

# Canada-wide Standards: A Pollution Prevention Program for Dental Amalgam Waste

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## A b s t r a c t

*Dentistry and society have long recognized the benefits of using silver-based amalgams to restore and maintain the dental health of patients. However, recent studies by health and environment experts have shown that mercury is of great concern when it enters the biosphere as a contaminant. A rational approach to pollution prevention is mandatory. This article explains the relationship between mercury, particularly dental amalgam waste, and the environment and describes a new pollution prevention initiative intended to ensure that the dental community becomes part of the solution to this serious environmental health problem.*

**MeSH Key Words:** dental amalgam/adverse effects; environmental pollutants/prevention and control

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The dental sector and society in general have long recognized the benefits of using amalgams to restore and maintain the dental health of patients. It is therefore understandably difficult to convey a message of serious environmental concern for mercury, which has been used with no apparent negative implications for centuries. However, several recent studies<sup>1</sup> by health and environment experts have shown that mercury is of great concern when it enters the biosphere as a contaminant. The governments of many developed and developing nations are becoming increasingly aware of the risks to human health and the environment posed by the inappropriate management of mercury and mercury-containing wastes.<sup>2</sup> In fact, Canada's Minister for the Environment, recently elected president to the United Nations Environment Program's Governing Council,<sup>3</sup> has strongly supported the development of a global assessment of mercury by 2003.

Mercury in the environment contaminates the food chain, particularly the fish and traditional foods consumed by Northern Canadians.<sup>4</sup> The nutritional benefits of eating fish and traditional foods are so important that a rational approach to pollution prevention actions is mandatory. Although mercury is a naturally occurring element in the global environment, most scientists throughout North America and the world are in agreement that the volume of

emissions from naturally occurring mercury and the volume of emissions resulting from human activities — that is, from anthropogenic sources — are about equal.<sup>5</sup>

Levels of mercury in the environment have been increasing since the beginning of the industrial age (about 1800-1850 AD).<sup>6</sup> The impacts of this increase are felt around the globe, because mercury vapours are carried by air currents in a phenomenon known as long-range atmospheric transport. This same phenomenon is responsible for acid rain and its resulting problems, as described by the Canadian government in the early 1980s.<sup>7</sup> We now know that mercury is similarly carried from various sources of emissions to distant receiving environments.

This article explains the relationship between mercury, particularly dental amalgam waste, and the environment. It also describes a significant new pollution prevention initiative intended to ensure that the dental community becomes part of the solution to this serious environmental health problem.

### The Paradox of "Liquid Silver"

The chemical symbol for mercury is Hg, derived from the Latin word *hydrargyrum*, or liquid silver. The apparent paradox of mercury being both beneficial and noxious typifies the unique physical and chemical properties of this

element. It is a liquid at room temperature, yet it is also a metal, with all of a metal's electrical properties. It has the unique ability to dissolve or soften many other metals at room temperature — the basis for its use as a dental amalgam. In some societies, elemental mercury is an icon of health and good fortune.<sup>8</sup>

Despite the fact that it is very dense, the elemental form of mercury is volatile. It can evaporate and travel throughout the atmosphere on air currents and thus affect ecosystems extremely remote from the source of emission. This atmospheric source is consequently captured by rainfall and other precipitation events and adds to the burden of mercury contamination entering lakes and rivers from various land-based sources such as sewage treatment effluent and sewage sludge applied to land.

### Mercury Contamination

In both Canada and the United States, the greatest environmental health impact of mercury is manifest in the thousands of fish consumption advisories issued as a result of elevated mercury levels in fish tissue.<sup>9</sup> These advisories are either for specific varieties of fish or for specific water bodies — or even for entire provinces such as New Brunswick or Nova Scotia.

In the natural environment, the mercury that enters water bodies, including the amalgam wastes from dental practices, can be transformed by bacteria in the water column and sediments of lakes and rivers into a class of organometallic chemical compounds collectively referred to as methylmercury. Methylmercury is persistent in the environment. It bioaccumulates in living tissues and organs and is extremely toxic. Canada, the United States and many other countries have extensive programs in place to reduce the presence of methylmercury and other persistent, bioaccumulative and toxic substances (PBTs).

Although all affected ecosystems are of concern, the most significant environmental impacts of mercury are in water and air. The contribution to water leads to the direct bioaccumulation of methylmercury in fish, and the contribution to air emissions leads to water contamination through both wet and dry atmospheric deposition.

