CCME

Canadian Council of Ministers of the Environment

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GUIDELINES FOR COMPOST QUALITY

PN 1340

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La présente publication est également offerte en français sous le titre *Lignes directrices pour la qualité du compost.* PN 1341

ISBN 1-896997-60-0

Abstract

The benefits of compost to aid plant growth and add stability and fertility to soils are well demonstrated. Based on these attributes, the composting industry in Canada has become a vibrant industry that continues to grow in size and strength.

In order to ensure a consistent, high quality product that is safe for all uses, early in the 1990s CCME established a committee to develop quality guidelines for compost that is sold or given away. CCME, the Bureau de normalization du Québec (BNQ) and the Canadian Food Inspection Agency (CFIA) agreed to coordinate efforts and developed compost standards that provide a significant level of consistency, while being flexible enough to accommodate different (e.g. regional) interests and issues. This joint effort led to the development of the first edition of the CCME Compost Quality Guidelines in 1996.

Since 1996, the industry has grown to what it is today. During that growth, new science and technologies have improved our understanding of composting and compost. Thus, a revision to the 1996 guidelines was necessary. These revised guidelines reflect our new understanding while still providing the same level of protection that was intended in the first version.

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

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Glossary

aerated static pile: a heap of compostable materials formed to promote the aerobic decomposition of the organic matter. Ventilation is either provided by passive or forced aeration, rather than through frequent agitation (turning). French: ***tas statique aéré***

biosolids: organic product obtained from the physico-chemical and/or biological treatment of wastewater. Biosolids result from primary wastewater treatment (primary biosolids), or from secondary wastewater treatment (secondary biosolids), and these two types of biosolids are often combined (mixed biosolids). These biosolids can be derived from the treatment of either municipal wastewater or industrial wastewater. French: ***biosolides***

compost: solid mature product resulting from composting. French: ***compost***

composting: managed process of bio-oxidation of a solid heterogeneous organic substrate including a thermophilic phase. French: ***compostage***

contaminant: 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. French: ***contaminant***

foreign matter: any matter over 2 mm in dimension that results from human intervention and has organic or inorganic components such as metal, glass, synthetic polymers (for example plastic and rubber) and that may be present in the compost but excluding mineral soil, woody material and pieces of rock. French: ***corps étranger***

in-vessel composting: diverse group of composting methods in which composting materials are contained in a reactor vessel; the purpose is to maintain optimal conditions for composting. French: ***compostage en milieu fermé***

mature: term used to designate a compost that, when used as an organic soil conditioner, does not have phytotoxic effects arising from, for example, nitrogen immobilization or anaerobioses. NOTE — The opposite of "mature" is immature. French: ***mature***

micronutrient: plant nutrient (for example boron, copper, molybdenum, manganese, iron and zinc) required in lesser quantities than major (for example nitrogen, phosphorus and potassium) and secondary (for example calcium and magnesium) plant nutrients, having essential physiological functions in plant metabolism. French: ***oligoélément***

municipal biosolids: biosolids obtained from municipal wastewater pretreated to remove gravel and coarse solid waste. French: ***biosolides municipaux***

municipal solid waste (MSW): solid non-hazardous refuse that originates from residential, industrial, commercial, institutional, demolition, land clearing, or construction sources. French: ***déchets solides municipaux***

pathogens: 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. French: ***organismes pathogènes***

sharp foreign matter: any foreign matter over a 3 mm dimension that may cause damage or injury to humans and animals during or resulting from its intended use. NOTE — Sharp foreign matter may consist of, but is not limited to, the following: metallic objects or pieces of metallic objects, for example utensils, fixtures, electrical wiring, pins, needles, staples, nails, bottle caps; glass and porcelain or pieces of glass and porcelain, for example, containers, dishes, glass panes, electric light bulbs and tubes, mirrors. French: ***corps étranger tranchant***

