



Mercury in Minnesota's Environment

Mercury has been used for hundreds of years in spite of its well documented toxicity to the human central nervous system.

Only recent studies have revealed that small amounts of atmospheric mercury pollution can lead to mercury being deposited in remote lakes. There the mercury can concentrate in fish tissue enough to make eating the fish hazardous to human health and wildlife. On average, the level of mercury in the environment is about four times higher than it would be naturally, and at least 37 states have health advisories suggesting limits on eating locally caught fish.

Contamination of fish can only be reduced by reducing releases of mercury into the environment.

Sources of mercury

Nearly all of the mercury that ends up in lakes results from air pollution from nearby and distant sources. Like acid rain, mercury pollution is a regional, national and international problem.

In the Upper Midwest, about one third of the mercury deposited in lakes comes from natural sources.

The rest is generated through human activity:

- emissions from burning fossil fuels containing trace amounts of mercury;
- emissions from the disposal, use, or manufacture of mercury-containing products or industrial wastes; and
- incidental emissions from processing mineral resources containing mercury (e.g., lead, taconite or copper ores, and limestone).

In 1990, United States emissions of mercury from human activities were estimated to be about 200 tons per year. About 50 percent of this mercury was from intentional use, about 40 percent was from energy production, and less than 10 percent was from minerals processing.

By 1994 U.S. mercury emissions had declined to about 145 tons per year, mostly because of controls on incinerators and less use of mercury in products (see graph on page two).

Mercury's unique properties

Mercury's unusual properties make it a useful and challenging metal. Because it conducts electricity while it is in a liquid form at room temperature, it is used in electrical switches, batteries and fluorescent lamps.

Unfortunately, mercury evaporates easily and therefore can be transported long distances in the air. When diluted in the atmosphere, many pollutants no longer present risks to human health in the environment. Not so with mercury. Mercury actually becomes concentrated in fish over time.

Mercury bioaccumulates

Bacteria in wetlands, lakes and rivers convert metallic mercury to an organic compound, methylmercury, which bioaccumulates in fish. When animals, including humans, *bioaccumulate* an environmental contaminant, they store the chemical more rapidly than their bodies can eliminate it.

Biomagnification is the increase in concentration of a contaminant at each level of a food chain. Plant-eating animals bioaccumulate

**U.S. ESTIMATED MERCURY EMISSIONS
1994-1995**

(From U.S. Environmental Protection Agency Report to Congress, 1997)

some of the contaminant. The animals that eat them bioaccumulate more, and the animals that eat *them* bioaccumulate even more.

Fish happen to bioaccumulate mercury very efficiently. (It is not clear if the fish are harmed by the mercury they accumulate in their

bodies.) Any animal (wildlife or human) that eats fish at the top of the food chain (walleye, northern pike, small mouth bass, shark, tuna, etc.) may get a big dose of mercury. If contaminated fish are repeatedly eaten, the fish-eating animal is at high risk.

In this way, very low levels of mercury contamination in the environment can result in toxic concentrations in fish at the top of the aquatic food chain. Through bioaccumulation, it is possible for the water in a lake to be safe to drink, yet the fish growing in that water can be unsafe to eat on an ongoing basis.

The toxic effects of eating mercury-contaminated fish

Methyl mercury causes damage to the central nervous system of humans and other animals through a number of ways. The most sensitive exposure is to a fetus or infant while its nervous system is under development.

Children who have been exposed to methylmercury in this way may experience delayed or altered neurological development, resulting in effects such as being slow to learn to walk and talk.

Such effects would be subtle and difficult to detect, except in large studies such as those being conducted among fish-eating populations in the Seychelles Islands in the Indian Ocean and the Faroe Islands in the North Atlantic.

These studies offer promise of reducing scientific uncertainties regarding how much mercury humans can safely consume in their diet.

Evidence indicates that some wildlife accumulate toxic levels of mercury, although the data are difficult to collect and are not definitive.

The cost of reducing mercury pollution

Emission-reduction strategies are least costly if they prevent mercury releases or replace mercury in products being manufactured. With these pollution-prevention strategies, there is no cost for pollution-control equipment or for

recycling mercury, as is conducted for mercury-containing products. However, mercury substitutes may cost more. Substitutes are available for every use of mercury in products except high-efficiency lighting (fluorescent lamps).

When mercury in discarded products is captured through carbon treatment at a waste incinerator, it costs \$3,000 to \$8,000 to capture each pound of mercury.

Capturing mercury released from coal combustion might cost more than five times as much. Unless substitutes prove very costly, the least expensive way to reduce mercury pollution will be to not use mercury in products or manufacturing processes.

Progress in reducing mercury releases

The connection between air pollution and widespread mercury contamination of fish was unknown until the late 1980s. Many manufacturers and the public are still unaware that mercury in products contributes to mercury contamination in fish.

Several states in the Upper Midwest have taken effective measures to reduce mercury use and emissions. For example, the Minnesota Legislature banned the use of mercury in alkaline batteries in 1990 and each year since then has enacted or refined laws intended to prevent mercury releases.

On a national basis, mercury use by all industries has been reduced by 75 percent since 1980. This is due in part to gradual reduction in the use of mercury in paint and pesticides.

Mercury use in other developed countries has declined on a similar scale. However, the United States and Europe have been exporting their now-unwanted mercury to nations that have less-established environmental protections. Mercury use is increasing in Asia, as are emissions of mercury from fuel combustion.

Given long-range atmospheric transport of mercury, increasing world emissions of mercury will continue to contaminate fish in the United States, despite our progress to reduce use and emissions of mercury.

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