

SUPPORT DOCUMENT FOR COMPOST QUALITY CRITERIA

**NATIONAL STANDARD OF CANADA
(CAN/BNQ 0413-200)
THE CANADIAN COUNCIL OF
MINISTERS OF THE ENVIRONMENT
(CCME) GUIDELINES
AGRICULTURE AND AGRI-FOOD
CANADA (AAFC) CRITERIA**

FOREWORD

The "Support Document for Compost Quality Criteria - National Standard of Canada (CAN/BNQ 0413-200) The Canadian Council of Ministers of the Environment (CCME) Guidelines and Agriculture and Agri-Food Canada (AAFC) Criteria" was made possible by an Agriculture and Agri-Food Canada (AAFC) and Environment Canada (EC) initiative. The *Centre de recherche industrielle du Quebec*, with the collaboration of organizations involved in the development of criteria for compost quality, was responsible for producing this document. We wish especially to note the vital contributions made by Ms. Suzanne Fortin (Agriculture and Agri-Food Canada), Ms. Nicole Folliet-Royte (Environment Canada), Mr. Daniel Lefebvre (*Bureau de normalisation du Quebec*), and all those who provided their valuable comments. For more information please contact:

Daniel Lefebvre
Bureau de normalization du Quebec (BNQ)
70, rue Dalhousie, bureau 220
Quebec (Quebec) G1K 4B2
Phone: (418) 644-9299
Fax.: (418) 646-3315

Nicole Folliet-Hoyte
Waste Treatment Division
Hazardous Waste Branch
Environmental Protection Service
Environment Canada
Ottawa, Ontario K1A 0H3
Phone: (819) 953-2822
Fax.: (819) 953-6881

Suzanne Fortin
Fertilizer Section
Plant Products Division
Agriculture and Agri-Food Canada
59 Camelot Drive
Nepean, Ontario K1A 0Y9
Phone: (613) 952-8000
Fax.: (613) 992-5219

TABLE OF CONTENTS

	PAGE
1.0 CONTEXT	1
2.0 MAJOR PARTICIPANTS	2
2.1 BUREAU DE NORMALISATION DU QUÉBEC	2
2.2 CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT	3
2.3 AGRICULTURE AND AGRI-FOOD CANADA	4
3.0 BACKGROUND INFORMATION	5
4.0 DEFINITION OF COMPOST	7
4.1 BNQ STANDARD	7
4.2 CCME POSITION	7
4.3 AAFC POSITION	7
5.0 CLASSIFICATION	8
5.1 BNQ STANDARD	8
5.2 CCME POSITION	9
5.3 AAFC POSITION	9
6.0 MAIN CRITERIA CONSIDERED FOR THE COMPOST STANDARDIZATION PROJECT	10
6.1 MATURITY	10
6.1.1 BNQ standard	10
6.1.2 CCME Position	11
6.1.3 AAFC Position	12

TABLE OF CONTENTS (continued)

		PAGE
6.2	<u>FOREIGN MATTER</u>	12
	<u>6.2.1</u> BNQ Standard	12
	<u>6.2.1.1</u> Evaluation of samples containing foreign matter	14
	<u>6.2.1.2</u> An additional method for evaluating foreign matter	15
	<u>6.2.2</u> CCME Position	15
	<u>6.2.3</u> AAFC Position	15
6.3	<u>TRACE ELEMENTS</u>	16
	<u>6.3.1</u> BNQ Standard	16
	<u>6.3.1.1</u> Approaches considered	16
	<u>6.3.1.2</u> Elements not considered	22
	<u>6.3.2</u> CCME Position	22
	<u>6.3.3</u> AAFC Position	22
6.4	<u>PATHOGENIC ORGANISMS</u>	26
	<u>6.4.1</u> BNQ Standard	27
	<u>6.4.2</u> CCME Position	28
	<u>6.4.3</u> AAFC Position	29
6.5	<u>ORGANIC CONTAMINANTS</u>	30
	<u>6.5.1</u> BNQ Standard	30
	<u>6.5.2</u> CCME Position	31
	<u>6.5.3</u> AAFC Position	31
7.0	<u>OTHER CHARACTERISTICS</u>	32
	<u>7.1</u> BNQ STANDARD	32
	<u>7.1.1</u> Organic Matter	32
	<u>7.1.2</u> Water	32
	<u>7.1.3</u> Excluded Parameters	32
	<u>7.1.3.1</u> pH	32
	<u>7.1.3.2</u> Electrical Conductivity	33
	<u>7.1.3.3</u> N, P ₂ O ₅ and K ₂ O Concentrations	33
	<u>7.1.3.4</u> Water Retention Capability	33

TABLE OF CONTENTS (continued)

	PAGE
8.0	
<u>REVISION OF THE NORMATIVE DOCUMENT</u>	33
<u>TABLE I:</u> TRACE ELEMENT CONCENTRATIONS IN SOIL, COMPOST OR FROM SLUDGE, ACCORDING TO SEVERAL DIFFERENT APPROACHES	
<u>TABLE II:</u> MAXIMUM TRACE ELEMENT CONCENTRATIONS FOR THE BNQ STANDARD'S THREE TYPES OF COMPOST	
<u>TABLE III:</u> MAXIMUM TRACE ELEMENT CONCENTRATION LIMITS FOR COMPOST ESTABLISHED BY THE CCME	
<u>TABLE IV:</u> MAXIMUM ACCEPTABLE CONCENTRATIONS OF METALS IN TREATED SEWAGE SLUDGE PRODUCTS, SEWAGE SLUDGE-BASED PRODUCTS OR OTHER BY-PRODUCTS, AND MAXIMUM ACCEPTABLE CUMULATIVE METAL ADDITIONS	
 <u>BIBLIOGRAPHY</u>	
<u>APPENDIX A:</u> CCME AND AAFC DISCUSSION PAPERS	
<u>APPENDIX B:</u> DEFINITIONS OF COMPOST AND COMPOSTING	

1.0 CONTEXT

During the past few years, the Canadian composting industry has been expanding, which has meant an increase in the number of composting sites and, consequently, in the quantity of compost produced from organic waste of diverse origins.

In Canada, many organizations are involved in the development of standards and regulations. In the area of compost and composting, Agriculture and Agri-Food Canada (AAFC) (through the Plant Products Division), the provincial and territorial governments (through the Canadian Council of Ministers of the Environment (CCME)), and the Standards Council of Canada (SCC) (through the BNQ) are all concerned with developing quality criteria. The necessity and feasibility of establishing safety criteria for compost have led AAFC, the CCME and the BNQ to collaborate in developing uniform criteria while retaining sufficient flexibility for the different organizations to work within their mandates and reach their objectives.

This innovative approach brings together two levels of government (the CCME and the AAFC), as well as the producers and the users of compost (the BNQ). The following three distinct outcomes will result from this approach:

- a national Canadian standard for the composting industry (BNQ);
- guidelines for compost (CCME); and
- the adoption of new mandatory criteria for compost (AAFC).

The five categories of quality criteria for compost considered by these three organizations are:

- maturity;
- foreign matter;
- trace elements;
- pathogenic organisms; and
- organic contaminants.

The objective of this document is to describe the scientific and non-scientific rationale for selecting the five categories of criteria used in developing the BNQ standard and the CCME and AAFC guidelines, and to describe the positions of these three organizations.

For each of the criteria considered, this document describes the point of view of the BNQ and the BNQ standard's parameters. The respective positions of both the CCME and AAFC follow.

This document, which is a collection of the available scientific and non-scientific arguments taken into consideration by the two task forces (13NQ and CCME), will also describe the process that led to the final version of the standard and the positions taken by both the CCME and AAFC.

2.0 MAJOR PARTICIPANTS

This section summarizes the mandates and objectives of the three main organizations involved in the development of standards, regulations and guidelines for compost.

