THE OHIO STATE UNIVERSITY EXTENSION

FACT SHEET

Community Development

CDFS-200-08

The Invisible Environment Fact Sheet Series

Mercury

Joe E. Heimlich
Specialist, OSU Extension@COSI
Community Development

Mercury (Hg) is a naturally occurring element in the Earth's crust. It is used in many products, such as disinfectants, antiseptics, diuretics, and preservatives. Derivatives of mercury in the form of dusts, wettable powders, solutions, and fumigant vapors are used as fungicides and insecticides and as seed and cereal protectants. Most people have been beneficiaries of mercury through its use in dental fillings, lab instruments, paints, and fabric softeners. Industrial uses also include processing of wood, plastics, and paper.

But overexposure to mercury has a history of causing health problems. During the 19th century, mercury was used in hat making. Hatters were exposed to mercury fumes and, over time, lost some of their rational thought due to central nervous system damage. This resulted in the phrase "mad as a hatter." Today, there are still concerns over mercury exposure. This fact sheet will briefly summarize the effects of mercury on the human body and look at some of the major issues regarding this valuable but potentially dangerous element.

Mercury and the Human Body

The four primary forms of mercury are:

1. **Metallic Hg**: The liquid, silvery, heavy globule found in thermometers. Metallic mercury is 13 times denser than water. Though insoluble, metallic mercury can vaporize sufficiently at room temperature to reach toxic levels over time.
2. **$HgCl_2$**: A white, corrosive, crystalline salt. It is sparingly soluble in water and is used in some pesticides.
3. **Organic bivalent mercury compounds**: Very volatile and able to be absorbed into the body through all portals (openings) including the skin. These compounds are used as fungicides and as preservatives and in manufacturing processes.
4. **Methylmercury**: Water-soluble form of mercury that can pass the brain barrier and cause central nervous system damage. This is the most toxic of all mercury forms and is the result of a conversion of soluble mercury into an insoluble metallic mercury byproduct.

Mercury is a cumulative toxin, which means it can build up in the body and be passed on through food webs (bioaccumulations). The concern over exposure is different if the exposure is chronic or acute. If the exposure is low grade and chronic (continual over time) as is much of the industrial exposure, the kidneys ***may*** remove it in urine. This can occur for several months after the last exposure. This flushing process happens without apparent damage to the body.

The difficulties with mercury arise from acute (larger doses) exposure. In the body, mercury combines with sulfhydril groups in the cells and depresses the enzymatic system of the cells. Repeated exposure at high levels can harm the central nervous system and cause mood swings, shaky hands, difficulty walking, slurred speech, hallucinations, and loss of memory and concentration.

All forms of mercury are poisonous if absorbed into the body, although the form of the mercury determines the level of toxicity. When ingested, a lethal dose for an adult is between 1 and 4 grams. Every class of mercury

can create typical "mercury intoxication" when there is a large enough dosage. Acute poisoning is the major threat, but because mercury is a cumulative poison, subacute and chronic intoxications are also seen, especially in industry. Accidental exposures to volatile mercury compounds usually occur when people breathe them into their body.

In acute exposure, absorption of mercury through the blood system is very rapid. If treatment is not initiated within 10 to 15 minutes, the affect of the poisoning is set and may lead to death. Mental and nervous systems are not likely to be affected in acute as in chronic mercury poisoning. Absorption through the skin (dermis) leads to a systemic poisoning. If the entrance is through the eye, there is likely to be ulceration of the conjunctiva and cornea of the eye.

Many organic mercury compounds do affect the mental and nervous systems; however, these effects are temporary. There is disagreement as to what levels of exposure affect parts of the brain including vision, hearing, and balance. Inorganic mercury can damage the liver, kidneys, and the small intestine. The toxin creates difficulty in reabsorption and secretion.

A Continuing Concern

Humans have used mercury in various forms for centuries. During the twentieth century, the toxic nature of mercury was identified and documented. So why should mercury be an issue today?

