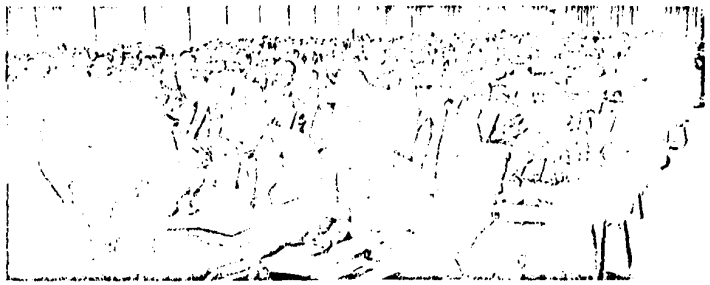
GREAT LAKES
FOCUS On Water Quality
International Joint Commission — Windsor, Ontario
Editor: Patricia Bonner
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PCB's — A Review



EPA Administrator Russell Train and his audience at the November PCB's Conference (Courtesy EPA-Chicago)

by the Editor

In Chicago, Illinois, November 19-21, the Environmental Protection Agency, in cooperation with the United States Department of Agriculture, Council on Environmental Quality, Department of Health, Education and Welfare and the Department of the Interior, sponsored a symposium on polychlorinated biphenyls (PCB's). Over 600 scientists, politicians, industrialists and environmentalists attended. What led the agencies to sponsor the conference and why so many people attended should become clear to you as you read through this article.

HISTORY AND USE

PCB's are man-made chemicals produced by chlorination of biphenyl with the use of a catalyst. There may be as many as 209 compounds which can be produced in this way. PCB's have been in use since 1929, but not until the DDT scare of the late 1960's did scientists begin worrying about the possibility that the chemicals could be toxic.

At the time of the DDT alarm, there were several anomalies in stream measurements of the chemical. High concentrations of DDT were identified as coming from sources which did not manufacture, store or use it. Gas chromatography enabled researchers to refine analytical methods used to identify DDT. Analysis revealed that PCB's were being confused with DDT. Some uses of PCB's, it was then determined, were resulting in uncontrolled losses to the environment. Then in 1968 over 1,000 people in Japan were struck by an epidemic of a disfiguring skin disease which was traced to rice oil that had been

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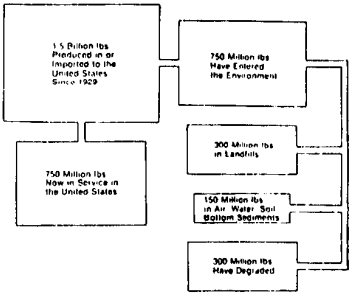
contaminated with PCB's. Sixteen deaths and two stillbirths were blamed on this contamination. As a result of this series of events, a National Task Force on PCB's was convened. It recommended stringent controls and limited uses only by the electrical industry. The United States Food and Drug Administration (FDA) set maximum levels to be tolerated in foods effective in 1973, e.g. 5 parts per million (ppm) in edible portions of fish.

Monsanto, the only United States company then manufacturing PCB's, voluntarily stopped selling the chemicals to United States customers except for "closed system" electrical applications. Yet today the chemical is ubiquitous; it is in the air, in the water, and in the soils. Pollution levels are not appreciably decreasing despite the controls. There are several reasons why: the persistence of PCB's, importation, accidents during the manufacturing processes which still use PCB's, its presence in NCR paper and release during recycling, direct emissions into waterways, fallout from the atmospheric input and fallout due to investment (wax) casting processes or low temperature incineration (PCB's can be incinerated at 2200-2600°F), and leaching from landfills. Of the 1.5 x 10^9 lbs produced in or imported to the United States to date, 750 x 10^6 lbs are still in use by the electrical industry, 300 x 10^6 lbs have been burned in landfills, approximately 150 x 10^6 lbs is in the environment; the remainder have been incinerated or lost (300,000 lbs).

In 1970, 85 million pounds of PCB's were produced by Monsanto. Today about 40 million pounds are produced and 0.5 million pounds are imported. PCB's are still attractive because of their thermal stability, resistance to oxidation, excellent electrical insulating properties, and low biodegradability. Firms using PCB's have rejected potential substitutes in transformers and capacitors for reasons of safety. Insurance underwriters have been reluctant to approve of substitutes because the substances may not be as safe as PCB's in the sense of fire risk. Uses in lubricants, "carbonless" duplicating paper, die casting, paints and coatings, adhesives, fireproof sealants, plastics, etc., are continuing

PCB HISTORY IN THE UNITED STATES

Source: Environmental Protection Agency



in some countries for the same reasons and because most substitutes are more expensive.

At least six substitutes for PCB's are under development by major chemical companies, but none has reached the United States market. Dow Chemical is developing one for use in power capacitors; Exxon is considering phthalate esters; and Dow Corning is working on a dimethyl silicon for use in transformers. The last has been successfully used in Japan for the past four years. The Environmental Protection Agency is strongly encouraging acceleration of development and marketing of appropriate substitutes.