2.1 BUREAU DE NORMALISATION DU QUÉBEC

In Canada, voluntary standardization activities are co-ordinated by the Standards Council of Canada (SCC), which represents the country within the International Standards Organization (ISO). Only five standards writing organizations, including the *Bureau de normalisation du Québec* (BNQ), are accredited by the SCC and have the authority to develop and introduce national standards for Canada.

The BNQ deals mainly with environmental, health, safety, construction and public works issues. Moreover, as an organization drafting standards (ODS) accredited by the SCC, the BNQ has been given primary responsibility over the following areas:

- soil amendments;
- organic fertilizers (with the exception of chemical fertilizers);
- arboriculture;

-
- fertilization;
 - greenhouse products;
 - treatment of municipal sewage; and
 - treatment and quality of municipal drinking water.

In November 1992, following a request from representatives of the composting industry, the BNQ informed the SCC that it would develop a national standard for compost within the scope of its responsibilities regarding soil amendments and fertilization.

This consensual standard will be applied on a voluntary basis and will be accompanied by a BNQ accreditation program that aims to verify, with the collaboration of laboratories accredited by the BNQ, whether products meet the standard's requirements. The BNQ's approval label will then be stamped on the products that meet the standard.

Compliance with these requirements does not necessarily mean that the product meets the additional requirements of certain government authorities, such as the AAFC and the CCME. Compost producers will be responsible for verifying whether their products meet the requirements of each provincial authority. However, this does not exclude the possibility that authorities may refer to certain aspects of the national standard upon its completion.

2.2 CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT

By the year 2000, Canada aims to divert 50 percent of its waste relative to 1988. The provinces and territories regulate, through provincial environmental legislation, the diversion and the beneficial use of waste. They therefore regulate both the production and the use of compost. All the provinces and territories have endorsed the 50 percent diversion goal through the Canadian Council of Ministers of the Environment (CCME).

During the past few years, interest in composting as an alternative for the management of the organic portion of waste has increased significantly in Canada. As a result, through a national committee, the CCME has begun developing national guidelines for the production and utilization of compost for all provinces and territories. The specific objectives of these guidelines are:

- to protect the environment and public health throughout the country;
- to encourage source separation of municipal solid waste in order to produce high quality compost;
- to develop harmonized, nation-wide compost standards that will accommodate various groups and diverse interests;
- to ensure consumer confidence by establishing national quality criteria for compost; and
- to ensure that composting is allowed to develop as a waste/resource management solution and as an environmentally conscious industry that diverts organic waste from landfills and incinerators.

The CCME guidelines have four criteria for compost quality and safety: maturity, foreign matter, trace elements and pathogenic organisms.

2.3 AGRICULTURE AND AGRI-FOOD CANADA

The Plant Products Division of Agriculture and Agri-Food Canada (AAFC) administers the *Fertilizers Act and Regulations* and, therefore, regulates fertilizers and supplements sold in Canada. All compost sold as a soil amendment or fertilizer is controlled and regulated under the Fertilizers Act. The Act requires that fertilizers and soil amendments sold in Canada be safe, efficacious and properly labelled. They must not pose a significant risk to humans, plants, animals or the environment when used according to the directions, and they must be efficacious when used for their intended purpose. Moreover, when random sampling and analysis of these products is conducted, they must meet the established criteria.

AAFC is currently working at adopting safety criteria from the BNQ standard in the *Fertilizers Act and Regulations*. AAFC anticipates including criteria for trace elements, pathogenic organisms and sharp objects. These requirements would then be detailed in a trade memorandum.

AAFC approach is based on the following considerations:

- The composting industry, through *l'Association québécoise des industriels du compostage* (AQIC), has requested that the BNQ standard be adopted under the Fertilizers Act.
- The criteria and procedures included in the BNQ standard were consensually developed by the standardization committee.
- The technical committee as well as the nation-wide public consultation were organized by the BNQ, which was also responsible for writing all the procedures in the minutes. These stages were successfully completed in accordance with the requirements of the SCC.
- By using the BNQ reference approach, whose standard's criteria were developed by the industry and made compatible with both AAFC and the CCME standards, AAFC ensures the highest possible degree of conformity between the standard and the Regulation.
- The BNQ is responsible for the development and monitoring of a compliance program, financed by the industry, which ensures that accredited compost continues to meet the standard's criteria. By referring to the BNQ standard in the Regulation, it is expected that AAFC and BNQ compliance programs will complement each other to a greater extent.

3.0 BACKGROUND INFORMATION

The end of 1992 marked the start of three activities concerning the development of quality criteria for compost.

The AQIC called on the BNQ to conduct a feasibility study on the development of a standard for compost. The results of the study confirmed the feasibility of and interest in developing a nationwide standard for the industry. But the establishment of a useful industry standard on compost quality would not be feasible without taking into consideration the existing regulations and guidelines at the federal or provincial level.

The BNQ set up a task force to develop a national compost standard that would protect both the environment and consumers, as well as promote the composting industry through the production of quality compost. The national committee on composting standardization comprised composting industry representatives, compost users, specialists, and representatives from the CCME and AAFC.

At the same time, the CCME set up another task force whose objective was the development of a national guideline on composting. This guideline must ensure the production of compost that is safe for both the user and the environment, and must, as far as possible, be harmonized with existing regulations.

Simultaneously, AAFC prepared safety criteria for pathogenic organisms and planned to review their safety criteria for metals.

In January 1993, Environment Canada (EC), AAFC and the BNQ met with representatives of the provincial and territorial organizations that regulate composting and compost activity. At this meeting, the organizations agreed to co-ordinate their efforts to develop criteria for compost quality that would, as far as possible, be harmonized throughout the country and that would be sufficiently flexible to recognize and respect the mandates and objectives of the different organizations involved.

The organizations in attendance also agreed to consider the following five categories of criteria on the quality and safety of compost: foreign matter, maturity, organic contaminants, pathogenic organisms and trace elements. Further criteria dealing with the quality of compost - organic matter, water content, etc. - were also considered by the BNQ standardization committee.

To facilitate harmonization of the compost quality criteria and to ensure the exchange of pertinent information between the two task forces (BNQ/CCME), a representative of AAFC, the CCME and the BNQ participated in the work of both committees. AAFC was involved in both task forces because the *Fertilizers Act and Regulation* requires that all products sold as fertilizers or as soil amendments must be safe, efficacious and properly labelled.

In 1993, draft documents on the five categories of criteria (trace elements, pathogenic organisms, organic contaminants, maturity and foreign matter) were prepared to sustain and stimulate discussion on these five main aspects of compost safety and quality. These five discussion papers were distributed to the provinces, the territories and the BNQ. The standardization committee used these papers as references during the process of developing the standard. A list of these

discussion papers is presented in Appendix A.

The work done by the BNQ, the CCME and AAFC will produce the following three documents: a normative document for the industry (the standard), CCME guidelines and an AAFC trade memorandum describing the criteria adopted under the Fertilizers Act.

4.0 DEFINITION OF COMPOST

"Composting" and "compost" are two distinct terms. The former refers to the bio-oxidation process and the latter refers to the resulting product: stabilized organic matter.

4.1 BNQ STANDARD

Within the scope of the standardization efforts for compost quality, and after consulting several references, it was decided that the definition of the term "compost" would include the notion of process so that it could correspond to AAFC terminology. Appendix B presents all the definitions that were taken into consideration at the committee level.

In the BNQ standard (P 0413-200/1995), the word "compost" is defined as follows:

"A solid mature product resulting from composting, which is a managed process of bio-oxidation of a solid heterogeneous organic substrate including a thermophilic phase. French: compost."

4.2 CCME POSITION

The definition of the words "compost" used by the CCME is identical to the above definition used by the BNQ.

