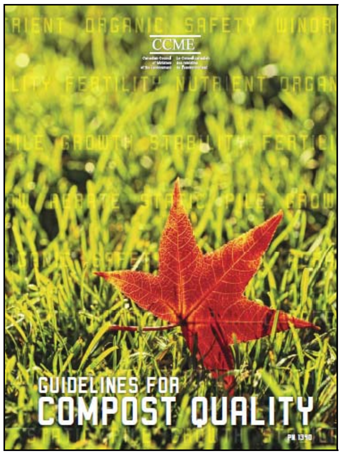
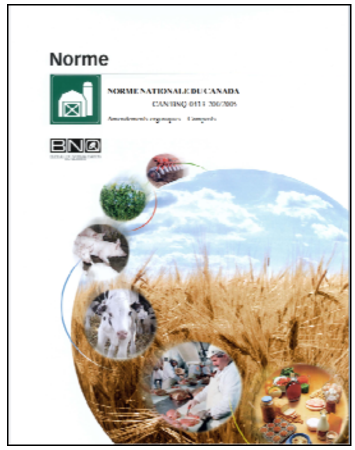
BNQ and CCME compost quality standards

How were they defined?





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Abstract

The Canadian Council of Ministers of the Environment (CCME) compost quality guidelines and the Bureau de normalisation du Québec (BNQ) national voluntary standard have become widely-accepted compost quality references in Canada. They have contributed to the development of the composting industry and fostered increased harmonization within the Canadian federation. It is important to document and review how these standards were developped and by whom.

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1- Once upon a time…

Twenty years ago, following a request from the Association québécoise des industriels du compostage (AQIC), the BNQ created a working group aimed at developing national environmental and consumer protection compost standards and promoting the compost industry through the production of high-quality compost (BNQ, EC and AAFC, 1996). With this in mind, the BNQ solicited the participation of organizations from across the country to represent compost manufacturers, users, and other stakeholders such as scientists and government representatives (Table 1). The three sub-groups were tasked with developing consensus around each of the selected criteria. The development of a BNQ standard and its voluntary application by industry also presupposed that there would be a public consultation, in accordance with the requirements of the Standards Council of Canada (SCC).

Concomitantly, spurred by Environment Canada, the Canadian Council of Ministers of the Environment (CCME) also formed a compost committee, which was primarily comprised of government representatives. It was mandated to create inter-provincial harmonization with the Canadian Food Inspection Agency (CFIA). The CFIA, which at that time was part of Agriculture and Agri-Food Canada (AAFC), also wanted to update its normative compost framework.

In order to facilitate dialogue, it was agreed that three government bodies would sit on both committees (CFIA, Environment Canada, and the Québec MDDELCC). The BNQ and CCME committees met on parallel schedules over a period of more than three years and published their respective documents in 1996. These 1996 guidelines/standards were centered on compost quality and environmental protection and dealt mainly with the following parameters: a) inorganic trace elements, b) organic trace compounds, c) pathogens, d) maturity, e) foreign matter, and f) definitions. They covered all types of compost, including urban residuals.

TABLE 1

CAN/BNQ 0413-200 standard committee members (and collaborators*)

Stakeholder	Description	1996 standard[1]	2005 standard
Canadian Food Inspection Agency (CFIA)	User/other	√	√*
All Treat Farms	Manufacturer	√	√
Association québécoise des industriels du compostage (AQIC)	Manufacturer	√	√
Centre de recherche industrielle du Québec (CRIQ)	Other	√	√
Compost Council of Canada (CCC)	Manufacturer	√	√
Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques (MDDELCC)	Other	√*	√
FoodShare (Toronto)	User	-	√
British Columbia Ministry of Water, Land and Air Protection	Other	-	√
Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec (MAPAQ)	User	-	√
Envirem Technologies Inc.	Manufacturer	-	√
Earth Tech Inc.	Manufacturer	-	√
Miller Composting Corporation	Manufacturer	-	√
Hole's Greenhouses & Gardens Ltd.	User	-	√
A&L Laboratories	Other	-	√
M.D. Webber Environmental Consulting	Other	-	√*

1–Other stakeholders for the 1996 standard only: Consortium sur le développement du compostage au Québec, Union des producteurs agricoles du Québec (UPA), Environment Canada, Conporec, Biomax, Paul Taylor Compost Management, Consolidated Envirowaste Industries Inc., Sukku Mathur, Edmonds Landscape Services

2- Type A or B?

