

PCB: AN INDUSTRY PROBLEM

Outline

1. Origin of Current Concern - Ecological Effects
2. Toxicity, Fire and Other Health Hazards
3. General Electric Usage
4. Disposal Practices
5. Questions to be Answered
6. A Proposed Program

J. S. Nelson
Corporate Engineering
October 30, 1967

PCB: AN INDUSTRY PROBLEM?

1. Origin of Current Concern - Ecological Effects

Late in February, 1969, a West Coast newspaper carried a major feature about "a menacing new pollutant" found in the San Francisco Bay area. The article was based on marine life research carried out by Dr. Robert Risebrough of the University of California. The article stated that residues of pesticides (DDT and DDE) and polychlorinated biphenyl (PCB) were threatening the welfare of certain birds and posed long-term threat to humans.¹

The following is Nature's synopsis of Dr. Risebrough's paper:²

Polychlorinated biphenyls are widely dispersed in the global ecosystem, and are powerful inducers of hepatic enzymes which degrade estradiol. Together with other chlorinated biocides, such as DDT, they could account for a large part of the aberration in calcium metabolism which has been observed in many species of birds since the Second World War.

These excerpts are representative of press coverage:³

PCB's are produced under the trade name Aroclor by Monsanto Chemical Company, St. Louis. They were first identified in European birds by Swedish scientists. They apparently are released into the atmosphere and waterways by vaporizing, from factory smokestacks, by discharge into rivers and oceans....

A team of University of California and Cornell University scientists has determined that PCB's are five times more powerful than DDT in hormone-destroying activity. Like DDT, they are found throughout the environment and their quantities are increasing rapidly. ~~They have been found in the milk of nursing mothers in Colorado and in marine life off California, as well as in European birds....~~

What effects PCB's will have on man is not known, although in vapor form these chemicals are highly toxic....the federal government has not set tolerance limits....Monsanto Company spokesmen say only that their scientists and sales executives are studying the problem....

2. Toxicity, Fire and Other Health Hazards

Company literature has long contained cautionary notes on the handling of Pyranol (the G. E. registered trademark for chlorinated diphenyls). For example:⁴

1. From a Statement by the Monsanto Company, St. Louis, Mo., 3-3-69
2. "Polychlorinated Biphenyls in the Global Ecosystem", by Risebrough, Rieche, Peakall, Herman, and Kirven, Nature, Vol. 220, Dec. 14, 1968.
3. Gainesville, Florida, Sun, April 25, 1969
4. Instructions GEI-65080 (11-54 1M): Pyranol Insulating Liquid and Tre
Drying.

Transformer Pyranol can be handled in the same manner as mineral oil. Although continued exposure to liquid Pyranol may produce local skin irritation, cleanliness among workmen constitutes an adequate safeguard against such effects.... As with most volatile materials, exposure to concentrated Pyranol vapors in unventilated rooms should be avoided.

CAUTION—Hydrogen chloride gas is formed when Pyranol is decomposed by an electrical arc....

Early this year, an inquiry was received by Mr. John J. Ferry, Specialist-Environmental Health Engineering, Schenectady from an industrial hygienist at Ford Motor Company, as to the toxicity and fire hazard of transformer askarel. The following is extracted from the Medium Transformer Department's reply to the Ford questionnaire:⁵

Material: Pyranol A50P524

Components: trichlorobiphenyl 80%
trichlorobenzene 14.5%
tetrachlorobenzene 5.5%
diepoxide scavenger 0.125%

Toxicity: ingestion — highly toxic
inhalation — moderate
respiratory tract — moderate

Skin Sensitizer: No.

Estimated threshold limit value: 0.5 to 1 mg/cubic meter.

Is material flammable? No.

What products might be formed in the event of fire or abnormal temperature? In an incinerator burner designed for the disposal of chlorinated solvents, the products of combustion will be HCL and CO₂.

In considering the question of flammability, it should be kept in mind that askarels are chosen for insulation applications partly because they are, "by definition", non-flammable liquids which, when decomposed by electric arc, evolve only non-explosive gaseous mixtures. Recently discovered exceptions have been reported, and Medium Transformer Department has at least temporarily abandoned the use of A50P524, based on Aroclor 1242, in favor of the "classical" Aroclor 1254 (EPIS A13B3B).⁶

Some people have sensitivity to Pyranol such that their skin erupts in a rash upon exposure. When discovered in the factory, they are transferred to

5. Transmitted with letter from F. J. McCann, Medium Transformer Department to R. G. Anderson, Ford Motor Company, 2-5-69.

