Glossary of Metals

Antimony

Antimony is a silvery-white metal found in the earth's crust. Most antimony is brought into the United States from other countries for processing. Antimony is used in lead storage batteries, sheet and pipe metal, paints, ceramics, and fireworks. It is also is added to textiles and plastics to prevent them from catching fire.

Route of exposure

Antimony is released to the environment from natural sources and from industry. Rivers, lakes, and streams contain low levels of antimony. Because antimony is found naturally in the environment, people are exposed to low levels of it every day, primarily in food, drinking water, and air. Workers in industries that process or use antimony ore can be exposed to higher levels.

Health effects

Breathing high levels of antimony for a long time can irritate a person's eyes and lungs and can cause heart and lung problems, stomach pain, diarrhea, vomiting, and stomach ulcers. Ingesting large doses of antimony can cause vomiting. We do not know of other problems caused by eating or drinking it. Long-term studies in lab animals found liver damage and blood changes when animals ingested antimony.

In some lab studies in which the animals breathed high levels of antimony, the animals got lung cancer. We do not know whether antimony will cause cancer in people.

Measuring exposure

The lowest urine level of antimony associated with health problems is not known.
Workers who are exposed to antimony but do not have signs of illness from this exposure can have urine levels of antimony up to 300 µg/L.

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Arsenic

Arsenic is a naturally occurring element widely distributed in the earth's crust. It combines with oxygen and other elements to form inorganic arsenic compounds. Inorganic arsenic compounds have various industrial purposes, including the smelting of other metals such as lead, manufacture of some types of glass, and formulation of pesticides and fungicides. Inorganic arsenic compounds also can be used in pressure-treated wood.

Route of exposure

Inorganic arsenic compounds can dissolve in water, get into food, or blow on the wind in arsenic-containing soil. Arsenic can get into plants when their roots take up water that contains arsenic. It can get into animals when they eat food, drink water, or breathe air that contains arsenic. In plants and animals, arsenic combines with carbon and hydrogen to form organic arsenic compounds. Organic arsenic compounds are less toxic than inorganic arsenic compounds. Arsenic can build up in fish and shellfish, but the arsenic in fish is mostly the organic form and therefore much less harmful.

Health effects

People exposed to high levels of arsenic can have nausea and vomiting, diarrhea, anemia, and low blood pressure. These symptoms may be followed by a feeling of "pins and needles" in the hands and feet (neuropathy).

Chronic (long-term) exposure to arsenic can cause stomach ailments, headaches, fatigue, neuropathy, dark splotches on the skin, and small "corns" or "warts" on the palms of the hands, soles of the feet, and torso.

People exposed to inorganic arsenic can have more cancer of the lung, skin, bladder, liver, kidney, and prostate. Studies have not linked arsenic exposure to leukemia in adults or children.

Measuring exposure

Normal urine levels of arsenic are less than 50 µg/L. A level between 50 and 200 µg/L should be monitored by your physician but does not necessarily represent a health risk. A level over 200 µg/L is considered abnormal and may require treatment if symptoms of arsenic poisoning are present. The best test to confirm too much arsenic exposure is a 24-hour urine collection and analysis after 3 days of a seafood-free diet.

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Barium

Barium is a silvery-white metal found in nature. Barium compounds are used to make paint, bricks, tiles, glass, and rubber; used by the oil and gas industries in drilling muds; and sometimes used by doctors to perform medical tests.

Route of exposure

Barium is found in most soils and foods at low levels. Barium builds up in fish and other aquatic plants and animals. People are exposed to barium by drinking water and eating food that contains barium, and breathing very low levels of barium in air.

Health effects

The health problems from different barium compounds depend on how well the compound dissolves in water. Barium compounds that do not dissolve well in water, such as those used in medical tests, generally are not harmful.

The barium compounds that do dissolve well in water can harm people. Eating food and drinking water with high levels of barium compounds that easily dissolve in water for a short time can cause stomach irritation, higher blood pressure, muscle weakness, or damage to the liver, kidney, heart, and spleen.

