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1. History of Monsanto Production and Sales of Chlorinated Biphenyls

Monsanto entered the chlorinated biphenyls business in 1935, when it purchased the Swann Chemical Company. Production and distribution increased until the early 1970s, when, in response to reports of its presence in the environment, Monsanto restricted sales of chlorinated biphenyls. In 1977, the company ceased production and distribution of chlorinated biphenyls in cooperation with the electrical industry. Chlorinated biphenyls were banned (except for certain applications) in the U.S. in 1979.

Sales and Distribution

The chemical structure of the polychlorinated biphenyls has been known for nearly 100 years. Commercial production of these materials was initiated in 1929 by the Swann Chemical Company in response to the electrical industry's need for improved dielectric insulating fluids which would also provide increased fire resistance when used in transformers and capacitors. (See para. 2, page 2 of the Interdepartmental Task Force on PCBs report, "Polychlorinated Biphenyls and the Environment," May 1972 - Attachment 1J)

As the unique functional characteristics of these materials became more fully understood, additional uses were found. Their fire resistance made them an excellent choice in high pressure hydraulic applications associated with high risk of fire such as die casting and steel production. Their thermal stability and fire resistance were valuable in heat transfer systems.

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Their stability, low water solubility, low vapor pressure and solvency power made them attractive in carbonless paper systems. Their fire resistance, thermal stability and viscosity characteristics made their use desirable in hot melt adhesives and other plasticizer applications.

Chlorinated biphenyls, therefore, evolved as a unique class of chemicals which met important needs for both industry and society.

In some instances, fire and building codes required ~~the use~~ ^{the use} (protection of life and property) ~~offered by~~ ^{offered by} chlorinated biphenyls. 4

It was within this framework that Monsanto and other producers developed a growing worldwide business for these versatile products.

Attachment 2 charts the available Monsanto production and sales data for chlorinated biphenyls through Monsanto's voluntary phaseout program to termination of production and sales in 1977.

Significant points in this chart are:

1. Heat Transfer -- Between 1970 and 1972, a task force of Monsanto engineers worked closely with customers to replace chlorinated biphenyl fluids with materials of equivalent thermal stability but with unavoidable lower fire resistance. Phaseout was completed in 1972.
2. Hydraulic Fluid -- Development of replacement fluids began in 1970, and sales of chlorinated biphenyl-based fluids were discontinued in 1971.
3. Plasticizer Applications -- Sales of most chlorinated biphenyl plasticizers were terminated in 1970, with phaseout completed in 1971.

4. Miscellaneous Industrial Uses (such as vacuum pump fluids) --
Sales ended by 1971.

These voluntary restrictions resulted in a 64 percent reduction in Monsanto sales of chlorinated biphenyls from 1970 to 1972.

However, termination of sales for dielectric uses would have resulted in severe economic and social dislocation. This was recognized by the federal Interdepartmental Task Force on PCBs which concluded in 1972 that "Their continued use for transformers and capacitors in the near future is considered necessary because of the significantly increased risk of fire and explosion and the disruption of electrical service which would result from a ban on PCB use." (See para. 6, page 4, of Attachment 1.1)

- Therefore, Monsanto agreed to continue supplying the products to manufacturers of electrical power distribution equipment who use chlorinated biphenyls only in sealed systems such as capacitors and transformers. In continuing to sell to such customers, however, Monsanto required assurances that the materials would be safely handled and properly disposed of.

In making this decision Monsanto believed 1) that entry of chlorinated biphenyls to the environment could be effectively limited and controlled by users (see Attachment 1.3), 2) proper maintenance and decommissioning practices could limit fluid

escape from transformer operations, and 3) withdrawal from production for these applications would have stopped production of equipment essential to the safe and efficient distribution and use of electrical energy. In addition, a more biodegradable lower chlorinated product (Aroclor 1016) had been developed by Monsanto for use by the capacitor industry (see Attachment 4).

Steps Taken in Labeling and Transport Practices for Ongoing Dielectric Sales 1972-77

Monsanto shipped PCB fluids in both bulk carriers and in drums. Bulk shipments were made in Monsanto-owned railroad tank cars, which were used exclusively for that service, or in customer-owned tank trucks. Drum shipments were made in special reinforced drums. A multilingual warning label was affixed to each package giving a brief description of the nature of the contents and appropriate actions to be taken in the event of a spill or leak. We also supplied a label to be used on return shipments for incineration, which gave similar information.

Industry Guidelines

In June, 1970, the Board of Directors of the Power Equipment Division of the National Electrical Manufacturers Association appointed a committee to review the chlorinated biphenyl situation as it affected electrical usage. As a result, In April, 1971, American National Standards Committee C107 was established to develop guidelines for the safe use, maintenance and disposal

of askarel* and askarel-soaked materials used in electrical equipment. Monsanto participated in this committee. A final draft was completed by November, 1972, and the Standard Guideline was published in 1974 as ANSI C107.1-1974 (Attachment-5).