6. See letters from G. G. Poulsen, Mgr.-Engrg., MDT to Glassanos Haywood, Pozefsky, and Deck, under dates of 5-27-69 and 8-5-69.

other lines of work and their symptoms disappear.

The broad class of materials we are dealing with here, polycyclic aromatics, contains known or suspected carcinogens. This aspect has been considered in the industrial hygiene or medical review of operations in at least one plant.

3. General Electric Usage

EPIS specifications list seven different formulations of Pyranol. The basic material is chlorinated diphenyl purchased from Monsanto under the designation Aroclor 1254, Aroclor 1242, and Aroclor 1260. These are blended with other chlorinated aromatics, inhibitors, and scavengers to produce other askarels with different characteristics, all designated by the GE registered trademark, Pyranol. Product responsibility is assigned to the Medium Transformer Department, Rome, Georgia, presumably because MTD sells Pyranol to customers who fill their transformers or other equipment in their own shops.

The following is a list of departments assumed to be using Pyranol in the dielectric systems of products manufactured in-house:

- Industrial and Power Capacitor Department
- Specialty Transformer Department?
- Wire and Cable Department?
- Commercial Distribution Transformer Department
- Lighting Systems Department?
- Medium Transformer Department
- Power Transformer Department
- Canadian General Electric Company
- Service Shops

Total usage has not been ascertained. The Transformer Departments have in recent years cut their relative use of Pyranol, limiting it to cases where the non-flammability property is very important, such as indoor applications. (They are using ~~aliphatic~~ hydrocarbons, especially one known as "10-C".) As a result of this trend, the Power Transformer Department at Pittsfield uses Pyranol in only about 5% of its units, and Residential Distribution Transformer Department, at Hickory, uses none.

No search has been made for non-dielectric applications of Pyranol. Such may conceivably include use as a hydraulic fluid (e.g. in aircraft or materials-handling systems); heat transfer applications; and as a plasticizer in the production of polymers used as adhesives, elastomers, or surface coatings.

The largest user is the Industrial and Power Capacitor Department, Hudson Falls, N. Y., which uses 10 million pounds per year — probably more than the rest of the Company, combined.

4. Disposal Practices

The Industrial and Power Capacitor Department purchases approximately 10 million pounds per year, of which 9 million pounds are accounted for in terms of products shipped. Waste is handled in the following manner:

Reclaimable material returned to Monsanto	200,000 lb./yr.
---	-----------------

Badly contaminated material hauled away by a New Jersey scavenger (recommended by Monsanto)	800,000
---	---------

Contained in scrapped small industrial units disposed in town dump, where daily burial is thought to be the practice	60,000
--	--------

Total waste and scrap, approx.	1,060,000 lb./yr.
--------------------------------	-------------------

At various times in the past, other disposal methods have been used, including sale to a manufacturer of insecticide; in the recent past, at least one representative of the Monsanto Company was recommending its use, alone or in combination with mineral oils, as a road spray to allay dust.⁷

At Pittsfield, there has been some experimentation with a decomposition chamber which fires at 3000 F., but the bulk of contaminated material is sold; at Rome, waste is buried on the Company site. Although nearby neighbors have shallow wells, no complaints have been registered.⁸

5. Questions to be Answered

It is apparent from the above discussion that our knowledge of chlorinated diphenyl formulations and possible deleterious effects is not as complete as is desirable in today's climate of concern for maintaining and improving the quality of life in its environmental aspects, with regard to worker protection, and in terms of product safety. Nevertheless, it is not responsive to suggest that "other materials be substituted" until all doubts are resolved. It must be remembered that virtually all applications of Pyranol are the end product of intensive research directed toward finding the best material for the application; that substitution would involve trade-offs, not only with performance factors and economic factors, but with product safety considerations themselves — i.e., flammability and explosion possibilities.

While it is desirable to attain a better quantitative expression of the toxic effect of PCB and its various additives, and a better understanding of the flammability of degradation products, the most important question, long range, appears to be, "does industrial use of PCB represent a credible ecological threat?"

7. Letter from T. W. Oneson, Monsanto Sales Representative, to V. R. Mulhall, Canadian General Electric Co., Ltd., Peterborough, 11-12-68.