We do not know the effects in people who have ingested low levels of barium over a long time but lab animals that ate barium over a long period had high blood pressure and changes in the heart. The few animal studies that have been done to determine whether barium causes cancer have produced unclear results.

Measuring exposure

The lowest urine level of barium associated with health problems is not known. A study of 18 welders exposed to barium showed an average barium level of 101.7 µg/L in their urine but no health problems in these welders were proven.

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Cadmium

Cadmium is a metallic element that occurs naturally in the earth's crust. All soils and rocks contain some cadmium. Most cadmium used in the United States is extracted during the production of other metals like zinc and copper. Cadmium has many uses, including batteries, pigments, metal coatings, and plastics.

Route of exposure

Cadmium enters the air from mining, industry, and burning household wastes. Plants and animals take up cadmium from the environment.

People are exposed to cadmium by inhaling cigarette smoke and contaminated air and by eating foods and drinking water contaminated with cadmium.

Health effects

Breathing high levels of cadmium can damage the lungs. Eating food or drinking water with very high levels can irritate the stomach, leading to vomiting and diarrhea. Exposure to lower levels of cadmium over a long time builds up cadmium in the kidneys and possibly leads to kidney disease. Other long-term effects are lung damage and fragile bones.

Some studies have shown that workplace exposure to cadmium can cause lung and prostate cancer but other studies have not shown this. According to the Environmental Protection agency, cadmium probably causes lung cancer and possibly causes prostate cancer.

Measuring exposure

A blood cadmium level lower than 5 μg/L is considered normal. The World Health Organization considers concentrations lower than 10 μg/L in blood acceptable for workplace exposures.

Several studies have indicated that cadmium levels more than 10 μg/L in urine of workers have been associated with kidney disease. Thus, a level greater than 10 μg/L in a worker's urine requires medical attention according to the Occupational Safety and Health Administration (OSHA) .

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Cesium

Cesium is a naturally occurring element in rocks, soil, and dust at low concentrations. Cesium is not mined or produced in the United States, and very little is imported from other countries. Cesium metal and its compounds have few commercial uses. Sometimes cesium is used to absorb for residual gas impurities in vacuum tubes and as a coating in tungsten filaments or cathodes of the tubes.

Naturally occurring cesium occurs in the environment mostly from the erosion and weathering of rocks and minerals. The mining and milling of certain ores can also release cesium to the air, water, and soil. The level of cesium in air and water is usually low.

Route of exposure

People can be exposed to cesium by breathing air, drinking water, or eating food that contains it. When you eat, drink, breathe, or touch things containing cesium compounds that can easily be dissolved in water, cesium enters your blood and is carried to all parts of your body.

Health effects

You are very unlikely to experience any health problems that could be related to naturally occurring cesium itself. In lab animals, cesium is not very toxic. Animals given very large doses of cesium compounds had changes in behavior, such as more activity or less activity, but you are not likely to breathe, eat, or drink amounts of cesium large enough to cause similar effects.

Cancer has not been related to exposure to naturally occurring cesium.

Measuring exposure

The lowest urine concentration of natural cesium that is associated with health problems is unknown.

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Chromium

Chromium is a naturally occurring element in rocks, animals, plants, soil, and volcanic dust and gases. Chromium is present in the environment in several different forms. You were tested for a total chromium concentration.

Some forms of chromium occur naturally in the environment and are essential nutrients in the human diet. Industrial processes generally produce other forms of chromium.

Route of exposure

Chromium can enter the air, water, and soil. In air, chromium compounds exist mostly as fine dust particles that eventually settle over land and water. Chromium does not build up in fish from water. People are exposed to chromium by eating food, breathing air, or drinking water containing chromium.

Health effects

All forms of chromium can be toxic at high levels, but some forms are more toxic than others. Breathing high levels of chromium can cause irritation to the nose, such as runny nose and nosebleeds. Ingesting large amounts of chromium can cause stomach upsets and ulcers, seizures, and kidney and liver damage. Skin contact with certain chromium compounds can cause skin ulcers. Some people are extremely sensitive to chromium and can have allergic reactions consisting of severe redness and swelling of the skin.