4.3 AAFC POSITION

The Fertilizers Act defines "compost" as follows: "A homogeneous and friable mixture of partially decomposed organic matter, with or without soil," and as a synonym for humus and leaf mould. AAFC is aware that this definition no longer reflects the current composting activities in

Canada and is working to modify it. AAFC has suggested that since the definition of "compost" used in the BNQ standard corresponds to the concept promoted by AQIC, the provinces and other countries, it should be adopted by AAFC in accordance with the Fertilizers Act. The following is the definition of "compost" that AAFC anticipates adopting:

"A solid mature product resulting from composting, which is a managed process of bio-oxidation of a solid heterogeneous organic substrate including a thermophilic phase."

5.0 CLASSIFICATION

5.1 BNQ STANDARD

The implementation of a single class of compost, as well as the development of a multi-class approach, was considered and discussed at length by the standardization committee. The Committee reached a consensus to establish a standard comprising of more than one class.

A classification approach based on compost use (non restricted use and restricted use subject to a permit issued, or regulations determined, by regulatory authorities) was also considered by the members of the BNQ standardization committee.

For the five main criteria categories and for each type of compost, the Committee took the following into consideration when establishing the different acceptable limits:

- existing Canadian regulations, policies, laws and guidelines;
- existing scientific literature and technical information;
- compost safety;
- the agronomic value of compost;
- analyses of compost made in Canada;
- the needs, constraints and interests of compost producers;
- the compatibility of the approaches used by the various participants (the CCME, the AAFC and the BNQ);
- the requirements of environmental organizations, various experts and the many concerned stake holders, as expressed during the public consultation.

The BNQ standard, which comprises three types of compost, classifies the products in decreasing order of quality: Types AA, A and B. Globally, the recognition of Types AA, A and B compost is based on the level of compost quality and safety, and not on the end use of the product. The classification itself is based on the total organic matter, foreign matter and trace elements in the compost. The other criteria do not differ between the 3 classes of compost.

Compost classified as Types AA and A is of high quality, while the specified requirements for Type B compost are considered to be the minimum necessary to obtain a good compost. Because of its trace element content, Type B compost must be accompanied by appropriate use instructions when sold and distributed (*Bureau de normalisation du Québec 1995*).

Types AA and A compost have the same concentration limits for trace elements. All three types of compost have the same criteria regarding water content, maturity and pathogenic organisms.

5.2 CCME POSITION

Regarding trace element concentration, the CCME guidelines recognize two compost categories:

A and B. Category A compost can be used for all types of applications: on agricultural lands, in residential gardens, in horticultural operations, in nurseries or others. For trace elements, Category A criteria meet or are more stringent than the current CCME interim soil quality criteria for contaminated sites. Category A criteria for trace elements are achievable using source separated municipal solid waste feedstock

Category B compost may be subject to use restrictions. This compost may require authorization (control) when judged necessary by the provinces or the territories. For Category B compost, the provinces could develop sub-categories according to regional needs.

5.3 AAFC POSITION

AAFC recognizes the existence of only one class of compost. This class recognizes the importance of product safety, is based on the limits of Type B compost for trace elements and refers to the requirements of the standard on pathogenic organisms, maturity and the presence of sharp objects. This position represents the fact that AAFC, through the Fertilizers Act, establishes the minimum safety criteria for all compost sold as fertilizers or supplements in Canada.

6.0 MAIN CRITERIA CONSIDERED FOR THE COMPOST STANDARDIZATION PROJECT

6.1 MATURITY

The maturity of compost is an important characteristic to consider when evaluating the quality of the product, given the harmful effects of immature compost use on plant growth. The many CCME, BNQ and AAFC stakeholders have determined that maturity is an inherent compost characteristic: if the product of the composting process is not mature, the term "compost" cannot be used. This is why the term "mature" is included in the definition of compost as it is defined in the normative document.

The existing methods of evaluating compost maturity are numerous; but many of them are still being perfected. The complexity of interpreting results is one of the problems in choosing a method to evaluate compost maturity. Taking into consideration the current level of knowledge on compost maturity evaluation and the absence of a single test that can adequately evaluate this criterion, the standardization committee determined that the use of several indicators is still necessary to determine compost maturity.

6.1.1 BNO Standard

Taking into account the draft discussion paper prepared for the CCME and the AAFC (discussion paper no.3, Appendix A), the Committee considered and adopted three tests for the evaluation of compost maturity. In light of the existing technical information, the standardization committee concluded that there is no single test that is sufficiently trustworthy and scientifically valid to evaluate compost maturity adequately. The Committee therefore recognized the necessity of adopting more than one test to evaluate compost maturity.

The three tests to be used as compost maturity indicators are: C/N ratio, oxygen uptake, and germination and growth rates of plants. The interpretation of the combined and quantifiable results obtained with these methods provides sufficient indicators to determine compost stability levels and to evaluate the qualitative risk factors of using the compost on plants.

According to the BNQ standard, a compost will be deemed mature if it meets two of the following requirements:

- C/N ratio < 25;
- oxygen uptake rate < 150 mg O₂/kg volatile solids per hour; and

germination of cress (*Lepidium sativum*) seeds and of radish (*Raphanus sativus*) seeds in compost must be greater than 90 percent of the germination rate of the control sample, and the growth rate of plants grown in a mixture of compost and soil must not differ more than 50 percent in comparison with the control sample.

Initially, it was proposed that compost with a C/N ratio 25 should be acceptable providing the compost producer could provide valid written scientific proof to demonstrate the absence of negative effects on the germination seeds and the growth of plants. Since it is difficult for the BNQ to evaluate and interpret this type of information, it was suggested that two of the three criteria be required instead of eliminating the C/N ratio criterion.

6.1.2 CCME Position

The CCME suggests using the following tests or methods of analysis:

The requirements regarding the criteria and their limits are the same as those adopted by the BNQ standardization committee and which are already in existence in certain provinces. Two of the three following criteria must be met:

- a C/N ratio < 25;
- an oxygen uptake < 150 mg O₂/kg volatile solids per hour; and
- a germination and growth test using cress (*Lepidium sativum*) seeds and radish (*Raphanus sativus*) seeds, which demonstrates an absence of phytotoxic effects.

OR

- Compost will not reheat upon standing to greater than 20⁰C above ambient temperature; and
- compost must be allowed to mature for at least 21 days after the thermophilic phase is completed.

OR

- Reduction of organic matter must be 60 percent by weight; and
- compost must be allowed to mature for at least 21 days after the thermophilic phase is completed.

OR

- If no other determination of maturity is made, 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.

6.1.3 AAFC Position

For AAFC, a compost must be mature (stable) at the time of sale. AAFC believes that the three compost maturity test indicators described in the BNQ standard are acceptable and satisfactory.

6.2 FOREIGN MATTER

When developing an industry standard for compost quality, the presence of foreign matter in compost should be taken into consideration since it has a negative impact on consumers and on the composting industry in general. The consumers look for compost free of visible foreign matter or otherwise harmful foreign matter. In Canada, such compost has been manufactured for many years.

6.2.1 BNO Standard

The standardization committee established three different foreign matter mass content limits for Types AA, A and B compost.

After discussion, the standardization committee agreed that soil, sand, rocks and pebbles found in compost are not considered foreign matter. Foreign matter is defined in the BNQ standard as follows:

"Any matter over a 2 mm dimension that results from human intervention and having organic or inorganic constituents such as metal, glass and synthetic polymers (e. g., plastic and rubber) that may be present in the compost but excluding mineral soils, woody material and rocks."

To establish the minimum foreign matter size at 2 mm, the Committee took into consideration that, in geoscience, arable mineral soils are defined according to the distribution of mineral particles smaller than 2 mm for sand (2.0 to 0.05 mm), from 0.05 to 0.002 mm for silt and less than 0.002 mm for clay.