Monsanto's Withdrawal from the Chlorinated Biphenyl Business

When Monsanto decided in 1970 to restrict sales of chlorinated biphenyls, there were no satisfactory alternate materials for closed-system dielectric uses. This view was later affirmed by the EPA. At least as late as a 1975 press conference, the EPA reiterated it would not ask Monsanto to stop production because that would shut down the electrical power industry and the railroads in short order. The EPA objective was to find a way to proceed without shutting down the country. That was precisely the objective to which Monsanto had been committed since 1970.

The problems encountered in replacing chlorinated biphenyls were rooted in their unique fire resistant and dielectric characteristics and in their role in electrical and industrial applications for 45 years. The challenge facing the electrical industry was to replace chlorinated biphenyls in an orderly manner, without creating other hazards of equal or potentially greater magnitude, and at the same time avoiding serious power and transportation disruptions.

* "Askarel" is a generic name for fire resistant dielectric fluids, including those which contained polychlorinated biphenyls, made to meet specifications set by transformers and capacitor manufacturers.

Monsanto expended considerable effort and money in major research programs aimed at developing environmentally compatible replacement fluids for the electrical industry. The level of this research was greatly reduced in 1976 when the electrical industry developed the technology to adapt other compounds to its needs. It now appears the ongoing demand for liquid-cooled transformers will be satisfied by using silicone compounds. In the capacitor industry, the trend has been toward materials such as phthalate esters.

In adopting these substitutes, the electrical industry has been forced to accept lower fire resistance. New safety devices have been required to ensure that replacement equipment will not lead to increased risk to society from fire hazards.

In our press statement of October 5, 1976, Monsanto said we would complete distribution of all inventories and withdraw from the chlorinated biphenyl dielectric business by October 31, 1977. In making the announcement, Monsanto said the company would have targeted an even earlier shutdown date had transformer and capacitor manufacturers' conversion timetables permitted. All chlorinated biphenyl production was halted by Monsanto in July, 1977, and all customer shipments were completed by September, 1977. At the time we stopped PCB production, Monsanto established policies which precluded licensing of chlorinated biphenyl technology and restricted sales of biphenyl to companies which agreed that their processes would not involve halogenation of biphenyls.

PCBs continue to be manufactured by other firms in Germany, France, Spain, Italy and certain eastern European countries. They continue to be widely used throughout the world.

Reasons for Monsanto Phaseout

Scientific knowledge about the presence of PCBs in the environment, and about its ^{possible} significance, began to evolve during the later 1960s. ^(Attachment 1b) That evolutionary process, which is still incomplete, began with two events -- one in Japan and 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 industrial accident which has come to be known as Yusho incident. The level of PCB contamination in the rice oil was 2000 to 3000 parts per million, extremely high concentrations. Conclusions about that incident have been clouded by the unknown impact of impurities in the Japanese PCB concerned. However, the incident sounded a cautionary signal. (See eg Attachment 2-1 pgs -)

In Sweden, Soren Jensen, using new analytical technology to investigate DDT residues in the environment, reported the possible presence of PCBs in fish tissue. Monsanto and others began immediately to study the Swedish work. Before the findings could be confirmed or duplicated in the U.S., analytical methods had to be refined in order to definitively separate PCBs from other chlorinated hydrocarbons that were known to be present in the environment. New techniques were required to enable researchers to ~~detect~~ ^{now} identify the chemicals in the parts per billion ranges ^{being reported.}

The presence of PCBs in the environment in the U.S. was confirmed by 1970, but little was known about its potential impact. Because PCBs were reported in the environment and tests indicated they could accumulate in the food chain, Monsanto voluntarily decided to terminate sales of chlorinated biphenyls to open applications -- those which could result in losses to the environment. Plasticizer and carbonless paper applications fell into this category.

Because of the contamination of rice oil in Japan, food processors using Monsanto's chlorinated biphenyl heat transfer fluids were advised to change to alternative heating methods and Monsanto reemphasized the need for improved monitoring of finished food products to preclude contamination by any heat transfer fluid. The decision was made in 1971 to terminate all heat transfer fluid sales of chlorinated biphenyls, in substituting other products with equivalent thermal stability.

High operating pressures cause hydraulic systems to leak. Monsanto therefore alerted users to manage wastes to eliminate PCB discharge to the environment. As new hydraulic fluids were developed in 1971, we terminated sales of those containing PCBs.

As described earlier, Monsanto agreed with the electrical industry and government that the benefits to society of continued chlorinated biphenyl dielectric use outweighed the low risk of uncontrolled release from these sealed applications. The key to managing the

risk was sound maintenance practice and disposal control.

With particular reference to the use of PCBs in human food and animal feed processing facilities, the FDA proposed usage regulations in 1972, which were adopted in 1973, and continue in force today (21 CFR § 109.15; 110.40(b); 500.45).