source separation: separation of wastes into specific types of material at the point of generation. French: ***tri à la source***

thermophilic phase: biological phase in the composting process characterized by the presence of micro-organisms which grow optimally in a temperature range of 45˚C to 75˚C. French: ***phase thermophilic***

trace element: chemical element present in compost at a very low concentration. French: ***élément trace***

volatile solids: solids in water or other liquids that are lost on ignition of dry solids, generally above 500˚C. French: ***solides volatils***

windrow: elongated piles of triangular or trapezoidal cross-section that are turned in order to aerate and blend the material. French: ***andain***

yard waste: vegetative matter resulting from gardening, horticulture, landscaping, or land clearing operations and includes materials such as tree and shrub trimmings, plant remains, grass clippings, and chipped trees. French: ***résidus de jardin***

Acronyms

AAFC	Agriculture and Agri-Food Canada
BNQ	Bureau de normalisation du Québec
CCC	Composting Council of Canada
CCME	Canadian Council of Ministers of the Environment
CFIA	Canadian Food Inspection Agency
CRIQ	Centre de recherche industrielle du Québec
MPN	most probable number
MSW	municipal solid waste
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyls
SCC	Standards Council of Canada

Preface

Guidelines for Compost Quality, 2005, is published by the Canadian Council of Ministers of the Environment (CCME) and replaces the previous version – *Guidelines for Compost Quality*, 1996.

This document was prepared by the CCME Compost Guidelines Task Group. Membership of the Task Group was representative of provincial, territorial, and federal governments.

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Acknowledgements

The Compost Guidelines Task Group acknowledges the following individuals and organizations that have contributed to the production of these guidelines:

Sylvain Allard	Bureau de normalisation du Québec
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Section 1

Introduction

Canadians have long understood that organic matter, when composted, is a valuable product. Compost provides many benefits, returning nutrients and organic matter to the soil, making it a valuable amendment for landscaping, horticulture, and agriculture.

In 1996, CCME developed guidelines for compost products, at a time when the composting industry was still relatively young. Since then, many industries and municipalities have implemented large-scale composting operations.

By setting standards for the quality of compost material, the guidelines helped protect public health and the environment, as well as ensured that compost products were used beneficially. The composting industry also benefited since the guidelines helped secure compost as a beneficial soil amendment, increased the demand for organic materials, and encouraged source separation of organic wastes. In short, the guidelines helped organic materials to be regarded as a resource.

As is often necessary, updates to guidelines and standards are necessary in order to recognize advances in new technologies and science. This 2005 revision is meant to reflect these advances and to provide even better use of organic resources in Canada and to protect the environment and human health.

1.1 Background

Several standard-setting organizations across Canada are mandated to regulate compost and 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)[1].

Within the federal government, the Canadian Food Inspection Agency (CFIA) regulates compost when it is sold either as a soil amendment or as a product with plant nutrient claims under the *Fertilizers Act*. The provinces and territories regulate the disposal and beneficial use of wastes on land, and therefore, the production and use of compost. In its role, acting on behalf of the SCC, the BNQ establishes voluntary industry standards for adoption by the SCC and endorses products that meet their standards.

Since 1993, CCME, BNQ and CFIA have aimed 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 interest (e.g., regional) and issues.

[1] The SCC coordinates voluntary industry standardization activities in Canada and represents Canada in the International Organization for Standardization (ISO). Four standard-development organizations are accredited by the SCC, one of which is the BNQ. Within the SCC, 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.

CCME produced its first Guidelines for Compost Quality in 1996. In 2003, CCME directed the Compost Guidelines Task Group to review the 1996 CCME Compost Guidelines since the Canadian voluntary standard (BNQ) was also being revised. The BNQ public consultations and standard revisions have led to the development of these revised CCME Guidelines for Compost Quality.

