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GUIDELINES FOR COMPOST QUALITY

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Guidelines for Compost Quality

prepared by the

**Composting Subcommittee
Solid Waste Management Task Group
Canadian Council of Ministers of the Environment**

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Abstract

Recognizing the likelihood of significant growth within the composting industry and the potential health and environmental concerns associated with compost, the CCME Solid Waste Management Task Group established a national committee to develop quality guidelines for compost that is sold or given away. The CCME, Agriculture and Agri-Food Canada, and the Bureau de normalisation du Québec agreed to coordinate efforts in an attempt to develop compost standards that provide a significant level of consistency, while being flexible enough to accommodate different (e.g., regional) interests, and issues.

These compost guidelines are based on the following four criteria for product safety and quality: foreign matter, maturity, pathogens, and trace elements. These guidelines attempt to integrate the concept that exposure is an integral part of risk by establishing two grades (unrestricted and restricted grade) of material. These guidelines will help protect public health and the environment, and help composting to develop as an important waste/resource management solution.

Résumé

Conscient du potentiel de croissance considérable des opérations de compostage et des craintes pour la santé et l'environnement associées à l'utilisation du compost, le Groupe de travail sur les déchets solides du Conseil canadien des ministres de l'environnement (CCME) a formé un comité national pour établir des critères de qualité du compost. Le CCME, Agriculture et Agroalimentaire Canada et le Bureau de normalisation du Québec ont également convenu de coordonner leurs efforts en vue d'obtenir des critères qui assurent un degré suffisant de cohérence tout en demeurant assez souples pour être adaptés en fonction d'intérêts ou de problèmes divers (p ex., de nature régionale)

Les critères reposent sur les quatre indicateurs suivants de la qualité et de la sécurité du produit : la teneur en éléments traces, la teneur en corps étrangers, la maturité et la teneur en organismes pathogènes. On a aussi tenu compte du risque lié à l'exposition au produit en établissant deux catégories de compost (avec ou sans restrictions d'usage). Ces critères aideront à protéger la santé publique et l'environnement et à assurer le développement du compostage à titre de méthode valable de gestion des déchets et des résidus.

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Glossary

Aerated static pile composting is a heap of compostable materials so formed as to promote the aerobic decomposition of the organic matter. Ventilation is either provided by passive or forced aeration, rather than through frequent agitation.

Compost is a solid mature product resulting from composting. Composting, which includes a thermophilic phase, is a managed process of bio-oxidation of a solid heterogeneous organic substrate.

Contaminant is an element, compound, substance, organism, or form of energy which through its presence or concentration causes an adverse effect on the natural environment or impairs human use of the environment.

Foreign matter is any matter resulting from human intervention and made up of organic or inorganic components such as metal, glass, synthetic polymers (e.g., plastic and rubber) that may be present in the compost. Foreign matter does not include mineral soils, woody material, and rocks.

In-vessel composting is a diverse group of composting methods in which composting materials are contained in a reactor or vessel; the purpose is to maintain optimal conditions for composting.

Municipal Solid Waste (MSW), for the purpose of this guideline, means solid non-hazardous refuse that originates from residential, industrial, commercial, institutional, demolition, land clearing, or construction sources.

Pathogens are organisms, including some bacteria, viruses, fungi, and parasites, that are capable of producing an infection or disease in a susceptible human, animal, or plant host

Sludge is a semi-solid substance consisting of settled sewage solids combined with varying amounts of water and dissolved materials generated from municipal or industrial wastewater treatment plants.

Source separation refers to the separation of wastes into specific types of material at the point of generation.

Thermophilic phase is a biological phase in the composting process characterized by the predominance of active micro-organisms which thrive at a temperature range of 45 to 75°C

Windrows are elongated piles of triangular or trapezoidal cross-section that are turned in order to aerate and blend the material

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Section 1

Introduction

In 1992, Canadians disposed of about 21 million tonnes (Environment Canada, 1995) of municipal solid waste each year, and organic waste makes up a significant fraction of this amount (about 50%). If waste reduction targets set by the Canadian Council of Ministers of the Environment (CCME) are to be achieved (50% reduction by the year 2000, relative to a 1988 base year), the composting of organic waste material is essential.