Moreover, for the practical identification of foreign matter, the Committee decided that particles measuring < 2 mm would not be considered foreign matter for the following reasons:

- it is difficult to identify foreign matter of < 2 mm in size and to determine its mass content; and
- the possible long-term effects of applying foreign matter of < 2 mm on soil were discussed but remain unknown and unexpected.

For the three types of compost, foreign matter of 2 mm in compost must meet the requirements indicated below:

	Type AA	Type A	Type B
Foreign matter content as a percentage of oven-dried mass	< 0.01	< 0.5	< 1.5
Foreign matter, maximum dimensions, in mm	12.5	12.5	25

Type AA compost must not, for all intents and purposes, contain any visible foreign matter (< 0.01 percent of the dry weight of the compost). This type of compost has already been commercialized (mostly in bags) by many compost producers in Canada.

To determine the maximum allowable mass percentages for Type A and Type B compost, the Committee evaluated two series of compost samples with varying types and quantities of foreign matter that were unknown to committee members. The evaluation procedure used by the Committee is described in Section 6.2.1.1.

All three types of compost (AA, A, B) must not contain sharp foreign matter, defined in the standard as follows:

"Any foreign matter measuring over a 3 mm dimension that may cause damage or injury to humans and animals during or resulting from its intended use."

Although the following items do not constitute an exhaustive list, they are the most common forms of sharp foreign matter:

- objects made mostly of iron or non-ferrous metal objects, such as utensils, electrical cords and appliances, pins, needles, staples, nails and bottle caps; and

- objects made of glass or porcelain, such as containers, dishes, glass panels, light bulbs, fluorescent light tubes, mirrors and broken glass.

In other words, the compost must not contain any sharp foreign matter measuring more than 3 mm.

6.2.1.1 Evaluation of Samples Containing Foreign Matter

Compost samples containing various quantities of foreign matter were prepared by the *Centre de recherche industrielle du Québec (CRIQ)*, thanks to the financial support provided by the *Consortium québécois sur le compostage* and AAFC. The objective of this procedure was to determine the relationship between the mass quantity of foreign matter and the visual aspect of compost.

In total, 49 compost samples (two independent series) with variable foreign matter content were examined by the Committee during two meetings, one held in February and the other in May 1994. The foreign matter, introduced according to compost dry-weight mass, included particles of heavy and light plastic, of glass and of metal measuring 2 to 25 mm in any dimension. All the samples were put into transparent plastic bags, numbered and placed on a table; the evaluators were not aware of the foreign matter content in the samples. The members present during the two evaluations then examined each sample and classified each one according to its apparent foreign matter content: Category A, Category B or as a product that should not be sold (rejected).

The members of the Committee were surprised to see the relatively uniform results achieved in the evaluations.

The visual evaluation of the samples brought out the following points:

There were no patterns to the results except for the foreign matter weight distribution as a percentage of the sample.

The Committee realized that the plastic content in compost could be better evaluated using dimensional limits and observation instead of weight. The Committee wanted to take into consideration the aesthetic, safety and market development aspects of compost but, after the first series of evaluations, it experienced some difficulties in determining dimensional and weight limits for foreign matter.

- The subjects of glass crushing, acceptable quantities and dimensions for plastic particles, as well as source separation, were all addressed. The foreign matter dimensional limit proved critical to the evaluation of foreign matter.

While knowing that the safety and aesthetic aspects could be evaluated by a visual examination, the necessity of determining a weight limit (percentage of foreign matter by dry weight) was discussed.

It is necessary to have a sampling protocol and a standardized test for the visual and physical examinations of samples. The effect of rain, the definition of the word "sharp" and the representativeness of the samples were also discussed.

6.2.1.2 An Additional Method For Evaluating Foreign Matter

The Committee recognized the complexity of using a method based on foreign matter mass proportion and, therefore, also studied the possibility of using a simple visual method. The latter would rely on a visual examination and the collection of foreign matter from compost sifted with the help of a series of standardized sifters. With this approach, there is more tolerance of foreign matter in compost.

A specific quantity of compost would be spread out on a smooth and squared surface in order to facilitate the counting of foreign matter. The evaluator would visually identify the presence of foreign matter and would determine, by means of a dozen compost samples, the dimensions of the foreign matter. This method was not adopted for the following reasons:

- the method should be developed and tested to determine its validity;
- standardized equivalent method does not exist; and
- the Committee did not reach a consensus on the adoption of such a method.

6.2.2 CCME Position

In the guidelines prepared by the CCME, mineral soils, sand, rocks and wood are not considered to be foreign matter. Both Category A and Category B compost must be virtually free of foreign matter that may cause nuisance, damage or injury to humans, plants or animals, during or resulting from intended use. The compost must not contain any sharp foreign matter measuring over 3 mm in any dimension or any foreign matter greater than 25 mm in any dimension.

The CCME position is based on concepts similar to those of the BNQ committee regarding tolerance limits for foreign matter.

6.2.3 AAFC Position

Compost must be free of harmful foreign matter that may cause harm or injury to humans, plants or animals, during or resulting from intended use. The compost must not contain any sharp

foreign matter measuring over 3 mm in any dimension. The AAFC position regarding foreign matter takes into consideration the product safety aspect by considering the level of tolerance for sharp objects; the aesthetic aspect of compost is not taken into consideration.

6.3 TRACE ELEMENTS

6.3.1 BNO Standard

Within the context of the work being done on standardization, a "trace element" is defined as:

"A chemical element present in compost at a very low concentration."

The trace elements considered by the Committee include those that are essential to plant growth (particularly Cu, Mo, Zn) and heavy metals which, depending on their concentration in the soil, could be harmful to human health and to the environment. Environmental and agronomical concerns regarding the presence of trace elements in compost vary according to the aspect under consideration. Evaluating the level of risk and the possible consequences to human and environmental health for each of the trace elements considered is complex and requires a great deal of expertise. Given these constraints, the BNQ standardization committee considered concepts whose respective principles led to maximum trace element limits in compost that vary depending on the concept being considered.

6.3.1.1 Approaches Considered

Before establishing the maximum acceptable trace elements limits for each of the three compost classes, the following three approaches were taken into consideration:

- no net degradation;
- no observable adverse effects level (NOAEL); and
- best achievable approach.

1) No net degradation

The no net degradation approach is based on the principle that product use (e.g., compost) does not affect the normal background level of toxic compounds in the environment. According to this approach, "toxic", "normal" and "background" are fixed terms that can be precisely defined.

The background is defined in an Environment Canada document (1991) as being "the concentration of chemical substances found in an environment removed from any source of industrial activity for a specific area and for a region considered to be relatively uninfluenced by industrial activity."

The no net degradation concept generally recognizes that the maximum acceptable trace element concentrations in compost should be calculated by taking the arithmetic average of the background levels and adding the equivalent of three standard deviations.

Of the three approaches taken into consideration, this one calculates the strictest critical limits. In Canada, the approach used to determine the critical limits for trace elements in compost is generally based on the concept of no net degradation or on a combination of the best achievable approach and the no net degradation approach.

2) No observable adverse effects level

The no observable adverse effects level (NOAEL) approach, also called the risk approach, is based on the following assumptions:

- there is sufficient information on trace element dynamics in the ecosystem to predict, with certainty, the acceptable levels of contaminants; and
- there are sufficient observations on the absence of adverse effects linked to applications of metals contained in the sludge of purification plants.

This information is used to establish critical limits for contaminants at levels that ensure the absence of adverse effects on the health of both humans and the environment.

Three major reasons justify why the Committee chose not to adopt this approach: the risk analysis is complex and costly, the methodology used to analyse risk is debatable and the limits obtained using this approach would be much more permissive than those obtained using the no net degradation approach.

