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REPORT OF
THE ADVISORY BOARDS ON CONTROL OF POLLUTION OF THE BOUNDARY WATERS
AND
THE INTERNATIONAL GREAT LAKES WATER POLLUTION BOARDS
ON
POLYCHLORINATED BIPHENYLS

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REPORT OF
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Polychlorinated biphenyls (PCBs) may become as well known as DDT. PCBs, like DDT, contain chlorine, hydrogen and carbon; like DDT, it is not soluble in water, it is soluble in fat, and it is extremely persistent in the environment. The chemical similarity between the two suggests similar physiological effects in the bodies of fish, birds, and perhaps people. A significant difference, however, is that DDT has been used in the open environment with intent, because of its toxic effects, to destroy insects; PCB, although known to be toxic, has been used for its other qualities, and has escaped into the environment by accident.

Polychlorinated biphenyls are chemical compounds manufactured in this country by the Monsanto Chemical Company and in Europe and Japan by other manufacturers. PCBs were first produced in 1929 by the Swan Corporation which later became part of the Monsanto Corporation; European production followed, probably about ten years later. Aroclor, the Monsanto trade name, began to be used extensively during World War II.

PCBs as a group have a wide variety of uses because of the following properties:

- Fire resistance
- Chemical resistance
- Adhesion
- Resistance to oxidation

Low volatility

Resistance to hydrolysis

These properties together with their compatibility with a wide range of material and synthetic polymers and copolymers have made PCBs desirable components in many products and industrial formulations.

Among these products are natural and synthetic rubber, electrical products, floor tile, printer's ink, coatings for paper and fabric, brake linings, automobile-body sealants, paints, varnishes, waxes, asphalt, and many kinds of adhesives and resins. PCBs are also recommended by Monsanto for mixing with chlorinated insecticides to suppress their vaporization and extend their "kill-life."

Major volume uses for the PCBs as identified by Monsanto are as fire resistant fluids in closed system applications such as:

Transformers

Capacitors

Heat transfer systems

Industrial and hydraulic applications

where their excellent dielectric properties, fire resistance, inertness and stability at elevated temperatures make them key factors in maintaining a high level of safety in many industrial operations.

The detection of PCBs in North America began in the spring of 1967 when Monte Kirven of the San Diego Natural History Museum was searching the southwest for peregrine falcons, those swift-flying and now fast-disappearing birds of prey. He found a nest with a single, unhatched, abandoned egg and brought it to the laboratory at

the Institute of Marine Resources, University of California in Berkeley. The egg was found to contain five milligrams of DDE, the DDT compound that is apparently the most abundant synthetic pollutant in the environment. The analysis also showed the presence of other compounds which could not be identified. These same compounds had been evident in the analysis of other species of birds and of fish. Because of the importance of the peregrine, an attempt was then made to identify the compounds, but without success until the Swedish papers became available. With this clue, further work in the laboratory made it clear that the hitherto unknown compounds were polychlorinated biphenyls.

Very little data is available about PCBs in people. Both Swedish and British scientists have reported finding them in a few samples of human fat. In North America the profile of the PCB compounds on gas chromatograms of human milk samples was found by Dr. James Enderson and Fred Beland of the Colorado College in Colorado Springs. Although the air of Colorado Springs is much cleaner than the air of our larger cities, it was not evident whether the people of Colorado Springs were obtaining the PCB in their food or were inhaling it. Enderson then measured the PCB in a series of mothers' milk samples from Berkeley and from Los Angeles. Every sample tested contained both PCB and DDT compounds.

The Monsanto Company now reports that:

"In view of the possible threat to the environment posed by the polychlorinated biphenyls, Monsanto has taken the position that it will restrict sales of PCBs only to those applications where their unique fire resistant properties are important and where it is possible to control collection and regeneration or incineration of spent material. We are therefore taking the following actions:

- 1) Discontinue sales of PCBs for all general plasticizer applications. - August 30th, 1970.
- 2) Phase out the PCBs as components of industrial and hydraulic fluids where control of spillage and collection of spent material is not possible--the major part of this program will be completed within six months.
- 3) Continue sales of PCBs as dielectric fluids for transformers and capacitors, cooperating with customers collecting spent and arced fluid for regeneration and/or incineration.
- 4) Continue sales of PCBs as fire resistant heat transfer fluids ensuring modification to systems designed to make provision for collection of spills and leakage. Collect spent fluid for regeneration and/or incineration.
- 5) Continue research effort to develop alternatives to the PCBs and modify PCBs to make them biodegradable in conventional secondary waste treatment facilities.

Other Work

In addition to these major actions, we are continuing to study

analytical techniques for accurately determining the PCBs in air, water and animal tissues--the biodegradation of the PCBs--the toxicity of the PCBs to mammals, birds and fish."