One form of chromium compound can increase the risk of lung cancer (the EPA classifies it in air as a human carcinogen).

Measuring exposure

Measuring chromium levels after exposure does not predict future problems.

According to the American Conference of Governmental Industrial Hygienists, workers who have been exposed to chromium should not have urine chromium levels higher than 30 µg/g creatinine.

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Cobalt

Cobalt is a naturally occurring element that exists in several forms. You were tested for nonradioactive cobalt. Cobalt is not mined in the United States. All cobalt used in industry is imported or obtained by recycling scrap metal that contains cobalt.

Cobalt is used in alloys (mixtures of metals) and as a drier for paint and porcelain enamel used on steel bathroom fixtures, large appliances, and kitchenware. Radioactive cobalt is used to sterilize medical equipment and food and to treat cancer and anemia.

Route of exposure

Small amounts of cobalt are naturally found in food. Vitamin B12 is a cobalt-containing compound that is essential for good health. Other important natural sources of cobalt occur in the environment, such as soil, dust, and seawater. Cobalt is released to the environment from burning coal and oil and from automobile exhaust. Small amounts of radioactive cobalt can be released into the environment as contaminants in radioactive waste; it is not produced by nuclear weapons testing.

Everyone is exposed to low levels of cobalt in air, water, and food. People can be exposed to cobalt if they work in industries that process cobalt or make products containing it.

Health effects

Exposure to high levels of cobalt can harm your health. Some workers who breathed high levels of cobalt in the air in combination with tungsten ("hard metal disease") developed lung problems, including asthma, pneumonia, and wheezing.

Studies have not consistently shown that exposure to natural (nonradioactive) cobalt causes cancer in humans. One study in workers with hard metal disease showed more deaths from lung cancer than in workers not exposed to cobalt dust. Another study linked workers' exposure to dust containing a mixture of tungsten and cobalt to lung cancer.

Measuring exposure

According to the American Conference of Governmental Industrial Hygienists, workers with a known exposure to cobalt should not have urine cobalt levels greater than 15 µg/L.

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Lead

Lead is a naturally occurring metal found in small amounts in the earth's crust. Lead can be found in all parts of our environment. Much of it comes from human activities that include mining, manufacturing, and burning fossil fuels.

Lead has many different uses. It is used to make batteries, ammunition, metal products (solder and pipes), and devices to shield X-rays. Because of health concerns, the amount of lead used in gasoline, paints, ceramics, and pipe solder has been dramatically reduced in recent years.

Route of exposure

People are exposed to lead in various ways:

- Eating food or drinking water that contains lead
- Spending time in areas where lead-based paints have been used and are deteriorating
- Working in a job where lead is used
- Engaging in certain hobbies in which lead is used (for example, stained glass)
- Using health-care products or folk remedies that contain lead

Health effects

Lead can affect almost every organ and system in the body. The most sensitive system, particularly in children, is the central nervous system (which includes the brain). Slow development can occur in young children who have lead levels as low as 10 ug/dL. At hazardous levels, lead can decrease reaction time; cause weakness in fingers, wrists, or ankles; and affect the memory. Lead also can cause anemia, stomach problems, and high blood pressure.

Lead can cause cancer in lab animals but not enough studies in humans have been done to show whether lead causes cancer in humans.

Measuring exposure

For children aged 1–5 years and for pregnant women, a blood lead level of 10 µg/dL or higher can cause health problems. For nonpregnant adults, problems can occur if lead levels are 30 µg/dL or higher.

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Manganese

Manganese is a naturally occurring metal in many types of rocks. It exists naturally in rivers, lakes, and underground water. Manganese is a trace element essential for good health. It can be found in several food items, including grains and cereals, and is found in high amounts in other foods, such as tea.