HEALTH EFFECTS

The safety features of PCB's may be outweighed by their toxicity as more evidence mounts against the chemical. There is, however, a question (currently being researched) whether it is PCB's and/or the impurity in PCB's, tetrachlorodibenzofuran (TCBF) which is the more toxic substance. TCBF in studies of chickens was found to be 10,000 times more toxic than PCB's.

Liver cancer and reproductive failures have resulted from laboratory feeding experiments with rats, chickens, minks and rhesus monkeys. Only a few months after being placed on diets containing as little as 2.5

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ppm of PCB's, rhesus monkeys at the University of Wisconsin Primate Research Center showed signs of the toxic effects. They began to lose hair, had skin lesions, evidenced general metabolic disturbance and severe stomach aches. Apparently, in these studies, PCB's at low levels caused abortions and sickly offspring. It is important to note that a "no effect" level has not been established.



The monkey on the right was exposed to the PCB Aroclor 1248 at a 5.0ppm level for 1 year. (Photo courtesy Wisconsin Sea Grant Program.)

People who work with PCB's have complained of nausea, skin disease, fungus infections, nose and eye irritation and asthmatic bronchitis. Even though the electrical industry has published guidelines for safe PCB use, in most small manufacturers, transformer rebuild shops, etc. (according to reports from recent Environmental Protection Agency inspections), gloves, other protective clothing, masks, etc., are not used because they are not issued.

Everybody is consuming PCB's in small quantities. Recent studies to measure the amount of PCB's in humans discovered levels approaching 1 ppm in 75 percent of the persons tested. Tissues from subjects in the Great Lakes in the United States and Canada contained PCB's above the national levels. Long term effects of ingestion of PCB's at low level concentrations are not known.

It appears that the air may be a major transport mechanism for PCB's. They are found world-wide. In fact, at the Chicago conference one researcher reported PCB levels in layers of Antarctic glaciers.

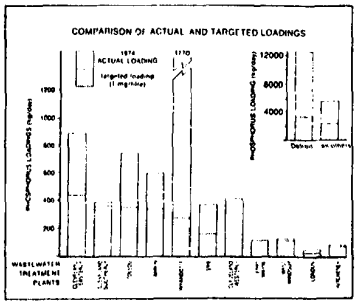
Increased chlorine levels in PCB's decrease toxicity of the PCB's to aquatic life, but increase the toxic levels to warm blooded species. The clearance rate of PCB's from tissue is very slow. Fish eggs with as low as 0.5 µg/g have difficulty in hatching. Reproductive failure and mortality in herring gulls around Lake Ontario has been directly linked to PCB's. Water with 10-100 µg/litre of PCB's has been shown to be fatal to aquatic species; 1-10 ug/litre has an effect on reproduction; and .001-.01 µg/litre enables biocentration to affect public health. A water level of .0001-.0005 µg/litre of PCB's was proposed by some participants in the Environmental Protection Agency conference.

Though the levels of PCB's found in birds, animals and most foods for human consumption appear to be decreasing, levels in fish, particularly Great Lakes fish, are not. Fish from the Great Lakes, the Hudson, Milwaukee and Ohio rivers and other waterways are displaying PCB levels in excess of the 5 ppm (µg/g) set by FDA. Shipments may be seized by FDA if the fish are considered contaminated. Health and Welfare Canada recently set a 2 ppm (µg/g) acceptable level in fish and that agency also has seizure powers. Canadians have grown so concerned about PCB concentrations in St. Lawrence River eels that they are considering terminating commercial eel fishing licences there. Eels have been tested at an average of 17.14 ppm (µg/g).

Fishermen are worried since they are facing a possible limit on their livelihood not dissimilar to the ban on commercial fishing on Lake St. Clair due to mercury contamination. During the Chicago conference representatives of fishery cooperatives and fishermen themselves spoke on the effect of the ban on fishing for certain species in Lake Michigan. The successes of the multi-million dollar programs to rebuild the Great Lakes fisheries will be reversed if the fish cannot be caught

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The Erie treatment plant has been experiencing periodic upsets during its start-up period due to the extremely high solids and organic loadings from its major industrial discharger, Hammermill Paper Company.

The IJC staff reported that:

> *The 1974 phosphorus loadings for the major municipal dischargers in the Lake Erie Basin, as reported by the jurisdictions to the Water Quality Board, represent the best estimates available.*

Limited copies of the complete report are available from the Regional Office.

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and sold. Other multi-millions in compensation may have to be paid by government and industry to commercial fishermen whose earning power is destroyed by prohibition of sale of fish species which contain excessive PCB's.

GOVERNMENTAL ACTIONS

Ontario's Ministry of the Environment set up a task force on PCB's in 1970 to review PCB's sources and to recommend control measures. Extensive monitoring was undertaken to determine occurrence, distribution and concentrations in the environment. Industrial plants using PCB's were inspected and control facilities improvements were made to eliminate discharges. An agreement was struck with Monsanto to assure that the company would sell PCB's only to closed system industrial users. Facilities of all forms and current PCB customers of Monsanto were inspected and monitored. All known sources of PCB's are periodically checked to make certain that control facilities are adequate. A Lewiston, New York facility or Monsanto now receive all scrap or waste PCB's for disposal.

