to the requirements found in the solid waste rules.

Planning Considerations

Types of Composting Operations. Three types of composting operations are used to compost waste on a large scale. These operation types are aerated windrows, static piles, and in-vessel. 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. This is the most common type of composting operation conducted in Utah.

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 air movement throughout the pile. Forced air might be necessary to facilitate the composting process. This type of operation is not generally suited to landfill composting operations as material is not moved through the process at a rate sufficient to make maximum use of the available acreage at the landfill. Also odors can be a problem.

In-vessel composting in a totally enclosed structure is carried out on a blended organic material 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.

Composting 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 ingredients are essential to minimize odors and to avoid attracting flies, rodents, and other small animals. R315-312-3(4)(e) of the Utah Administrative Code requires that the material maintain a temperature between 104 and 149 degrees Fahrenheit. The temperature must be maintained for a period of at least five days and a temperature of not less than 131 degrees Fahrenheit must be maintained for not less than four consecutive hours during the five days. Any composting plan submitted to the Division Director must address the methods that will be used to demonstrate that the required temperature was met and maintained for the required period.

Material that has not met the time and temperature requirements is not compost but is solid waste and subject to the disposal requirements of the solid waste rules. In addition to the time and temperature requirements, the finished compost must contain no sharp objects and must be sufficiently stable to be stored or applied to land without creating a nuisance, environmental threat, or hazard to human health.

The operation plan should address the frequency of temperature measurements and the records that will be kept to document time and temperature.

Carbon Source. Utah solid waste rules do not have any specific requirements for carbon to nitrogen ratio. However, for composting to take place this ratio is very important and is therefore discussed here.

Carbon and nitrogen are the two fundamental elements in composting, and their ratio (C:N) is significant. The bacteria and fungi in compost digest or "oxidize" carbon as an energy source and ingest nitrogen for protein synthesis. Carbon can be considered the "food" and nitrogen the digestive enzymes.

The bulk of the organic matter should be carbon with just enough nitrogen to aid the decomposition process. The ratio should be roughly 30 parts carbon to 1 part nitrogen (30:1) by weight. Adding 3-4 pounds of nitrogen material for every 100 pounds of carbon should be satisfactory for efficient and rapid composting. The composting process slows if there is not enough nitrogen, and too much nitrogen may cause the generation of ammonia gas that can create unpleasant odors.

Leaves are a good source of carbon; fresh grass, manures, and blood meal are natural sources of nitrogen

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. Maintaining the proper moisture content facilitates the composting process and helps control odors. The amount of water added to a compost pile should be recorded as part of the records of the facility.

Addition of moisture can cause concern for the handling of run-off from the composting operation. Operation plans must contain information on the method to be used to control run-off. Additionally, if the operation is using sludge or other material that may contain contaminants, the run-off water must be contained and composting conducted on an impermeable pad.

Composting in Utah can use large amounts of water to maintain the required moisture content. The operation plan should address the source of the water to be used.

Equipment Needs. Appropriate equipment should be available for initial mixing, turning, and hauling composted material and compost feedstock. Appropriate long stem thermometers should be available for monitoring the composting material.

Bulking Materials. Bulking materials may be added to enhance airflow within the composting material. Piles that are too compact will inhibit the composting process. 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, should 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.

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

Design Criteria

Location. 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. Location of a facility within 500 feet of several types of buildings is not allowed by the rules, R315-312-3(1)(b) of the Utah Administrative Code.

A composting facility should not be located in wetlands, along watercourses, or in a 100-year floodplain.

Soils. Locate composting facilities on soils having low 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 petroleum products. R315-312-3(4)(h) of the Utah Administrative Code requires operations that use sludge, septage, or municipal solid waste conduct the compost operation on a surface such as sealed concrete, asphalt, clay, or and artificial liner.

Run-off/run-on. 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 organic material, soluble substances, and substances attached to solids carried by runoff.

Run-off systems must be designed to collect the run-off from a 25-year storm event. If run-off cannot be handled within the operation, (used on the compost or in another use on-site) the owner must address handling run-off in some other way.

Carbon-Nitrogen Ratio. Calculate the amounts of the various ingredients to establish the desired carbon-nitrogen ratio (C:N) of the mix to be composed. 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 should 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 may be desirable, 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 2 weeks.

Facility Size. Where farm animals are composted, establish the size of the compost units on the basis of locally determined animal loss rates. Composting facilities for the purpose of processing animal carcasses may need a primary composting unit into which alternate layers of low moisture content 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.

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 be inhibited when moisture falls below approximately 40 percent. Water used for moisture control must be free of deleterious substances. The optimal moisture content for a particular compost mixture and location will very and should be determined through operation and experiment. The "squeeze test" is a good way to determine the moisture content of the composting materials. Squeezing a handful of material should have the moisture content of a well-wrung sponge. A pile that is too wet can be turned or can be corrected by adding dry materials.

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 maximizes solar warming. Windrows should be aligned to avoid accumulation of precipitation. Pile size may have to be changed throughout the year to take in to account temperature changes.

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. 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 by roofs or other suitable covers. UAC R315-312 requires that at least 50% of the material be removed from the site each year and no material can remain on the site longer than 2 years.

Operation Criteria

Temperature. For best results, operating temperature of the composting material should be 40 C to 65 C once the process has begun. R315-312-3(4)(e) of the Utah Administrative Code requires that the compost maintain a temperature of between 104 and 149 degrees Fahrenheit (40 and 65 degrees Celsius) for 5 days and maintain a temperature of 131 degrees Fahrenheit for a period of 4 consecutive hours during the five days. 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 104 Fahrenheit (40 degrees Celsius) for the remainder of the designated composting period.

If temperature trails 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. 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 plans and determine the effects of use and management of nutrients on the quality of surface water and groundwater 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 as the result of application to crops. Composted materials that are prepared for the retail market may require testing for labeling purposes.

Plans, Specifications, and Operation and Maintenance.

Plans and specifications for a composting facility should be in keeping with this standard and should describe the requirements for applying the practice to achieve its intended purpose. A written operation and maintenance plan should be developed with full knowledge and input of the owner-operator and included with the documents provided to the owner-operator.