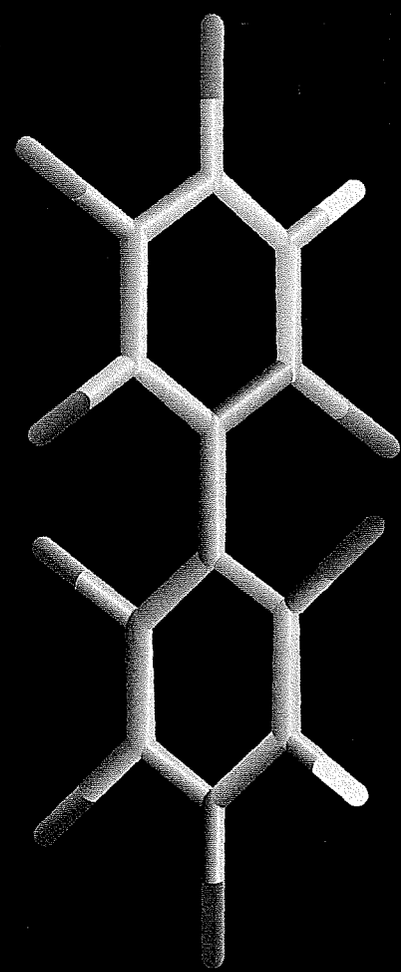
PCBs

What's the Story?

THE SCIENTIFIC FACTS ABOUT...



AMERICAN COUNCIL
ON SCIENCE AND HEALTH

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What Are PCBs ?

Polychlorinated biphenyls, or PCBs, are a family of more than 200 chemical compounds ("congeners"), each of which consists of two benzene rings and from 1 to 10 chlorine atoms. They range from light, oily fluids to heavier, greasy or waxy substances. PCBs were discovered over 100 years ago, but their production and commercial use began in 1929. An estimated 1.1 billion pounds of PCBs were produced in the United States between 1929 and 1977.

What Are the Benefits of PCBs?

Because of their remarkable insulating capacity and their flame-retardant nature, PCBs gained widespread use as coolants and lubricants in transformers and other electrical equipment. They replaced combustible mineral-oil insulating fluids and thereby reduced the risk of fires in office buildings, hospitals, factories, and schools. The use of PCBs also allowed for smaller capacitors, thus lowering equipment costs. Some city codes went so far as to require installation of PCB-containing electrical equipment in applications where fire-resistance was critical; insurance companies in many locations also required PCB-containing equipment.

Additionally, for several decades PCBs were routinely used in the manufacture of a wide variety of common products, such as plastics, adhesives, paints and varnishes, carbonless copying paper, newsprint, fluorescent light ballasts, and caulking compounds.

What Are the Charges Leveled Against PCBs?

In the mid-1960s PCBs were detected in soil and wildlife, and concern arose over their possible adverse effects on health and the environment. Research confirmed that some PCB congeners degrade very slowly in the environment and can build up in the food chain, notably in fish and fish-eating birds.

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In 1968 a widespread human-poisoning episode in Japan was at first attributed to the consumption of rice-bran oil contaminated with PCBs. In this incident and in a similar incident that occurred in 1978–79 in Taiwan, consumption of PCB-contaminated rice-bran oil resulted in chloracne (a severe form of acne), fatigue, nausea, and liver disorders. There was a preliminary report that liver cancer among Japanese males was significantly increased; however, the uneven geographic distribution of liver cancers between the two areas of western Japan involved in the incident (with a significant increase in liver cancers observed in only one of the areas) suggests that factors other than just the rice-oil poisoning were involved. Nevertheless, the Japan and Taiwan incidents increased the already growing concern over the safety of PCBs.

In 1975 Dr. Renate Kimbrough of the Centers for Disease Control published the results of a study in which rats were fed high doses of PCBs. This study indicated that the highly chlorinated PCBs increased the incidence of liver tumors in the rats. The study also raised further concerns about the potential long-term health effects of PCBs in humans. In 1971–72, many of the so-called "open" uses of PCBs in plastics and other common products were discontinued. Sales of PCBs were voluntarily restricted by the manufacturer to "closed" uses in electrical equipment. The manufacturer voluntarily ceased production completely in 1977, and the EPA banned the manufacture of PCBs in 1979.

In recent years some researchers have suggested that chemicals such as PCBs and other persistent synthetic chemicals present in the environment can find their way into our bodies and mimic the body's natural hormones, such as estrogen. Basing their conclusions largely on studies of wildlife, these researchers have further suggested that this "endocrine (hormone) disruption" can lead to infertility, to certain types of cancer, and to other hormone-related disorders.

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What Are the Facts?