Initial considerations included nomenclature and whether to define a single or multiple categories of compost. The CCME committee decided on two categories: Type A would be "very good compost" with a very low level of contamination and have no special use restrictions. Type B would be "good compost," with higher permitted levels of trace elements and foreign matter contamination and could be subject to specific provincial spreading restrictions. This approach allowed for rational risk management while incentivizing manufacturers to continuously improve their procedures and aim to produce Type A compost.

The national BNQ committee adopted the CCME approach but went even further, defining an AA type of compost that was more restrictive with regard to contamination by foreign matter. The 1996 Canadian standard (CAN/BNQ 0413-200) also took into consideration other criteria, unrelated to environmental protection, which will be discussed below.

3- Review work

The CAN/BNQ committee partially reviewed the 0413-200 standard in 1997 and then more comprehensively at the beginning of the 2000s, with a partially recast membership (Table 1). This initiative was initially funded by the Compost Council of Canada (CCC) and the Government of Quebec. The CCME also reactivated its compost committee. The concomitant work led to the publication of second-generation harmonized criteria in 2005 (BNQ, 2005a; CCME, 2005).

The following sections specify how choices were made with respect to various parameters and criteria, including their evolution over time. The entire body of numerical criteria is not included in detail here, but this information is available in the BNQ and CCME publications.

4- Heavy metals and other inorganic trace elements (ITE)

a) Which parameters should be analyzed?

Few people know this, but compost quality standards in Canada are heavily based on municipal biosolids spreading practices. Large-scale application of treated sludge foreshadowed composting. In fact, as early as 1978, the Government of Ontario produced a guide to agricultural sludge spreading that called for regular monitoring of the following 11 inorganic trace elements: arsenic, cadmium, cobalt, chromium, copper, mercury, molybdenum, nickel, lead, selenium and zinc. This list, based on characterization studies of municipal sludge, was used in the 1996

CCME and BNQ compost criteria and was reconfirmed in 2005. The list is also very similar to currently used guidelines in Europe and in the United States.

b) Origin of numerical criteria for ITE in Type B compost (restricted use)

The main difference between Type A and Type B compost lies in their maximum permitted concentrations of inorganic trace elements (ITE). To define Type B compost, the BNQ committee adopted, in their entirety, the 1992 CFIA criteria (which were based on the 1978 Ontario sludge approach). More technical details are given in the box below:

The origin of Type B inorganic trace element (ITE) criteria can be found in the 1978 Ontario approach used for municipal sludge, which aimed at preventing excessive soil enrichment through repeated application. The Ontario government had initially established maximum ITE concentrations for receiving soils. With respect to ITE deemed most toxic, such as cadmium and arsenic, a group of experts had established that the acceptable soil concentration should be twice the average natural concentration in farmland, expressed in mg/kg. On the other hand, soil concentration of 4 to 8 times the average natural concentration was to be tolerated for ITE that were useful to plant life or deemed less hazardous, such as cobalt and zinc. The differences between acceptable maximum and average soil concentration levels was first calculated in mg of ITE/kg of soil. Then, by factoring in sludge seepage to a determined soil depth, acceptable cumulative loads were set (in kg of ITE/hectare). Having set a ceiling on sludge spreading based on nitrogen contribution, the Ontario government could mathematically derive an acceptable ceiling for ITE in municipal sludge, in mg/kg. These concentrations, coupled with spreading restrictions, made it possible to constrain soil accumulation below acceptable thresholds in the long term (approximately 45 years).

The Canadian Food Inspection Agency (CFIA), then part of AAFC, published its T-4-93 Memorandum (Standards for Metals in Fertilizers and Supplements) in 1980. In brief, the CFIA adopted or adapted the acceptable Ontario soil load (kg inorganic trace elements/ha). Then, based on the planned rate of spreading for each type of fertilizer or organic soil conditioner over a period of 45 years, the CFIA calculated ceilings for ITE in various commercial products (mg/kg, dry weight). However, no criteria were retained by the CFIA for Cu and Cr, owing mainly to the fact that these are essential trace elements for plant and animal life. Cadmium limits were increased, taking into account the relatively high concentration of this element in phosphate mineral fertilizers. When it published a new edition of the T-4-93 Memorandum, the CFIA specified compost concentration ceilings (mg/kg) based on a spreading rate of about 4.4 dry tonnes/hectare/year (equivalent to 22 dry tonnes/hectare/5 years).

