ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

TIN AND TIN COMPOUNDS

Division of Toxicology ToxFAQs™ August 2005

This fact sheet answers the most frequently asked health questions (FAQs) about tin and tin compounds. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because these substances may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: The main route of exposure to tin and tin compounds is by eating food contaminated with these compounds. Swallowing large amounts of inorganic tin compounds may cause stomachache, anemia, and liver and kidney problems. Humans exposed for a short period of time to some organic tin compounds have experienced skin and eye irritation and neurological problems; exposure to very high amounts may be lethal. Metallic tin and inorganic tin compounds have been found in at least 214 of the 1,662 National Priority List (NPL) sites identified by the Environmental Protection Agency (EPA). Organic tin compounds have been identified in at least 8 of the NPL sites.

What are tin and tin compounds?

Tin is a natural element in the earth's crust. It is a soft, white, silvery metal that does not dissolve in water. It is present in brass, bronze, pewter, and some soldering materials. Tin metal is used to line cans for food, beverages, and aerosols.

Tin can combine with other chemicals to form compounds. Combinations with chemicals like chlorine, sulfur, or oxygen are called inorganic tin compounds (i.e., stannous chloride, stannous sulfide, stannic oxide). These are used in toothpaste, perfumes, soaps, food additives and dyes. Tin also can combine with carbon to form organotin compounds (i.e., dibutyltin, tributyltin, triphenyltin). These compounds are used to make plastics, food packages, plastic pipes, pesticides, paints, and pest repellents.

Tin metal, and inorganic and organic tin compounds can be found in the air, water, and soil near places where they are naturally present in the rocks, or where they are mined, manufactured, or used.

What happens to tin and tin compounds when they enter the environment?

❏ Tin is released into the environment by both natural processes and human activities, such as mining, coal and oil combustion, and the production and use of tin compounds. Metallic tin released to the environment will quickly form inorganic tin compounds.

❏ Inorganic tin cannot be destroyed in the environment; it can only change its form. Organic tin compounds can be degraded to inorganic tin compounds by sunlight and bacteria.

❏ In the atmosphere, tin exists as gases and fumes, and attaches to dust particles. Particles in the air containing tin may be transported by wind or washed out of the air by rain or snow.

❏ Inorganic tin binds to soil and to sediments in water. Some inorganic tin compounds dissolve in water.

❏ Organic tin compounds stick to soil sediment, and particles in water.

❏ The time each organic tin compound stays in water and soil differs for each compound. In water it may range from days to weeks and in soil it may be years.

❏ Organic tin compounds can build up in fish, other organisms, and plants.

How might I be exposed to tin and tin compounds?

❏ Eating food or drinking liquids from tin-lined cans (today greater than 90% of tin-lined cans used for food are protected with lacquer).

❏ Breathing air or touching dusts that contains tin in the workplace or near hazardous waste sites.

❏ Exposure to some organotins can occur by eating seafood from coastal waters or from contact with household products that contain organotin compounds (i.e., some plastics).

How can tin and tin compounds affect my health?

Metallic tin is not very toxic due to its poor gastrointestinal absorption. Human and animal studies show that ingestion

of large amounts of inorganic tin compounds can cause stomachache, anemia, and liver and kidney problems. Breathing or swallowing, or skin contact with some organotins, such as trimethyltin and triethyltin compounds, can interfere with the way the brain and nervous system work. In severe cases, it can cause death.

Some organotin compounds, such as dibutyltins and tributyltins, have been shown to affect the immune system in animals, but this has not been examined in people. Studies in animals also have shown that some organotins, such as dibutyltins, tributyltins, and triphenyltins can affect the reproductive system. This, also, has not been examined in people.

Inorganic or organic tin compounds placed on the skin or in the eyes can produce skin and eye irritation.

How likely are tin and tin compounds to cause cancer?

There is no evidence that tin or tin compounds cause cancer in humans. Studies in animals have not shown evidence of carcinogenicity for inorganic tin. A study in rats and another in mice showed that a specific organotin, triphenyltin hydroxide, can produce cancer in animals after long-term oral administration.

The Department of Health and Human Services (DHHS), the International Agency for Research on Cancer (IARC), and the EPA have not classified metallic tin or inorganic tin compounds for carcinogenicity. The EPA has determined that a specific organotin, tributyltin oxide, is not classifiable as to human carcinogenicity.

How can tin and tin compounds affect children?

There are no studies on health effects in children exposed to tin and tin compounds. However, it is reasonable to assume that children would exhibit the same type of health effects observed in exposed adults. There are no reports of adverse developmental effects in humans exposed to tin or its compounds. There are no studies examining developmental effects in animals exposed to inorganic tin. Exposure of rodents to some organotins during pregnancy has produced birth defects in the newborn animals. A study with tributyltin in rats found that exposure during gestation, lactation, and following lactation affected the development of some sexual characteristics in female rats. We do not know whether tin and tin compounds can be passed to newborn animals in maternal milk. We know that some organotins can cross the placenta and reach the fetus in animals.

How can families reduce the risk of exposure to tin and tin compounds?

- ❏ Because tin is naturally found in the environment, we cannot avoid being exposed to it.
- ❏ Reduce the amount of canned products you eat or drink and store unused portions in separate containers.
- ❏ Reduce your consumption of seafood from waters that may be contaminated with organic tin compounds and your contact with household products that contain organotin compounds (for example, silicon-coated baking parchment paper).

Is there a medical test to show whether I've been exposed to tin and tin compounds?

There are tests to measure total tin and specific organotin compounds in your blood, urine, feces, and body tissues. Normally, small amounts of tin can be found in the body because of the daily exposure to small amounts in the food. Therefore, the available tests cannot tell you when you were exposed or the exact amount of tin to which you were exposed, but can help determine if you were recently exposed to an unusually high amount of tin. These tests are not routinely performed at your doctor's office, but your doctor can take samples and send them to a testing laboratory.

Has the federal government made recommendations to protect human health?

The Occupational Safety and Health Administration (OSHA) has set a limit of 0.1 milligrams per cubic meter of air (0.1 mg/m^3) in the workplace for organotin compounds and 2.0 mg/m^3 for inorganic tin compounds, except oxides.

The Food and Drug Administration (FDA) regulates the use of some organic tin compounds in coatings and plastic food packaging. The FDA also has set limits for the use of an inorganic tin compound, stannous chloride, as an additive for food.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2005. Toxicological Profile for Tin and Compounds (Update). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.