Route of exposure

Manganese can enter the air from mining operations and from iron, steel, and power plants. It can enter the water and soil from natural deposits, disposal of wastes, or deposits from airborne sources.

Everyone is exposed to small amounts of manganese in air, water, and food. People who work in occupations that mine or use manganese are likely to be exposed to high levels in their work environment.

Health effects

Some people exposed to very high levels of manganese for long periods of time in their work have developed mental and emotional disturbances and slow and clumsy body movements. Exposure to high levels of the metal can also cause respiratory problems and sexual dysfunction.

No information is available about whether manganese causes cancer in humans. Male lab rats exposed to high levels of manganese in food had slightly more pancreatic tumors. Male and female mice had slightly more thyroid tumors.

Measuring exposure

The lowest level of manganese found in urine that can cause health problems is not known.

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Mercury

Mercury is a naturally occurring metal that has several forms. One form is metallic mercury, a shiny, silver-white, odorless liquid. Metallic mercury is used in thermometers, dental fillings, and batteries. Mercury combines with other elements to form inorganic mercury compounds or "salts," which are usually white powders or crystals. Mercury salts are sometimes used in antiseptic creams and ointments.

Route of exposure

When elemental or inorganic mercury gets into bodies of water (usually from contaminated rain), it can be converted by bacteria to methylmercury, an organic form of mercury that is much more toxic than other forms. The methylmercury is then taken up by microscopic plants and animals as they feed. These plants and animals are eaten by larger fish, in which the methylmercury becomes more concentrated. Thus, methylmercury is a bigger problem as it moves up the food chain.

Metallic mercury and inorganic mercury compounds enter the air from mining ore deposits, burning coal and waste, and manufacturing certain products such as laboratory and electrical instruments, and from volcanoes. Mercury enters water or soil from the atmosphere through rainfall, disposal of wastes, and volcanic activity.

People are exposed to mercury in various ways:

- Eating fish or shellfish contaminated with methylmercury
- Breathing vapors in the air from spills, incinerators, and industries that burn fossil fuels
- Breathing contaminated workplace air or having mercury touch skin during use in the workplace
- Practicing religious rituals that include mercury

Health effects

The nervous system is very sensitive to all forms of mercury. Methylmercury and metallic mercury vapors are more harmful than other forms because more mercury in these forms reaches the brain. Exposure to high levels of metallic, inorganic, or organic mercury can permanently damage the brain, the kidneys, and the developing fetus. Effects on brain functioning may cause irritability, shyness, tremors, changes in vision or hearing, and memory problems.

Short-term exposure to high levels of metallic mercury vapors can cause problems such as lung damage, vomiting, diarrhea, skin rashes, and eye irritation.

Not enough research has been done for us to know whether mercury causes cancer in humans. However, some forms of mercury cause cancer in lab animals.

Measuring exposure

A normal level of mercury in urine is less than 20 μg/L, and a normal level of mercury in the blood is less than 10 μg/L.

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Molybdenum

Molybdenum is a naturally occurring metal that is an essential dietary nutrient. It is used in the petroleum industry and by the steel industry to make steel alloys. Molybdenum increases the strength and heat resistance of these alloys.

Route of exposure

The diet is the major source of molybdenum for most people. Exposure can also occur during the release of dusts from mining and processing the metal. People can then breathe in the dusts and possibly absorb molybdenum through the skin.

Health effects

Molybdenum can irritate the eyes, nose, and throats of exposed workers. Some workers exposed to molybdenum have more headaches, backaches, and aching joints than workers not exposed to molybdenum.

Some workers exposed to molybdenum developed lung disease, but this could not be linked to molybdenum because these workers were exposed to other metals as well.

Molybdenum has not been linked to cancer in lab animals, and no information is available about whether it causes cancer in humans.

Measuring exposure

The lowest level of molybdenum in urine that causes health effects is unknown. Workers could have high levels of molybdenum in their blood or urine but not have health problems, or they could have health problems without high levels of molybdenum.