Human activity such as coal burning, incineration of wastes, and industrial emissions can release mercury into the environment. The mercury eventually returns to Earth in rain and is washed into streams, lakes, rivers, and oceans, where potential problems can arise. Some organisms in the water convert mercury into methylmercury (MeHg) through a process called methylation. Methylmercury is an insoluble metallic mercury refuse and can bioaccumulate through food chains or webs where it is potentially concentrated in fish. Many people fear that higher levels of MeHg in fish can be toxic to those who eat the fish.

What the Research Says

The real concern with methylmercury is that, in toxic doses, it can cause neurological and developmental disorders in humans. For an adult woman of average weight who eats four ounces of fish per week, all the fish would need to contain average tissue concentrations of 0.25 parts per million mercury to be toxic.

The U.S. EPA has developed a reference dose (RFD). The RFD is the amount that could be safely consumed every day over a person's lifetime. The EPA safe limit is 0.1 mu g (mu g means there is an average of 0.1 gram of mercury in every gram). RFD is used by states to develop their fish consumption advisories. This level is roughly one-half that of the World Health Organization, which suggests the daily level could be 1.6 mu g/kilogram/week.

Average total mercury concentrations in bass, halibut, crappie, dolphin, mackerel, pike, snapper, and tuna ranges from 0.2 to 0.4 parts per million. Four ounces of fish per week of 0.25 mercury concentration provides the RFD for methylmercury exposure.

The real concern is for pregnant women who live in communities where fishing is necessary for subsistence. Anyone who eats a lot of fish would be at a greater risk than most of the population. Because the threat to fetal development is one of the major concerns of mercury poisoning, pregnant women face the greatest threat from low level methylmercury intoxication. One EPA study showed that between 1 and 3 percent of women of childbearing age eat enough fish to be concerned.

Some people believe this threat to be too great. They advocate stricter limits on mercury emissions from utilities, manufacturing plants, and other sources. There are already efforts in place to reduce mercury emissions from municipal waste combustors, hazardous waste combustion facilities, and medical waste incinerators.

Eating Fish?

Fish and shellfish are foods high in protein and low in saturated fat. They also contain fatty acids that are important for optimal brain and eye development, maturation of the visual cortex, and motor development. There is also indication these same fatty acids help regulate quiet sleep episodes in infants. Consumption of fish has also been linked to reduced risk of coronary disease.

Many scientists believe the benefits from eating fish far outweigh the risks of methylmercury exposure. As in all environmental issues, careful consideration of options, moderation, and informed decision-making are the keys.

In 2004 the EPA and FDA issued the first-ever joint consumer advice about methylmercury in fish and shellfish. This advice was for women who might become pregnant; women who are pregnant; nursing mothers; and young children. The advisory provides three recommendations for selecting and eating fish or shellfish to ensure that women and young children will receive the benefits of eating fish and shellfish and be confident that they have reduced their exposure to the harmful

effects of methylmercury. The three recommendations are as follows:

1. Do not eat shark, swordfish, king mackerel, or tilefish as they contain high levels of mercury.
2. Eat up to 12 ounces (two average meals) a week of a variety of fish and shellfish that are lower in mercury.

   —Five of the most commonly eaten fish that are low in mercury are shrimp, canned light tuna, salmon, pollock, and catfish.

   —Another commonly eaten fish, albacore ("white") tuna has more mercury than canned light tuna. So, when choosing your two meals of fish and shellfish, you may eat up to 6 ounces (one average meal) of albacore tuna per week.
3. Check local advisories about the safety of fish caught by family and friends in your local lakes, rivers, and coastal areas. If no advice is available, eat up to 6 ounces (one average meal) per week of fish you catch from local waters, but don't consume any other fish during that week.

Follow these same recommendations when feeding fish and shellfish to your young child, but serve smaller portions.

For additional information, contact your local health department or district office of the EPA. The EPA also maintains a fish advisories web page (http://www.epa.gov/waterscience/fish/), which can be used to access information and contact your local health department.

Updated in 2007 by Victor S. Yocco. Series edited by Joe E. Heimlich and Jacqueline LaMuth, OSU Extension.