Canada passed the Environmental Contaminants Act late in 1975. Prior to passage of the Act a Task Force on PCB's was established. According to high level Canadian officials, one of the first contaminants to be specifically regulated under the Act will be PCB's.

In October of 1972 the Water Quality Board reported to the International Joint Commission on high levels of PCB's in Great Lakes fish. In January 1973 the International Joint Commission recommended several actions to the two Governments: joint research to provide information on the effects of small amounts of PCB's to human health; inventory of present stocks of PCB's and materials containing them; regulation of manufacture, importation and release of PCB's and products containing them.

On a wider international scale, in February 1973 the Organization for Economic Cooperation and Development member countries agreed to control the manufacture and trade of PCB's. Further the nations agreed to exchange data for the next three years on the amounts of PCB's (by type) manufactured, imported, exported, incinerated and consumed; replacements supplied; and disposals of surplus PCB's.

The Lake Michigan Toxic Substances Committee of the Environmental Protection Agency issued a report after a two-day meeting in May 1975 urging a near-total ban on PCB's. The members agreed that controls on the PCB's still used had not produced an observable decline in residuals in Lake Michigan and its basin from 1971-75. In Michigan and Wisconsin bills to phase out PCB's were introduced in the states' legislatures in 1975, but these have not become laws as yet.

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Indiana's legislation was introduced in 1976 and reached the Governor's desk for signature in early February.

In July 1975 the Great Lakes Water Quality Board passed a resolution on PCB's (see **Focus** 4 article). Members recommended that the Governments of Canada and the United States undertake public discussions on environmental contamination by PCB's and the consequences of strictly controlling their sale, use and disposal. Not long after, the Great Lakes Commission recommended that the Environmental Protection Agency hold public hearings to discuss banning the use of PCB's, that PCB's be replaced as soon as substitutes become available and that a disposal program be developed. The Great Lakes Basin Commission also made a recommendation that PCB's be banned and has asked Congress to approve the ban and classify the chemicals as prohibited hazardous substances. In August the Environmental Protection Agency announced its intention to hold the November conference.

EPA'S ROLE

At the conference many participants were highly critical of the lack of regulatory agencies' enforcement of laws relating to PCB's. What powers they have they have not applied in a timely manner or, in some cases, at all. Under Section 307 of the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500) the Environmental Protection Agency Administrator was directed to within 90 days of enactment establish a list of toxic pollutants for which effluent limitation would be established 180 days later. Thirty days later public hearings were to occur; six months later final standards were required and a year from then, compliance was required. Toxicity, persistence, degradability,



Francis Mayo, former EPA Region V Administrator, Donald Marshall, Region V Regional Council Staff, and Mrs. Lee Batts, Assistant for Congressional and Governmental Relations at the PCB's Conference.

the presence and importance of affected organisms in the waters, and the extent of the toxic effect were the criteria to be considered.

Six months after the deadline and acting under a court order, the Environmental Protection Agency proposed a list of toxic substances, one of them PCB's. In December 1973 effluent limits were proposed and from April - June 1974 hearings were held. Procedures prohibit the Environmental Protection Agency from introducing new evidence once the hearings begin and revisions have to be made on evidence presented at the hearings. The Environmental Protection Agency therefore withdrew its proposals and the entire process began again. As of this writing, new limits have yet to be proposed, but they may be in late February 1976.

Section 311 empowered the Environmental Protection Agency to enforce a "no discharge" policy regarding the hazardous substances listed by its administrator. Under Section 504 the administrator can bring suit to stop or modify a discharge which evidence shows is a danger to citizens' health or wel-

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fare. The word evidence makes this clause a difficult one to apply to PCB's because the courts will require specific proof of health/ welfare effects.

The National Pollutant Discharge Elimination System of permits issued under PL 92-500 enables the Environmental Protection Agency to specify the amount of PCB's (and any other substance) which an industrial facility may discharge. Approximately a dozen permits have been issued to PCB's dischargers in the Great Lakes Basin. The Environmental Protection Agency as a result of its conference has begun a review of these permits and may be proposing revisions to them toward mid 1976.

FOR ADDITIONAL COPIES

Write to Patricia Bonner - Editor, Great Lakes Focus, IJC Regional Office, 100 Ouellette Avenue, Windsor, Ontario, Canada N9A 6T3.

Versions of the United States Toxic Substances Act are still being revised by Congress. A U.S. House of Representatives Bill (HR 9525) sponsored by Representative Aspin of Wisconsin, was introduced in September 1975 to ban PCB's effective three years from the date of the bill's enactment. Senator Gaylord Nelson of Wisconsin introduced a Senate bill late last year to severely limit and ultimately ban the use of PCB's. In January, Environmental Protection Agency administrator Russell Train recommended a total ban on the use of PCB's and called upon "society" to eliminate the production, importation and use of PCB's as quickly as possible.

Whatever happens legislatively, implementation will not occur instantly and, if it could, banning PCB's will not cause them to disappear. The chemicals will be here in the Great Lakes through most of your lifetimes.

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