

toxics release inventory

Chemical Profile

*Environment
Science & Technology Development*

Dioxins

What are dioxins?

Dioxins are colorless, odorless solids. They are part of a family of 210 organic compounds that contain carbon, oxygen, and hydrogen arranged in a unique chemical structure. Replacing hydrogen with chlorine in certain positions in that structure creates 17 compounds that the U.S. Environmental Protection Agency (EPA) considers harmful to human health. They include polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs). EPA calls this group dioxins or dioxin-like compounds.

Dioxins are unwanted by-products of natural events and human activities. Very tiny amounts of dioxins are present in soils, plants, underwater sediments, water, and air. They have no useful commercial function.

How are dioxins released by electric utilities?

Although no one knows exactly how dioxins form when power plants burn fuel, the following process seems most likely. Trace amounts of chlorine are present in coal and oil. When electric utilities burn these fuels in their power plants, chlorine is released. Some of this chlorine takes the place of hydrogen in specific organic compounds to create very small amounts of dioxin vapor. These amounts are so small that only highly specialized sampling and analysis can measure them. As dioxin

vapor cools, it forms thin films on tiny ash particles.

Coal-burning power plants are equipped with devices to capture ash particles before they reach the air. Particle control devices typically capture more than 99% of the ash, so very little ash enters the air. Ash captured by these devices is usually sent to ash ponds and land disposal sites.

Dioxins from power plants were about 2-3% of all dioxins from human activities released into the air in the United States in 1995.

Are dioxins also released by other sources?

Dioxins are released into the air by soils as they erode in wind and rain, by volcanoes when they erupt, and by forest fires. These natural releases are smaller than those from human activities.

Dioxins released by human activities come mainly from incinerators that burn refuse, sewage sludge, and medical waste; backyard trash burners; landfills experiencing accidental fires; copper smelters; cement kilns; pulp and paper mills that use chlorine bleach; vehicle exhaust pipes; and wood-burning stoves and fireplaces. Dioxin releases from human activities in the United States peaked in the 1970s and have since declined about 80%. According to EPA, changes responsible for this decline include eliminating most open

burning of solid wastes, installing particle control devices on combustion burners, phasing out leaded gasoline, and banning or restricting the use of chemicals that contain dioxins.

What happens to dioxins after they are released by electric utilities?

Some ash particles carrying dioxins settle to the ground through gravity and air turbulence relatively near their source. Other particles travel further into the atmosphere, where they may remain for months. Eventually, these particles return to earth where they fall on soil and growing plants, and into bodies of water. Dioxins may remain in soil and underwater sediments for years. They build up in fish and in the fatty flesh of animals that eat plants, but not in the plants themselves.

Ash pond wastewater discharged into public waterways may contain very tiny amounts of dioxins. Dioxins are noted on local discharge permits.

How might people be exposed to dioxins?

People are commonly exposed to very tiny amounts of dioxins present in the air they breathe, the water they drink, and the foods they eat. For example, nursing infants are exposed to very tiny amounts of dioxins in their mothers' milk. However, people who eat large amounts of meat and dairy products

that are high in fat, or large amounts of fish that have accumulated dioxins in their body fat, may have greater exposure. EPA estimates that 95% of exposure to dioxins comes from eating animal fats. Because fewer dioxins are being released into the environment and people are eating less animal fat, the amount of dioxin measured in their bodies is decreasing.

Those who smoke may inhale dioxins found in tobacco, and industrial workers may breathe dioxins or touch substances that contain them. For example, an accidental explosion at a chemical plant in Seveso, Italy in 1976 contaminated the surrounding environment and exposed workers and local citizens to large amounts of dioxins. Military personnel in Vietnam were exposed to dioxins while using the herbicide, Agent Orange. Products known to contain dioxins, such as the pesticide 2,4,5-T and PCB dielectric fluids, are no longer sold.

What are the potential effects of dioxins on human health?

Dioxins are considered to be very toxic substances. People exposed to large amounts of dioxins experience a skin disease called chloracne. Some studies have shown that high exposures also may contribute to the development of liver, kidney, heart, thyroid, and blood disorders, as well as adult onset diabetes and cancer.

Eating the very tiny amounts of dioxins commonly present in food apparently does not make people sick. However, because dioxins build up in the human body, researchers are studying ways in which they might affect health over time—perhaps by altering normal reproduction, development, and immunity to disease.

Laboratory animals develop liver cancer when they eat food containing

2,3,7,8-TCDD, the most toxic form of dioxin. Based on animal and human studies, EPA has classified 2,3,7,8-TCDD as a “human carcinogen” and other dioxins as “likely human carcinogens.”

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

It is unlikely that dioxins from power plants pose a significant risk to human health. EPA has evaluated the potential cancer risk of exposure to dioxins from power plants. To do this, EPA modeled 16 different theoretical risk scenarios. In the highest risk scenario, adults lived near a large coal-fired power plant and relied on locally caught fish for much of their food. If 10,000 of these adults stayed in the same location and ate fish every day of their lives, 2 occurrences of cancer among them would be due to power plant dioxins. In the lowest risk scenario, children lived near a large oil-fired power plant and ate a typical American diet. If 1 billion of these children stayed in the same location all their lives, 1 occurrence of cancer among them would be due to power plant dioxins. EPA has not yet developed a method for evaluating non-cancer health risks from exposure to dioxins.

Since airborne ash particles carrying dioxins are widely scattered before they settle to the ground, it is unlikely that ash from power plants significantly increases the amount of dioxins in soil, water, or food.

How are dioxins regulated?

EPA has established limits for dioxins in drinking water. The Agency requires that 1 pound or more of 2,3,7,8-TCDD be reported if it is spilled or released without a permit. EPA regulates dioxins released into the air by

waste incineration (including hazardous waste burning), dioxins released into wastewater from pulp and paper manufacturing, and dioxins applied to the land in wastes used as fertilizers or soil amendments. EPA also regulates the manufacture and use of products contaminated with dioxins. The Food and Drug Administration has set a “safe level” for dioxins in fish that will be eaten. The Occupational Safety and Health Administration and the National Institute for Occupational Safety and Health recommend reducing workplace exposure to dioxins to the lowest feasible level.

Where can I get more information about dioxins?

Those interested in detailed information about dioxins from power plants may read EPA’s 1998 Final Report to Congress, Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units. This report is available on the Internet at <http://www.epa.gov/ttn/oarpg/t3rc.html>