1.2 Objectives

The objectives of *Guidelines for Compost Quality* are to:

- Protect public health and the environment across the country;
- Promote harmonization with the Canadian Food Inspection Agency (CFIA) and Bureau de normalisation du Québec (BNQ);
- Encourage source separation of municipal solid waste (MSW) to produce a high quality compost product;
- Produce compost standards that are consistent across the country, while accommodating different interests and issues;
- Incorporate the experience of industry and regulators in applying the guidelines and to ensure that the national guidelines reflect new science and technology advances;
- Discourage the application of untreated organic wastes to land; and,
- Ensure consumer confidence through consistent nationwide product quality standards.

1.3 Scope and Applicability

These guidelines apply to compost produced from any organic feedstock as determined by regulatory agencies. They apply to compost that is sold, given away or used on-site. Specific definitions and regulatory information on on-site composting can be obtained from federal, provincial and territorial authorities.

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

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

In response to special concerns, a jurisdiction may decrease or increase the number of parameters to be analyzed based on monitoring data, changes in the waste stream or

processing techniques, effectiveness of source separation programs, or the potential presence of toxic substances.

These guidelines only come into effect if adopted, in whole or in part, by an authority having jurisdiction. Where this guideline has been adopted, in whole or in part, by an authority having jurisdiction, it is subject to any restrictions or conditions added by the regulatory authority.

Readers of this guideline are advised to check with the federal, provincial, or territorial authority having jurisdiction to establish whether this guideline applies in their area of interest.

Section 2

Product Safety and Exposure

Products must be safe for sale or use. However, by the same token, “safety” (or “risk”) is the 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 the risk by establishing different grades of material (Category A - unrestricted and Category B - restricted) on the basis of safety.

Section 3

Compost Product Guidelines

These compost guidelines are based on the following four criteria for product safety: 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 and sharp foreign matter. These categories (A and B) are based on the end use of the compost material.

Unrestricted Use

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 best source separated MSW feedstock or municipal biosolids, or pulp and paper mill biosolids, or manure.

Restricted Use

Category B – Compost that has a restricted use because of the presence of sharp foreign matter or higher trace element content. Category B compost may require additional 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 and sharp foreign matter. 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, for example, mercury, cadmium, lead, may be present in raw materials from which compost products are produced. Excessive accumulation in soils over the long term may result in toxicity to plants, animals and humans. However, copper, cobalt, molybdenum and zinc (and possibly nickel and selenium) are plant micronutrients, and

their presence may be useful in compost. Also arsenic, cobalt, chromium, copper, molybdenum, nickel, selenium, and zinc are micronutrients required by animals and humans (Webber and Singh, 1995). Cadmium, mercury and lead are of no known value to either plants or animals. Compost applied repeatedly in large quantities to land without monitoring trace element concentrations could theoretically cause adverse effects on human health or the environment over the long term.

The concentrations of trace elements in finished compost (Category 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.

Background information about trace elements are provided in Annexes A and B.

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

	CATEGORY A	CATEGORY B	
Trace Elements* **	Maximum Concentration within Product (mg/kg dry weight)	Maximum Concentration within Product* (mg/kg dry weight)	Maximum Cumulative Additions to Soil* (kg/ha)
Essential or beneficial to plants or animals			
Arsenic (As)	13	75	15
Cobalt (Co)	34	150	30
Chromium (Cr)	210	**	**
Copper (Cu)	400	**	**
Molybdenum (Mo)	5	20	4
Nickel (Ni)	62	180	36
Selenium (Se)	2	14	2.8
Zinc (Zn)	700	1850	370
Other			
Cadmium (Cd)	3	20	4
Mercury (Hg)	0.8	5	1
Lead (Pb)	150	500	100

* These concentrations are the existing standards under the Canadian Food Inspection Agency's Standards for Metals in Fertilizers and Supplements, September 1997 (Trade Memorandum T-4-93).