Canada's major industrial source of mercury contamination in the 1970s was the chlorine-producing sector. The industrial production of chlorine for the pulp and paper industry involved a mercury cell process that left a legacy of mercury pollution in many of Canada's freshwater ecosystems.<sup>10</sup> As a consequence, the Canadian Environmental Protection Act<sup>11</sup> designates mercury and mercury compounds as toxic substances under Schedule 1 and thus subject to the requirements under that Act. Mercury is also regulated under the Fisheries Act and the Hazardous Products Act and is subject to the guidelines of the Canadian Food Inspection Agency. Provinces and municipalities also have legislation and bylaws that restrict

discharges of mercury or mercury-contaminated wastes to the environment.

### Keeping Track of Mercury

The Canadian government maintains an inventory of mercury emissions to the environment through the National Pollutant Release Inventory (NPRI). This regulated requirement to report releases of pollutants is mandated under the Canadian Environmental Protection Act, 1999. Reporting requirements for mercury have recently been amended to include any person or enterprise that manufactures, produces or otherwise uses 5 kg or more annually.<sup>12</sup> Dentists are exempted from this reporting requirement to minimize the paperwork burden of establishing that most clinics generate less than the minimum reporting quantity. This fact was confirmed with the dental community during the consultative discussions leading to the NPRI amendment in December of 1999.

The NPRI shows that the primary generators of mercury emissions are the mining and smelting sector, the coal-fired electric power generating sector and waste incineration facilities. In 1995, about 12 tonnes of mercury were emitted directly to the atmosphere by Canadian industry and enterprises. Despite the exemption noted above, dental offices did add significantly to the total emissions, as a Health Canada report indicates: "The main contributors to anthropogenic releases are coal-burning power stations and municipal and medical waste incinerators, followed by a host of minor sources. The release of mercury from dental offices due to the widespread use of mercury amalgam tooth fillings has now been recognized as an important source in municipal sewers."<sup>13</sup> The cities of Toronto, Victoria and Montreal have recently focused bylaws on restricting the discharges of amalgam wastes from dental offices to sewer systems.<sup>14,15</sup>

Overall, the dental sector contributed about 2 tonnes of mercury in total to the environment and about 0.5 tonnes through atmospheric emissions (Fig. 1). By comparison, the Canadian electrical power generating sector emits about 2 metric tonnes of mercury to the atmosphere, due almost entirely to fossil fuel combustion. Mercury emissions from dental waste management practices to all environmental media are calculated and shown in Table 1.

**Table 1 Amalgam-related mercury in the Canadian environment**

| Environmental Medium | Elemental Mercury Emitted |
|----------------------|---------------------------|
| Landfill             | 1,065 kg                  |
| Agricultural land    | 180 kg                    |
| Air                  | 558 kg                    |
| Water                | 188 kg                    |
| <b>Total</b>         | <b>1,991 kg</b>           |