3) Best achievable approach

The best achievable approach concept rests on the assumption that the best available technology for obtaining the desired final product should be used to define the maximum acceptable trace element concentrations in compost (*Bureau de normalisation du Québec* 1995). In line with this concept, British Columbia regulations (British Columbia, Waste Management Act 1993) regarding trace element concentrations in compost were established to encourage source separation management programs.

Analytical data from Alberta, Ontario and Quebec on trace element background concentrations in agricultural soils were made available to the CCME committee. Thus, these are the data that were used in considering metal standards. Table I presents trace element background concentrations in Canadian soils for the provinces of Quebec, Ontario and Alberta. Using an identical approach, the background concentrations for these three provinces were obtained by calculating the average trace element concentration in the soil and adding three standard deviations ($\bar{X} + 3 \delta$).

The Quebec data come from the analysis of the total amount of trace elements in Ap horizon topsoils taken from the 76 major soil series found in the 12 agricultural regions of Quebec. The analyses were conducted on samples ground to 100-mesh fineness and extracted with aqua regia (HCl + HNO₃) (Giroux et al. 1992).

The Ontario data come from the analysis of trace elements in rural soils taken at a depth of 0 to 5 cm. The analysis was conducted by the Laboratory Services Branch of the Ontario Ministry of the Environment in accordance with the standard techniques cited in Ontario, Ministry of the Environment, 1989.

For Alberta, the trace element data were obtained by analyzing agricultural soils taken at a depth of 0 to 15 cm (Alberta Environmental Protection 1994).

Table I also presents the trace element concentrations of the British Columbia Class I compost regulations, which were obtained using the best achievable approach (British Columbia, Waste Management Act 1993). The maximum acceptable limits suggested for use of sludge on agricultural land, which were calculated using the NOAEL approach and can be found in the (EPA) Regulation 503, are also presented in Table I (United States, Environmental Protection Agency 1992). Finally, the maximum acceptable concentration limits for products, according to AAFC's Trade Memorandum T-4-93, are also included in Table I.

Initially, the standardization committee decided to adopt the no net degradation approach for establishing the maximum trace element limits for Types AA, A and B. The Committee initially set the trace element concentration limits for Types AA and A based on the highest background concentrations for each of the trace elements found in soils in Alberta, Ontario and Quebec.

However, due to various considerations, the combined approach suggested by the CCME - no net degradation and best achievable approach - was adopted for Types AA and A by the Committee.

The adoption of this approach for trace element limits of compost of Types AA and A compost was based on the following considerations:

- the background concentrations for in-soil trace elements were provided by only three provinces;
- the comments made during the public consultation process;
- the adoption of the highest limits of the three provinces for which background concentrations were available may cause difficulties in staying true to the no net degradation concept because of the variations in background concentrations among provinces;
- the soil concentration that would result from compost with metals meeting British Columbia's best achievable approach may not actually conflict with the no net degradation;
- the adoption of maximum trace element limits for the micronutrients (Zn, Cu and Mo), from the no net degradation approach, generated low concentration limits in compost; and
- a consensus among AAFC, the CCME and the BNQ in establishing maximum trace element limits was always a desired objective.

The Committee is aware of the ensuing imperfections of such an approach and hopes that, if modifications are in order, they will be made as scientific data improve and become available.

TABLE I: TRACE ELEMENT CONCENTRATIONS IN SOIL, COMPOST OR FROM SLUDGE ACCORDING TO SEVERAL DIFFERENT APPROACHES

Trace Elements	Soil			Compost	Sludge	Products
	No Net Degradation (X + 3 _n)			Best Achievable Approach	No Observable Adverse Effects Level	Maximum Acceptable Concentration
	Quebec ¹ (mg/kg)	Ontario ² (mg/kg)	Alberta ³ (mg/kg)	British Columbia ⁴ (mg/kg)	EPA ⁵ Reg. 503 (mg/kg sludge, dry weight)	Agriculture Canada ⁶ T-4-93 (mg/kg)
As	---	10	---	≤ 13	75	75
Cd	2.5	3	1.6	≤ 2.6	85	20
Co	34	25	14	≤ 26	---	150
Cr	121	50	30	≤ 210	3,000	---
Cu	48	60	29	≤ 100	4,300	---
Hg	0.09	0.15	0.1	≤ 0.8	57	5
Mo	---	2	---	≤ 5	75	20
Ni	62	60	36	≤ 50	420	180
Pb	68	150	20	≤ 150	840	500
Se	---	2	---	≤ 2	100	14
Zn	144	500	124	≤ 315	7,000	1,850

■ Retained limits for Types AA and A compost of the BNQ standard

1 Giroux et al. 1992

2 Ontario, Ministry of the Environment 1989.

3 Alberta Environmental Protection 1994.

4 British Columbia, Waste Management Act 1993.

5 Folliet 1993.

6 Agriculture Canada 1991.

For BNQ standard Type B compost, the maximum acceptable concentration limits of trace elements come from AAFC Fertilizers Act (Trade Memorandum T-4-93). These limits have been in force for over 15 years: they were developed by a committee of experts that referred to the first version of the guide on the use of sludge on agricultural land prepared by the Ontario Ministry of Agriculture and Food (OMAF 1978). The OMAF document deals particularly with maximum acceptable soil additions for 11 trace elements (kg/ha). After analyzing the available information, AAFC committee revised the OMAF concentrations in 1980 and adopted those included in the Trade Memorandum T-4-93.

Table II presents the trace element concentrations adopted by the BNQ's standardization committee.

TABLE II: MAXIMUM TRACE ELEMENT CONCENTRATIONS FOR THE BNQ STANDARD'S THREE TYPES OF COMPOST

	Types AA AND A ¹	Type B ²
Trace Elements	Maximum trace element concentrations compost (mg/kg, air-dried mass)	Maximum trace element concentrations in compost per Trade Memorandum T-4-93 (mg/kg, air-dried mass)
As	13	75
Cd	3	20
Co	34	150
Cr	210	1,060
Cu	100	757
Hg	0.8	5
Mo	5	20
Ni	62	180
Pb	150	500
Se	2	14
Zn	500	1,850

Notes

1. Maximum acceptable concentrations for Types AA and A compost have been established using the less stringent requirements between the no net degradation and best achievable approaches.
2. Type B limits for maximum trace element concentrations in compost are based on the standards enforced by AAFC under Trade Memorandum T-493.
3. Current maximum permissible concentrations for Cr and Cu do not exist under the Fertilizers Act.

Source: *Bureau de normalisation du Québec* 1995.

6.3.1.2 Elements Not Considered

During the public consultation process, certain individuals expressed a need for limits on the maximum acceptable concentrations of some trace elements in compost, particularly iron (Fe), aluminium (Al) and boron (B). Based on the list established in the CCME and AAFC discussion paper, the standardization committee limited the number of trace elements addressed. The Committee decided to postpone the establishment of limits for these three elements (Fe, Al and B). Differences in speciation and bioavailability of the elements were also not addressed due to the fact that there is no precedent for these kinds of limits and because to investigate the possibility would have been expensive and very time consuming.

6.3.2 CCME Position

For the CCME, Category A trace element concentrations come from the maximum background concentrations derived from the arithmetic mean plus 3 standard deviations of rural and agricultural soils from Alberta, Ontario and Quebec, and from limits established through the British Columbia best achievable approach. This approach was adopted by the BNQ standardization committee for Types AA and A trace element concentrations in compost.

Other issues that were discussed include the following:

- cumulative application limits ultimately affect long-term soil trace element levels more than product quality standards;
- the no-net degradation and best achievable approach for the product quality are not based on risk assessment; and
- both the no-net degradation and best-achievable criteria ultimately lead to the source- separation on MSW.

Table III presents the maximum trace element limits proposed by the CCME for Categories A and B compost.

6.3.3 AAFC Position

AAFC's limits for trace elements in compost are those described in Trade Memorandum T-93. These limits have existed for over 15 years and no modifications of the existing numbers are currently being contemplated. There is, however, the possibility of additional elements being added to the list.

