



# PCBs

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## Introduction

PCBs are a group of synthetic organic chemicals that contain 209 individual compounds (known as congeners) with varying harmful effects. There are no known natural sources of PCBs in the environment. PCBs are either oily liquids or solids and are colorless to light yellow in color. They have no known smell or taste. PCBs enter the environment as mixtures containing a variety of individual components and mixtures. Seven types of PCB mixtures include 35% of all the PCBs commercially produced and 98% of PCBs sold in the United States since 1970. Some commercial PCB mixtures are known in the United States by their industrial trade name, Arochlor. The name, Arochlor 1254, for example, means that the molecule contains 12 carbon atoms (the first two digits) and approximately 54% chlorine by weight (second two digits). Because they don't burn easily and are good insulating materials, PCBs have been widely used as coolants and lubricants in transformers, capacitors, and other electrical equipment. The manufacture of PCBs stopped in the United States in October 1977 because of evidence that PCBs build up in the environment and cause harmful effects. Consumer products that may contain PCBs are old fluorescent lighting fixtures, electrical devices or appliances containing PCB capacitors made before PCB use was stopped, old microscope oil, and hydraulic fluids.

## Fate & Transport

Before 1977, PCBs entered the air, water, and soil during their manufacture and use. Wastes that contained PCBs were generated during manufacture and use of PCBs, and these wastes were placed in dump sites. PCBs also entered the environment from accidental spills and leaks during the transport of the chemicals, or from leaks or fires in transformers, capacitors, or other products containing PCBs. Today, PCBs can be released into the environment from poorly maintained hazardous waste sites that contain PCBs; illegal or improper dumping of PCB wastes; such as transformer fluids; leaks or releases from electrical transformers containing PCBs; and disposal of PCB-containing consumer products into municipal or other landfills not designed to handle hazardous waste. PCBs are also currently released into the environment by municipal and industrial incinerators from the burning of organic wastes.

PCBs in air can be present in both solid and liquid aerosols, and as vapors that eventually return to the land and water by settling or washout by snow and rain. PCBs may remain in the air for an average of more than 10 days depending on the type of PCB. Once in the air, PCBs can be carried long distances. They have been found in snow and sea water in areas far away from where they were released into the environment. In water, a small amount of PCBs may remain dissolved but most tend to stick to particles and sediments. The more volatile PCBs in water partially evaporate and then return to earth by rainfall, snow, or settling of dust particles. This cycle can be repeated many times. PCBs in water concentrate (build up) in fish and can reach levels hundreds or thousands of times higher than the levels in water. Extremely small amounts of PCBs can remain in water for years. PCBs bind strongly to soil and sediments and may remain there for several years. PCBs will not typically travel deep into the soil with rainwater. However, PCBs from some waste landfills have been found in groundwater. PCBs partially evaporate from soil surfaces to air. In general, the breakdown of PCBs in the water and soil occurs over several years, or even decades. Sediments containing PCBs at the bottom of a large body of water such as a lake, river, or ocean generally act as a

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reservoir from which PCBs may be released in small amounts to the water. PCBs have been found in a very limited number of drinking water supplies.

### Exposure Pathways

Although PCBs are no longer made in the United States, people can still be exposed to them. Many older transformers and capacitors still contain PCBs. These transformers can be used for 30 years or more. Old fluorescent lighting fixtures and electrical devices and appliances, such as television sets and refrigerators, made before PCB use was stopped may contain PCBs. When these electric devices get hot during operation, small amounts of PCBs may leak into the air and raise the level of PCBs in indoor air.

The two main sources of exposure to PCBs are from the environment and from the workplace. PCBs are found throughout the environment and remain there a very long time. Small amounts of PCBs can be found in almost all outdoor air, in indoor air, on soil surfaces, and in surface water. PCBs enter the bodies of fish from water, sediment, particulates in water, and from eating prey that have PCBs in their bodies. PCBs also enter bodies of birds of prey from eating contaminated fish. Measurements made in the late 1970s and 1980s indicate that the typical concentrations (1 to 10 thousandths of a millionth of a gram in a cubic meter of air [ng/m<sup>3</sup>]) in urban areas and 0.6 ng/m<sup>3</sup> in rural areas. The PCB concentrations in indoor air of seven public buildings (schools and offices) ranged from 230 to 460 ng/m<sup>3</sup>. The mean concentration of PCBs in waters of the Great Lakes is 0.5 to 17 nanograms per liter (0.5 to 17 thousandths of a millionth of a gram in a liter of water [ng/L]). Typical concentrations of PCBs in soil are less than 10 to 40 micrograms per kilogram (less than 10 to 40 millionths of a gram in one kilogram of soil [ug/kg]). Average PCB concentrations as high as 4.3 g/kg have been found in soil from a hazardous waste site. The mean concentration of PCBs in whole fresh water fish is 0.5 ug/g (0.5 millionths of a gram in 1 gram of fish). The concentrations of PCBs in air, water, soil, and food have generally decreased since PCB production stopped in 1977. Although PCBs are usually found in the parts of fish that most people do not eat, the amount of PCBs found in the parts of fish that are typically eaten is high enough to make eating fish an important source of exposure. PCBs are also found in meat and milk and their by-products. Breathing indoor air in buildings that have electrical parts that contain PCBs may also be a major source of human exposure. Persons may be exposed to several micrograms of PCBs per day from air, water, and food.

