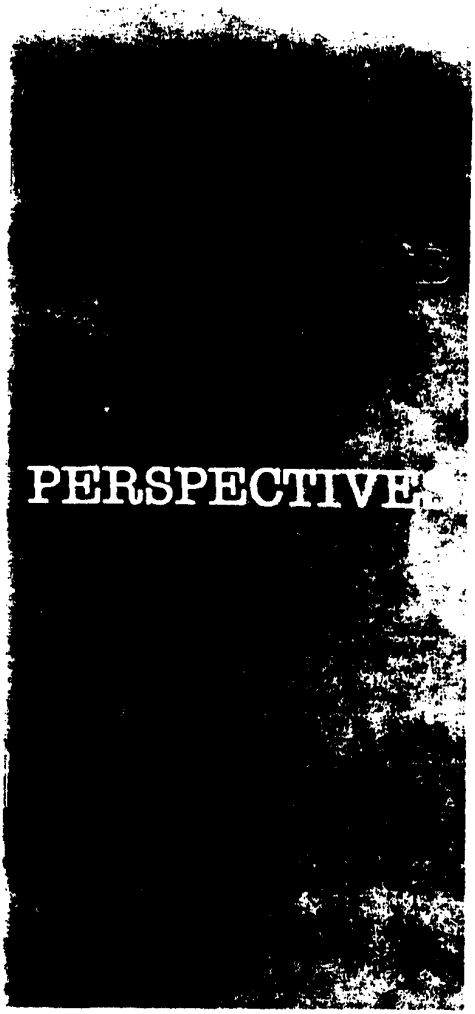


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PCBs, which were first used in electrical equipment in the 1930s, provided a unique combination of efficiency, economy, and fire safety. But in the early 1970s, PCBs acquired a reputation as posing a serious threat to human health. Recent information shows that PCBs are not the serious threat they were believed to be.

To assist the public in identifying responsible and factual information on human health effects of PCBs and to put this issue in perspective, the National Electrical Manufacturers Association (NEMA) has prepared this booklet.

NEMA is the principal national trade association of the electrical manufacturing industry. NEMA members manufacture products used in the generation, transmission, distribution, control and end-use of electricity, including transformers and large capacitors. Certain of these were once designed to use PCBs as an insulating fluid. While PCB electrical products have not been manufactured since about 1978, many are still in use and have many years of remaining service life.

WHAT ARE PCBs?

PCBs (polychlorinated biphenyls) are a family of over 200 chemical compounds, ranging from light, oily fluids to heavy oils to greases and waxes. They have been valuable because they are fire resistant, have excellent electrical insulation qualities and are chemically and thermally stable.

Production of PCBs started around 1930, when they were used in a number of industrial applications. Their chemical and thermal stability resulted in widespread use as a heat transfer fluid. They also became valuable in the paper industry, as plasticizers for various materials and as components for inks, dyes, dust-settling agents, die-casting lubricants, paints, pesticides and adhesives. But their major use was in the electrical industry, where they became an insulating liquid for capacitors and transformers. Here PCBs replaced combustible insulating fluids and reduced the risk of fire in office buildings, hospitals, schools and factories.

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THE PCB HEALTH QUESTION

After about 40 years of widespread industrial use, people began to question whether the benefits resulting from PCBs might be offset by adverse environmental effects.

Concern began around 1966 when environmental research in Sweden showed some buildup of PCBs in nature. Subsequent studies indicated that their rate of biodegradation was very slow and that natural forces would require a long time to remove PCBs from the environment.

In 1968, a human poisoning incident in Japan was initially attributed to PCBs and prompted concern about human health effects. Then, in 1974, a government scientist reported that PCBs caused cancer in a certain type of rat.

These events prompted Congress to single out PCBs for regulation in the Toxic Substances Control Act (TSCA) of 1976. Section 6(e) of the Act:

- Directs the U.S. Environmental Protection Agency (EPA) to prescribe PCB marking and disposal requirements;
- Bans continued PCB use except in selected situations; and
- Bans PCB manufacture, processing, and distribution except in selected situations.

It is interesting to note, however, that while production and sale of PCBs have also been discontinued in some other countries, their manufacture and use continues in four countries of Western Europe.

Since possible PCB human health effects have caused the most public concern, the health issue has been examined in great detail — both in the U.S. and in Japan.

THE YUSHO INCIDENT

In the Japanese poisoning incident, Japanese-manufactured PCBs were the heat transfer fluid in a heat exchanger used to heat rice oil. The heat exchanger developed a leak, causing some of its fluid to contaminate the oil. The rice oil was then packaged and later used as a cooking oil. In what is now known as the Yusho incident, about 1,300 people became ill from eating food cooked with the oil.

There were many different effects observed. In addition to acne-like skin conditions known as chloracne, victims also experienced feelings of lassitude, swelling of the upper eyelids, increased eye discharge, darkening of the nails and skin and a variety of other individual effects. In some cases, symptoms were passed on to newborn children.

The irony of the story is that subsequent research has presented strong evidence that PCBs were *not* to blame. In fact, the heat transfer fluid which contaminated the rice oil contained only about 50% PCBs. The combination of high temperature and some air in the

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heat exchanger had changed about half of the original PCB fluid into materials called quaterphenyls, whose physiological effects are unknown.

But more importantly, about 2500 parts per million (ppm), or 1/4 percent, of the original PCB fluid had been converted to polychlorinated dibenzofurans (PCDFs), materials with a reported animal toxicity greater than PCBs. Later investigations by the Japanese linked the Yusho symptoms to the PCDF content of the rice oil, *not* to the PCBs themselves. By the time these findings became generally known, however, the public already believed that PCBs were extremely toxic.