Table IV presents the maximum acceptable trace element concentrations in specified products from Trade Memorandum T-4-93. These limits were adopted by the standardization committee for Type B compost. Table IV also presents the maximum acceptable cumulative metal additions

to soil, as described in Trade Memorandum T-4-93.

Based on the maximum acceptable cumulative limits for metal additions to soil, the maximum acceptable trace element concentrations in compost were calculated by assuming an application rate of 4,400 kg/hm²/yr¹ of dry-weight compost, which may contain up to 5 percent of nitrogen (by dry weight) and 50 percent humidity, based on a 45 year-period.

¹ 1 hm² - 10,000 m² - 1 hectare

TABLE III: MAXIMUM TRACE ELEMENT CONCENTRATION LIMITS FOR COMPOST ESTABLISHED BY THE CCME

Trace Elements***	Category A	Category B*	
	Maximum trace element concentrations (mg/kg dry weight)	Maximum trace element concentrations within product (mg/kg dry weight)	Acceptable cumulative metal additions to soil (kg/ha)
As	13	75	15
Cd	3	20	4
Co	34	150	30
Cr	210	**	**
Cu	100	**	**
Hg	0.8	5	1
Mo	5	20	4
Ni	62	180	36
Pb	150	500	100
Se	2	14	2.8
Zn	500	1,850	370

* These concentrations are those described in AAFC Trade Memorandum T-4-93 (January 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 concentration within the compost product.

***Other elements, such as boron, manganese, aluminium, and iron, may eventually be regulated in certain provinces to accommodate regional and national concerns

Source: Canadian Council of Ministers of the Environment. "Guidelines for Compost Quality", part 1.1995.

As an example, the maximum acceptable cumulative addition for arsenic (As) is 15 kg/ha. If we were to apply 4,400 kg of dry weight compost/ha for 45 years, the maximum As concentration in compost would be calculated as follows:

$$\begin{aligned}
 \text{Maximum As concentration} &= \frac{\text{Maximum cumulative addition of As (kg/ha)}}{\text{Cumulative compost application (kg/ha)}} \\
 \text{(mg/kg)} & \\
 & \frac{15 \text{ kg/ha As}}{4,400 \text{ kg/ha-yr compost} \times 45 \text{ years}} \\
 & \frac{15 \text{ kg/ha As}}{198,000 \text{ kg/ha compost}} \\
 & \frac{15,000,000 \text{ mg/ha As}}{198,000 \text{ kg/ha compost}} \\
 & = 75 \text{ mg As/kg compost (75 ppm)}
 \end{aligned}$$

When the present standard was being developed, the maximum acceptable concentration limits for chromium (Cr) and copper (Cu) did not exist in the Fertilizers Act. As a result, the calculations for these two trace elements were done according to the equation used for the other trace elements (cumulative addition, application rate and period of application). The maximum acceptable limits for cumulative additions of chromium and copper, 210 and 150 kg/ha respectively, were taken from the OMAF document (1978), which was revised in January 1986. Based on the calculations presented above, the maximum acceptable cumulative addition limits are 1,060 mg/kg for Cr and 757 mg/kg for Cu.

The standardization committee adopted these two limits, which are presented in Table II for Type B compost.

TABLE IV: MAXIMUM ACCEPTABLE CONCENTRATIONS OF METALS IN TREATED SEWAGE SLUDGE PRODUCTS, SEWAGE SLUDGE-BASED PRODUCTS OR OTHER BY-PRODUCTS, AND MAXIMUM ACCEPTABLE CUMULATIVE METAL ADDITIONS

Metal	Maximum Acceptable Concentrations Within Product (mg/kg)	Acceptable Cumulative Metal Additions (kg/ha)
As	75	15
Cd	20	4
Co	150	30
Hg	5	1
Mo	20	4
Ni	180	36
Pb	500	100
Se	14	2.8
Zn	1,850	370

Source: Agriculture Canada, 1991.

6.4 PATHOGENIC ORGANISMS

The feedstocks used to make compost sometimes contains pathogenic organisms. As a result, the compost may also contain pathogenic organisms; this is a concern, given the possible ensuing health risks.

From a regulatory standpoint, two approaches exist for evaluating compost and sludge safety, as follows:

- the evaluation of processes to further reduce pathogens (PFRPs); and
- the criteria established in accordance with the product's precise biological specifications.

The ability to eliminate or diminish the number of pathogenic organisms was evaluated for a number of sludge treatment methods. PFRPs are processes that reduce the number of pathogenic organisms to an acceptable level. These processes specify the treatment standards for products (temperatures, time of exposure). These treatment standards were proposed by the U.S. EPA in 1979 and, since then, have been used by many organizations as a substitute for direct analysis of pathogenic organisms (Appendix A, discussion paper no.5, 1993).

The approach that identifies the type and number of pathogenic organisms in products bears no relation to the type of treatment and does not discriminate against any new processes. To reduce the cost inherent in these types of analyses, indicator organisms are used as substitutes for pathogenic organisms.

Finally, in order to ensure product safety, a combination of these two approaches can be used to detect the presence of pathogenic organisms in compost and in sludge (Appendix A, discussion paper no.5, 1993).

6.4.1 BNQ Standard

In the early stages of its work, the Committee took into consideration the combination of the two approaches (PFRPs with the faecal coliform and salmonellae count) and the use of two additional criteria for sludge-based compost (viruses and helminth ova).

The standardization committee faced a problem: PFRPs are linked to processes that must maintain a proper temperature for a specified time. Within the scope of the standardization efforts, these conditions are difficult to verify by analyzing the final product, which creates a problem determining if the compost complies with the standard.

Moreover, the standardization committee wished to give industry the necessary flexibility to develop new composting treatment methods that would allow for a further reduction in the number of pathogenic organisms.

Initially, the Committee adopted two additional criteria for sludge-based compost. But in the end, the requirements regarding pathogenic organisms became identical for all types of compost. This decision was made based in part on the fact that available evaluation methods for viruses and helminth ova are very costly, complex, not very sensitive and not always reliable. Moreover, the sophistication level of these methods of analysis limits the number of laboratories capable of conducting this type of analysis.

Therefore, for the three types of compost described in the BNQ standard, the pathogenic organism content must not exceed the following limits:

- the quantity of faecal coliforms must be < 1,000 MPN/g of total solids (oven-dried mass); and
- there can be no salmonellae present.

These organisms (faecal coliforms and salmonellae) serve as compost safety indicators with respect to the potential presence of pathogenic organisms in compost.

The limits proposed by the BNQ committee are based on USEPA limits and are in accordance with those proposed in the CCME's compost guidelines and with those included in the AAFC proposals.

6.4.2 CCME Position

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 Section A or B depending on the feedstock source.

A. When a compost does not contain feedstock known to be high in human pathogens, the following criteria shall be met:

1. The compost shall undergo the following treatment or other process recognized a equivalent by the relevant authority.

Using the **in-vessel composting method**, the solid waste shall be maintained at operating conditions of $55^{\circ}C$ or greater for three days.

Using the **windrow composting method**, the solid waste shall attain a temperature of $55^{\circ}C$ 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 solid waste will be maintained at operating conditions of $55^{\circ}C$ 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 not exceed the following:

faecal 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: faecal coliforms are good long-term indicators of pathogenic bacteria

B When compost contains feedstock known to be high in human pathogens, the following criteria shall be met:

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

AND

2. Organisms shall not exceed the following:

faecal 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

6.4.3 AAFC Position

For regulatory organizations to allow the sale and use of compost and sludge, these products must be safe, that is, they must not contain any pathogenic organisms or the type and number of such organisms must be reduced to an acceptable level. For the application activities and compliance with these requirements, the following limits have been retained:

- faecal coliforms < 1,000 MPN/g of total solids; and
- non-detectable salmonellae (< 3 MPN/4g total solids).