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Nickel

Nickel is a very abundant element. Pure nickel is a hard, silvery-white metal. In the environment, it is found in all soils and is emitted from volcanoes. The industries with particular exposure to nickel are coin and jewelry making; fossil fuel combustion; welding; making rechargeable (nickel-cadmium) batteries; and production of glass bottles.

Small nickel particles in the air settle on the ground or are taken out of the air in rain. Much of the nickel in the environment is found in soil and sediments. Nickel does not appear to collect in fish or animals used for food, but plants that are grown in nickel-rich soil can collect it.

Route of exposure

People are exposed to nickel by breathing air or smoking tobacco containing nickel, by eating food or drinking water containing nickel, or by handling coins and contacting other metals containing nickel, such as jewelry. Skin absorption from certain internal medical devices is possible.

Health effects

Nickel is essential to maintain health in animals. A small amount of nickel is probably essential for humans, although a lack of nickel has not been found to affect human health.
The most common health problem from nickel is an allergic reaction. People can become sensitive to nickel when jewelry or other items containing it touch their skin. Once a person is sensitized to nickel, further contact with it will produce a reaction. The most common reaction is a skin rash at the site of contact. Some people who are sensitive to nickel have asthma attacks or conjunctivitis after exposure.

Workers who breathed large amounts of nickel can have chronic bronchitis, sinusitis, nasal polyps, asthma, and nasal and lung cancers. Today, levels of nickel in workplace air are much lower than they were in the past, and few workers now show symptoms of nickel exposure.

Workers who accidentally drank water containing very high levels of nickel (100,000 times more than in normal drinking water) had stomach aches, shortness of breath, headaches, and blood and kidney problems.

Measuring exposure

The average level of nickel in the urine of unexposed persons is 4.5 µg/L (range 1.9 – 9.6). Based on the International Federation of Clinical Chemistry guidelines, the highest level of normal for nickel in humans is 5 µg/L.

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Selenium

Selenium is a metal commonly found in rocks and soil and in low levels in water. It is an essential nutrient in the human diet. The major man-made source of selenium is burning coal. Selenium also is used in paints, fertilizers, and dandruff shampoos.

Route of exposure

People are exposed to selenium by skin contact, by breathing air that contains selenium, and by eating food, drinking water, or taking dietary supplements that contain it.

Health effects

Selenium compounds in the diet can be harmful at daily levels 5–10 times higher than the daily requirement. Too much dietary selenium produces nausea, fatigue, hair loss, deformed nails, and a feeling of "pins and needles" in the hands and feet (neuropathy). Overexposure to selenium in foods is unlikely to occur in the United States. Selenium compounds that touch the skin can cause redness and pain. High levels of selenium in workplace air can irritate the nose and throat.

Selenium sulfide, a compound very different from the selenium compounds found in foods and in nature, caused liver tumors in lab rats and lung tumors in lab mice that were fed high amounts daily. However, its use in dandruff shampoos is considered safe.

Measuring exposure

Serum selenium levels of 179 µg/L and higher can cause health problems.

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Thallium

Thallium is a bluish-white metal found in trace amounts in the earth's crust. In the past, it was obtained as a byproduct of smelting other metals; however, it has not been produced in the United States since 1984. All thallium in the United States now is imported or obtained from thallium reserves.

Thallium is used mostly in manufacturing electronic devices, switches, and closures, mainly for the semiconductor industry. It is used in making special glass and for certain medical procedures. In the past, thallium was used as a rodenticide.

Route of exposure

Thallium enters the atmosphere primarily from coal burning and metals smelting. From the atmosphere it gets into rain and snow and then into groundwater, surface water, and soil. Eventually it is absorbed by plants and enters the food chain. It also builds up in fish and shellfish.

Eating food contaminated with thallium and smoking cigarettes may be major sources of exposure for most people.

Health effects

Exposure to high levels of thallium can cause health problems. Workers who breathe thallium on the job over a long period can have nervous system problems, such as numbness of the fingers and toes.

