SOURCES OF POLYCHLORINATED BIPHENYLS IN WISCONSIN

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Abstract

The past and present users of PCB's are discussed and effluent sampling data are presented for municipal wastewater treatment plants and industries in Wisconsin. Data are also presented covering PCB levels in surface waters, fish, sediments, and snow melt. A general assessment of the PCB problem in Wisconsin is made with comments concerning the need for further study and regulation.

My report will summarize the work completed by the Wisconsin Department of Natural Resources and others to determine concentrations of PCB's in fish and to identify discharge sources in Wisconsin. Our interest in PCB's began in the late 1960's, when interfering substances were detected in the gas chromatograms of fish being tested for DDT. Later we were to learn these interfering substances were PCB's.

In 1970, the department collected fish samples along the Mississippi River bordering Wisconsin. Analysis revealed that fish from the Upper Mississippi River between Prescott and Pepin, Wisconsin, commonly exceeded the Food and Drug Administration tolerance level of 5 ppm (ref. 1). During 1971, Lake Michigan fish were collected and later tested in studies conducted by Dr. Veith in a University of Wisconsin study (ref. 2). Mean concentrations of PCB's expressed as Aroclor 1254 (wet weight) in the fish ranged from 2.7 ppm in smelt to 15 ppm in lake trout. Subsequent studies confirmed the presence of PCB's in fish in Lake Michigan and other waters of Wisconsin (ref. 3).

The search for PCB's in water was also underway at this time. Veith and Lee (ref. 4) sampled water from the Milwaukee River in 1969 and sampled effluents from selected municipal and industrial outfalls to the river in 1970. The analysis of water from the Milwaukee River indicated that PCB's were present in the river from West Bend to Lake Michigan and were being discharged through municipal and industrial effluents. In 1971, 11 municipal wastewater treatment plant effluents in Wisconsin were sampled by Dube, Veith, and Lee (ref. 5). Nine of the plant effluents contained PCB's identified as Aroclor 1254 and one contained Aroclor 1248. Studies of the Cedarburg wastewater treatment plant indicated that more than 70 percent of the PCB's coming in[to] plant were removed during the treatment proces[s] comparatively high concentrations of PCB's were f[ound] in the digester and primary settling sludges.

The department surveyed many municipal w[aste]water treatment plant effluents in Wisconsin from [1971] through 1974. PCB's were detected in concentrati[ons] exceeding .05 ppb (the detection level for screening p[ur]poses) in more than half of the treatment plant efflu[ents] tested, even where there were no suspected indust[rial] sources. In most cases, the discharge of PCB's was [at] below 1 ppb and .01 pounds per day. However, the h[ig]er concentrations of PCB's were found in sewage tr[eat]ment plant effluents from industrial areas.

Tracing sources of PCB's reaching a large munic[ipal] wastewater treatment plant is a difficult and t[ime] consuming task. The department is attempting to t[race] sources of PCB's reaching treatment systems where [the] final effluent exceeds 1 ppb. At the present time, [we] know of only two municipal wastewater treatm[ent] plants in Wisconsin which exceed 1 ppb—the Sheboy[gan] and Portage facilities.

The main source of PCB's being discharged to [the] Portage treatment plant was found to be a facility t[hat] had used PCB's in the manufacture of carbonless co[py] papers prior to the summer of 1971. After ceasing [the] use of PCB's and after repeated cleanings of the holdi[ng] tanks of the facility, the company substantially reduc[ed] the discharge. Residuals still remain, however, in [the] sewer system and the sewer sludges, resulting in an effl[u]ent of several ppb at the municipal sewage treatme[nt] plant. We are continuing to check sources of discharge [to] the Sheboygan treatment plant.

The department has checked effluents from iro[n] and steel foundries and aluminum foundries. The testi[ng] has shown that the cooling water effluents from five [to] seven aluminum foundries contained PCB's ranging fro[m] 11.5 to 335 ppb. Close investigation revealed the com[-] mon source to be leaking hydraulic fluids containi[ng] PCB's, which were used in die cast machines. We a[re] working with company officials to correct the problem. PCB's have been found in the cooling water effluent o[f] only one of nine iron and steel foundries checked to date and these were at a concentration of .9 ppb.

The Department of Natural Resources has tested the effluents of 17 pulp and paper mills for PCB's. The testing has revealed that nine of the mills that recycle waste papers had measureable discharges ranging from .1 to

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more than 25 ppb. Mill representatives indicate that the paper industry no longer uses PCB's and those found in wastepapers come primarily from carbonless copy papers that were produced prior to 1972. The old carbonless copy papers were widely used in forms and continue to enter the wastepaper market as old files are discarded. Aroclor 1242 is the principal form found in wastepaper, however, some Aroclor 1254 has also been reported. Because their solubility in water is low, we believe that most of the PCB's discharged from wastepaper mills are absorbed on fibers and other particulate matter. Mill wastewater treatment systems, which effectively remove particulate matter, should also remove PCB's.

The electrical industry continues to use PCB's as dielectric fluids in some capacitors and transformers. Although the units are sealed, some fluids may be lost as a result of accidents or disposal practices. In March 1975, the department corresponded with the major electrical companies in Wisconsin to determine current handling practices for capacitor and transformer fluids. The correspondence was followed by visits to many facilities. The companies contacted were aware of the PCB problem, but some were not aware of the recommended Guidelines of the American National Standards Institute (1974) for Handling and Disposal of Capacitor and Transformer Askarels (Fluids) Containing PCB's (ref. 6). We also found that some facilities were storing defective capacitors until a proper disposal method could be found. As a result of this survey, specific guidance was given to Wisconsin electric utilities for the proper handling and disposal of PCB's.

