

**Summary of selected  
Minnesota Pollution Control Agency  
and Office of Environmental Assistance  
mercury-reduction programs**

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### **Mercury-Free Zone Program**

The statewide Mercury-Free Zone Program is an expansion of a regional Minnesota Pollution Control Agency (MPCA) project that began in seven northeastern Minnesota counties. In the statewide program, 70 schools have so far pledged to become Mercury-Free Zones, and elemental mercury, mercury-containing chemicals and mercury-bearing equipment have been removed from 60 of these schools. This has effectively prevented about 114 pounds of elemental mercury from ever polluting the environment. Helping to find hidden mercury and to publicize the effort is Clancy, the only mercury-detecting dog in the nation and one of three in the world, and his trainer and handler, MPCA mercury educator Carol Hubbard.

Goals of the program are:

1. to reduce the risk of potential mercury exposure to students and school staff,
2. to prevent releases of mercury to the environment by eliminating mercury from schools, and
3. to educate students and staff about the dangers that mercury poses.

For more information, go to:

*<http://www.pca.state.mn.us/programs/mercury-free/index.html> .*

### **Mercury Switches in State Vehicles**

The Office of Environmental Assistance (OEA), the MPCA and the nonprofit group INFORM worked with the Department of Administration, Materials Management Division, to include a mercury component disclosure requirement in the 2002 Vehicle Request for Bids. The state intends to require the vehicles it buys to be mercury free in future model years, and will use this year's information disclosure to develop future bid specifications. The Travel Management Division, OEA and MPCA are also cooperating on a pilot project to remove, recycle and replace mercury switches in TMD vehicles being withdrawn from state service.

### **Mercury Switches in Steel Scrap Project**

The MPCA and OEA are working on a cooperative project with Ramsey County, North Star Steel and other counties to reduce the amount of mercury that is released when scrap steel is recycled. The MPCA has provided ready-to-mail containers for mercury switches to scrap yards, and North Star Steel has started paying a bonus to scrap suppliers who remove mercury switches from vehicles before crushing them. The OEA and Ramsey County are active in national efforts to reduce the use of mercury switches in vehicles and appliances and in the collection of mercury already in these products.

### **Mercury Thermometer Sales Ban**

The Office of Environmental Assistance developed a 2001 Session legislative proposal to prohibit the sale of most mercury thermometers in Minnesota. Two legislators also introduced mercury thermometer sales prohibitions. The legislature passed the most comprehensive language from these proposals. With a few narrow exemptions to cover legally required uses, products with no available alternative, and primary calibration standards, the sales prohibition became effective January 1, 2002.

### **Dental Amalgam Waste Management**

Through a grant to the Minnesota Dental Association, the OEA supported the development of a dental amalgam management training video and associated Continuing Dental Education credit for all dental office staff.

### **Health Care Workshops and Mercury Reduction**

The OEA and the Minnesota Technical Assistance Program (MnTAP) conducted three health care workshops in 2001. Additional workshops will be held in the first half of 2002. These workshops introduced the Hospitals for a Healthy Environment (H2E) training materials, including mercury reduction and elimination, to Minnesota health-care industry professionals. H2E training materials were developed pursuant to the memorandum of agreement between the American Hospital Association and U.S. Environmental Protection Agency (EPA).

### **HealthSystems Minnesota Mercury Reduction Intern**

The MnTAP funded a summer 2000 intern project at HealthSystems Minnesota to identify all mercury-containing materials and develop a mercury-elimination plan. The final intern project report is an excellent model for other health-care facilities and organizations.

### **Internet-based Mercury Information Management Pilot Project**

The mercury contamination problem spans so many technical and regulatory areas — air, water, waste disposal and others — that tracking and understanding even a small part can be expensive and time consuming. The MPCA and the OEA, in cooperation with the EPA, U.S. Department of Energy and Environment Canada, are cooperating on a pilot project to develop new ways to integrate and organize widely dispersed mercury information. The project is also intended to improve citizen access and understanding of this information. The Minnesota pilot project is scheduled to be launched by February 1, 2002.

