

## Mercury



### WHAT IS MERCURY?

Mercury - known as "Hg" to chemists - is a naturally occurring element. It is a metal and conducts electricity. Liquid at room temperature, it combines easily with other metals and expands and contracts evenly with temperature changes. Because of these properties, mercury has been used in many household, medical and industrial products.

Although mercury performs many useful functions in our workplaces and homes, it is toxic and can impair the way we see, hear and function.

Mercury evaporates slowly. If spilled or improperly stored, this evaporation will cause continuous contamination of the air you breathe.

Mercury poisoning attacks the central nervous system in all humans. Children, especially those under the age of 6, are more susceptible to mercury poisoning. Each year, Indiana has about 300 reported cases of mercury poisoning involving children exposed to mercury from broken thermometers alone.

Less than a third of the mercury in the environment is naturally occurring. The majority is released through preventable human pollution. It enters the atmosphere, lakes and streams from coal burning for power generation, from industrial sources and by improper disposal of household products that contain mercury.

Improper mercury disposal includes: pouring it down drains, putting it in the trash and burning it in barrels and incinerators. These improper disposal methods can elevate mercury contamination to harmful levels.

When mercury seeps into lakes and waterways, it undergoes a natural chemical process and is converted to a more deadly form - methyl mercury. It then contaminates the food chain by building up in the tissue of fish and animals including those we eat. Because of high mercury concentrations in fish, the State of Indiana issues annual fish consumption advisories, which are available from your local health department.

## MERCURY FACTS

- Mercury is one of the 92 naturally occurring chemical “elements” that make up our physical world. Mercury has some unusual chemical and physical properties that make it a useful substance for a variety of electrical devices and other industrial applications.
- Although mercury is a metal, it exists in a liquid state at room temperature. It generally occurs in nature as mercury sulfide (HgS), a reddish ore also known as cinnabar. Cinnabar was once used as a pigment and small figurines and reliefs also were carved from it.
- Because mercury is a metal, it is an excellent conductor of electricity, and therefore is frequently used for electric switches. Mercury also is used in fluorescent, or mercury-vapor lights.
- Because it readily expands and contracts as it gets warmer or cooler, it also is used in thermometers and thermostats.
- Because it is liquid, but also is extremely dense and heavy compared to water and other liquids, it is used in barometers and other pressure detection devices.
- Because mercury compounds can interfere with the growth of fungi, it also was previously used in latex paint to prevent mold.
- Unfortunately, mercury is highly toxic to humans and other animals. In humans, it can affect the liver, kidney's, the central nervous system, or the brain. It is especially harmful to children and developing fetuses.
- Because mercury also has a high surface tension which causes it to “bead up” and to absorb loose particles as it rolls along, it was in the past used to clean felt hats. However, “hatters,” as the hat cleaners were known, eventually succumbed to mercury poisoning and suffered from dementia. Hence, the phrase “mad as a hatter.” (and the character, the Mad Hatter, of Alice in Wonderland.)
- Because mercury is a liquid, and also because it easily evaporates into the air, mercury can enter the environment very easily. Once it is in the environment, it can be difficult to clean up, can spread easily, and may persist for a long time.

## IN WHAT FORMS DOES MERCURY EXIST?

Mercury occurs naturally in the environment. Sometimes known as quicksilver, it is a heavy metal, like lead or cadmium, that exists in different chemical forms:

- Elemental mercury or metallic mercury is the element in its pure, ‘un-combined’ form. It is a shiny, silver-white metal that is liquid at room temperature, but is rarely found in this form in nature. If not sealed off, mercury slowly evaporates into the air, forming a vapor. The quantity of vapour formed increases as temperatures rise. Elemental mercury is traditionally used in thermometers and some electrical switches.
- Inorganic mercury compounds or mercury salts, more commonly found in nature, include mercuric sulphide (HgS), mercuric oxide (HgO) and mercuric chloride

(HgCl<sub>2</sub>). Most of these are white powders or crystals, except for mercuric sulphide which is red and turns black after exposure to light. Some mercury salts, such as mercury chloride, also form vapor, but they stay in the air for a shorter time than elemental mercury because they are more soluble in water and more reactive.

- Organic mercury is formed when mercury combines with carbon and other elements. Examples of organic mercury compounds are dimethyl mercury, phenyl mercuric acetate and methyl mercuric chloride. The form most commonly found in the environment is methyl mercury.

