

toxics release inventory

Chemical Profile

Environment Division

Nickel

What is nickel?

Nickel (Ni) is a hard, silvery-white metal that resists corrosion. It commonly occurs in all types of soils, and in rocks and underwater sediments.

Nickel combines easily with other metals to form mixtures called alloys. For example, nickel mixed with steel forms stainless steel, a common alloy that resists rust and corrosion. Our familiar nickel coin contains 25% nickel mixed with copper. Nickel and its alloys are also used in batteries, spark plugs, electrical resistance wires, metal jewelry, cookware, and textile dyes.

How is nickel released by electric utilities?

Small amounts of nickel are present in oil and coal. When electric utilities burn these fuels at their power plants, nickel is released and forms compounds such as nickel oxide, nickel sulfate, nickel chloride, and nickel sulfide. Most of this nickel is carried by particles of ash.

Oil-burning power plants produce little ash, so they typically do not use particle control devices to capture it. Small amounts of ash carrying nickel may enter the air from these plants or stick to the walls and bottoms of their boilers. Coal-burning power plants produce much larger amounts of ash. However, they use particle control devices to capture more than 99% of it, so very little ash enters the air from

these plants. Nickel-carrying ash captured by particle control devices or removed from boilers is usually sent to ash ponds or land disposal sites.

Although study of nickel sources is ongoing, present information shows that nickel from power plants is about 10% of all the nickel from human activities released into the air each year in the United States. The U.S. Environmental Protection Agency (EPA) estimates that U.S. power plants released about 375 tons of nickel into the air in 1994. About 85% of this nickel came from oil-burning plants.

Is nickel also released by other sources?

Nickel is released by soils as they erode in wind and rain, and by volcanoes when they erupt. These and other natural sources account for an estimated 9400 tons of nickel released around the globe each year—about 60% of the nickel released into the environment from all sources.

Nickel released by human activities comes mainly from steel mills, metal production facilities, boilers that burn oil, and incinerators that burn refuse and sewage sludge.

What happens to nickel after it is released by electric utilities?

Ash particles carrying nickel settle to the ground after they are released into the air from power plants. Nickel com-

pounds that dissolve in water are carried to the ground by rain and snow.

Other nickel compounds that don't dissolve reach the ground through gravity and air turbulence. Nickel does not seem to build up in the flesh of fish.

Ash pond wastewater discharged into public waterways may contain small amounts of nickel, but these amounts are regulated by local permits.

How might people be exposed to nickel?

People are commonly exposed to nickel in the foods they eat. For example, chocolate, soy beans, nuts, and oatmeal all contain nickel. Foods can also pick up small amounts of nickel from cooking utensils. People may drink water or breathe particles in the air that carry trace amounts of nickel, and those who smoke may inhale nickel found in tobacco. People are also exposed when they handle coins and wear jewelry made from nickel alloys. Finally, industrial workers may breathe nickel dust or fumes, or touch substances that contain nickel.

What are the potential effects of nickel on human health?

Very small amounts of nickel in people's diets may promote good health. However, some people exposed to small amounts of nickel for a long time develop an allergic reaction to it. The most common reaction is itching when

nickel contacts their skin. In less common, severe cases, people experience vomiting and diarrhea when they swallow nickel or asthma attacks when they breathe it.

People who are not allergic have health problems only when they are exposed to very large amounts of nickel not normally found in the environment. Before regulations were passed limiting the amount of nickel in workplace air, such exposures could occur in industrial settings. Some workers in nickel refineries and processing plants who breathed large amounts of nickel refinery dust developed chronic bronchitis and reduced lung function. Some also developed cancer of the lungs or sinuses. EPA has classified nickel refinery dusts and the nickel subsulfide they contain as substances that can cause cancer in people.

How likely is it that utility releases pose a risk to human health?

It is unlikely that nickel from power plants poses a significant risk to human health. EPA has evaluated the potential health risks of breathing nickel for people who live near power plants that burn oil and coal. They found that the highest risks were from oil-burning power plants. Eleven oil-burning plants out of nearly 600 power plants in the United States posed cancer risks from nickel exposure greater than one in a million. In the single case of highest risk, a person living all his life near an oil-burning power plant would have 50 chances in a million of developing cancer as a result of his exposure to power plant nickel. Risks due to nickel from coal-burning power plants were much lower: less than half a chance in a million of developing cancer for a person living near one all his life.

In making these risk estimates, EPA assumed that 50% of the nickel released

was as likely to cause cancer as nickel subsulfide. However, university research to identify the specific nickel compounds released by power plants suggests that this percentage may be too high. For example, while power plants may release very small amounts of nickel subsulfide, they primarily release other nickel compounds that are thought to be much less likely to cause cancer. Although research is underway on these issues, we don't have all the answers yet.

How is nickel regulated?

EPA has established limits for nickel in air. Under the National Pollutant Discharge Elimination System, federal and state regulators determine how much nickel each power plant may release in wastewater discharges. The Occupational Safety and Health Administration has set limits on the amount of nickel in workplace air.

Where can I get more information about nickel?

The Agency for Toxic Substances and Disease Registry (ATSDR) has a fact sheet with answers to frequently asked health questions about nickel. It is available through the ATSDR Information Center at 1-800-447-1544, or on the Internet at <http://atsdr1.atsdr.cdc.gov:8080/tfacts15.html>

EPA also has a fact sheet that is available on the Internet at <http://www.epa.gov/ttnuatw1/hlthef/nickel.html>