POLYCHLORINATED BIPHENYLS

A RISK/BENEFIT DILEMMA

MONSANTO COMPANY

ST. LOUIS, MO.

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HISTORY AND BACKGROUND

The chemical structure of polychlorinated biphenyls (PCBs) has been known for nearly 100 years. Commercial production of the material was initiated in 1929 in response to the electrical industry's need for an improved dielectric insulating fluid which would also provide increased fire resistant benefits when used in transformers and capacitors.

Mineral oil, the only known alternate material for these applications, had stability and flammability problems that made it potentially hazardous. Power surges in electrical equipment can cause arcs. A sustained, high-energy arc can vaporize mineral oil to the point where the material will ignite. The unique properties of PCBs -- inertness, fire resistance and their ability as dielectric insulators to act as non-conductors of direct electric current -- made them ideally suited for those applications where high-voltage arcing could occur, and result in fires and/or explosions, damage to equipment and create hazards to people.

As the unique properties of this material became more fully understood, many additional uses were found. Their fire resistant nature made them an excellent choice for use in hydraulic and heat-transfer fluids. Their inertness imparted long-lasting qualities to lubricants. They also improved the waterproofing characteristics of surface coatings and offered similar and other benefits to the manufacturers of carbonless copy paper, printing inks, plasticizers and special adhesives.

PCBs, therefore, evolved as a truly unique class of chemicals which met important needs for both industry and society. It was within this framework that Monsanto and other producers developed a growing, worldwide business for these versatile products.

FIRST SIGNS OF ENVIRONMENTAL CONCERN

In the late 1960s, some 40 years after PCBs were introduced, the first signs of potential environmental problems turned up in two separate events -- one in Japan, the other in Sweden.

In 1968, about 1,000 people in Japan became ill from eating rice oil heavily contaminated with Japanese produced PCBs as a result of an unfortunate industrial accident which has come to be known as the "Yoshu Incident." PCBs were being used as a heat-transfer fluid in equipment used to heat the rice oil. A leak developed in the equipment and went undetected, allowing the PCB to spill into the

oil. Some news accounts have erroneously linked this incident with deaths, stillbirths and miscarriages. While, in fact, no such cases were actually attributed to the incident, those exposed to PCB contaminated rice oil did experience dizzyness, nausea, loss of appetite, weakness and dermatological side effects. Infants, born to mothers who had been exposed during pregnancy, exhibited darkened skin at birth, however, in every case, this condition cleared within three months. It should be pointed out that the levels of PCB contamination in the "Yoshu Incident" were in the two-to-three parts-per-thousand range (extremely high concentrations) while the levels being reported in fish and wildlife today are in the low parts-per-million and billion. It is also important to note that a similar industrial accident today, at least in the U.S., is virtually impossible since PCBs are not used in heat-transfer applications.

THE JAPANESE BAN

Primarily as a result of "Yoshu," the Japanese Government announced, in 1971, a total ban on all PCB usage to become fully implemented by September of 1973. Monsanto and the U.S. electrical industry are often asked how Japan has been able to get along without PCBs in its electrical applications. It should be pointed out that the major uses for PCBs in Japan were in "open applications," particularly for

carbonless paper. The Japanese power distribution industry, less advanced than the U.S. technically, had never actually gotten around to taking advantage of fire resistant transformers to the extent they have been used in this country. Most of their transformers were either using mineral oil or were dry-type units. The Japanese capacitor industry on the other hand was only in the beginning stage of converting its equipment to the more reliable PCB dielectrics when the ban was announced. Reliability standards for capacitors in the U.S. are much more stringent than they are in Japan or anywhere else in the world. So the Japanese ban really did not materially impact that country's electrical power distribution industry.

The other early sign of trouble was reported by a Swedish biologist, who, while using a new and totally unique technique, for the first time identified PCBs in the bodies of fish. Monsanto and others began immediately to study the Swedish work. But before these findings could be confirmed or duplicated in the U.S., analytical methods had to be refined in order to separate PCBs from the other chlorinated hydrocarbons (like DDT) that were known to be present in the environment. Techniques also had to be developed to enable researchers to identify the chemicals in a very small (parts-per billion) range.

MONSANTO'S RESTRICTED SALES PROGRAM

When these scientific investigations first confirmed the presence of PCBs in the environment in the U.S. in 1970, and long before information regarding the potential impact of this contamination was determined, Monsanto voluntarily began its program of terminating sales of PCBs to open applications -- those which could likely result in losses to the environment.

Major applications affected by the company's unilateral withdrawal were in carbonless paper, fire resistant hydraulic fluids, heat transfer fluids and plasticizers. These restrictions resulted in a reduction in uses of PCBs, in applications where their loss to the environment was less controllable, of some 45 million pounds per year -- cutting production in half.