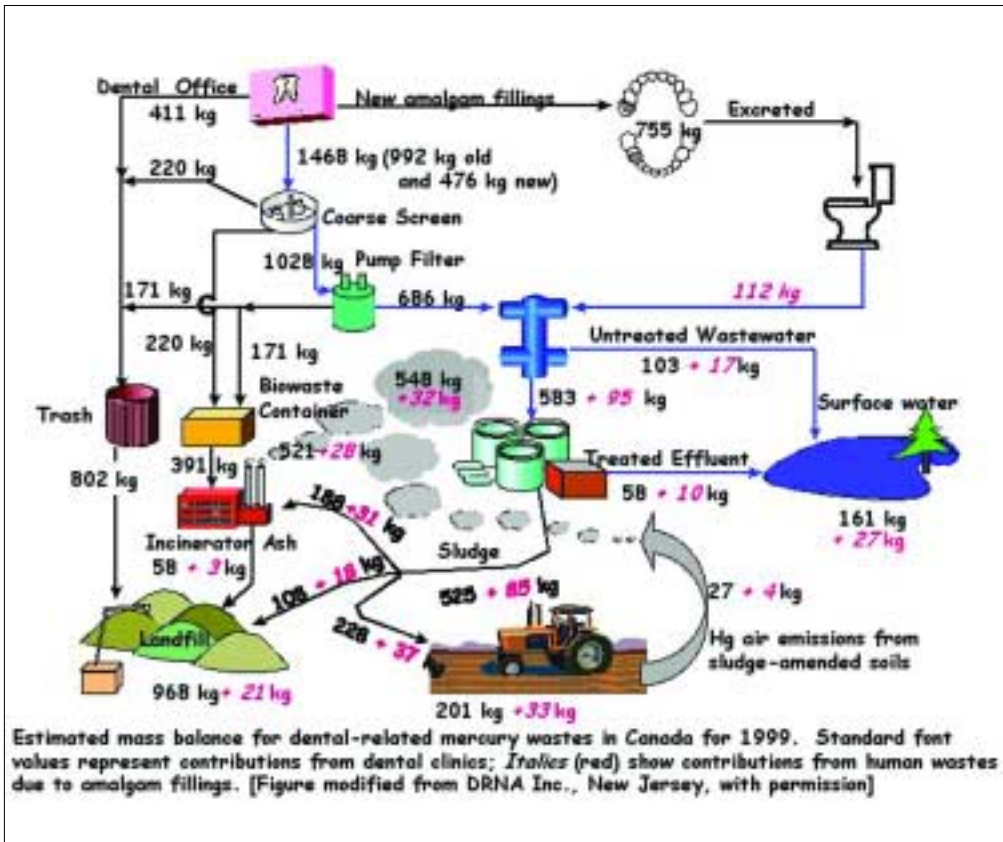


Figure 1: Estimated mass balance of dental amalgam waste, Canada, 1999.<sup>19</sup>

### Regulating the Problem

In Canada, the management of mercury pollution crosses many jurisdictional boundaries, with different responsibilities residing among various government agencies. To effectively and efficiently manage expectations and to avoid duplication, the responsible jurisdictions are working together under the auspices of the Canadian Council of Ministers of the Environment (CCME) to develop a made-in-Canada mercury management program.

The CCME is a unique intergovernmental council comprised of the 14 ministers of the Environment for the federal, provincial and territorial governments in Canada. Under its auspices, the Canada-wide Accord on Environmental Harmonization is the framework agreement establishing the common vision, objectives and principles that govern the partnership between jurisdictions and the development and implementation of sub-agreements.<sup>16</sup>

To date, mercury management options under the CCME process are proposed or under consideration for the base metal smelting sector, the waste incineration sector, the electric power generation sector (including lighting products) and the dentistry sector. For the last, the specific program is called the Canada-wide standard (CWS) for mercury in dental amalgams.<sup>17</sup>

During the initial development of the CWS for mercury in dental amalgams, it became clear that there would be

questions raised about environmental regulators proposing initiatives that would have a direct impact on the health care of dental patients. Consequently, the CWS focuses specifically on the waste management aspects of dental amalgam use and pollution prevention as mandated by the CCME partners.

At a products workshop held in Winnipeg in March 2000, members of the CWS development committee met with stakeholders, including representatives of the Canadian and Ontario Dental Associations, to ensure that there was consensus on the path forward. Regulators are keenly aware of the extensive and expert knowledge of dental practitioners and have no

interest in directing the dental profession on the best way to treat its patients. Nationally, the policy on the use of dental amalgam and the various other dental products for restorative work falls under the auspices of Health Canada.<sup>18</sup>

The CWS for mercury in dental amalgams proposes to adopt a national reduction target based on best management practices to achieve a 95% national reduction in mercury releases from dental amalgam waste by 2005, from a base year of 2000.

To ensure that all dentists are aware of and will have the opportunity to participate in implementing the CWS for dental amalgams, Environment Canada and the Canadian Dental Association (CDA) are developing a Memorandum of Understanding (MOU). The MOU will focus on issues surrounding the management of amalgam waste in dental practices and will assist in implementing the associated CWS. The aims of the MOU are to achieve the voluntary implementation of the CWS, to provide regular progress reports in an open and transparent manner and to advocate and recognize supportive action by provincial and territorial governments and dental regulatory authorities. The text of the MOU is expected to be approved by CDA and Environment Canada in the spring of 2001 and will be available on the Greenlane Web site ([www.ec.gc.ca](http://www.ec.gc.ca)) and on CDA's Web site ([www.cda-adc.ca](http://www.cda-adc.ca)).

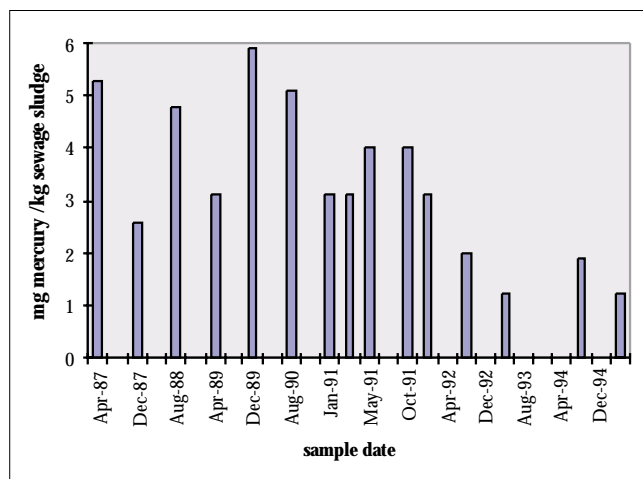


Figure 2: Mercury reductions due to amalgam separator installations at Vordingborg, Denmark, Population 24,200.