THE U.S. SITUATION

The situation in the United States is quite different from that which resulted in the Yusho incident. First, the use of heat exchangers containing 50 ppm or more PCB has been banned in the manufacture or processing of food, drugs, or cosmetics. Second, there is no evidence that PCDFs are generated in the operation of PCB electrical products. Third, the EPA rigidly controls the storage and disposal of PCBs. And finally, the Occupational Safety and Health Administration (OSHA) limits occupational exposure to PCBs.

Besides, the PCDF concentration of U.S. electrical-grade PCBs ranges from 0 to 2 ppm, hardly the 2500 ppm in the Japanese heat transfer fluid. About the only possible pathway for human exposure to PCDFs via PCBs is through eating fish from certain bodies of water where the fish are known to have measurable quantities of PCBs. Assuming that the fish contain the current Food and Drug Administration maximum limit of 5 ppm PCBs and that the PCBs contain 2 ppm PCDFs, our fish eater would have to eat about 1 pound of fish per day for over 150 years to acquire the minimum PCDF dose that caused illness in the Japanese Yusho incident.

DO PCBs CAUSE CANCER IN HUMANS?

The concern about PCBs as a cause of cancer stemmed principally from a government experiment reporting that PCBs caused cancer in a certain type of rat. This report has since been questioned by other scientists. In addition, another study by the National Cancer Institute failed to show that PCBs caused cancer in rats. But the real question is not whether PCBs cause cancer in animals, but whether they cause cancer in humans. The evidence strongly suggests that they do not. If PCBs were human carcinogens, signs of cancer should have shown up by now in the most highly exposed electrical workers. The exposure of some began almost 40 years ago. Signs of cancer attributed to PCB exposure have not been identified in these workers.

The most important study of PCB exposed workers

was reported in 1981. It was a mortality study by the National Institute for Occupational Safety and Health of about 2500 workers employed by two capacitor manufacturers. Exposure in one plant began as early as 1938; the other by 1946. The conclusion? No statistically significant excesses of cancer were observed. In fact, there was no apparent relationship between increasing lengths of employment in PCB-exposed jobs and the risk of death due to cancer, cardiovascular disease, neurological manifestations or from any other cause. This is particularly noteworthy since 50% of the 2500 employees in the study were exposed to PCBs for more than 17 years. Some were exposed for almost 40 years!

DO PCBs CAUSE OTHER ILLNESSES IN HUMANS?

Clinical studies of workers occupationally exposed to PCBs have been performed by the South Carolina Department of Health and Environmental Control, by the Mount Sinai School of Medicine, and by others. None of these studies revealed any serious health problems related to PCB exposure.

Other studies by the Michigan Department of Health and the Connecticut Department of Health Services examined fishermen who have consumed large quantities of PCB-containing fish. Again, no significant clinical effects were observed.

A comprehensive and scientifically evaluated PCB literature study was conducted in 1981 and reported in 1982 by the highly respected toxicology consulting firm of Drill, Friess, Hays, Loomis & Shaffer. Dr. Seymour L. Friess, president of the firm, summarized the findings in these words:

"At human exposure levels as high as those previously encountered in occupational settings, PCBs can cause chloracne and increases in one or more liver enzymes. Neither effect represents a serious or life-threatening problem. From present evidence, no firm associations can be made between PCB exposure and any other human health effects, even after long-term occupational exposures."

Dr. Friess went on to say that since the risk from even high-level occupational PCB exposure is low, PCBs in the natural environment do not present significant human health risks.

In May of 1982, the U.S. Environmental Protection Agency sponsored a symposium on PCB health effects. In his report to the EPA, part of which was quoted in the May 29, 1982, issue of SCIENCE NEWS, the symposium chairman stated that, "... it is evident ... after 50 years of industrial production (that) ... no significant clinical disease or clear epidemiological correlations have been observed in occupationally exposed persons. Considering the lower and declining exposure to PCBs via the environment, it seems unlikely

that significant injury will be observed from environmental exposure to PCBs."

Although there is no reason to believe that future research will result in any surprising new information, studies continue. Presently the National Institute for Occupational Safety and Health mortality study is being extended, manufacturers are continuing studies of exposed employees and some states are conducting their own research on human health effects.

ELECTRICAL EQUIPMENT REGULATION

Current EPA regulations require the early replacement of certain PCB capacitors and transformers, and permit the use of the remaining units to the end of their useful lives — subject to periodic inspection of transformers for leaks.

Other EPA regulations deal effectively with the disposal of PCBs. These disposal regulations permit destruction in high temperature incinerators or in high efficiency boilers. Such methods have been thoroughly tested and approved by the EPA, and are very effective.

PUTTING PCBs IN PERSPECTIVE

Despite the recent favorable information on PCB human health effects, the Federal Government continues its strict regulation of PCBs. The regulations were designed to permit the continued operation of PCB electrical equipment without excessive exposure of humans to PCBs and without excessive leakage of PCBs into the environment. Additionally, Federal statutes and regulations, put in place since 1976, prohibit the manufacture of PCBs. Although they disintegrate only slowly in the environment, they will eventually be removed by natural processes.

So, to put the PCB issue into perspective, PCBs are not the hazard to human health once thought. This conclusion is fairly drawn from a considerable body of objective study, examination and evaluation on the part of many scientists and medical personnel. At the same time, government regulations and industry practices have been designed to minimize the escape of PCBs from electrical equipment into the environment and to control the storage and disposal of PCBs at the end of their service life. The evidence and these safeguards should eliminate the fear of PCBs and establish that PCBs do not pose a serious threat to our lives and health.

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