A CASE STUDY*

POLYCHLORINATED BIPHENYLS

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Nature of Decision

Monsanto Company management decided to terminate the sale of commercial mixtures of polychlorinated biphenyls for all applications except for use in closed systems as a dielectric fluid in capacitors and transformers for which no acceptable fire resistant alternative materials exist. This decision was made voluntarily and is not based on any state or federal legislation.

Chronology

During the period 1968-1969 several laboratories throughout the world were developing analytical methodology for identifying and quantifying polychlorinated biphenyls. This activity followed a report in which Doctors S. Jensen and G. Widmark of the University of Stockholm had claimed that unknown peaks observed in chromatogrphs developed during pesticide analyses were due to the presence of polychlorinated biphenyls. Reports from these laboratories alleged that polychlorinated biphenyls were present in the environment. The material being discovered was reported to resemble commercial material containing highly chlorinated

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isomers. Also, about this same time, some investigators attributed the inability of some species of wild birds to properly reproduce because of poor egg shell formation to the presence of polychlorinated biphenyls, a premise, incidentally, that has not been supported by subsequent studies.

During this same period of time, Monsanto initiated studies to be carried out by an independent laboratory to attempt to determine the effects of polychlorinated biphenyls on test animals. When it became apparent that polychlorinated biphenyls were, in fact, present in the environment and that there might be some substance to the allegations of harm to the environment, the first phase of the sales termination program was initiated, resulting in the discontinuance of sales of polychlorinated biphenyls to "open type" uses. "Open type" uses were defined as those which offered minimum opportunity for control and could result in relatively easy entry into the environment. These applications included coatings, sealants, waxes, plasticizers, pesticide extenders, adhesives and inks.

Alternative fluids were developed and were promptly offered to users to replace the polychlorinated biphenyls in fire resistant industrial hydraulic fluids and in carbonless copy paper coating systems.

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During 1970 incomplete reports from Japan indicated that illness in humans had occurred, possibly because of the presence of polychlorinated biphenyls in cooking oil extracted from rice bran. It now appears that the illness might have resulted from a contaminant in the polychlorinated biphenyls, which were manufactured by a Japanese company. The Japanese reports, when interpreted and verified, raised the possibility, albeit a remote one under U. S. food processing conditions, of direct contamination of human food by heat transfer fluid. Monsanto terminated sales of polychlorinated biphenyls as heat transfer fluids for systems used in processing food for human consumption.

As a result of Monsanto's sales termination program, polychlorinated biphenyls were sold only as fire resistant fluids for use in closed systems. These were (a) dielectric fluids in capacitors and transformers and (b) heat transfer fluids in systems not used in human food processing.

Monsanto's final act in its sales termination program was to cease all sales except for dielectric fluids in capacitors and transformers. In addition, as this program proceeded, steps were taken to replace the higher chlorinated mixtures with the less persistent lower chlorinated mixtures. Aroclor 1248 and Aroclor 1254 were no longer sold

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to the heat transfer applications. Aroclor 1260 was replaced by Aroclor 1254 in transformer fluids. Aroclor 1016 was developed to replace Aroclor 1242 as the preferred capacitor fluid.

Objectives

The objectives of Monsanto Company's management in arriving at the polychlorinated biphenyl marketing policy were and continue to be as follows:

1. Minimize the potential for the entry of polychlorinated biphenyls into the environment.

2. Eliminate the potential for the entry of polychlorinated biphenyls into human food.

3. Retain those applications of polychlorinated biphenyls which involve closed systems offering opportunity for control and in which the fire resistant and dielectric properties of polychlorinated biphenyls are necessary.

4. Avoid major disruptions in commerce and industry resulting in unwarranted adverse consequences to society in general.

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Information

Early reports available to Monsanto Company repeatedly referred to the detection in environmental samples of the presence of the higher chlorinated polychlorinated biphenyl mixtures. The absence of the lower chlorinated mixtures, which were used in greater quantities, led to some early misunderstandings relating to the polychlorinated biphenyl types and their applications which were the possible sources of entry into the environment.