It should be noted that the requirements are the same as those adopted by the BNQ standardization committee and that they come from the U.S. EPA's sludge regulations.

6.5 ORGANIC CONTAMINANTS

There is likely a very high number of organic contaminants to be found in compost made from collected and treated industrial and household waste. Each year, the use of new compounds increases by a few thousand. Some of these compounds break down or undergo a transformation during the composting operations, while others remain stable. The presence of organic contaminants in compost used on soils could represent a potential risk to the environment and to the quality of crops intended for human or animal consumption.

6.5.1 BNQ Standard

The Committee decided that, at the present time, there is no valid reason for including organic contaminant criteria in the standard. This stance can be reconsidered and modified should any information or scientific findings justify a review.

In light of the results obtained during a study commissioned by the CCME and the AAFC (Appendix A, discussion paper no.1, 1993) on the current world-wide situation regarding organic contaminants (FIAPs and PCBs), the standardization committee did not adopt criteria for these compounds or for the following compounds: dioxins, furans, chlorinated benzenes, pesticides, organochlorines, ester phthalates, haloethers, nitrosamines, phenols, cresols, etc. The Committee's decision was based on the following considerations:

- Very little information exists on organic contaminants in Canadian compost. For Canadian sludge, data are limited and unreliable. Reliable data must be obtained to evaluate the risks associated with the application of these organic contaminants on soils (Appendix A, discussion paper no.1, 1993).
- Even if the current data do not allow for an evaluation of risk, it would seem that the concentrations of organic contaminants in sludge and compost of Canadian origin, and from elsewhere, are low and do not pose a significant risk to the food chain or the environment (Appendix A, discussion paper no.1, 1993). For one thing, the assimilation of PCBs in soil, through plants, is limited. Also, the compost analysis program conducted by AAFC, in 1993 and 1994, did not discover any traces of PCBs in the approximately 50 different composts that were evaluated.

The study on leaf and yard waste composting conducted in 1993 (Association of Municipal Recycling Co-ordinators 1993) presents the following information:

- With the exception of those for PCBs (0.5 mg/kg), no guidelines have been established for organic contaminants; but such guidelines could be developed in the future.

The data compiled on compost made with green waste show trace or non-detectable concentrations of the main organochlorinated pesticides. The concentrations of these compounds are generally found at the detection limit of the instruments used in this type of analysis.

Many commonly available and commonly used insecticides and herbicides are non-persistent; i.e., they quickly break down or disperse following their application. As a result, the residue concentrations in compost made from green waste (Canadian or American) are not of major concern.

6.5.2 CCME Position

The CCME decided that, at the present time, there is no valid reason to support the inclusion of organic contaminant limits in its document. This stance will be reconsidered and modified should any information or scientific findings justify a review.

The provinces and territories may wish to establish specific requirements for organic contaminants based on to feedstock source.

6.5.3 AAFC Position

The AAFC decided that, at the present time, there is no valid reason to support the adoption of criteria for organic contaminants in compost.

The compost and sludge sold in Canada are regulated by the AAFC in accordance with the Fertilizers Act and Regulation. For compost, organic contaminants can be evaluated on a case-by-case basis depending on the feedstock used.

NOTE: The CCME, the BNQ and AAFC all require further information on organic contaminants in Canadian compost. Therefore, a review, compilation and evaluation of research in this field is required. Special attention should be paid to dioxins, furans and pesticides.

During the development of the standard, the inclusion of limits on organic contaminants in compost could not be supported or justified by reference to the scientific data. However, this stance may have to be modified when scientific advancement in the field and new scientific data justify a review.

7.0 OTHER CHARACTERISTICS

In the area of safety and health concerns regarding the use of compost, the standard takes into consideration the following four categories of criteria: foreign matter, maturity, pathogenic organisms and trace elements. However, compost, which is primarily an organic soil conditioner, also has other characteristics by which its agronomic value can be evaluated.

7.1 BNQ STANDARD

7.1.1 Organic Matter

Organic matter content in compost is an important characteristic for evaluating product quality. For this reason, organic matter content in compost was adopted as a quality criterion by the standardization committee. For Types AA, A and B compost, the minimum total requirements for organic matter are 50, 40 and 30 percent, respectively.

7.1.2 Water

Compost water content is a criterion that was adopted by the standardization committee for the following reasons. By not establishing a critical limit for water content in compost, it is possible that Type AA compost, for example, would be sold containing high levels of water. This, in turn, would lead to a deterioration of the image of superior quality compost and thus appears undesirable from a standardization viewpoint. Moreover, it is desirable to limit the water content so the consumer does not buy (by weight) more water than dry matter (compost).

Therefore, for Types AA, A and B compost, the maximum acceptable water content - expressed as a percentage of the compost's humid mass - must not exceed 60 percent.

7.1.3 Excluded Parameters

The following characteristics were taken into consideration by the standardization committee, but were not adopted as indicators of compost agronomic value.

7.1.3.1 pH

Compost is primarily an organic soil conditioner and should be used with this in mind. The use of pure compost is not recommended. As a result, even if the pH analysis of compost provides useful information, it cannot be considered as a criterion for absolute quality when developing a compost standard. The standardization committee did not think it was relevant to include this

criterion in the standard.

7.1.3.2 Electrical Conductivity

Electrical conductivity in compost provides interesting information on the presence of soluble salts. Potassium, magnesium, calcium and sodium cations particularly come to mind, as do anions, such as chlorides and sulphates. Some of these ions are essential to plant growth (K, Ca, Mg) while others are often undesirable (Na). Even if the electrical conductivity of a compost has a tendency to increase as its fertilizing value increases, this parameter does not provide information as to the nature of the ions in play. For this reason, the standardization committee decided not to use electrical conductivity as a quality criterion for compost.

7.1.3.3 N, P₂O₅ and K₂O Concentrations

The concentration of major fertilizing elements in compost is also a criterion to be taken into consideration when evaluating the agronomic value of compost. However, it is extremely difficult and arbitrary to establish reference values for N, P₂O₅ and K₂O for each compost type, since the fertilizing role of compost, although not negligible, seems of secondary importance. Therefore, a compost with 0.5 percent N, P₂O₅ and K₂O is not as rich as a compost with 1 percent, but on the basis of these values, it would be difficult to justify the exclusion of a compost type for this reason. As a result, this criterion is excluded from the standard.

7.1.3.4 Water Retention Capability

Compost water retention capability is an interesting element to consider when evaluating the quality of compost. This criterion was briefly addressed during discussions and could be taken into consideration within the scope of possible future standardization efforts.

8.0 REVISION OF THE NORMATIVE DOCUMENT

Given the currency of the subject dealt with in this support document, and given the urgency of receiving an indication of how the current standard should be used, the BNQ agreed to put the standard to the test by applying it for a period of two years. The benefits derived from experience could guide the BNQ in eventually confirming the validity of the trials and in specifying requirements. At the end of this period, the standardization document will be revised, if necessary, taking into consideration the suggestions and comments received.

The BNQ is relying on the users to bring to its attention all comments and suggestions that could improve the standard.