In 1996, the CCME also adopted the CFIA approach, with some minor exceptions. This meant that, as of then, there existed consistency throughout Canada between the CCME, the BNQ, and the CFIA with regards to maximum levels of inorganic trace elements for Type B compost. These criteria were retained in 2005 and are somewhat similar to U.S. "Exceptional Quality" standards for biosolids composts (US-EPA, 1993).

c) Origin of ITE criteria for Type A compost (unrestricted use)

Defining concentration ceilings for Types A (and AA) compost became a much more difficult task. At the beginning of the process, achieving consensus on a "risk management philosophy" turned out to be most difficult of all. As significant amounts of this compost could be applied on the same soil, more than type B (restricted use), some committee members were of the opinion that inorganic trace element concentrations in Type A compost should never exceed statistically normal soil levels. This "no net degradation" approach was particularly popular at that time in Ontario and in some European countries. Other stakeholders, like the Association québécoise des industriels du compostage (AQIC) and the British Columbia Ministry of the Environment, deemed this approach unrealistic for compost made from domestic residues and municipal biosolids. They instead supported a "best achievable technology" approach to the issue. In the end, there was also support for concentration ceilings based on scientific risk analysis, such as the Exceptional Quality (unrestricted use) sludge compost in the United States. This last approach implied, however, the use of some values that exceeded those already retained for Type B sludge, in particular those relating to cadmium. A detailed discussion of these approaches can be found in the appendices to the BNQ and CCME 2005 publications.

The need to find consensus within the BNQ multi-stakeholder committee resulted in combining the "no net degradation" approach (approximately the 98^{th} percentile of Canadian soils) with the "best achievable technology" approach based on B.C. criteria for source separated organic (SSO) compost. For each inorganic trace element, the higher of the two values generated by the two approaches was selected, including for Cu and Cr. The CCME then endorsed these consensus-based agreements.

In the 2005 versions of the BNQ and CCME Type A compost criteria, the concentration ceilings for Cu and Zn were increased in order to achieve improved consistency with “best achievable technology” for compost produced from animal manures and biosolids. However, all ITE criteria in Type A compost remained similar to several European standards, and were substantially lower than the American risk-based standards for Exceptional Quality sludge compost.

Over the years, several Canadian provinces adopted/adapted BNQ/CCME Type A and B ITE limits in their respective compost guidelines or standards. Québec in particular made good use of the Canadian consensus to define its own C1 and C2 categories, which also applied to other residuals such as biosolids. For the C2 category, a 22 dry tonnes/hectare/5 years loading limit enabled the CFIA requirements for commercial products to be met.

5- Dioxins and furans

The 1996 first editions of the BNQ and CCME compost standards did not include organic trace compound (OTC) requirements, because of the lack of adequate scientific information. The matter was reviewed in the early 2000s, since at that point in time the CFIA was using a criterion of 27 ng TEQ/kg for dioxins and furans for all composts.

A survey revealed however that concentrations of dioxins and furans in Canadian compost were generally low, particularly with biosolids compost (Groeneveld and Hébert, 2003). There was thus no justification for including this parameter. In addition, the cost of analysis was very high. Moreover, the validity of the CFIA criterion remained debatable, since it was equivalent to a soil criteria used in Maine and that state tolerated much higher concentrations in composts with restricted applications.

6- Other organic trace compounds (OTC)

The compost survey (Groeneveld and Hébert, 2003) also revealed very low concentrations of other persistent and/or legacy organic compounds, such as polycyclic aromatic hydrocarbons (PAH) and co-planar polychlorinated biphenyls – the most toxic of PCBs. In addition, composting was a process recognized for degrading less persistent organic compounds, including a majority of pharmaceutical and personal care products and herbicides. Consequently, in its 2005 publication, the BNQ committee maintained its position of not retaining numeric criteria for OTC while suggesting that manufacturers monitor the quality of compost feedstocks. The CCME committee concurred.

Later, when the Canadian standard on municipal biosolids (CAN/BNQ 0413-400) was revised in 2009, it did not retain criteria for organic trace compounds, except for dioxins and furans. Detailed justification for this is shown in the Appendix to the CAN/BNQ biosolids standard.

