Iowa Science Teachers Journal

Volume 15 | Number 1 Article 11

1978

PCB's

Erwin Richter
University of Northern Iowa

PCB'S

Erwin Richter
Department of Chemistry
University of Northern Iowa
Cedar Falls, Iowa 50613

PCB's, or polychlorinated biphenyls, is a general name applied to compounds consisting of two benzene rings joined together, with several to all of the remaining hydrogen atoms substituted with chlorine (Fig. 1). Because of this, formulations of PCB's vary in the percentage of chlorine with the sample taken.

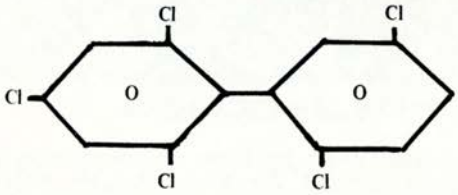

Fig. 1. A PCB molecule.

PCB's were introduced into commercial use more than 45 years ago and are structurally similar to DDT (Fig. 2). At the time they were thought to be non-toxic. They have high thermal and chemical stability and thus are useful in a number of different products. They are used as a dielectric medium mixed with oil in transformers and as impregnants for capacitors and condensers. They also find use in inks, paints, plastics and golf club castings. PCB's reached their sales peak in 1970 when 72 million pounds of the material were sold. It was soon after this that Monsanto began to restrict production of the material when the material was shown to be an environmental contaminant.

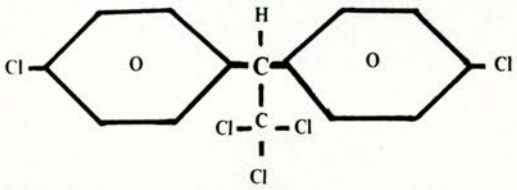

Fig. 2. A DDT molecule.

The first detection of PCB build up in the environment was shown in 1966 when the Swedish chemist, S. Jensen, demonstrated its presence in fish and wildlife. Since that time its presence has been demonstrated in many aquatic and animal species and in the adipose tissue of humans. High concentrations of PCB's have also been found in industrial waste discharges, river bottom sediments, food packaging materials and in poultry, fish and dairy products.

PCB's show little solubility in water but exhibit a high solubility in fats and oils. It is for this reason that they tend to become stored in fatty tissue and are thus not readily metabolized and excreted. Because of this property, accumulation of subacute doses tend to produce chronic disorders. Prolonged exposure to chlorinated biphenyls can result in visual impairment, an acne-like skin condition called chloracne, and in increased pigmentation. Acting as solvents they have a tendency to remove protective oils from the skin which causes drying and cracking of that tissue.

Research at the University of Wisconsin indicated that rhesus monkeys fed PCB contaminated mothers' milk suffered from swelling of the eyelids, hearing loss and chloracne, and were much more susceptible to infectious diseases. The same study indicated that PCB's cause reproductive failures in monkeys. At a dietary level of 5 ppm, only 12.5% achieved pregnancy as compared to 90% for the control group. The offspring of the PCB contaminated monkeys were significantly smaller in size and were much more subject to disease than were the control offspring.

Another study at the Center for Disease Control in Atlanta by the EPA, National Cancer Institute, and the Johns Hopkins University School of Medicine involved rats. Female rats were fed a diet containing 100 ppm of PCB's for 21 months. Twenty-six of 184 developed malignant liver tumors, while 146 had tumorous lesions in the liver.

The FDA has calculated what they call an "acceptable daily dietary intake" in the human diet, or a level of PCB's which, if ingested over an extended time period, would be toxicologically insignificant. Animal and human toxicological data were used in establishing the allowable dose of the chemical at 70-280 micrograms per day for a 70 kilogram person. There is some controversy whether this is a "safe" amount of a carcinogenic material that has a long biological half-life.

Safe, effective substitutes for PCB's have been developed by Dow and Monsanto and will soon be in production. Depletion of present stockpiles of PCB's is expected by May of 1978. On December 22, 1975, the EPA announced a far reaching federal policy of "totally eliminating the use of PCB's as rapidly as possible in the U.S."

References

Ahmed, A. K. 1976. PCB's in the environment. *Environment* 18:6-11.

DiNardi, S. R. and A. M. Desmarais. Polychlorinated biphenyls in the environment. 1976. *Chemistry* 49:14-17.

Highland, J. 1976. PCB's in food. *Environment* 18:12-16.

Kaiser, L. E. 1976. PCB's; how toxic? *Science* 192:614.