BIBLIOGRAPHY

- Agriculture Canada. "Metal Concentrations in Processed Sewage and By-products", Trade Memorandum T-4-93. January 2, 1991. P.3.
- Agriculture Canada and Environment Canada. "Proceedings of the Federal-Provincial-Territorial Meeting on Compost and Sludge Regulations". Ottawa, Canada: 1993. P.23.
- Alberta Environmental Protection. "Trace Element Concentrations in Alberta Agriculture Soils". Summarized File Data, Soil Protection Branch. 1994.
- Association of Municipal Recycling Co-ordinators. "AMRC Leaf and Yard Waste Composting Study,. Part 1: A Review of Composting Principles and Municipal Programs". April 1993. P. 145.
- Bureau de normalisation du Quebec. "Amendments organiques - Compost". P 0413-200. 15 mai 1995. P.7.
- British Columbia, "Waste Management Act: Production and Use of Compost Regulation". British Columbia Regulation 334/93. November 19, 1993. P.15.
- Canadian Council of Ministers of the Environment. "Guidelines for Compost Quality", part 1. 1995.
- Environment Canada. "Revue et recommandations pour les criteres provisoires canadiens de qualite' environnementale pour les lieux contamines". Etude no.197, Serie scientifique, Direction generale des eaux interieures, Direction de la qualite' des eaux. Ottawa, Ontario. P. 183.
- Folliet, N., S. Fortin and D. Lefebvre. "National Compost Standards", in *Composting* 1994, The Composting Council of Canada. Toronto, Ontario: October 13 and 14, 1994. P.1-8.
- Giroux, M. et al. "Caracterisation de la teneur en metaux lourds totaux et disponibles des sols du Quebec". Agrosol V (2), Service de recherche en sols, Ministere de l'Agriculture des Pecheries et de l'Alimentation, 1992. P.46-55.
- Ontario, Ministry of the Environment & Upper Limit of Normal; Contaminant Guidelines for Phytotoxicology Samples. Phytotoxicology Section, Air Resources Branch ARB- 1 38-88-Phyto. March 1989. P.7.
- Ontario, Ministry of Agriculture and Food, Ministry of the Environment and Ministry of Health. "Guidelines for Sewage Sludge Utilization on Agricultural Lands". April 1978. Revised January 1986. P.29.
- Ontario, Ministry of Agriculture and Food and Ministry of the Environment. "Guidelines for Sewage Sludge Utilization on Agricultural Lands". Prepared by the Sludge and Waste Utilization Committee. October 1992. P.32.
- United States, Environmental Protection Agency. "Standards for the Use or Disposal of Sewage Sludge". Regulation no.503. Final. November 25, 1992.

Waste Conversion Inc. "An International Survey of Composting Criteria". An Internal Report for Environment Canada, Solid Waste Division, Contract no. KE 144-1-6173. Ottawa, Ontario. August 1992. P.96.

APPENDIX A

CCME AND AAFC DISCUSSION PAPERS

Environment Canada. "CCME Discussion Paper on Regulations for Trace Element Concentrations in Compost". Draft no.2. Hull, Quebec: May 1994. (Original paper prepared by Nicole Folliet, Environment Canada, April 1993.)

Environment Canada. "CCME Discussion Paper on Regulations for Pathogenic Organisms in Compost". Draft no.2. Hull, Quebec: May 1994. (Original paper prepared by Suzanne Fortin, Agriculture and Agri-Food Canada, Ottawa, Ontario, April 1993.)

Environment Canada. "CCME Discussion Paper on Regulations for Foreign Matter in Compost". Draft no.2. Hull, Quebec: May 1994. (Original paper prepared by Dr. Sukhu Mathur, Compost and Peat Specialist Inc., Kanata, Ontario, for Agriculture and Agri-Food Canada, April 1993.)

Environment Canada. "CCME Discussion Paper on Regulations for Compost Maturity". Draft no.2. Hull, Quebec: May 1994. (Original paper prepared by Dr. Sukhu Mathur, Compost and Peat Specialist Inc., Kanata, Ontario, for Agriculture and Agri-Food Canada, April 1993.)

Environment Canada. "CCME Discussion Paper on Regulations for PCB Contaminants in Municipal Compost". Draft no.2. Hull, Quebec: May 1994. (Original paper prepared by Dr. Mel Webber, Waste Water Technology Centre, Burlington, Ontario, for Agriculture and Agri Food Canada, Ottawa, Ontario, April 1993.)

NOTE: The original papers were prepared with the objective of introducing the subjects for discussion and to stimulate communication within the CCME and BNQ task forces regarding quality parameters for compost. These papers were revised in 1993 and in 1994.

APPENDIX B

DEFINITIONS OF COMPOST AND COMPOSTING

"Compost: A homogeneous and friable mixture of partially decomposed organic matter, with or without soil. According to the Act, compost, leaf mould and humus all have the same definition." (Agriculture Canada 1986)

"Compost: A homogeneous and friable mixture comprising essentially stabilized organic substances (that are no longer decomposing)." (Environmental Choice 1992)

"Compost: The material produced by an aerobic composting process, which can be used as soil amendment, or for other similar uses. Simple exposure of solid organic waste under non-engineered conditions resulting in uncontrolled decay is not considered to be composting and will not be permitted." (Ontario, Ministry of the Environment)

"Composting: An aerobic biological process, conducted under controlled, engineered conditions designed to decompose and stabilize the organic fraction of solid waste." (Ontario, Ministry of the Environment)

"Compost: The product from the composting of organic components of municipal solid waste which is used or sold for use as a soil amendment, artificial topsoil, growing medium or other applications to land." (British Columbia, Ministry of Environment)

"Composting: The biological decomposition of organic municipal solid waste under controlled circumstances to a condition sufficiently stable for a nuisance-free storage and for safe use in land application." (British Columbia, Ministry of Environment)

"Composting: The aerobic thermophile degradation of organic matter to make compost." (United States, Solid Waste Composting Council)

"Composting: An officially controlled method or operation whereby putrescible solid wastes are broken down through microbic action to a material offering no hazard or nuisance factors to public health or well-being." (Alabama)

"Compost: Solid waste which has undergone biological decomposition of organic matter, and has been disinfected using composting or similar technologies, and has been stabilized to a degree which is potentially beneficial to plant growth and which is used or sold for use as a soil amendment, artificial topsoil, growing medium amendment or other similar uses." (Florida, Louisiana, Mississippi)

"Composting: The process by which biological decomposition of organic solid waste is carried out under controlled aerobic conditions, and which stabilizes the organic fraction into a material which can easily and safely be stored, handled and used in an environmentally acceptable manner. The presence of anaerobic zones within the composting material will not cause the process to be classified as other than composting. Simple exposure of solid waste under uncontrolled conditions resulting in a natural decay is not composting." (Florida, Louisiana, Mississippi)

"Composting: The biological decomposition of organic waste under controlled conditions." (Idaho)

"Composting: The process in which organic solid waste is biologically decomposed under controlled conditions to yield a nuisance-free humus-like product." (Maryland, Pennsylvania)

"Composting: The controlled aerobic, thermophilic, microbial degradation of solid organic material such as raw or treated sewage sludge, animal manure, paunch manure, plant or food residue or their mixtures, to a stabilized, humus-like material." (Nebraska)

"Compost: Stabilized and sanitized product of composting which is beneficial to plant growth. It has undergone an initial rapid stage of decomposition and is in the process of humification." (Zucconi and de Bertoldi 1987)

"Urban Compost: A mixture of predominantly household solid waste which has undergone, during the manufacturing process, a natural heating of its mass to a temperature of 60⁰C or more during a period of at least four days and preceded or followed by certain mechanical operations (sorting, crushing, shredding, iron removal, sifting, etc.)." (France, Standard NF U 44-051, 1981)

"Compost: All organic matter (animal or vegetable), with or without additives (organic or inorganic), having undergone, by means of aerobic micro-organism action, an increase in temperature (40⁰C) and a more or less advanced organic matter stabilization (humification)." (Potvin and Cloutier 1989)

"Compost: Organic conditioner obtained by fermenting a mixture mostly comprising, initially, a variety of vegetable residues and, eventually, animal-based organic matter, and having limited mineral matter content." (ISO standard 8157-1984)

"Compost: Organic soil conditioner obtained by decomposition of a mixture consisting mainly of various vegetable residues, occasionally with organic materials of animal origin, and having a limited mineral content." (ISO standard 8157-1984)