

TCLP Analysis of Waste Dental Amalgam

April 2004

Background

As part of its 2003 Mercury Initiative, DEP contracted with NEWMOA to conduct a literature and web survey, and to contact appropriate state, federal, dental society, and other individuals, for the purpose of identifying, collecting and analyzing available data on dental amalgam waste classification test results.

Summary of Literature Search/Individuals Contacted:

NEWMOA searched the following online databases for studies or reports on TCLP analysis of dental amalgam waste and dental wastewater: PubMed (<http://www.ncbi.nlm.nih.gov/entrez/query.fcgi>), Scirus, <http://www.scirus.com/about/>, and EPA's online library. PubMed is a service of the National Library of Medicine with access to over 12 million MEDLINE citations back to the mid-1960's and additional life science journals. Scirus is a comprehensive science-specific search engine that searches both databases of journal articles and web sites.

NEWMOA also conducted general internet searches using TCLP and dental amalgam as key words, and sent a request for data through the mercury policy listserv.

At NEWMOA's request, Jeri Weiss sent an email to relevant people at EPA soliciting data on TCLP analysis of dental amalgam waste. NEWMOA also asked the Toxics Use Reduction Institute to search a number of databases of scientific journals that NEWMOA does not have access to. These included ScienceDirect, Expanded Academic, Academic Search Premier, EBSCO Online, Compendex, Applied Science and Technology, General Science and ELibrary.

NEWMOA also spoke or corresponded via email with the following individuals: Mark Stone, Naval Institute for Dental and Biomedical Research; P.L. Fan, American Dental Association; Owen Boyd, Solmetex; Alexis Cain, EPA; Luke Tripp, formerly of Environment Canada, and Robert Krauel, Environment Canada.

Results:

NEWMOA identified nine studies containing data on TCLP analysis of dental amalgam waste or dental wastewater. Only two of these were published.

About half of the studies were conducted on fresh amalgam scrap or the remainder of used amalgam capsules—this is amalgam that has not contacted an oral cavity. The remaining studies were conducted on amalgam sludge or waste collected from wastewater lines, separators, or chair-side traps. Only one study, conducted by the Florida DEP, performed TCLP analyses on a mixture of both amalgam scrap and amalgam wastes.

The Table summarizes, for each study, the institute conducting the study, the type of samples collected and analyzed (i.e., used amalgam capsules, or sludge from wastewater lines), and the number of samples exceeding the RCRA limit of 0.2 milligrams per liter (mg/L).

Dental practitioners and researchers generally define true amalgam waste as a mixture of:

- contact amalgam (e.g., extracted teeth containing amalgam);
- amalgam sludge captured by chairside traps, vacuum pump filters, and screens;
- fresh, non-contact amalgam (also called scrap);
- the remainder of used amalgam capsules.

Observations:

- The data show high variability in the results, with mercury concentrations ranging from 10 times lower than the RCRA limit to ten times above it. Even within the same study, this level of variability was observed.
- In all but one of the studies, amalgam scrap and/or wastes exceeded the RCRA limit at least 20% of the time. The only study that had no samples exceeding the RCRA limit analyzed amalgam scrap that had been cured for more than 30 days. This study was conducted by the ADA.
- Researchers suggest that the variability in the TCLP analyses could be due to a number of factors including the brand and type of amalgam tested, the laboratory conducting the analysis, the age of the scrap (the longer it's cured, the more likely it will pass TCLP), and the type of sample (contact amalgam is thought to be less likely to fail TCLP).
- The data show that the use of bleach can mobilize the mercury in sludge from wastewater lines.

Other Related Studies:

At DEP's request, NEWMOA reviewed several of the presentations from the Binational Toxics Strategy Meeting held in Chicago on December 2, 2002. The presentations reported on regulations and best management practice campaigns to lower the amount of mercury discharged in dental wastewater, but did not include TCLP analysis of dental wastes.