In addition to the amount of waste going to landfill, composting also returns nutrients and organic matter to the soil, making it a valuable amendment for landscaping, horticulture, and agriculture. It is not surprising, then, that industry and municipalities have implemented large-scale composting operations

Recognizing the likelihood of significant growth of composting operations and the potential health and environmental concerns associated with the use of compost, the CCME Solid Waste Management Task Group established a national committee to develop guidelines for compost products. By setting standards for the quality of compost material, the guidelines would help protect public health and the environment, as well as ensure that compost products are beneficially used. The composting industry would also benefit since the guidelines would help secure compost as a beneficial soil amendment, increase the demand for organic materials, and encourage source separation. In short, the guidelines

would help organic materials to be regarded as a resource rather than a waste.

1.1 Background

Several standard-setting organizations across Canada are mandated to regulate compost and/or write standards concerning compost. These include the federal government, provincial and territorial governments, and the *Bureau de normalisation du Québec (BNQ)*, acting on behalf of the Standards Council of Canada (SCC)*. Within the federal government, Agriculture and Agri-Food Canada (AAFC) administers the *Fertilizers Act* that regulates fertilizers and soil supplements sold in Canada. Agriculture and Agri-Food Canada, therefore, regulates compost when it is sold either as a soil amendment or as a product with plant nutrient claims. The provinces and territories regulate the disposal and beneficial use of wastes, and therefore, the production and use of compost. In its role, acting on behalf of the SCC, the BNQ establishes industry standards for adoption by the SCC and endorses products that meet their standards.

When the CCME began developing national compost guidelines, different sets of standards for several aspects of compost existed among the federal and provincial regulators. These included standards for trace element concentrations and product labelling under the federal *Fertilizers Act* (AAFC), the *B.C. Waste Management Act: Production and Use of Compost Regulation*, and the "Interim Guidelines for the Production and Use of

* The SCC coordinates voluntary industry standardization activities in Canada and represents Canada in the International Organization for Standardization (ISO). Five standard-writing organizations are accredited by the SCC, one of which is the BNQ. Within the SCC, the BNQ is primarily responsible for standardizing fertilization, organic fertilizers, and soil supplements. As such, the BNQ is the only standard-writing organization of the SCC accredited to write industry standards for compost.

Aerobic Compost in Ontario". Federal and provincial regulators, as well as the BNQ/ SCC, were in the process of developing additional standards for compost safety and quality. In January 1993, stakeholders met in Ottawa to discuss and evaluate the existing and future compost standards, and the general regulatory situation pertaining to compost. As a result, the parties agreed to coordinate efforts in an attempt to develop compost standards that provide a significant level of national consistency, while being flexible enough to accommodate different interests (e.g., regional) and issues.

It was recognized that, due to the different mandates and objectives of the CCME, AAFC, and BNQ, three separate documents must be produced. These would consist of CCME Guidelines (for use by provinces and territories adopting new regulations for compost), a Trade Memorandum describing compost standards adopted under AAFC's *Fertilizers Act*, and BNQ or SCC voluntary industry standards.

A sound and consistent approach is more likely to decrease frustration and increase the level of credibility of all public agencies and standard-setting organizations involved in this exercise

1.2 Objectives

The objectives of these guidelines are to

- protect public health and the environment across the country;
- encourage source separation of MSW to produce a high quality compost product;
- produce compost standards that are fairly consistent across the country, while accommodating different interests and issues,

- ensure consumer confidence through consistent nationwide product quality standards; and
- ensure that composting develops as an important waste/resource management solution and an environmentally sound industry that diverts valuable organic materials from landfills and incineration

1.3 Scope and Applicability

These guidelines apply to compost produced from municipal solid waste (MSW) or other feedstock as determined by regulatory agencies. They apply to compost that is sold or given away. These guidelines do not apply to on-site composting such as residential backyard composting or on-farm composting of materials generated on-site with use of finished compost on-site. Specific definitions and regulatory information on on-site composting can be obtained from the provincial/territorial contacts listed in the Appendix.

These guidelines do not apply to compost-based products, e.g., potting soil mixes, although, the provinces may wish to apply or modify the guidelines for these products.

Due to the diversity of regulatory approaches that exists in Canada, these guidelines apply to the quality of compost rather than the composting process. Provinces will develop individual siting and operating guidelines to accommodate jurisdictional needs

In response to special concerns, a province or territory may decrease or increase the number of parameters to be analyzed and the frequency of analysis based on monitoring data, changes in the waste stream or processing techniques, effectiveness of source separation programs, or the potential presence of toxic substances

Section 2

Product Safety and Exposure

For sale or use products must be safe. However, by the same token “safety” (or “risk”) is a function of exposure. When assessing the safety of a product, exposure must also be considered; if there is no exposure there can be no “risk”. Ultimately, exposure is a function of the quantity, the intended use, and the users of a product. The question then

becomes whether a product is “safe enough” for “use as intended”. It should be recognized that a product may be safe for one type of use and user, but not for another use in which, the product may be further exposed to the public, water, environment, or plants in the food chain. These guidelines attempt to integrate the concept that exposure is an integral part of risk by establishing different grades of material (unrestricted and restricted grade) on the basis of safety and quality.