Snow samples were collected early in 1975 to determine if PCB's were deposited on land and water as fallout from the air. Analysis of the snow melt water from Racine, Kenosha, Madison, and Milwaukee revealed concentrations from .17 to .24 ppb. These values suggest that fallout of PCB's from the air may be a principal source of PCB's entering the waters of the State.

PCB's are present in sediments in harbors and streams near industrial areas. The sediments act as a reservoir where PCB's may be released slowly over a long period of time. Sediment samples have tested 3.5 ppm in the Milwaukee River near the Capital Drive Bridge, 9 ppm in Superior Harbor, and 72 ppm in the Fox River below the outfall of the Portage sewage treatment plant.

We have tried to work out a materials balance for PCB's entering the environment using the domestic sales figures provided by the Monsanto Company as well as other data. There are so many pieces missing from the puzzle, though, that our efforts to work out a materials balance have been unsuccessful. Some general comments can be made, however.

1. PCB's have been sold by the Monsanto Company for more than 45 years (ref. 7). The company has reported domestic sales of 795 million pounds of PCB's for the years 1957 through 1974. Aroclor 1242 accounted for 15 percent, Aroclor 1260 accounting for 11 percent, and Aroclor 1248 accounting for 7 percent of the sales. In 1974, the Monsanto Company's domestic sales of PCB's were reported to be 34 million pounds for use in closed electrical systems. In addition, the Office of Toxic Substances, EPA (ref. 8) has reported that foreign sales of PCB's in the United States in 1974 exceeded 375,000.
2. The PCB problem in Wisconsin is a fishery problem caused because residues have accumulated in certain fish in Green Bay and Lake Michigan and the Upper Mississippi River in excess of FDA tolerance level of 5 ppm. Laboratory experiments have shown that fish accumulate PCB's more than 100,000 times the levels present in the water (ref. 9). Therefore, PCB's in the water, even at ppt levels, have significance to the fishery resource.
3. Our data indicate that levels of PCB's in fish in the Upper Mississippi River have declined in recent years. We have not detected a corresponding decline in levels in Lake Michigan fish.

If Lake Michigan water contains an average of 10 ppt PCB's, then there are more than 100,000 pounds of PCB's in solution in the lake waters and there is probably a much larger poundage in the sediments. We have tested the major effluents of both municipalities and industries discharging to the Lake Michigan drainage in Wisconsin and estimate a discharge of about 2 pounds per day or 730 pounds of PCB's per year to Wisconsin's drainage to Lake Michigan. Most of PCB's identified in our testing of major effluents occur in the wastewaters of pulp and paper mills that recycle wastepapers.

Discharges of PCB's from pulp and paper mills that recycle wastepapers will diminish as the mills meet their discharge permit requirements. Wisconsin mills that recycle wastepapers are required to reduce their discharge of suspended solids from 131,000 pounds per day (for calendar year 1973) to 45,000 pounds per day by the 1977 compliance date. Recently one mill in the State, which uses only recycled papers, began operation of a new treatment system that has reduced the discharge of suspended solids from 40,000 pounds per day to 3,000 pounds per day. Tests at this facility revealed 39 ppb PCB entering the treatment system with only 1 ppb being discharged in the final effluent.

4. In our search for sources of PCB's entering the environment, we have not looked closely enough at fallout from the air. Our testing of snow melt suggests that fallout may be contributing much greater amounts of PCB's than are being contributed by industrial and municipal effluents. Trace concentrations in fallout over Lake Michigan and its watershed, which cover 67,900 square

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miles, could result in appreciable amounts of PCB's entering the waters of Lake Michigan.

Because PCB's are stable compounds with low vapor pressures, little loss is expected to occur through vaporization from disposal sites where capacitors and other equipment and materials have been disposed and covered with overburden. Entry into the air may be expected to occur at locations where papers are incinerated, at foundries where imported casting waxes containing PCB's are heated to high temperature, and at manufacturing facilities. PCB's adsorbed on fine particulate matter may also be entering the air, as windblown dust.

5. Further information is needed to define the amount of PCB's contributed to Lake Michigan and other waters through past accumulations in sediments. A University of Wisconsin study is currently underway in Southern Lake Michigan; this should provide some of the answers.

The Department of Natural Resources does not have the authority to regulate the sale or use of PCB's, but can adopt effluent standards. The department held hearings on two proposals for effluent limitations for PCB's on August 28-29, 1975. The first proposal would prohibit the discharge of PCB's and the second would limit the discharge to .005 mg/l or 5 ppb. The hearing record is being reviewed by the Natural Resources Board. No final decision has been made on an effluent standard as yet.

On September 10, 1975, Congressman Aspin of Wisconsin introduced a bill (HR 9525) to prohibit the introduction or delivery for introduction into commerce of PCB's. This bill is pending in the House Interstate and Foreign Commerce Committee, Subcommittee on Consumer Protection and Finance. This legislation would become effective 3 years after enactment providing industry with a 3-year changeover period to alternate substances.

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Abstract

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