Studies of people who have ingested large amounts of thallium in contaminated food or water over a short time reported vomiting, diarrhea, temporary hair loss, and problems with the nervous system, lungs, heart, liver, and kidneys. We do not know what the problems are from ingesting low levels of thallium over a long period of time.

No information is available for people or animals about whether thallium exposure causes cancer.

Measuring exposure

Most people in population studies have thallium levels of around 1.0 µg/L. Thallium levels >300 µg/L in urine indicate thallium poisoning.

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Tungsten

Tungsten is a naturally occurring steel-gray to tin-white metal or fine powder that comes from more than 20 different tungsten-bearing minerals. It is used to increase the toughness and strength of steel for cutting tools and to make filaments for electric lighting and electron tubes (for TVs, radios, etc.).

Route of exposure

People can be exposed to tungsten through both natural processes and human industrial activities. Trace amounts are found in seawater, and very small concentrations are present in the atmosphere. Large amounts of dust can be released into the air from industries that make tungsten. People are exposed to it by breathing air that contains tungsten; they can also be exposed by eating food or drinking water contaminated with tungsten.

Health effects

Workers exposed to high levels of tungsten dust or vapors can have skin, eye, throat, or nose irritation. Workers who are exposed to tungsten often are exposed to other heavy metals, such as cobalt, that usually are part of the tungsten refining and compounding processes. Over long periods of time, these workers can develop lung problems, such as cough, shortness of breath, or wheezing (hard metal disease). Early research on this respiratory condition attributed these symptoms mostly to cobalt exposure instead of to tungsten exposure. In lab animals recent research shows that cobalt and tungsten together can cause lung damage.

We do not know about any studies of health problems in people who do not work with tungsten.

Very little research has been done to study whether tungsten can cause cancer in animals or humans. Lab animals that were exposed to high amounts of tungsten and cobalt showed early signs of lung cancer. Studies in human workplaces do not link exposure to tungsten alone with more cancer, but one study linked workplace exposure to dust containing a mixture of tungsten and cobalt with lung cancer.

We found no reports of any research suggesting that tungsten causes leukemia.

Measuring exposure

The lowest level of tungsten that can cause health problems is unknown.

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Uranium

Uranium is a naturally occurring radioactive element. It is a normal part of rocks, soil, air, and water. Natural uranium is a mixture of three types, or isotopes, called U-234 (^{234}U), U-235 (^{235}U), and U-238 (^{238}U). You were tested for total uranium, which is a combination of these isotopes.

All three types of uranium are the same chemical, but they have different radioactive properties. U-238 is by far the most common type of uranium on earth and is the least radioactive. U-234 is the most radioactive type of uranium. U-235 is used as a fuel in power plants and weapons. The amount of U-234 and U-235 in natural uranium is increased through a process called enrichment.

Route of exposure

Human activities, wind, and streams can move uranium through the environment and change the amount of uranium people are exposed to. Uranium exists in dust in the air that can settles onto surface water, soil, and plants. People can be exposed to uranium by breathing air, drinking water, or eating food containing uranium. Certain areas of the United States have higher levels of uranium in the environment than other areas.

Health effects

Large amounts of uranium can react with the tissues in the body and damage the kidneys. This damage results from the chemical properties of uranium, not from its radioactive properties.

As with other radioactive elements, the more radioactive the element, the higher the chance of getting cancer. For uranium, the chance of getting cancer is greater for people who are exposed to enriched uranium. No cancer of any type has ever been seen in humans as a result of exposure to natural (nonenriched) uranium.

Even though studies have reported lung and other cancers in uranium miners, some of the miners also smoked and were exposed to other substances that cause cancer, such as diesel engine exhaust fumes and silica dust.

Measuring exposure

We do not know about any studies that showed health problems in people with levels of urine uranium between undetectable and 2.15 µg/L as found in the Churchill County population.

The U.S. Nuclear Regulatory Commission's action level to protect people exposed to uranium at work is a urine uranium level of 15 µg/L.

In one study of people who drank well water with high natural uranium concentrations, the median urinary concentration was 78 µg/L without effects on their kidney function.

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