Section 3

Compost Product Guidelines

These compost guidelines are based on the following four criteria for product safety and quality: foreign matter, maturity, pathogens, and trace elements.

The standards for compost quality are summarized in this section. For additional information on the limits recommended, please refer to the "Support Document for Compost Quality Criteria [National Standard of Canada CAN/BNQ 0413-200, Canadian Council of Ministers of the Environment (CCME) Guidelines and Agriculture and Agri-Food Canada (AAFC) Criteria]".

3.1 Categories

Two compost categories have been developed for trace element concentrations. These categories (A and B) are based on the end use of the compost material.

Category A- Compost that can be used in any application, such as agricultural lands, residential gardens, horticultural operations, the nursery industry, and other businesses.

Category A criteria for trace elements are achievable using a source separated MSW feedstock. The trace element criteria meet or are more stringent than the current CCME interim soil quality criteria for contaminated sites.

Category B- This is compost that has a restricted use. Compost may require some control when deemed necessary by a province or territory.

Please note that for a compost to meet the unrestricted use category, it must meet the unrestricted (Category A) requirements for all trace elements. If the compost fails one

criterion of the guideline for unrestricted use but meets the criteria for restricted (Category B) use, then it is classified as a Category B product. Products that do not meet the criteria for either Category A or B must be used or disposed of appropriately.

3.2 Trace Elements

Trace elements, i.e., mercury, cadmium, lead, may be present in the raw materials from which compost products are produced. Although some trace elements, e.g., copper, molybdenum, zinc, are plant micro-nutrients, compost applied to land without monitoring trace element concentrations could cause adverse effects on human health or the environment.

The concentrations of trace elements in the finished compost (Categories A and B) and the cumulative additions to soil (Category B) shall not exceed those levels provided in Table 1 as calculated on a dry weight basis.

3.3 Foreign Matter in Compost

Foreign matter in compost, also referred to as inerts, nonbiodegradables, and contraries, is material that is not biodegradable and as such detracts from good quality compost. As most compost feedstocks and products contain foreign matter, the following quality criteria are important.

Compost should be virtually free of foreign matter that may cause nuisance, damage, or injury to humans, plants, or animals during or resulting from intended use. It should contain no sharp foreign matter measuring more than 3 mm in any dimension and no foreign matter greater than 25 mm in any dimension.

Table 1 Concentrations of Trace Elements in Compost and Cumulative Trace Element Additions to Soil

Trace Elements***	CATEGORY A		CATEGORY B	
	Maximum Concentration within Product (mg/kg dry weight)	Maximum Concentration within Product* (mg/kg dry weight)	Maximum Concentration within Product* (mg/kg dry weight)	Maximum Cumulative Additions to Soil* (kg/ha)
Arsenic (As)	13	75	75	15
Cadmium (Cd)	3	20	20	4
Cobalt (Co)	34	150	150	30
Chromium (Cr)	210	**	**	**
Copper (Cu)	100	**	**	**
Mercury (Hg)	0.8	5	5	1
Molybdenum (Mo)	5	20	20	4
Nickel (Ni)	62	180	180	36
Lead (Pb)	150	500	500	100
Selenium (Se)	2	14	14	2.8
Zinc (Zn)	500	1850	1850	370

* These concentrations are the existing standards under Agriculture and Agri-Food Canada's *Fertilizers Act* (Trade Memorandum, T-4-93, January 2, 1991)

** Limits for copper and chromium are not established in the *Fertilizers Act*. Calculated in the same manner as limits for the other nine elements, the limits for chromium and copper would be chromium = 210 kg/ha and copper = 150 kg/ha for the maximum acceptable cumulative trace element additions to soil, and chromium = 1060 mg/kg and copper = 757 mg/kg for maximum acceptable trace element concentrations within the compost product. Details of these calculations are in the "Support Document for the Bureau de normalisation du Québec Standard and the Canadian Council of Ministers of the Environment and Agriculture and Agri-Food Canada Guidelines"

Agriculture and Agri-Food Canada will begin a consultation process for adopting limits for chromium and copper. The CCME will re-evaluate these parameters when this process is complete. The CCME Compost Subcommittee recognizes that the effect on liquid waste management of setting specific limits for copper has yet to be determined.