PCBs have been recognized as a potential environmental hazard in water. The PCBs are chemically similar to the chlorinated hydrocarbon pesticides and could interfere with the analysis for such pesticides, particularly DDT and DDE. Many occurrences of PCBs have been reported in fish and wildlife. Surveillance activities carried out by the FWQA Analytical Quality Control (AQC) Laboratory, Cincinnati, Ohio, have cited only two areas where PCBs have been tentatively identified. Since 1961, the AQC has noted what appears to be Aroclor 1248 in Carbon Absorption Method (CAM) samples from Messina, New York on the St. Lawrence River. On two occasions within the past year, the same material was tentatively identified at four points on the Great Miami River below Dayton, Ohio.

The major problem areas identified with regard to PCBs are:

1. Analytical
2. Sources
3. Biological Effects
4. Existing Levels

To keep abreast of the analytical needs, and to better determine existing levels, the AQC Laboratory is evaluating the efficiency of the CAM for recovery of low concentrations of various PCBs from water. The current FWQA method for organochlorine pesticides carries PCBs along with the pesticides, and efforts are being made to modify the method

to enable separation and identification of both classes of compounds in the same sample.

In the Lake Michigan Basin, a project is being initiated immediately by the States to determine sources of PCB contamination in the environment.

Recommendation:

The Advisory Boards recommend that IJC recognize the potential for water pollution caused by PCB escaping to the environment, and encourage water pollution control agencies of both the United States and Canada to pursue research and investigations into possible sources, toxic effects, analytical methods, and techniques for control.

Reference:

Risebrough, R. with Brodine, V. "More Letters In the Wind", Environment, Vol. 12, No. 1, pp. 16-27, January-February, 1970.

POLYCHLORINATED BIPHENYLS

Summary of OWRC Investigations

Introduction

The OWRC task force, originally established to deal with the mercury pollution problem, was subsequently assigned the task of investigating the usage, mode of entry into the environment and the environmental effects of polychlorinated biphenyls.

Details of Survey

Users of these compounds, being supplied directly by Monsanto Company, the only North American manufacturer, have been contacted and plants inspected to observe the practices employed in handling these materials. Losses or wastage have been assessed where possible and methods of disposal noted.

Analytical capability is being developed in OWRC Laboratories to determine levels of polychlorinated biphenyls in fish in the presence of DDT residues. A catalytic dehalogenation-gas-liquid chromatographic analytical procedure has been proposed and is undergoing further development. It is concluded both by OWRC Laboratories and the Provincial Pesticide Residue Laboratories that no confidence can be placed in much of the currently available data on polychlorinated biphenyl residues

in fish and wildlife. This lack of reliable data will continue until a universally accepted reliable analytical procedure is developed.

Close contact has been maintained with Monsanto Company in this investigation and reports on biodegradation studies, analytical procedures and chronic toxicity studies have been received from the company.

Uses of Polychlorinated Biphenyls in Ontario

Electrical:

- Most of the material produced by Monsanto Company is used in electrical apparatus. Under the trade name Askerils, these compounds are used as fire resistant coolants in power transformers, as dielectrics in capacitors and in oil switch gear.

High Temperature Hydraulic Fluids:

- Under the trade name Pydraul, polychlorinated biphenyls are used as hydraulic fluids in die-casting machines, furnaces and other applications where a fire hazard exists.

Heat Transfer Media:

- Polychlorinated biphenyls have limited applications in this area as heat transfer fluids in autoclaves and reactors.

Sealants, Caulkings and Adhesives:

- Because of their chemical stability and physical properties, polychlorinated biphenyls have wide application in this area.

Paints and Coatings:

- Polychlorinated biphenyls have limited application in specialty coatings such as swimming pool paints.

In assessing the quantities of polychlorinated biphenyls being used, the nature of the usage is of prime importance. Many of the uses are non-consumptive. In this category are applications in the electrical industry where a very high percentage of the material is retained in the equipment manufactured. Off specification transformer fluids are either reclaimed or returned to the manufacturer. It was noted during the inspection of electrical manufacturing plants that considerable care is exercised in handling these materials.

High temperature hydraulic systems have the greatest potential for direct loss of polychlorinated biphenyls to the water environment, although this usage in Ontario is quite small.

Uses as sealants, adhesives and caulking are likely to result in the widespread introduction of polychlorinated biphenyls into the environment. The principal supplier of polychlorinated biphenyls for these uses in Ontario markets about 100,000 lbs of

these compounds annually. Information on non-consumptive uses in Ontario is not complete but so far, in excess of 50,000 gallons per year has been reported.

No agricultural applications of polychlorinated biphenyls are known, including incorporation into pesticide formulations.

Conclusions and Recommendations:

The Monsanto Company have recently withdrawn from the market those compounds known to be used in open systems in which the ultimate introduction into the environment cannot be controlled. In this category are compounds used in adhesives, sealants, chlorinated rubber and specialty coatings. In other application where there is a possibility of loss to the environment, such as in fire resistant hydraulic fluids, alternative formulations have been developed by the company. The reclamation of used compounds received from customers has also been instituted by the company.

The principal modes of entry into the environment are through the cleaning and disposal of containers and the incineration and/or disposal of materials containing or bearing polychlorinated biphenyls.

It is recommended that investigations into the development of reliable analytical techniques, and hence, the reliable determination of polychlorinated biphenyls residues in fish and wildlife be continued. Cooperation both nationally and internationally in this area, should be encouraged.

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