Although a variety of effects of PCBs has been postulated from research of widely varying quality, there is no persuasive evidence of PCBs being a major ^{human} health or ~~environmental~~ hazard. However, it became apparent that the public perceived risks associated with continued PCB dielectric use and preferred to forego its undoubted functional benefits. Therefore, in October of 1976, we advised dielectric customers that it was our intent, consistent with their progress with substitute products, to terminate chlorinated biphenyl production and sale by October, 1977. Each of them forecast how much product would be required to effect an orderly technical transition. In 1977, we made sufficient dielectric chlorinated biphenyl to satisfy the forecast transition demand and made final shipments in September. The small residual inventory was incinerated in our pyrolysis unit, bringing to a close our chlorinated biphenyl business.

(Qs 2 and 3 omitted)

4. Customer Records

Over the years, Monsanto developed the normal commercial records on its sales of chlorinated biphenyls. They were useful for sales and service calls, accounting, production forecasting, and, when decisions were reached to limit chlorinated biphenyls, customer lists served as the basis for our notification visits, telephone calls, letters, and publication mailings in the period 1970-1972, as we phased out all but dielectric chlorinated biphenyl sales.

5. Notification Procedures

Beginning in February, 1970, Monsanto notified its customers of the early reports that PCBs had been detected in the environment. Additional information was transmitted to customers as it became available, along with details of Monsanto's phaseout. The notification letters, included as Attachment 5-1, indicate the priority given to terminating applications that seemed relatively likely to lead to environmental release and were food related, or used the more highly chlorinated products. We cooperated with users of hydraulic fluids and heat transfer fluids to discontinue PCB use.

Simultaneously we introduced Aroclor 1016, a lower chlorinated product for capacitor use, and restricted transformer fluid sales to equipment manufacturers only. In the case of both capacitor and transformer producers, we emphasized the need for control of PCBs. In 1974, Monsanto revised its dielectric literature to conform to the ANSI guideline (Attachment 5-4) which resulted from the industry work with ANSI referred to earlier. In 1976 the ANSI

committee was reconvened to consider the need for revision of the guidelines. Completion of this task has been deferred pending issuance of EPA regulations on PCBs.

Q#6 [During the years Monsanto made chlorinated biphenyls, the quantity of waste produced was relatively low and consisted chiefly of distillation residues, after separation of the useful product mix. Until 1971 these residues were landfilled. From 1971 to 1977 production waste was incinerated.

Monsanto Provided PCB Disposal Assistance to Customers

In 1969 Monsanto started testing the efficiency of PCB destruction by high temperature pyrolysis and constructed a 6 million pound per year unit which was completed in May, 1971. This incinerator was designed, and was demonstrated, to destroy 99.9998 percent of PCB wastes. (Attachment 5.)

By September, 1971, this unit was in continuous operation and was destroying both waste from our production and PCBs returned by customers as they converted to non-PCB replacements. When phaseout from nonelectrical applications was complete, the incinerator was used to destroy waste PCB which collected from ongoing dielectric use.

A system was developed to properly handle customer return of wastes (Attachment 5). When some customers did not follow our suggested procedures, Monsanto reemphasized the need for proper packaging (Attachment 5). To assist in proper handling, posters

were prepared and distributed to further educate those responsible for collection and handling of PCB wastes. 5.8

In the period 1975-1976, large commercial facilities became available which could handle controlled PCB incineration more efficiently and economically than Monsanto's small prototype unit. These units incinerated PCBs until their operations were curtailed by the need for a specific permit under the EPA PCB disposal regulation which became effective on April 18, 1978. The first permit has yet to be issued. The potential risks of accidental PCB contamination have undoubtedly increased because of the delay in EPA implementation of an incineration policy.

Label Warnings

In 1970 Monsanto modified the labeling of PCB packages to emphasize the need to keep it from the environment (Attachment 5.9).

Subsequently, labels on drums were written in seven languages (Attachment 5.10).

Assistance with Identification of PCBs

Because of the changes in composition of PCB dielectrics since their introduction, Monsanto worked with the IEC to document such changes. This led to ASTM standard D2283, which lists the composition of all transformer askarels used at various times since 1932 (Attachment 5.11).

Monsanto researchers worked within ASTM to develop refined technology for determination of PCBs in the environment. This resulted in approval of ASTM D3304 (Attachment __) which has become standard methodology for PCB quantification. ~~Recent~~ ^{Regulations} ~~also~~ require many such tests ~~to~~ be performed. ~~but~~ While many laboratories have the necessary equipment, proficiency in the methodology varies widely. Monsanto's Applied Sciences group regularly consults with laboratories as they gain experience in testing for PCBs. The testing load has been greatly increased by the policy EPA adopted in controlling PCB-contaminated oils at the 50-500 ppm level. This is causing serious delays in reporting of test results.

We recognized that after Monsanto terminated production of chlorinated biphenyls small samples of products which had previous commercial significance would be required for research and standardization of detection equipment. Arrangements were concluded with a laboratory supply house to take custody of a limited drum quantity and to supply such samples.