7- Pathogens

By and large, Canadian pathogen criteria originated in the United States. In 1993, the US-EPA established federal standards for Class A biosolids compost that was deemed virtually free of fecal pathogens. Briefly, this unrestricted use compost had to meet the following requirements:

- Contain less than 1000 fecal coliforms/g of dry weight total solids (approximately 99.999% reduction);
    - or be virtually free from *Salmonella* bacteria (< 3/4 g);
- and undergo a recognized disinfection process (temperature, duration, etc.) to also reduce odours, in order to reduce attraction of vectors, such as flies, seagulls, and vermin).

Acting preventatively, the BNQ committee in 1996 selected both the fecal coliforms and *Salmonella* criteria for all types of composts (AA, A, and B). But the committee did not adopt the "process" requirements, since they were considered hard for government agencies to oversee and enforce. Instead, the process criteria were replaced by "product" quality criteria (compost maturity/stability, see below).

Requiring that both fecal coliforms and *Salmonella* criteria be met, contrary to the US-EPA approach, proved to be an unfortunate choice, since in practice it disqualified compost made from plant residues (such as wood chips). This type of compost sometimes tests "false positive" for fecal coliforms that are, in fact, just ubiquitous *Klebsiella* bacteria. This analytical artefact problem was partially corrected in the 2005 CAN/BNQ standard, which permits analysis of *E. coli* instead of fecal coliforms. However, *E. coli* analysis may also have bias (Hébert, 2005).

The CCME adopted the BNQ approach to pathogen "product" criteria while maintaining the possibility of also using "process" criteria such as 3-day composting at 55°C, which was based on U.S. standards.

8- Maturity (microbiological stability)

Maturity was probably the subject that took up the most BNQ committee time. This was due to the fact that the concept is fundamentally vague. Some committee members were of the opinion that maturity meant absence of odour (stabilization), while others took the position that the criterion should be absence of phytotoxicity or achieving a specific level of disinfection.

A second problem was related to the abundance of tests (and their limitations) used by different organizations. For example, the C/N ratio criterion could vary from 25 to 15, depending on whether the compost included peat and/or bark, or not. As for the test based on germination/growth, in the event of phytotoxicity one could wrongly conclude a lack of stability (i.e. the presence of toxic volatile fatty acids), whereas the phytotoxicity could also result from excessive salt content. This is why, in 1996, the BNQ committee recommended the simultaneous use of at least two of the following three tests:

- C/N
- germination/growth
- oxygen uptake

In its 2005 standard, the BNQ committee considerably revised its approach, concentrating only on tests related to microbiological stability. The following three tests were selected:

- Oxygen uptake (the same test as in 1996, but with a revised criterion)
- CO_2 release
- Spontaneous heating (Dewar method)

To be considered mature, a compost would have to pass at least one of the three tests. Based on the experience of the Centre de recherche industrielle du Québec (CRIQ), the numeric oxygen uptake criterion corresponded to compost that was free of fetid odor. Equivalent numeric criteria for the other two tests were now needed, and so the committee initially used a CRIQ database containing both oxygen uptake and spontaneous heating values (Dewar test) for commercial composts. A U.S. Composting Council (USCC) compendium of analytical methods was also employed to determine numeric equivalence between CO_2 release and oxygen uptake.

These methods for evaluating microbiological stability also provided the benefit of confirming that a high-level process of microbial degradation actually took place, which implied a decrease in pathogenic organisms. Low odours were also concomitant with a reduction in attraction of vectors.

In 2005, the CCME adopted the BNQ approach to maturity because of its flexibility and ease of monitoring. However, since these tests did not make it possible to evaluate the risk of some types of phytotoxicity, such as from excessive salts, other tests for maturity were also suggested by the Compost Council of Canada (CCC) within the Compost Quality Alliance; these agronomic criteria include sodium (Na), pH, C/N, etc.

9- Foreign matter

The concept of “foreign matter” in compost first appeared in Canada with the publication of the first BNQ and CCME documents in 1996. The term “matter” designated visible particles, whereas “foreign” referred to their anthropogenic origin (plastics, glass, etc.) as opposed to natural objects such as sand particles, stones, and wood fibres. The CRIQ developed a methodology for measuring their size, numbers, and weight (CAN/BNQ 0413-210 method).