** Limits for copper and chromium are not established in the Trade Memorandum. Calculated in the same manner as limits for the other nine elements, the trace element additions to soil for chromium and copper would be: chromium = 210 kg/ha and copper = 150 kg/ha for the trace element concentrations within the compost product , chromium = 1060 mg/kg and copper = 757 mg/kg. Details of these calculations are in 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".

*** Concentrations of other elements may eventually be regulated in certain provinces to accommodate regional and national concerns.

3.3 Foreign Matter in Compost

Foreign matter detracts from good quality compost. As most compost feedstocks and products contain foreign matter, the following quality criteria are important to protect human health, and to be an incentive for source separation of residuals or sorting out of foreign matter in the final product.

a) Sharp Foreign Matter

Category A - Compost shall not contain any sharp foreign matter of dimension greater than 3 mm per 500 ml.

Category B - Compost shall have a sharp foreign matter content less than or equal to three (3) pieces of sharp foreign matter per 500 ml, and the maximum dimension of the sharp foreign matter shall be 12.5 mm. However, this compost shall not be used in pastures, parks or for residential purposes.

b) Other Foreign matter

Category A - Compost shall contain no more than one (1) piece of foreign matter greater than 25 mm in any dimension per 500 ml.

Category B - Compost shall contain no more than two (2) pieces of foreign matter greater than 25 mm in any dimension per 500 ml.

3.4 Maturity/Stability of Compost

Characteristics of mature and stable compost include biostabilization and humus formation. Guidelines for compost maturity are necessary as unstable/immature product has the potential to cause adverse effects on plants when applied in large amounts or attract vectors, such as flies, and to cause odours.

Compost shall be mature and stable at the time of sale and distribution. To be considered mature and stable, a compost shall be cured for a minimum of 21 days and meet one of the following three requirements:

a) the respiration rate is less than, or equal to, 400 milligrams of oxygen per kilogram of volatile solids (or organic matter) per hour; or,

b) the carbon dioxide evolution rate is less than, or equal to, 4 milligrams of carbon in the form of carbon dioxide per gram of organic matter per day; or,

c) the temperature rise of the compost above ambient temperature is less than 8 °C .

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 a risk to human health. 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 compost contains ***only yard waste*** 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 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. Organism content shall meet the following:

   Fecal coliforms[2] < 1000 most probable number (MPN)/g of total solids calculated on a dry weight basis,

   AND

   No *Salmonella* sp. with a detection level < 3 MPN/4g total solids calculated on a dry weight basis.

[2] Preliminary research suggests that some composts may have high fecal coliform counts due to bacteria of environmental origin and not of fecal origin. Thus, fecal coliforms may not be a reliable indicator of pathogen levels under all circumstances. In cases where high levels of fecal coliforms are suspected to be due to environmental contamination, additional analysis for *Escherichia coli* should be conducted. Use of *Escherichia coli* content as a direct indicator of pathogen levels is not yet supported by all regulatory agencies in Canada, but it may be used to help verify the reason for the high fecal coliform levels.

b) When compost contains ***other feedstock***, the following criteria shall be met:

1. Undergo a treatment (described in a),

   AND

2. Organism content shall meet the following:

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

   OR

   No *Salmonella* sp. with a detection level < 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 (including composting) and storage, some of these organic chemicals persist.

Some compost feedstocks may contain trace amounts of persistent[3] or bio-accumulating organic contaminants, such as dioxins, furans, pesticides, polychlorinated biphenyls (PCB), polycyclic aromatic hydrocarbons (PAH) or herbicides (e.g. clopyralid). The manufacturer should pay special attention to raw materials that might contain such contaminants. To this effect, it is recommended that the composting of raw materials with high contents of these contaminants be avoided.

However, given the low content of dioxin and furans in compost feedstock (Webber, 1996) and in composts produced in Canada (Groeneveld and Hébert, 2004), routine analysis under the CCME Guidelines is not considered necessary. The same also applies to PCB and PAH. For specific sampling requirements in each province or territory, contact the provincial or territorial authority having jurisdiction.