#### HOW DOES MERCURY EXIST IN THE ENVIRONMENT?

- Several forms of mercury exist naturally in the environment, the most common being metallic mercury, mercuric sulphide, mercuric chloride, and methyl mercury.
- Natural processes can change the mercury from one form to another. For instance, chemical reactions in the atmosphere can transform elemental mercury into inorganic mercury.
- Some micro-organisms can produce organic mercury, particularly methyl mercury, from other mercury forms. Methyl mercury can accumulate in living organisms and reach high levels in fish and marine mammals via a process called bio-magnification (i.e. concentrations increase in the food chain).
- Because mercury is one of the basic chemical elements, of which all things are made, it cannot be broken down or degraded into something else. Once released into the biosphere through natural events or human activities, mercury readily moves and cycles through the environment. Soil, water bodies and the sediments underneath them are believed to be the places where mercury comes to rest until it is ultimately removed from the biosphere again.

#### HOW DOES THE FORM OF MERCURY AFFECT

#### LIVING ORGANISMS AND THE ENVIRONMENT?

- The different forms mercury exists in (such as elemental mercury vapor, methyl mercury or mercuric chloride) are commonly designated "species". As mentioned above, the main groups of mercury species are elemental mercury, inorganic and organic mercury forms. Speciation is the term commonly used to represent the distribution of a quantity of mercury among various species.
- Speciation plays an important part in the toxicity and exposure of mercury to living organisms. Among other things, the species influence:
  - The physical availability for exposure - if mercury is tightly bound to in-absorbable material, it cannot be readily taken up (e.g. into the blood stream of the organism);

- The internal transport inside the organism to the tissue on which it has toxic effects - for example the crossing of the intestinal membrane or the blood-brain barrier;
  - Its toxicity (partly due to the above mentioned);
  - Its accumulation, bio-modification, detoxification in – and excretion from – the tissues;
  - Its bio-magnification on its way up the trophic levels of the food chain (an important feature particularly for methyl mercury).
- Speciation also influences the transport of mercury within and between environmental compartments including the atmosphere and oceans, among others. For example, the speciation is a determining factor for how far from the source mercury emitted to air is transported. Mercury adsorbed on particles and ionic (e.g. divalent) mercury compounds will fall on land and water mainly in the vicinity of the sources (local to regional distances), while elemental mercury vapor is transported on a hemispherical/global scale making mercury emissions a global concern. Another example is the so-called "polar sunrise mercury depletion incidence", where the transformation of elemental mercury to divalent mercury is influenced by increased solar activity and the presence of ice crystals, resulting in a substantial increase in mercury deposition during a three month period (approximately March to June).
  - Moreover, speciation is very important for the controllability of mercury emissions to air. For example, emissions of inorganic mercuric compounds (such as mercuric chloride) are captured reasonably well by some control devices (such as wet-scrubbers), while capture of elemental mercury tends to be low for most emission control devices.

#### WHAT IS MERCURY POISONING?

- Mercury poisoning is the ill effects on humans nervous system and other bodily systems due to the over-exposure of mercury. Mercury is a neurotoxin, meaning it affects the nervous system. The "mad hatters" of the 19th century suffered from mercury poisoning which caused personality changes, nervousness, trembling, and even dementia. The hatters were exposed to mercury in the felting process, where mercury was rubbed onto cloth to preserve it.
- Today, people are more aware of the dangers of mercury and many of its uses have been discontinued. However, mercury exposure is still an occupational hazard for people in many industries and mercury is present in the environment around us. There is also the risk of exposure due to a thermometer breaking or mercury leaking out of a thermostat or any number of mercury-containing devices. If mercury vapor is inhaled, as much as 80 percent may enter the bloodstream.
- The effects of mercury poisoning can be classified as acute, chronic, or other.

- The degree of risk varies depending on the amount of mercury, the form, how often, and the age of the exposed person. Children (and also unborn fetuses) are the most vulnerable to the effects of mercury poisoning.
- The work environment can be designed to minimize workers' exposure. But some mercury will still escape into the environment and much of it will change into methyl mercury and eventually be eaten by fish. Mercury-contaminated fish are the most likely source of mercury poisoning. It is recommended that mercury's uses in buildings be eliminated, not because its presence makes the buildings dangerous, but to help keep mercury out of the environment.