Tim Tuominen, from the Western Lake Superior Sanitary District (WLSSD) in Duluth Minnesota, reported on 10 year educational campaign the WLSSD did in cooperation with the local dental society. The campaign focused on teaching dental offices how to recycle amalgam waste, and the installation of separators. WLSSD achieved a reduction in mercury discharge from 20.6 to 1.9 nanograms per liter from 1995 to 2002.

Robert Krauel, Environment Canada reported on Canada's newly enacted Sewer Use By Law, a discharge-based standard that requires dentists to (1) submit pollution prevention plans (2) install and maintain an amalgam separators and (3) meet a maximum mercury discharge concentration of 0.01 mg/L. Biosolid reductions of approximately one-third to two-thirds were achieved at four Toronto sewer districts following implementation of the By Law.

Table: Summary of TCLP Data

Study	Sample Type	No. Samples	Conc. Hg (mg/L)	No. Exceeding RCRA Limit (0.20 mg/L)
Naval Institute for Dental and Biomedical Research <i>Stone, ME, Pederson ED, Cohen ME, Ragain JC, Karaway RA, Auxer AR, Saluta AR, Residual mercury content and leaching of mercury and silver from used amalgam capsules, Dent Mater. 2002 Jun;18(4):289-94</i>	The remainder of used amalgam capsules (10 brands)	10 batches of 25 capsules	0.0104-0.4120	2 of 10
Naval Institute for Dental and Biomedical Research <i>Unpublished data presented at Dental Mercury Release Reduction Symposium, 1/23/03</i>	The remainder of used amalgam capsules	12 batches of pooled 100 gram samples from several manufacturers	0.0369-0.6700	3 of 12
Naval Institute for Dental and Biomedical Research <i>TCLP Analysis and Residual Mercury Levels in Dental Wastewater Lines, Stone ME, Kuehne JC, Karaway RS, Gullett JM, abstract on Web site</i>	Sludge from wastewater lines from dental offices with 30 to 100 chairs	Not provided	Average 0.1153 ± 0.1069 Range 0.0179-0.396	Concluded that waste lines are capable of leaching Hg over RCRA limits and that Hg in waste line sludge can be mobilized by the action of an oxidizing cleanser such as bleach.
King County, WA Hazardous Waste Management Program, 1997	Waste from chair side traps/ vacuum pump filter	5	0.03-0.70	2 of 5
Florida DEP, Tallahassee Florida, 1997	Mix of chair side trap waste and remainder of used amalgam	5	0.01-1.00	4 of 5
American Dental Association <i>Fan PL and Chang CS, Environmental hazard evaluation of amalgam scrap, Dental Materials, 8:359-361, 1992.</i>	Fresh amalgam scrap cured for at least 30 days	3	0.07-0.09	0 of 3

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U.S. Army Center for Health Promotion and Preventive Medicine	Freshly mixed amalgam tested under 3 scenarios: (1) within 2 weeks, (2) cured for 30 days and bleached, (3) stored under photographic fixer for 14 days to suppress mercury vapor	Scenario 1: 9 samples from 3 brands	0.312 – 1.81	9 of 9
		Scenario 2 (cured): 6 samples from 3 brands	0.05 -1.3	2 (same brand) of 6 (bleach was also tested and none of the samples failed TCLP)
		Scenario 3 (fixer): 3 samples from 1 brand	0.333-1.06	3 of 3
	AND Amalgam waste from dental operatories	Amalgam waste: 6	0.008-1.1	2 of 6
USAF Dental Investigation Service (2 studies)	(1) Fresh amalgam	6 samples from 2 brands (one spherical and one dispersed phase)	0.35-3.3	6 of 6
	(2) Fresh amalgam with and without 1:10 sodium hypochlorite treatment	4 samples from 2 brands	0.46-1.8 without bleach 0.14-0.36 with bleach	2 of 2 1 of 2 (the bleach from each sample was tested and both samples failed TCLP)
Solmetex	Sludge from amalgam separators	6	0.021-3.16	4 of 6

