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**SOLID WASTE MANAGEMENT PROGRAM
WASTE MANAGEMENT DIVISION
DEPARTMENT OF ENVIRONMENTAL CONSERVATION
AGENCY OF NATURAL RESOURCES
STATE OF VERMONT**

**PROCEDURE
Defining
High Carbon Bulking Agents
Used in Composting**

March 2012

I. Introduction

In 2008 the legislature passed Act 130 which amended the statutory definition of solid waste to exclude high carbon bulking agents used in composting (10 VSA 6602(2)). This procedure defines which materials are considered high carbon bulking agents and qualify for this exemption.

The benefit of using high carbon bulking agents in composting is to increase aeration in a compost pile and improve pile structure, while providing sufficient carbon for the composting process. To qualify for the solid waste statutory exemption, the material must be high in carbon content, provide bulking of materials to be composted, and be free of unnecessary contaminants.

Background:

The carbon to nitrogen ratio of a material is an important factor in composting. Composting occurs most effectively when the carbon to nitrogen (C:N) ratio of all the materials in the pile is approximately 30:1. Food waste and grass clippings are examples of materials that have relatively low C:N ratio (generally 15:1 or less) and need to be mixed with materials that have high C:N ratio for good composting. Appendix A list the C:N ratio for several materials commonly used as carbon sources in composting.

Adequate aeration and pile structure are also important factors in optimizing the compost process. Materials are added to compost piles as “bulking agents”. Bulking agents can be defined as “materials of sufficient size to provide structural support and maintain air spaces within the composting matrix.”¹ Woodchips are commonly used bulking agents. Tree trimmings, straw, along with other materials, have also been used as bulking agents.

There are other materials that can be added to wet compost piles that will increase aeration by absorbing excess water; however, they do not directly add to the structure of the pile. Fine sawdust and shredded paper are examples. Leaves can provide some structure, but tend to fit in this category, depending on how old they are and whether they were shredded.

Materials that have a high water content and/or decompose quickly would not make good bulking agents. Examples are food waste and paper pulp. Materials found on the farm such as corn silage and spoiled round bale hay, though they could be used as part of the compost recipe, would be questionable as bulking agents, due to their limited structure and high nitrogen content which increases their putrescibility during storage and their compostability.

¹ The Practical Handbook of Compost Engineering by Roger Tim Haug, 1993 by Lewis Publishers.

II. Applicability

- (a) This procedure is applicable to all compost facilities and other facilities that act as storage facilities for compost facilities.
- (b) This procedure does not apply to any other collection of similar waste that is not directly associated with a compost facility.
- (c) Any material, including high carbon bulking agents, must be properly managed including the storage of such materials, to prevent any undue impacts to the environment and human health.

III. Acceptable Materials

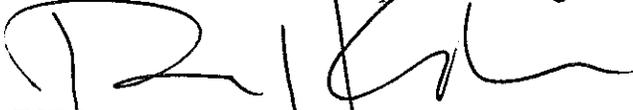
- (a) The following materials are considered exempt from the solid waste definition when used as a high carbon bulking agent in composting:
 - (1) Clean wood chips and shavings
 - (2) Bark wood chips
 - (3) Straw
 - (4) Shelled corn cobs
 - (5) Corn Stalks
 - (6) Shrub Trimmings
 - (7) Clean dry leaves, excluding any leaves vacuumed or accumulated from roadways
 - (8) Coarse Sawdust
 - (9) Nut shells
 - (10) Pine needles – brown
 - (11) Non-legume hay – dry
 - (12) Heavily-bedded horse manure
 - (13) Paper or paper products, as approved by the Solid Waste Management Program

Information on these materials can be found in Attachment A.

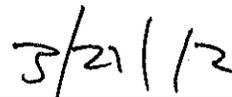
- (b) The acceptable materials under subsection (a) of this section must be clean, not pose a hazard, and contain less than 5% foreign materials. Foreign materials must be easily removable prior to, during, or after the composting process. The exception would be minor amounts of materials that do not pose any harm to human health or the environment.

IV. Effective Date

This Procedure is effective upon date of signature.



David K. Mears, Commissioner
Department of Environmental Conservation



Date

APPENDIX A

Material	C:N ratio	%N	Bulk Density (lbs/cy)	Value as a bulking agent	Value as a carbon source	Comments
Clean wood chips and shavings.	212-1,313, ave 600	0.04-0.23, ave. 0.09	445-620	Excellent	Poor	Most stable, but leachate needs to be controlled due to BOD. Chips are a poor source of available carbon and would likely need to be screened out to make finished compost. Shavings may take a long time to degrade.
Bark wood chips	116-1285, ave 365			Excellent	Poor	Same as clean wood
Corn Silage	38-43	1.2-1.4				
Heavily bedded hoarse manure	22-50	1.4-2.3	1215-1620			
Straw	48-150	0.3-1.1	58-378	Very good	Fair	Straw has a coating that slows its composting. It varies greatly in its C:N ratio depending on what plant the straw comes from. Wheat straw generally has a higher C:N ratio than oat straw, due to its lower nitrogen content. Straw is hollow which allows more air circulation and makes it a better bulking agent than hay. When used as a carbon source, it is chopped into smaller pieces, which could make it less useful as a bulking agent.
Shelled corn cobs	56-123	0.4-0.8	557	Very good	Poor	Corn cobs are high in cellulose like tree branches and are slow to break down. Some chopping would be preferred.
Corn stalks	60-73	0.6-0.8	32	Very good	Fair to good	Minimal chopping preferred. Breaks down slowly.
Shrub Trimmings	53	1.0	429	Good to very good	Fair to good	This C:N indicates some green leaves present. Some chopping may be needed.
Clean leaves, dry, excluding leaves vacuumed or accumulated directly from roadways.	40-80, ave 54	0.5-1.3, ave. 0.9	100-300	Poor to good.	Excellent	Dry leaves can greatly improve a wet piles porosity and have been used successfully as a "bulking agent". However, leaves compact, particularly when wet. They are not a bulking agent in the normal sense and may require greater pile maintenance.
Coarse Sawdust	200-750	0.06-0.8	350-450	Fair to very good.	Good	Size of sawdust particles and moisture of pile affects bulking agent value.
Nut shells	35 for peanut shells ¹			Fair to good	Fair to Good	Different shells will have different bioavailability.
Pine needles - brown	60-110 ²			Fair (limited)	Poor	Thick, outer waxy coating. Acidic so need to use in limited quantity. For backyard composting t
Non-legume hay - dry	27-40 ³	1.0-1.5 ³		Fair	Good	Large amounts of dry non-legume hay can improve a piles structure. It has better value in adjusting moisture of pile and as a carbon source.

All C:N, %N and Bulk Density values come from the On-Farm Composting Handbook, Northeast Regional Agricultural Engineering Service, ©1992, Ithaca, NY except as footnoted.

¹<http://www.composting101.com/c-n-ratio.html>

²<http://www.compostinfo.com/tutorial/ElementOfComposting.htm>

³<http://www.organicgardening.com/feature/0,7518,s-5-21-112,00.html>