[3] The term "persistent" is used to indicate resistance to transformation (i.e. breakdown or degradation) in the environment. A compound is considered persistent in soil or aquatic systems when its half-life (T ½) or its time for 50% decline or disappearance is greater than 180 days.

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 0413-200-2005 – Organic Soil Conditioners – Composts. (Amendements organiques – Composts.)

CAN/BNQ 0413-210-2005 – Organic Soil Conditioners – Composts – Determination of Foreign Matter Content – Sieving Method. (Amendements organiques – Composts – Détermination de la teneur en corps étrangers – Méthode granulométrique.)

CAN/BNQ 0413-210-2005 – Organic Soil Conditioners – Composts – Determination of Respiration Rate – Respirometric Method. (Amendements organiques – Composts – Détermination du taux de respiration – Méthode respirométrique.)

These publications are available at the Bureau de normalisation du Québec (BNQ).

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CENTRE D'EXPERTISE EN ANALYSE ENVIRONNEMENTALE DU QUÉBEC, Dénombrement des salmonelles ; méthode par tubes multiples. MA. 700 **–** Sal-tm 1.0, Ministère de l'Environnement du Québec, 2003, 19 p.
http://www.ceaeq.gouv.qc.ca/methodes/pdf/MA700Saltm10.pdf

Compost sampling and analysis protocols can also be found in *Test Methods for the Examination of Composting and Compost* (TMECC).

US COMPOSTING COUNCIL RESEARCH AND EDUCATION FOUNDATION (CCREF), and UNITED STATES DEPARTMENT OF AGRICULTURE (USDA), *Test Methods for the Examination of Composting and Compost*.
http://www.tmecc.org/tmecc/

Annex A

Maximum Acceptable Trace Element Contents in Category A Compost — No Net Degradation and Best Achievable Approach Concepts[4]

The **no net degradation** and the **best achievable approach** concepts are two different concepts that were considered for the determination of the maximum acceptable trace element contents in **Category A** compost.

The **no net degradation** concept referred to in *An International Survey of Composting Criteria* (Waste Conversion Incorporated, 1992) requires that the use of compost not change the regional background levels of trace elements in the receiving soils. In the *Review and recommendations for Canadian interim environmental quality criteria for contaminated sites* (1991), Environment Canada defines **background level** as "the concentration of a chemical substance occurring in a media removed from the influence of industrial activity at a specific site and in an area considered to be relatively unaffected by industrial activity."

The **no net degradation** concept generally recognizes that the maximum acceptable trace element contents in compost should be established by taking the arithmetic mean of measured background levels in a defined region and adding three standard deviations from the mean. For ***normal distributions***, 99 % of all trace element content results for samples from a region considered to be uninfluenced by industrial activities shall be below these maximum acceptable contents.

At the time of the first edition of this guideline (1996), measurements of background levels of trace elements were available only for the agricultural soils of Alberta, Ontario and Québec. Requirements based on the **no net degradation** concept were thus established using the highest values of background levels of soils obtained from these three provinces.

The **best achievable approach** concept favours the use of the best available technology to produce an end product. This concept is based on the fact that the best available technology (such as source separation) to produce the desired end product should be used to establish the requirements for maximum acceptable trace element contents in compost.

At the time of the first edition of this guideline (1996), data based on the **best achievable approach** concept was available in British Columbia's *Production and Use of Compost Regulation* (1993). The data specified in this regulation were derived from municipal solid waste residue and source separation management programs. In 2004, numbers for Cu and Zn were derived to allow composting of other feedstocks. For Cu, the value was raised from 100 to 400 mg/kg in order to allow composting of hog manure and municipal biosolids. Environmental justifications of trace element contents are found in Hébert and

[4] Adapted from Bureau de normalisation du Québec (2005)

Groeneveld (2003). For Zn, the concentration limit was raised from 500 to 700 mg/kg to allow composting of poultry and hog manure, and vermicomposting. The limits for poultry manure were based on CRIQ (1994) database values for manure and manure composts. It is important to note that both the **no net degradation** approach and the **best achievable technology** standards are policy-based criteria for compost products and are not based on risk assessment associated with local soil quality.