Also, early reports of effects on wildlife were speculative in relating presence of polychlorinated biphenyls to noted harm; e.g., soft egg shells, dead sea birds and baby seals. Subsequent analyses of the data have not supported the early conclusions. The only observable effects to wildlife, fish and birds, have resulted from research studies conducted at exposure levels not found in the environment. The only exception reported was the sensitivity of juvenile shrimp to extremely low concentrations of polychlorinated biphenyls.

From all available information the following impressions were derived:

1. Polychlorinated biphenyls of higher chlorine content were present in the environment.

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2. No known harm to wildlife has been conclusively documented, but the potential for harm at high concentrations of polychlorinated biphenyls did exist.

3. The food chain could possibly be adversely affected by the presence of polychlorinated biphenyls based on the allegations relating to the Japanese incident.

Information on what the unavailability of polychlorinated biphenyls has cost the ultimate user is not available. Conversion costs to alternate materials has in some cases been considerable; e.g., heat exchange applications have required extensive equipment modifications to permit use of flammable alternate fluids as well as the installation of fire detection and control equipment. Some applications, although small in volume, still lack a satisfactory alternative material; e.g., immersion fluid for optical microscopy, ingredient in investment casting wax formulations and component in military systems.

The decision to restrict the sales of polychlorinated biphenyls has resulted in a decrease in the amount of material manufactured by Monsanto Company by approximately

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50 per cent. One Monsanto production unit has been dismantled and about 75 jobs (production, maintenance, administrative, engineering, shipping) have been eliminated. The cost of controlling effluent losses at the remaining production unit, installation of facilities to produce a less persistent mixture for capacitor application and the installation of an incinerator to destroy scrap polychlorinated biphenyls has exceeded $2,000,000.00. The cost of controlling effluent losses at the capacitor and transformer plants using polychlorinated biphenyls is not available.

One of the key considerations in arriving at the decision to continue to supply polychlorinated biphenyls as dielectric fluids in capacitors and transformers was the fact that in these applications the fluids are hermetically sealed in metal containers permitting a high degree of control of escape into the environment. Another major consideration was the important role these capacitors and transformers have in the efficient generation, transmission and distribution of power with reduced risk of fire and explosion and in compliance with specific laws, codes and insurance restrictions mandating fire resistant liquid content.

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Implementation

Implementation of the restricted sales policy did create some localized hardships for the users of polychlorinated biphenyls. The costs involved in developing alternative materials or in sacrificing performance in their applications would be impossible to quantify.

There have been reports of fires in heat transfer systems which were converted to alternative flammable fluids. The number of fires and extent of damage is unknown. The risk of fires still exists and is exemplified dramatically by the potential hazards that are associated with installations such as off-shore gas and oil producing platforms.

During 1974 investigators with the EPA laboratory in Duluth, Minnesota, reported that the concentrations of polychlorinated biphenyls in the Milwaukee River are decreasing. Also in 1974 studies by Woods Hole Institute of Oceanography personnel indicate that the amount of polychlorinated biphenyls in the Atlantic Ocean is decreasing.

Observations, Comments, Recommendations

The lack of reliable data relating to the fate and effect of the many isomers of chlorinated biphenyl in the environment continually frustrated the decision making process.

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Unproven claims of total nondegradability, carcinogenicity, teratogenicity, mutagenicity and extremely high toxicity created emotional unwarranted concerns.

The availability of more information could perhaps have helped define which commercial mixtures and which applications were undesirable. Lacking this data, the termination of sales was made on a broad rather nondiscriminatory basis. For example, it can be seriously challenged whether the use of polychlorinated biphenyls in immersion optical microscopy results in environmental problems. Also, the use of these materials in selected heat transfer systems, properly maintained and operated, could in all probability be justified based on the highly desirable fire resistant property of the fluids.

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