People who live near hazardous waste sites that contain PCBs may be exposed primarily by breathing air that contains PCBs. Children playing at or near these sites may be exposed by touching and eating soil that contains PCBs. The most likely way infants will be exposed is from drinking breast milk that contains PCBs or from the exposed mother when in the womb.

Workplace exposure to PCBs can occur during repair and maintenance of PCB transformers; accidents, fires, or spills involving PCB transformers; and disposal of PCB materials. Contact with PCBs at hazardous waste sites can happen when workers breathe air and touch soil containing PCBs. Exposure in the workplace occurs mostly by breathing air containing PCBs and by touching substances that contain PCBs. Fewer than 2,500 people were thought to be exposed to excess levels of PCBs in the workplace during 1981 to 1983.

### Metabolism

If you breathe air that contains PCBs, they can enter your body through your lungs and pass into the bloodstream. We do not know how fast or how much of the PCBs will pass into the bloodstream. If you swallow food, water, or soil contaminated with PCBs, most of the PCBs will probably enter your body and pass from the stomach into the bloodstream quickly (in minutes). If you touch soil containing PCBs (for example, at a hazardous waste site) some of the PCBs will pass through the skin and then into the bloodstream. A common way for PCBs to enter your body is through eating meat or fish products or other foods that contain PCBs. PCBs can also enter your body if you breathe indoor air in buildings that have electrical parts containing PCBs. Exposure from drinking water is less than from food.

Once PCBs are in your body, some may change into other related chemicals called metabolites. Some metabolites of PCBs may have the potential to be as harmful as unchanged PCBs, but there is no conclusive experimental evidence to support this assumption. Some of the metabolites may leave your body in the feces in a few days, but others may stay in your body fat for months. Unchanged PCBs may also stay in your body and be stored for years in your body fat and liver. PCBs build up in milk fat and can enter the bodies of infants through breastfeeding.

#### Health Effects

Skin irritations, such as acne and rashes, can occur in people exposed to PCBs. Studies in the workplace suggest that exposure to PCBs may also cause irritation of the nose and lungs. The concentrations of PCBs in the workplace are usually much higher than concentrations in other places such as in air in buildings that have electrical parts that contain PCBs or in outdoor air, including air at hazardous waste sites. We do not know the possible effects in persons who are exposed to high levels of PCBs for a short period.

Rats that ate food containing large amounts of PCBs for a short period had mild liver damage, and some died. Animals that ate smaller amounts of PCBs in their food over several weeks or months had many serious health effects, including liver, stomach, and thyroid gland injuries. They also had anemia, acne, and damaged reproduction. These effects have been seen in many different kinds of animals, including monkeys, as well as in the offspring of animals that ate PCBs. No birth defects have been found. Only a small amount of information exists on the health effects in animals exposed to PCBs by skin contact or breathing. This information indicates that liver, kidney, and skin damage occurred in rabbits following repeated skin exposure, and that a single exposure to a large amount of PCBs on the skin caused death in rabbits and mice. Breathing PCBs over several months also caused liver and kidney damage in rats and other animals, but the levels necessary to produce these effects were very high. It is not known if the same effects would happen in people if they were exposed in the same way.

Studies of workers do not provide enough information to determine if PCBs cause cancer in humans. Rats that ate certain PCB mixtures throughout their lives developed cancer in their livers. Based on the cancer in animals, the Department of Health and Human Services has determined that PCBs may reasonably be anticipated to be carcinogens. The International Agency for Research of Cancer has determined that PCBs are probably carcinogenic to humans. The EPA has determined that PCBs are probable human carcinogens.

Information excerpted from

Toxicological Profile for PCBs August 1995 Update  
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