The toxicity observed in the Japanese and Taiwanese rice-bran oil victims was not observed in workers exposed to high doses of PCBs over long periods of time—even though the levels of PCB in the blood of the workers exceeded the levels in the blood of the rice-bran oil victims. The effects in the rice-bran oil victims are now believed to have been due to the presence in the rice-bran oil of polychlorinated dibenzofurans ("furans")—substances similar to dioxins—and polychlorinated quaterphenyls (PCQs)—toxic substances generated from the heat-related breakdown of PCBs. These thermal-degradation products are far more toxic than PCBs themselves. Analysis of the contaminated rice-bran oil in Japan and Taiwan revealed that the PCB heat-transfer fluid that had contaminated the rice-bran oil was partially heat-degraded due to mechanical problems in the heat exchanger and so contained high levels of furans and PCQs.

Acute health effects of PCBs have been found in animals only at extremely high doses. Those high doses have been shown to cause tumors in animals with long-term exposure. Several regulatory and advisory agencies, including the U.S. Environmental Protection Agency (EPA), have therefore determined that there is sufficient evidence to consider PCBs both animal carcinogens and potential human carcinogens.

Recent studies, however, have produced evidence that the cancer-causing potency of PCBs in animals had generally been over-estimated and that some PCBs are much less potent than others. The EPA now takes this into account when it conducts the risk assessments it uses to make remedial decisions.

In addition, studies of workers exposed by inhalation and skin contact to high doses of PCBs over long periods of time have not revealed an increased risk of cancer. The only effects in the workers attributable to PCBs are

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skin and eye irritation.

The halt of PCB production in the United States and other countries, the elimination of "open" uses, the continued reductions of use in electrical equipment, and efforts to clean up contaminated sites have significantly reduced general-population exposure to PCBs in fish and other foods since the 1970s. PCB levels in human blood are also decreasing. Studies of people who ate PCB-contaminated fish have shown that while the quantity of fish consumed was correlated with PCB blood levels, there were no significant health differences between people who ate a lot of fish and those who ate little.

A recent report has suggested an increased risk of neurodevelopmental problems—such as lowered IQ—in infants and children exposed prenatally to PCBs through the expectant mothers' consumption of contaminated fish. Other studies have found no relationship between maternal PCB exposure and either infant birth weight or head circumference, however. Additionally, the concentrations of PCBs in the blood of the mothers who ate contaminated fish were only slightly greater than the concentrations found in the blood of mothers who did not report eating fish; and both groups were within the range of PCB blood concentrations for North America. Some studies have also been criticized for failing to consider the potential effects of other environmental contaminants commonly found in the fish eaten by the study subjects.

There is insufficient evidence to conclude that environmental PCBs pose significant health problems through "endocrine disruption" or estrogenic effects. Numerous researchers have characterized as both unproved and implausible claims that environmental estrogen exposure causes breast cancer or male reproductive problems.

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The Bottom Line

It is important to recognize that both commercial and environmental PCBs consist of mixtures of individual PCB congeners. These congeners, and the many PCB mixtures, vary in their degree of toxicity.

Laboratory studies of PCBs are conducted largely on commercial products. But the environmentally degraded PCBs to which people may be exposed can differ, both in their composition and their toxicity, from the original commercial mixtures. Regulatory agencies are now beginning to acknowledge this as an important factor to consider when evaluating risk from exposure to PCBs in the environment.

There is no conclusive evidence that background PCB levels in the general population, or even the very high levels to which some occupational groups have been exposed, have resulted in acute effects, increased cancer risk, "endocrine disruption," or widespread intellectual deterioration in children exposed to PCBs in the womb. Furthermore, even those effects (e.g., cases of chloracne) that have been noted in populations exposed to unusually high PCB levels cannot be linked definitively to PCBs, because of the victims' simultaneous exposure to toxic, heat-related breakdown products such as furans and PCQs.

General population exposure to PCBs in fish and other foods has been reduced significantly over the past two decades, and PCB levels in human blood are also decreasing. Today's leaders in industry and government alike should focus, first, on developing new, cost-effective remediation and disposal techniques and, second, on developing scientifically improved health risk analyses to reduce the uncertainty associated with PCB exposure and its health effects in humans.

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The nucleus of ACSH is a board of 250 physicians, scientists and policy advisors—experts in a wide variety of fields—who review the Council's reports and participate in ACSH seminars, press conferences, media communications and other educational activities.

ACSH was founded in 1978 by a group of scientists who had become concerned that many important public policies related to health and the environment did not have a sound scientific basis. These scientists created the organization to add reason and balance to debates about public health issues and bring common-sense views to the public.

With these goals in mind, ACSH produces a wide range of publications including peer-reviewed reports on important health and environmental topics; a quarterly magazine, *Priorities*; and a semi-annual review of ACSH press coverage, *Media Update.* The organization has also produced a documentary, "Big Fears, Little Risks," narrated by Walter Cronkite.

ACSH representatives appear regularly on television and radio, in public debates and in other forums. In addition, ACSH hosts media seminars and press conferences on a variety of public health issues. ACSH also provides an in-house internship program for students in health science fields and participates in legislative and regulatory hearings.

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