8. Letter, Dr. J. S. Anderson (RECO) to Mr. V. R. Mulhall, CGE, 12-20-68.

One circumstance which makes it difficult to answer the question of ecological effects is that PCB has not been found alone in any of the reported observations of nature, but always accompanied by larger quantities of DDT or DDE. In the work previously cited, Dr. Risebrough has shown, by direct intra-muscular injection, that PCB has "the capacity to produce sublethal physiological effects in birds" — but this is not the same thing as saying that it does, in fact, do so outside of the laboratory. Scientific examination of this question degenerated, at the Wisconsin hearings on DDT, into a shouting contest between partisans of conservation (who seem willing to ban any chemical, regardless of its otherwise beneficent results, if it is suspected of harm); the makers of insecticides (e.g., Shell Company); and the producer of PCB (Monsanto). The same witnesses have been quoted on both sides of the question. The reader may choose between the following statements, each attributed by the press to Dr. Risebrough:

- (a) (PCB is) apparently playing a role in the decline of the peregrine falcon and it may have abetted the disappearance from the Gulf Coast of the brown pelican. (San Francisco Examiner, Feb. 25, 1969).
- (b) Tests with eggs...showed mathematically by correlation with eggshell thickness that DDE and not PCB's were to blame. (Milwaukee Sentinel, May 13, 1969). Ironically, the second statement was made when Dr. Risebrough was called to the stand by the attorney defending the insecticide interests.

Should it be established that PCB is to blame for ecological damage, it remains to trace the transport mechanism and determine at least plausible sources and sets of conditions for propagation into the environment. Estimating from GE capacitor usage, total industry usage might be 20 to 40 million pounds, most of which ends up in closed systems from which dispersion is at a very low rate. This contrasts with much larger usage of DDT — 180 million pounds in 1963, 103 million pounds in 1967 — most of which is broadcast on the land, in the atmosphere.

Monsanto has a research program to identify the compounds reported to be PCB by the Swedish and California scientists. This involves precise analysis of environmental samples of water, air, soil and wildlife, including metabolic studies. Also under way are studies to determine the biological effects of deliberate dosage of PCB's on fish, birds, and mammalian animals. Special emphasis is being paid to endocrinological effects, mineral metabolism and reproduction physiology.

As we become more pollution conscious, we wish to know what volume of unused Askarel is being buried, sequestered or incinerated on the North American continent, particularly, and what hazards does it present. What degree of responsibility should Monsanto shoulder in this affair? Will it be necessary to diligently collect unusable Askarel, including Askarel-saturated fuller's earth, and develop techniques to destroy it? Should we return it to our factories for chemical decomposition? We must answer these questions soon. 7

The above quotations indicate Monsanto's concern with the ecological effects and state some of the questions to be answered. Monsanto is the only U. S. supplier, but additional information may be sought from European and Japanese suppliers. Prodelec, in France, is the principal continental source of PCB, and maintains a large toxicological laboratory. About three months ago, Mr. K. E. Scoville, Product Safety Representative of the Industrial and Power Capacitor Department, wrote to Mr. Pierre Jay, Manager-Dielectric Fluids Development for Prodelec, calling attention to the Risebrough research and asking for comments and further information. No reply has been received as yet.

6. A Proposed Program

The Company's stance on the PCB situation must take into consideration not only the need for technical assessment of hazards, but the need to guard against well-motivated but possibly needless or precipitate legislative action, e.g., to tack a PCB rider onto an anti-DDT bill.

As a first step, it is suggested that an outside consultant, with more freedom to operate than our own people, be engaged to sort through the conflicting evidence, touch base with the people doing the research at Monsanto, and give us his views as to whether the Company needs to do anything further at this time. This consultant would combine, ideally, the disciplines of analytical chemistry, ecology and toxicology. He would be asked to spend not more than two weeks on this initial survey, and report informally to interested departments and Corporate functional components.

Depending upon his findings, a possible second step would be to engage the electrical industry in cooperative investigation of the problem, through an appropriate industry technical body (e.g., the dielectric committee of NEMA).

The above recommendation is the outcome of discussions between Drs. Anderson and Murphy of REOD (environmental pollution); Mr. E. N. Deck (Safety and Plant Protection); and Messrs. Marquis and Nelson (Product Safety). It has been reviewed at length with Dr. Pozefsky, Dr. George, Mr. Scoville and others at Hudson Falls, and briefly with Mr. Alimansky and Dr. Osthoff at Pittsfield, all of whom have expressed general agreement.

Mr. Deck has suggested that we consider Dr. Horace W. Gerard, a toxicologist at Fairleigh Dickinson University for the assignment as our liaison scientist. Dr. Gerard is a hydrocarbon expert who does much work for the Mobil Company and has carried out assignments for GE in the past.

J. S. Nelson
October 30, 1969