### **Low-level Wastewater Monitoring Training**

Each March, the Minnesota Wastewater Operators Association holds its annual meeting. This meeting would serve as the opportunity to provide training annually to facility personnel in procedures to collect low-level mercury samples. Ultimately these personnel would be collecting samples at their respective facilities as part of permit-monitoring requirements. These samples would then be sent to laboratories certified for low-level mercury analysis.

### **Estimating Releases from Products That Use Mercury**

The MPCA commissioned a study in 2001 to better quantify mercury releases from various product lines that intentionally use mercury, such as electrical switches, dental amalgam, and many other products. (More than 300 tons of mercury are still used in the manufacture of various products in the United States each year.) The purpose of the study was to improve statewide inventory estimates, and to better quantify and “credit” the release reductions associated with efforts to collect and properly dispose of mercury in products or forgotten on shelves or in drains. Product lines evaluated include lamps, thermostats, automotive switches and other relays, thermometers, batteries, measurement devices, paint, dental amalgam and others. A quantitative flow diagram was developed for each product line showing the fate of mercury during product use and disposal, including points at which mercury may be released to air, water or land.

**Mercury research at  
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## *2000-2003 Research Activities*

### **EPA Science To Achieve Results (STAR) Grant:**

#### **Methylmercury sources to lakes in forested watersheds: Has enhanced methylation increased mercury in fish relative to atmospheric deposition? (1999-2002)**

The purpose of this research is to explore the potential of local approaches to alleviate mercury consumption advisories in fish. From previous work, we know that mercury deposition to lakes in Minnesota has increased by three to four times since presettlement times. We also have evidence that fish mercury levels have increased up to 10 times in several lakes since the 1930s based on mercury analysis of museum fish. Why would a discrepancy exist between increases in deposition and mercury levels in fish? The reason is that mercury may be methylated to form methylmercury (MeHg) before it can accumulate in fish. Local factors may increase the efficiency of MeHg formation in lakes, resulting in increased levels of mercury in fish without increasing the load of mercury to a lake. We are exploring the reverse effect, potentially decreasing mercury levels in fish, in lieu of reductions in loading.

This study includes laboratory studies performed at the University of Minnesota and field studies conducted at the Marcell Experimental Forest near Grand Rapids. The field studies focus on quantifying the major sources of MeHg to lakes; including wetland transport, formation/export from lake sediments, and deposition from the air. Most of the focus is on wetlands and lakes sediments. Air deposition, despite being the major source for mercury to lakes, is a minor direct source of MeHg (Important note: The air still provides the mercury that is methylated in sediments and wetlands.). The lab studies complement the field studies by determining whether MeHg formation can be enhanced in lake sediments or different types of wetlands. Additions of sulfate, nitrogen and organic matter (to simulate the impacts of acid rain, agriculture or sewage runoff, eutrophication, mine tailings discharge, etc.) will be made at increasing levels to observe under what conditions methylation is enhanced.

### **Voyageurs National Park Mercury Studies:**

#### **Which factors are causing large variability in mercury levels in Minnesota fish?**

Two small lakes in Voyageurs National Park have the highest levels of mercury in fish when standardized to a 55-cm northern pike (Ryan Lake Hg NP<sub>55</sub> = 2.4 ppm; Tooth Lake Hg NP<sub>55</sub> = 1.8 ppm). Other inland lakes in Voyageurs National Park have NP<sub>55</sub> Hg levels ranging from 0.1 to 1.1 ppm. What is the cause of the extreme variation in the fish from Voyageurs National Park? By understanding which factors lead to lakes with high fish mercury levels, we can better manage our lakes by determining which lakes are sensitive to mercury deposition.

Several hypotheses are simultaneously being tested to determine what causes the large variability in mercury methylation efficiency in Voyageurs National Park lakes. Mercury methylation efficiency is important because methylmercury (MeHg) is the form of

mercury that accumulates in fish. Indicators being explored are MeHg in the water, the fraction of sediment mercury that is MeHg, and MeHg levels in one-year-old yellow perch. To investigate the effects lake food chain structure has on mercury levels in fish, one-year-old yellow perch mercury levels are being compared to mercury levels in game fish. In the simplest scenario, if all lakes have similar mercury levels in one-year-old yellow perch, then variation in mercury levels in game fish are due to food web effects or variation in the growth rate of northern pike. Mercury loading from the watershed has been investigated previously by dating sediment cores from five interior lakes and measuring mercury accumulation in the cores. Current work is being conducted measuring mercury levels in soils in several lake watersheds that vary in underlying geology. The major mercury-removal process that is being studied is the variability in volatilization of mercury from lake surfaces back to the atmosphere.