*** Concentrations of other elements, such as boron, manganese, aluminum, and iron, may eventually be regulated in certain provinces to accommodate regional and national concerns.

3.4 Maturity of Compost

Characteristics of mature compost include biostabilization and humus formation. Guidelines for compost maturity are necessary as immature product has the potential to cause adverse effects on plants when applied in large amounts

At present, no single test of compost maturity is reliable and sufficient by itself, therefore, the use of more than one test is recommended. The compost shall conform to one of the following:

1. Two of the following three test requirements shall be met.
 - a) Testing for the ratio of carbon and nitrogen, which must be. $C/N \leq 25$
 - b) Oxygen uptake, which shall be. $< 150 \text{ mg O}_2 / \text{kg organic matter (volatile solids) per hour}$
 - c) The germination of cress (*Lepidium sativum*) seeds and radish (*Raphanus sativus*) seeds in compost shall be greater than a value corresponding to at least 90% of the germination rate of the control sample, and plant growth rate of the compost-soil mix shall not be less than 50% in comparison to plant growth of the control sample.

OR

2. The compost must be cured for a minimum of 21 days and the compost will not reheat upon standing to greater than 20° C above ambient temperature

OR

3. The compost must be cured for a minimum of 21 days and the reduction of organic matter must be $> 60\%$ by weight.

OR

4. If no other determination of maturity is made, then the compost must be cured for a six-month period. The state of the curing pile must be conducive to aerobic biological activity. The curing stage begins when the pathogen reduction process is complete and the compost no longer reheats to thermophilic temperatures.

3.5 Pathogens in Compost

As pathogenic organisms may be present in the compost feedstock, the compost itself may also contain pathogenic organisms and, as a result, may pose health risks. To adequately reduce these health risks, the compost shall conform to the criteria outlined in either a) or b) depending on the feedstock source.

- a). When a compost does not contain feedstock high in human pathogens, the following criteria shall be met:
 1. The compost shall undergo the following treatment or other process recognized as equivalent by the relevant province or territory.

Using the **in-vessel composting method**, the material shall be maintained at operating conditions of 55° C or greater for three days

Using the **windrow composting method**, the material shall attain a temperature of 55° C or greater for at least 15 days during the composting period. Also, during the high temperature period, the windrow shall be turned at least five times.

Using the **aerated static pile composting method**, the material will be maintained at operating conditions of 55° C or greater for three days. The preferable practice is to cover the pile with an insulating layer of material, such as cured compost or wood chips, to ensure that all areas of the feed material are exposed to the required temperature.

OR

2. Organisms shall meet the following:

fecal coliforms <1000 most probable number (MPN)/g of total solids calculated on a dry weight basis,

AND

Salmonella sp. <3 MPN/4g total solids calculated on a dry weight basis

Note. fecal coliforms are good indicators of pathogenic bacteria

- b). When compost contains feedstock high in human pathogens, the following criteria shall be met:

1. Undergo a treatment (described in a) or other process recognized as equivalent by the relevant province or territory

AND

2. Organisms shall meet the following:

fecal coliforms <1000 MPN/g of total solids calculated on a dry weight basis,

OR

Salmonella sp <3 MPN/4g total solids calculated on a dry weight basis

3.6 Organic Contaminants in Compost

Organic chemicals enter waste streams from a variety of industrial and domestic sources. While many degrade or volatilize during waste collection, treatment (includes composting) and storage, some of these organic chemicals persist. However, the risk of contamination by organic compounds is negligible in the majority of composts, e.g., leaf and yard waste compost. As well, the lack of information about the presence of organic contaminants in other types of compost prevents the inclusion of any requirements in a national guideline. The provinces/territories and federal government can establish specific requirements for organic contaminants based on feedstock source, e.g., some industrial sludges. For specific examples in each province, contact the organizations listed in the Appendix.

More information is required about organic contaminants in Canadian compost, and existing data must be compiled, reviewed, and evaluated, with particular focus on dioxins, furans, and pesticides

Section 4

Sampling and Analytical Methods for Testing Compost Quality

The following documents can be used as a basis for sampling and analytical test methods.

