



Arsenic

Introduction

Arsenic is a naturally-occurring element. Pure arsenic is a gray metal-like material which is usually found in the environment combined with other elements such as oxygen, chlorine, and sulfur. Arsenic combined with these elements is called inorganic arsenic. Arsenic combined with carbon and hydrogen is called organic arsenic. Organic forms are usually less harmful than the inorganic forms.

Most inorganic and organic arsenic compounds are white or colorless powders that do not evaporate. They have no smell, and most have no special taste. Thus, you usually cannot tell if arsenic is present in your food, water, or air.

Inorganic arsenic occurs naturally in many kinds of rock, especially in ores that contain copper or lead. When these ores are heated at smelters to get the copper or lead, most of the arsenic enters the air as a fine dust. Smelters collect this dust and purify the arsenic for several uses. The main use is as a preservative for wood to make it resistant to rotting and decay. Arsenic is also used to make several types of insect killers and weed killers.

Fate & Transport

Arsenic can enter the environment in several ways. Even though it does not evaporate, arsenic can get into air as dust. This can happen when smelters heat ores containing arsenic, when people burn any material containing arsenic, or when wind blows soil that contains arsenic into the air. Once in the air, the arsenic particles will travel with the wind for a while, but will then settle back to the ground. Most arsenic compounds can also dissolve in water. Thus, arsenic can get into lakes, rivers, or underground water by dissolving in rain or snow, or through the discharge of industrial wastes. Some of the arsenic will stick to the sediment on the bottom of the lake or river, and some will be carried along by the water.

Arsenic is not broken down or destroyed in the environment. However, it can change from one form to another by natural chemical reactions, and also by the action of bacteria that live in soil or water. Although some fish and shellfish build up arsenic in their tissues, most of this is in a form (often called "fish arsenic") that is not toxic.

Exposure Pathways

Because arsenic is a natural part of the environment, low levels of arsenic are present in soil, water, food, and air. Soil usually contains the most, with average levels of about 5,000 parts of arsenic per billion parts of soil (ppb). Levels in food are usually about 20-140 ppb and levels in water are about 2 ppb. Levels in air are usually about 0.02-0.10 micrograms per cubic meter. Thus, you normally take in small amounts of arsenic in the air you breathe, the water you drink, and the food you eat. Of these, food is usually the largest source. You are also likely to swallow

small amounts of dust or dirt each day, so this is another way you can be exposed to arsenic. The total amount you take in from these sources is probably about 50 micrograms each day.

In addition to the normal levels of arsenic in air, water, soil, and food, you could be exposed to higher levels in several ways, such as the following:

- Some areas of the country contain unusually high natural levels of arsenic in rock, and this can lead to unusually high levels of arsenic in soil or water. If you live in an area like this, you could take in above-average amounts of arsenic from the soil or from the water.
- Some hazardous waste sites contain large quantities of arsenic. If the material is not properly disposed of, it can get into surrounding water, air, or soil. If you live near such a site, you could be exposed to above-average levels of arsenic from these media.
- If you work in an occupation that involves arsenic production or use (for example, copper or lead smelting, wood treating, pesticide application), you could be exposed to above-average levels of arsenic during your work. The government estimates that about 55,000 people may be exposed in this way.
- If you saw or sand arsenic-treated wood, you could inhale some of the sawdust into your nose or throat. Similarly, if you burn arsenic-treated wood, you could inhale arsenic in the smoke.
- In the past, several kinds of products used in the home (rat poison, ant poison, weed killer, some types of medicines) had arsenic in them. However, most of these uses of arsenic have ended, so you are not likely to be exposed from home products any longer.

Metabolism

If you swallow arsenic in water, soil, or food, most of the arsenic quickly enters into your body. This is the most likely way for you to be exposed near a waste site. If you breathe air that contains arsenic dusts, many of the dust particles settle onto the lining of the lungs. Most of the arsenic in these particles is then taken up from the lungs into the body. You might be exposed in this way near waste sites where arsenic-contaminated soils are allowed to blow into the air. If you get arsenic-contaminated soil or water on your skin, only a small amount will go through your skin into your body, so this is usually not of concern.

If you are exposed to arsenic, your liver changes some of this to a less harmful organic form. Both inorganic and organic forms leave your body in your urine. Most of the arsenic will be gone within several days, although some will remain in your body for several months or even longer.

Health Effects

Inorganic arsenic has been recognized as a human poison since ancient times, and large oral doses (above 60,000 ppb in food or water) can produce death. If you swallow lower levels of inorganic arsenic (ranging from about 300 to 30,000 ppb in food and water), you may experience irritation of your stomach and intestines, with symptoms such as pain, nausea, vomiting, and diarrhea. Other effects you might experience from swallowing arsenic include decreased production of red and white blood cells, abnormal heart rhythm, blood vessel damage, and impaired nerve function causing a "pins and needles" sensation in your hands and feet. Although there is no good evidence that arsenic can injure pregnant women or their fetuses, studies in animals show that doses of arsenic that are large enough to cause illness in pregnant females may cause low birth weight, fetal malformations, or even fetal death.

Perhaps the single most characteristic effect of long-term oral exposure to inorganic arsenic is a pattern of skin changes. This includes a darkening of the skin and the appearance of small corns or warts on the palms, soles, and torso. While these skin changes are not considered to be a health concern in their own right, a small number of the corns may ultimately develop into skin cancer. Swallowing arsenic has also been reported to increase the risk of cancer in the liver, bladder, kidney, and lung. The Department of Health and Human Services determined that arsenic is a known carcinogen. The International Agency for Research on Cancer (IARC) has determined that arsenic is carcinogenic to humans. The EPA has determined that arsenic is a human carcinogen. Both the EPA and the National Toxicology Program (NTP) have classified arsenic as a known human carcinogen.

If you breathe high levels of inorganic arsenic, you are likely to experience a sore throat and irritated lungs. You may also develop some of the skin effects mentioned above. The exposure level that produces these effects is uncertain, but is probably above 100 micrograms per cubic meter. However, these effects are usually not serious. Of much greater concern is the ability of inhaled inorganic arsenic to increase the risk of lung cancer. This has been seen mostly in humans exposed to arsenic in or around smelters. People who live near smelters, chemical factories, or waste sites with arsenic may have increased risk of lung cancer as well.

If you have direct skin contact with inorganic arsenic compounds, your skin may become irritated with some redness and swelling. However, it does not appear that skin contact is likely to lead to any serious internal effects.

Despite all the adverse health effects associated with inorganic arsenic exposure, there is some evidence that the small amounts of arsenic in the normal diet (10-50 ppb) may be beneficial to your health. For example, animals fed a diet with unusually low concentrations of arsenic did not gain weight normally. They also became pregnant less frequently than animals fed a diet containing a normal amount of arsenic. Further, the offspring from these animals tended to be smaller than normal, and some died at an early age. However, no cases of arsenic deficiency in humans have ever been reported.

Almost no information is available on the effects of organic arsenic compounds in humans. Studies in animals show that most organic arsenic compounds are less toxic than the inorganic forms. However, high doses can produce some of the same effects. Thus, if you are exposed to high doses of an organic arsenic compound, you might develop nerve injury, stomach irritation, or other effects, but this is not known for certain.

Information excerpted from *Toxicological Profile for Arsenic April 1993 Update*
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