### **Mercury Trends in Fish**

The State of Minnesota first collected fish for mercury analysis in 1969. From 1969 to 1981 spotty collections of fish for mercury analysis were made as part of special studies. Since 1982, regular funding has come from the U.S. Environmental Protection Agency (EPA) or the Minnesota Legislature to collect fish for the purpose of issuing fish consumption advisories. From this historic database, MPCA scientists have attempted to quantify long-term trends in mercury levels by two methods. The first method simply looked at mean mercury levels (expressed as a standard-size, 55 cm northern pike) collected in the Northern Lakes and Forests ecoregion. The selection of lakes each year was not random, but in general mercury levels increased to the mid-/late 1980s and possibly have decreased since then. The second method compared mercury levels in lakes that have been sampled more than once. This set consists of 101 lakes and only includes lakes last sampled in 1995 or later and with the first and last collection greater than five years apart. Fifty-one of the lakes have experienced decreased mercury levels in fish, while 22 increased, and 25 showed no statistical change ( $p < 0.05$ ).

MPCA scientists plan to monitor fish mercury levels in a more consistent set of lakes and in yearling prey species which are not impacted as greatly by food chain dynamics as are predator game fish. Historic fish mercury concentrations were not collected with the intent of constructing trends, but rather for human health protection. Ecoregion reference lakes, long-term acid rain study lakes, 55 lakes from a statewide mercury in sediments project, and selected heavily fished lakes will be sampled more consistently (about every five years). A smaller set of lakes in Voyageurs National Park and five other lakes in Minnesota are also being sampled on an annual basis.

### **Investigations with Tekran Mercury Vapor Analyzers (2000-2001)**

Under a joint EPA grant written by Michigan, Wisconsin and Minnesota, the MPCA has occasional access to two Tekran mercury vapor analyzers. The Michigan Department of Environmental Quality equipped a mobile trailer with a 5-kilowatt propane generator to power the Tekran analyzers; a meteorological boom that can be swung up, in the air, to measure wind speed and direction; a computer for logging and analyzing data; and air conditioning and heat so the equipped trailer can be used year-round. One of the Tekrans can be used as a mobile unit.

The ability to measure mercury accurately in outdoor air is being used by MPCA research staff in several ways:

1. MPCA staff used the mobile Tekran on small lakes in Voyageurs National Park to measure the volatilization rate of mercury from the lake back to the atmosphere.
2. MPCA staff parked the trailer near suspected atmospheric mercury sources, and measured increases in mercury when the wind was directly from the source. Such data, when combined with wind direction and speed, can be used to estimate the mercury emission rate of the source. The mobile Tekran can be located on the other side of the suspected source to confirm that upwind air is not the source of the mercury.
3. MPCA staff estimated the rate that mercury is released from land-applied wastes by measuring the increase in mercury vapor under a chamber pressed into the soil.
4. MPCA staff quantified the difference in mercury concentrations between urban air in Minneapolis-St. Paul and more rural areas. In general, mercury is higher and more variable in the urban area.

These investigations provide a more detailed inventory of sources so that customized mercury-reduction strategies can be considered and developed.

### **Mercury in Waste Water Treatment Plant Effluent (2001)**

The amount of mercury that comes from waste water treatment plants is relatively low compared to the amount that comes from air sources. However, waste water treatment plants discharge directly to waterways and, therefore, may have significant impacts. Waste water treatment plants must meet water quality standards of 6.9 ng (nanograms) per liter (1.3 ng/l in the Lake Superior Basin) set by the MPCA. Waste water treatment plants that discharge more than 1 million gallons a day must monitor their effluents quarterly for five years using trace-level sampling techniques and certified laboratories that meet low part per trillion detection limits. The MPCA also plans to randomly sample 40 “minor” facilities this winter to determine the monitoring requirements needed for smaller plants.