The BNQ committee was originally concerned about the risk of consumers scraping or cutting themselves while handling compost sold in bags. Some members of the committee actually tried handling shards of glass and concluded that there was no risk of minor lacerations to the hands from particles that were equal to or less than 3 mm in size. This threshold was then selected as the definition of “sharp foreign matter,” and such particles were consequently prohibited in all compost beginning in 1996.

The BNQ committee was also concerned about the effects of the aesthetic aspect of compost related to marketing. The question then became how to objectively define what consumers would accept? It was first established that sizes of 2 mm and less (equivalent to a coarse grain of sand) were hardly visible and would not be seen by consumers as foreign matter. Maximum weight limit concentrations for each type of compost (AA, A, and B) were then set. The committee also established criteria for limiting the size of foreign matter, in line with how visible they were.

These first-generation criteria were slightly modified in the 2005 CAN/BNQ standard, which set tolerance levels for sharp foreign matter in Type B compost sold in bulk, because SSO urban compost could occasionally contain glass. At the same time, those composts were prohibited in residential landscapes and pastures where cattle and sheep grazed at ground level. Various threshold levels of tolerance for foreign matter greater than 2.5 cm in size were also established, varying by type of compost (AA, A, or B).

The CCME adopted the majority of these criteria, without however distinguishing between bagged and bulk products. In addition, they did not set maximum weight concentrations because they were not directly related to consumer perception (i.e. visible aspects such as size, concentration, colour, etc.).

10 - Other parameters

Table 2 presents additional distinctions between the 2005 CAN/BNQ standard and the corresponding CCME guidelines. In general, the CAN/BNQ 0413-200 standard is more detailed and complete. However, the CCME criteria, being fewer in number, allow for greater flexibility.

TABLE 2

Comparison between the CAN/BNQ 0413-200 standard and the CCME Compost Quality Guidelines (selected parameters)

	BNQ (2005)	CCME (2005)	Comments
Minimal organic matter concentration	√	-	The minimum concentration of 30% for Type B is equivalent to organic soil. Concentrations are higher for types A (40%) and AA (50%).
Maximum water concentration	√	-	The criterion of <65%, which corresponds to compost water retention capacity, aims at limiting leaching during storage and at avoiding pasty lumps.
Mandatory analytical methods	√	-	Improves validity of results, but reduces flexibility.
Mandatory labelling	√	-	Relatively limited in the 2005 CAN/BNQ standard.
Possibility of independent certification	√	-	Some composts are currently certified in Quebec and New Brunswick

11 - Summary and conclusion

In 1993, a number of stakeholders undertook to establish product quality standards to engender the harmonious development of the compost industry in Canada in the context of environmental and public health protection. This goal was achieved.

Today, most Canadian provinces base their compost quality requirements in whole or in part on the CCME guidelines. However, the CCME guidelines would never have been possible without the consensus work carried out by a collegium of stakeholders within the BNQ committee and without the advances in biosolids standards achieved by the CFIA, the Government of Ontario, and the US-EPA.

The BNQ is currently updating its compost standard. This is of particular importance to Québec, which makes abundant use of the standard and of BNQ certification in overseeing compost utilization. Although this standard works well, some minor improvements may be considered (Table 3).

TABLE 3

Changes under consideration for CAN/BNQ compost standard 0413-200.

	Modifications	Justifications
Compost types	Eliminate type AA.	The standard is not sufficiently detailed in terms of agronomic specifications to distinguish between Types AA and A.
	Revisit the nomenclature.	The Type B nomenclature is counter-productive in regard to communications and marketing.
Pathogens	Only use *Salmonella*.	This is the approach adopted in the CAN/BNQ municipal biosolids standard.
Foreign matter	Adjust Type A criteria to actual concentrations in SSO composts.	Use of the best available technology approach would require a characterization study.
	Remove weight limits.	Weight limits are not directly related to aesthetics and consumer acceptability.
Organic matter	Retain a 30% minimum threshold for all compost types	Very mature compost generally contains less – but more stable – organic matter.
Inorganic trace elements	Type B: Slightly reduce Pb, Hg (and As?) concentration limits.	Harmonization with the CAN/BNQ biosolids standard (the same as with EQ biosolids).
Analytical methods	Permit inorganic trace element measurement by equivalent methods used in accredited laboratories.	Harmonization with the approach used in Québec, where laboratories are accredited by the MDDELCC.
Labelling	Bioaerosols (fungi spores) warning for bagged compost.	To protect people suffering from asthma and other breathing problems.

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