OhioEPA
State of Ohio Environmental Protection Agency

Pollution Prevention Fact Sheet

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Persistent, Bioaccumulative and Toxic Chemicals

Nickel and Nickel Compounds

What are PBT chemicals?

Persistent, bioaccumulative and toxic (PBT) chemicals do not readily break down in the environment, are not easily metabolized, may accumulate in human or ecological food-chains through consumption or uptake and may be hazardous to human health or the environment. A PBT chemical, once released to the environment, may present increasing long-term toxic effects to human health and the environment, even if the release was of a small amount. The U.S. Environmental Protection Agency (U.S. EPA) has created a priority in its hazardous waste minimization program to reduce the presence of PBT chemicals, promote pollution prevention and avoid the transfer of PBT chemicals across environmental media.

Nickel is a high-priority PBT chemical.

Pure **nickel** is a hard, silvery-white metal, which has properties that make it very desirable for combining with other metals to form mixtures called alloys and is used in many industrial settings. It is essential to animals and probably to humans also. Nickel and its compounds have no characteristic odor or taste. Nickel does not degrade and is not destroyed by combustion. It cycles between the soil, the atmosphere, surface waters and ground water. High levels of nickel can cause allergic reactions and kidney damage. Dust or fumes of nickel can be a human carcinogen. Nickel usage and pollution should be reduced wherever possible.

In 1999, Ohio's hazardous waste program regulated facilities reported generating 22 million pounds of nickel and nickel compounds in waste.

What is the adverse effect of nickel?

Nickel is essential to maintaining good health in animals. A small amount of nickel is probably essential for humans also, and there have been no observed human health effects from low levels of nickel.

The most common adverse health effect of nickel in humans is an allergic reaction. People can become sensitive to nickel when jewelry or other items containing nickel touch the skin. Wearing earrings containing nickel in pierced ears may also sensitize people to nickel. Once a person is sensitized to nickel, further contact with the metal will produce a reaction. The most common reaction is a skin rash at the site of contact. In some sensitized people, dermatitis may develop at a site away from the area of contact. For example, hand eczema is fairly common among people sensitized to nickel. Less frequently, some people who are sensitive to nickel have asthma attacks. Some sensitized individuals react when they eat nickel in food or water, or breathe dust containing nickel.

People who are not sensitive to nickel must eat very large amounts of nickel to suffer adverse health effects. Workers who accidentally drank water containing 250 parts nickel in a million parts of water (ppm) from a contaminated drinking fountain had stomach aches and suffered adverse effects in their blood (increased red blood cells) and kidneys (increased protein in the urine). This concentration of nickel is more than 100,000 times greater than the amount of nickel usually found in drinking water. A two-year-old child died from heart failure after eating 5,700 milligrams of nickel as crystals of nickel sulfate. The dose of nickel that this child ate was about 50,000 times greater than the usual daily intake of a child.

U.S. EPA has determined that nickel refinery dust and nickel subsulfide are human carcinogens.

Other lung effects including chronic bronchitis and reduced lung function have been observed in workers breathing nickel.

Where is nickel found?

Pure nickel is a hard, silvery-white metal. It has properties that make it very desirable for combining with other metals to form mixtures called alloys. Some of the metals that nickel can be alloyed with include iron, copper, chromium and zinc. These alloys are used in making metal coins, jewelry, valves and heat exchangers. Most nickel is used to make stainless steel. There are many compounds of nickel combined with other elements, including chlorine, sulfur and oxygen. Many of these compounds dissolve fairly easily in water and have a characteristic green color. Nickel and its compounds have no characteristic

Nickel and Nickel Compounds

odor or taste. Nickel compounds are used for nickel plating, to color ceramics, to make some batteries and as substances known as catalysts that increase the rate of chemical reactions.

Nickel combined with other elements occurs naturally in the earth's crust. It is found in all soil and is emitted from volcanos. In the environment, it is found primarily combined with oxygen or sulfur as oxides or sulfides. Nickel is released into the atmosphere during nickel mining and by industries that make alloys or nickel compounds or industries that use nickel and its compounds. These industries may also discharge nickel in wastewater. Nickel is also released into the atmosphere by oil-burning power plants, coal-burning power plants and trash incinerators.

Much of the nickel released into the environment ends up in the soil or sediment where it is strongly attached to particles containing iron or manganese. Under acidic conditions, nickel is more mobile in soil and may seep into ground water. Nickel does not appear to concentrate in fish. Studies show that it does not accumulate in plants growing on land that has been treated with nickel-containing sludge or in small animals living on that land.

Who is at risk?

People may be exposed to nickel by breathing air, drinking water, eating food or smoking tobacco containing nickel. Skin contact with soil, water or metals containing nickel as well as with metals plated with nickel can also result in exposure. Stainless steel and coins contain nickel. Jewelry is often plated with nickel or made from nickel alloys. Patients may be exposed to nickel in artificial body parts made from nickel-containing alloys.

One may be exposed to higher than average levels of nickel in drinking water if the person lives near industries that process or use nickel.

Soil usually contains between four and 80 parts of nickel in a million parts of soil (ppm). The highest soil concentrations (up to 9,000 ppm) are found near industries where nickel is extracted from ore. High concentrations of nickel occur because dust released to air from stacks during processing settles on the ground. You may be exposed to nickel in soil by skin contact. Children may also be exposed to nickel by eating soil.

Food contains nickel and is the major source of nickel exposure for the general population. A person eats about 170 micrograms of nickel in food every day. Foods naturally high in nickel include chocolate, soy beans, nuts and oatmeal. Human daily intake of nickel from drinking water is only about two micrograms. People breathe in between 0.1 and 1 micrograms of nickel each day, excluding nickel in tobacco smoke.

Workers in industries that process or use nickel may be exposed to higher levels of nickel by breathing dust or fumes (as from welding) or by skin contact with nickel-containing metal and dust or solutions containing dissolved nickel compounds. A national survey conducted from 1980 to 1983 estimated that 727,240 workers are potentially exposed to nickel metal, nickel alloys or nickel compounds.

How can people reduce the risk of nickel exposure?

To reduce the risk of occupational exposure, ask why nickel is used in the manufacturing of your company's products. Also inquire about how it may be removed or replaced. Discourage children from eating dirt. Make sure children wash their hands before meals and at bedtime. Discourage hand-to-mouth activity in children.

Measurements of the amount of nickel in one's blood, feces and urine can be used to estimate exposure to nickel. However, it is easier to establish exposure to soluble forms of nickel than to less-soluble forms of nickel. The nickel measurements do not accurately predict potential health effects from exposure.

Sources

Agency for Toxic Substances and Disease Registry
www.atsdr.cdc.gov

TOXNET, National Library of Medicine, National Institutes of Health
www.toxnet.nlm.nih.gov

The Office of Pollution Prevention was created to encourage multimedia pollution prevention activities in Ohio to reduce risk to public health, safety, welfare and the environment. Pollution prevention stresses source reduction and, as a second choice, environmentally-sound recycling while avoiding cross media transfers. The office develops information related to pollution prevention, increases awareness of pollution prevention opportunities, and can offer technical assistance to business, government and the public.

For more information, visit the Office of Pollution Prevention's Web site at
www.epa.state.oh.us/opp

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