CAN/BNQ 0413-200-M95 - Amendement organiques - Composts (Organic Soil Conditioners - Compost)

CAN/BNQ 0413-210-M95 - Amendements organiques - Détermination de la teneur en corps étrangers - Méthode granulométrique (Organic Soil Conditioners -Determination of Foreign Matter Content - Sieving Method)

CAN/BNQ 0413-210-M95 - Amendements organiques - Détermination du taux d'assimilation d'oxygène - Méthode respirométrique (Organic Soil Conditioners - Determination of Oxygen Uptake - Respirometric Method)

These are available at the Bureau de normalisation du Québec, 70 Dalhousie Street, Suite 220, Quebec, Quebec, G1K 4B2,
☎ (418) 644-5114 or 1-800-386-5114,
📠 (418) 646-3315

References

- AC (Agriculture Canada), "Metal Concentrations in Processed Sewage and By-products", Trade memorandum T-4-93, Ottawa, Ontario, p 3 (January 2, 1991).
- BC (British Columbia), "Waste Management Act: Production and Use of Compost Regulation", British Columbia Regulation 334/93, p. 15 (November 19, 1993).
- CCME (Canadian Council of Ministers of the Environment), "Interim Canadian Environmental Quality Criteria for Contaminated Sites", Report CCME EPC-CS34 (September, 1991).
- OMEE (Ontario Ministry of Environment and Energy), "Interim Guidelines for the Production and Use of Aerobic Compost in Ontario", Toronto, Ontario (November, 1991)
- "Support Document for Compost Quality Criteria [National Standard of Canada CAN/BNQ 0413-200, Canadian Council of Ministers of the Environment (CCME) Guidelines and Agriculture and Agri-Food Canada (AAFC) Criteria]", Final Version (March 1996).

Appendix

Provincial, Territorial, and Federal Contacts

Province/Territory/Federal	Organization	Telephone/Fax
Alberta	The Action on Waste Division Alberta Environmental Protection 1401, Standard Life Centre 10405 Jasper Avenue Edmonton, Alberta T5J 3N4	☎ (403) 422-8466 ☎ (403) 427-1594
British Columbia	Municipal Waste Reduction Branch Ministry of the Environment, Lands and Parks 777 Broughton Street Victoria, British Columbia V8V 1X5	☎ (604) 387-6663 ☎ (604) 356-9974
Federal Government	Fertilizer Section, Plant Products Division Agriculture and Agri-Food Canada 59 Camelot Drive, 3rd Floor, East Ottawa, Ontario K1A 0Y9	☎ (613) 952-8000 ☎ (613) 992-5219
Manitoba	Pollution Prevention Division Department of Environment 139 Tuxedo Avenue, Building 2 Winnipeg, Manitoba R3N 0H6	☎ (204) 945-8443 ☎ (204) 945-1211
New Brunswick	Solid Waste and Recycling Section New Brunswick Department of the Environment 364 Argyle Street, 1st Floor, Box 6000 Fredericton, New Brunswick E3B 5H1	☎ (506) 457-4848 ☎ (506) 457-7805
Newfoundland	Environmental Management Division, Department of Environment Confederation Building West Block P.O. Box 8700 St. John's, Newfoundland A1B 4J6	☎ (709) 729-2556 ☎ (709) 729-1930
Northwest Territories	Environmental Protection Division Department of Renewable Resources Government of Northwest Territories 600, 5102-50 Avenue Yellowknife, NWT X1A 3S8	☎ (403) 873-7654 ☎ (403) 873-0221

Nova Scotia	Resource Management & Pollution Control Division Department of the Environment 5151 Terminal Road, 5th Floor P.O. Box 2107 Halifax, Nova Scotia B3J 3B7	☎ (902) 424-2387 ☎ (902) 424-0503
Ontario	Program Implementation Section Waste Reduction Office Ontario Ministry of the Environment and Energy 40 St. Clair Avenue West, 7th Floor Toronto, Ontario M4V 1M2	☎ (416) 325-4440 ☎ (416) 325-4437
Prince Edward Island	Waste Management Section Environmental Protection Division PEI Environmental Resources 11 Kent Street, 4th Floor, Box 2000 Charlottetown, Prince Edward Island C1A 7N8	☎ (902) 368-5029 ☎ (902) 368-5830
Québec	Ministère de l'Environnement et de la Faune Service de l'assainissement agricole et des activités de compostage 2360, chemin Ste-Foy, 2e étage Sainte-Foy (Québec) G1V 4H2	☎ (418) 644-6588 ☎ (418) 528-1035
Saskatchewan	Municipal Unit Standards and Approvals Section Municipal Branch Saskatchewan Environment and Resource Management 3211 Albert Street Regina, Saskatchewan S4S 5W6	☎ (306) 787-6200 ☎ (306) 787-5623
Yukon	Environmental Protection and Assessment Branch Department of Renewable Resources Government of Yukon 10 Burns Street, Box 2703 Whitehorse, Yukon Y1A 2C6	☎ (403) 667-5683 ☎ (403) 667-4727