### Achieving Significant Reductions

Recent certification tests have shown that the installation of ISO-11143-certified amalgam separators can attain an efficiency of at least 95% removal of amalgam based on mass fraction (see Table 2, ISO-Certified Amalgam Separators, <http://www.cda-adc/jcda/vol-7/issue-5/270.html>). The anticipated benefits to be achieved by this CWS are shown in Fig. 2, showing mercury reductions in sewage after high-efficiency separators have been installed in a typical town in Denmark.<sup>20</sup>

One of the areas still requiring investigation is the amount of mercury remaining in waste discharge lines and facility sewage pipes between the dentist's chair and the main trunk sewers of a municipality. Environment Canada has undertaken such a study and results are expected by June 2001. It is anticipated that careful cleaning of this residual source of mercury and incorporating the new CWS in the practitioner's clinics will have an impact even more dramatic than the 63% reduction shown in Fig. 2.

The scientific community and regulatory jurisdictions across Canada recognize that mercury is a toxic substance of concern because of its impact on the environment, particularly in marine and freshwater ecosystems. The Canadian dental sector, along with other commercial and industrial sectors, can play a significant role in preventing mercury releases to the environment. ♦

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The views expressed are those of the author and do not necessarily reflect the opinions or official policies of the Canadian Dental Association.

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**Table 2 ISO-Certified Amalgam Separators**

| Manufacturer/Distributor   | Confirmed ISO 11143 certification                        | Disposal information  |
|--|--|---|
| Daniel Ménard<br><i>Biodent (Metasys affiliate)</i><br>218 Audet Street<br>St. Basile-le-Grand, QC G3N 1G7<br><br>Tel.: 1-800-211-1200<br>Fax: (450) 441-0535<br><a href="http://www.biodent.com.au/">http://www.biodent.com.au/</a>   | Yes  | Licensed waste transporter arranged by Biodent.<br><br>Amalgam recycled in Austria.   |
| Dr. Richard Chilibeck<br><i>Maximum Separation Systems Inc.</i><br>100-1779 Sean Heights<br>Saanichton, BC M8M 1X6<br><br>Tel.: 1-800-799-7147<br>(250) 652-5279<br>Fax: (250) 652-9599<br><a href="http://www.amalgamseparators.com/index.html">http://www.amalgamseparators.com/index.html</a> | Yes  | Dentist must contact a recycling firm which specifically deals with amalgam waste. <i>Maximum</i> provides addresses of facilities in the lower British Columbia area.<br><br>Waste hauler in Toronto: Safety Kleen<br><br>Recycling facility: Mercury Waste Solutions, Wisconsin |
| Robert Donnelly<br><i>DRNA (Dental Recycling North America)</i><br>P.O. Box 1069<br>Hackensack, NJ 07601<br>USA<br><br>Tel.: 1-800-360-1001<br>Fax: (201) 489-4470<br><a href="http://www.drna.com/">http://www.drna.com/</a>  | MRU and BullfroHg (amalgam separators) are ISO certified | Associated with Mercury Refining (MEREKO) in Albany, NY.<br><br>Waste haulers in Toronto: Greenflow Environmental Services Inc. (Burlington)<br><br>Recycling facility:<br>1. DRNA pre-processing, Albany, NY<br>2. Mercury Waste Solutions, NY/WI                                |
| Tim Reber<br><i>Rebec (Reber Ecological Systems)</i><br>18921 Dellwood Drive<br>Edmonds, WA 98026<br>USA<br><br>Tel.: (425) 776-0723<br>Fax: (425) 672-1412  | Yes  | Dealer collects waste sludge and sends to Washington via UPS.   |
| <i>AB Dental Trends, Inc.</i><br>211 Grover Street<br>Lynden, WA 98264<br>USA<br><br>Tel.: (360) 354-4722<br>Fax: (360) 354-7460   | Yes  | Transported by Purolator to a collection depot in Abbotsford. From there, amalgam is trucked across the border to the United States and then sent to the United Kingdom for recycling.  |

*Neither the author nor the CDA expressly or otherwise recommend or support any of the above mentioned suppliers of dental amalgam separators. Mention is made only to provide information for interested dental practitioners.*