At the same time, Monsanto made the conscious decision to continue supplying PCBs only to the electrical power distribution industry where they were marketed as dielectric fluids in "closed" or sealed systems such as transformers and capacitors.

In making this decision, Monsanto felt, 1) that entry of PCBs to the environment would be effectively limited and controllable as a result of this restricted sales program (which became fully implemented by late 1972), 2) that a more biodegradable, lower chlorinated

homolog had been developed for use by the capacitor industry, and 3) that withdrawal from electrical applications would have brought to a halt production of equipment, essential to the safe and efficient distribution and use of electrical energy (there being no known, satisfactory replacement for PCB dielectrics available).

In the manufacturing area we took a number of significant steps to prevent loss of PCBs to the environment. Control, unique in the industrial chemicals industry, has been achieved. In addition, we installed a special high-temperature incinerator which completely destroys spent PCBs by burning. This service and other technical assistance has been available to our customers on a continuing basis.

In addition, representatives of the transformer and capacitor industries, utilities and governmental agencies formed the American National Standards Institute Committee C-107 and promulgated guidelines for handling and disposing of dielectric fluids. The actions of this committee reflect the industry's understanding of the need for proper control.

In 1972, Monsanto's voluntary program was reviewed by a Federal Interdepartment Task Force (consisting of representatives from the Office of Science and Technology, Council on Environmental Quality, Department of Agriculture, Department of Commerce, the EPA, HEW and the Department of the Interior). The Federal Task Force Report.

which is a matter of public record, supported and endorsed Monsanto's program.

CURRENT SITUATION...MONSANTO'S POSITION

Thus, the situation today is quite different from conditions which existed only a few years ago. Prior to 1971, Monsanto sold some 85 million pounds of PCBs per year to literally thousands of customers worldwide. At the present time, PCBs produced for U.S. consumption (about 27 million pounds per year) is used by fewer than 40 domestic customers and only in the manufacture of sealed electrical equipment.

All this notwithstanding, Monsanto is obviously aware of the mounting reports carried in the news media that would seem to suggest that the entry of PCBs into the environment has not been effectively curbed.

Monsanto simply cannot accept this hypothesis, given the following basic facts: 1) Production - reduced by over 50 per cent, 2) "Open-system" applications - totally eliminated, 3) Manufacturing controls (unique in the industry) - implemented, and 4) Stringent electrical industry guidelines (for handling and disposal) - established.

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On the contrary, Monsanto sincerely believes that its current program, together with an increased level of awareness and concern on the part of the electrical industry, has had to have drastically reduced the amount of PCBs entering the environment. It is now known that certain of the PCB isomers will persist in the environment for a considerable period of time. Monsanto is convinced, therefore, that the mounting reports of widespread contamination are not, as they would otherwise tend to suggest, "evidence" that the restrictions are not working, but rather, substantiation of our theory that PCBs, which, until the early 1970s, was being introduced into the environment without the current safeguards have remained in the environment and are now being increasingly identified by a growing number of researchers, equipped with improved, highly sophisticated analytical tools and armed with advance knowledge of what to look for.

And indeed, the findings of a task force involving agencies from Minnesota, Wisconsin and the Federal Government, organized in the spring of 1975, tend to support this theory. Their report, issued in November of 1975, said that industrial plants and sewage treatment facilities are not major sources of PCB contamination in the Mississippi River and its tributaries. Rather, the report suggested thet the present source is quantities of PCBs that had been dumped into the river in past years. The report explained that these PCBs

settled to the bottom and became lodged in the sediment -- only to be periodically stirred up by dredging operations.

MONSANTO'S FUTURE PLANS/INTENTIONS

Monsanto has invested millions of dollars to implement and maintain its restrictive measures and controls and, despite the company's strong belief that they are effective, it has invested additional millions in major, on-going, research programs to develop acceptable replacement dielectric fluids that would be, in themselves, more environmentally compatible. Significant progress is being made.

The capacitor industry has been evaluating a non-PCB capacitor dielectric candidate for some time and, subject fo final industry acceptance, Monsanto could begin supplying the new fluid in quantities sufficient to meet the entire U.S. industry's needs by late 1976.

Development work on new, non-PCB, transformer dielectric fluids is also being aggressively pursued. Several promising candidates have been identified and are presently being readied for further evaluation by the transformer industry.

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In the interim, Monsanto, while obviously intending to eventually phase out its production of PCBs entirely, will continue to work with industry and government to ensure that the restrictive measures and controls it voluntarily implemented in the early 1970s remain in force and are diligently enforced.

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