The following table presents maximum acceptable trace element contents for **Category A** compost established using the highest value derived from **no net degradation** and **best achievable approach** concepts.

Table 2 Maximum Acceptable Trace Element Contents for Category A Compost Using the Highest Value Derived from No Net Degradation and Best Achievable Approach Concepts.

Trace Element	Mean of Background Levels + 3 Standard Deviations			*No Net Degradation* Concept (1996)	*Best Achievable Approach* Concept	Maximum Acceptable Trace Element Content in Category A Compost
	Alberta	Ontario[1]	Québec[2]			
As		10		10	13[3]	13
Cd	1.6	3	2.5	3	2.6[3]	3
Co	14	25	34	34	26[3]	34
Cr	30	50	121	121	210[3]	210
Cu	29	60	48	60	400[4]	400
Hg	0.1	0.15	0.09	0.15	0.8[3]	0.8
Mo		2		2	5[3]	5
Ni	36	60	62	62	50[3]	62
Pb	20	150	68	150	150[3]	150
Se		2		2	2[3]	2
Zn	124	500	144	500	700[5]	700

NOTE — All results are expressed in milligrams per kilogram (dry weight basis).

1. Reference: Ontario Ministry of the Environment, 1989
2. Reference: Giroux, Rompré, Carrier, Audesse & Lemieux, 1992
3. Reference: British Columbia, 1993
4. Reference: Hébert and Groeneveld, 2003
5. Reference: Centre de recherche industrielle du Québec, 1994

Annex B

Maximum Acceptable Trace Element Contents in Category B Compost as outlined in Trade Memorandum T-4-93 [5]

Maximum acceptable trace element contents for **Category B** compost ensure that the cumulative trace element additions to soil will not exceed the requirements shown in the table below, assuming a wet basis annual application rate of 11,000 kg/hm² (1 hm^2 = 10,000 m^2 = 1 ha) of compost at 60% moisture content (equivalent to an oven-dried mass of 4,400 kg/hm^2 containing up to 5% total nitrogen) for a period of 45 years.

No maximum trace element content for Cu or Cr was retained for **Category B**, which corresponds to the absence of values indicated in "Trade Memorandum T-4-93" (CFIA, 1997).

Note that these values, except for As and Pb, are lower than «Exceptional quality» criteria derived by US EPA (1995) for municipal biosolids compost from a risk-based analysis.

Table 3 Maximum Acceptable Trace Element Contents for Category B Compost

Trace Element	**Maximum Cumulative Trace Element Addition to Soils* Based on *Table I* in "Trade Memorandum T-4-93",** kg/hm^2 (kg/ha)	**Maximum Acceptable Trace Element Content in Type *B* Compost Based on *Table II* in "Trade Memorandum T-4-93",** mg/kg (dry weight basis)
Arsenic (As)	15	75*
Cadmium (Cd)	4	20
Cobalt (Co)	30	150
Lead (Pb)	100	500
Mercury (Hg)	1	5
Molybdenum (Mo)	4	20
Nickel (Ni)	36	180
Selenium (Se)	2.8	14
Zinc (Zn)	370	1,850

* The maximum arsenic content in a compost in milligrams per kilogram is calculated as follows:

$$\frac{15\ \text{kg}/\text{hm}^2}{4400\ \text{kg}/\text{hm}^2\text{a} \times 45\ \text{a} \times 1\ \text{g}/1000\ \text{mg} \times 1\ \text{kg}/1000\ \text{g}}$$

[5] Adapted from Bureau de normalisation du Québec (2005)

References

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