

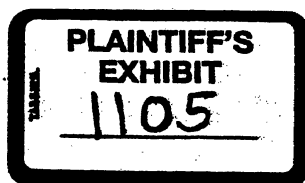
Trip Report: National Conference on Polychlorinated Biphenyls

Since the environmental problems of polychlorinated biphenyls (PCB) were first raised in the late 1960's, a good deal of data has been accumulated but few conclusions reached in regard to the true magnitude of the PCB problems. The complexity of this problem is illustrated by the major questions which are still unresolved after years of research by many highly qualified scientists. The magnitude and symptoms of PCB intoxication are still uncertain. The mode of entry and transport of PCB's in the environment has not been resolved. The value (especially short-term) of point source controls is not clear. The real importance of PCB's in the safety of the present applications is hard to define. This results in the dilemma of PCB control - how does one choose between an uncertain environmental health hazard and an uncertain safety hazard?

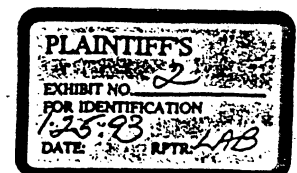
The EPA and other agencies, unable to resolve these questions, sponsored the National Conference on Polychlorinated biphenyls apparently hoping to freely exchange the latest information on PCB's and encourage a greater public awareness of this complex problem.

The conference was held in the Pick-Congress Hotel, Chicago, Ill. on Nov. 19-21, 1975. It was attended by 400-700 people from the U.S. and several other countries. The conference was divided into eight topical sessions. These covered Health effects and Human exposure; Use, sources and identification; environmental fate and occurrence; ecological effects and exposure; economics and substitutes; approaches to control; a summary session and a general session. The General Session was an open meeting at which anyone who wished could speak. The speakers at this session were mainly representatives of various interested citizens groups, unions, and affected industries (fisheries and paper makers). There were some speeches by scientists whose papers had not been included in the other sessions. Most of these speakers urged a solution to the problems as they saw them, but were not looking necessarily for assignment of guilt or punishment of offenders. Most seemed aware of the hard choices involved. Some of the fisheries spokesmen took the approach that while PCB's may be vital to the electrical industry they were detrimental to the fishing industry.

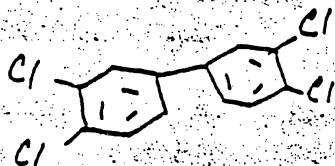
The most intriguing data presented in the session on Health Effects and Human Exposure dealt with the activity of polychlorinated dibenzofurans (PCDF). Dr. Kuratsune presented data which clearly showed unusually high levels of PCDF in the tissues of Yusho victims. Yusho refers to the poisoning by PCB contaminated rice oil which occurred in Japan in 1968. 2,3,7,8-Tetrachlorodibenzofuran has been found in the blood of Yusho victims. Penta and hexachlorodibenzofuran have also been found. In a later paper, Dr. John P. Moore discussed preliminary results of the toxicity of 2,3,7,8-tetrachlorodibenzofuran. PCDF appears to be several orders of magnitude more toxic than PCB's. More significantly, the symptoms of PCDF intoxication mimic the symptoms of Yusho. Since PCDF's were found in tissue from Yusho victims the evidence strongly suggests that PCDF's not PCB's were the causative agents in Yusho.



905183



There is some evidence that PCDF's can be found in fresh, commercial PCB's. Non-domestic PCB's such as Kanechlor appear to have higher levels of PCDF's than do the domestic PCB's - Aroclor. Kuratsune reported 17ppm PCDF in fresh Kanechlor. It is suspected that the aged Kanechlor involved in Yusho may have contained as much as 1000 ppm PCDF's, suggesting that PCB isomers may react under some service condition to produce PCDF's.



tetrachlorobiphenyl
(PCB)



tetrachlorodibenzofuran
(PCDF)

Dr. James R. Allen described his work on Reproductive Dysfunction in monkeys which had been fed low levels of PCB's. The most interesting aspect of this was the close similarity of the pathology observed in these monkeys to the symptoms of Yusho and PCDF intoxication. Allen claimed, during the question period, that he did not yet have the results of the analysis for PCDF's in his PCB samples. Again, however, there is the suspicion that PCDF's may be the causative agents.

It is tempting to point to PCDF's as the real culprit and claim that PCB's are not at fault. While this hypothesis is an excellent basis for further research into PCB toxicity, it could be very dangerous as a public position. There is no evidence that PCDF's are not products of PCB degradation in use, in the environment or in animal metabolism. One can claim that all PCB's which have been used in toxicological studies were contaminated to some extent with PCDF's and these PCDF's were the cause of the pathology observed. On the other hand, it is possible that at least some PCB isomers can be metabolized to PCDF's. Dr. Marco Blocca's paper on Biological responses in chicken and mice showed that 3,4,5,3',4',5'-hexachlorobiphenyl mimics the toxicity of PCDF. This isomer was one of the most toxic PCB isomers in Blocca's study. This toxicity may be intrinsic or it may be due to metabolic conversion. 3,4,5,3',4',5'-Hexachlorobiphenyl has all four ortho positions (2,2',6,6') unsubstituted by Cl. It is just these positions which must be oxidized to form the dibenzofuran. All the other PCB isomers in Blocca's study had at least 2 of these positions substituted by chlorine. Dr. James D. McKinney concludes "The rates of metabolism are considered of lesser importance than the potentially highly toxic nature of some of the intermediary and terminal metabolites such as chlorinated dibenzofurans."

Dr. Robert W. Risebrough reported that Aroclors (except MCS1016) contained 0.8 to 2.0 ppm PCDF. However, he did not find PCDF's in ducks fed the contaminated PCB's. He suggested that the PCDF's were preferentially eliminated. If so, why are PCDF's still found in Yusho victims? There may

be species specific physiology which explain this dichotomy but there is at the present time no answer supported by evidence.

It is clear that oxidation of PCB's can lead to the formation of PCDF's and that PCDF's are highly toxic. Before explaining the toxicity of PCB's on the basis of PCDF contamination, however, several questions must be answered.

1. Are PCDF's an inevitable and inseparable by-product of PCB synthesis?
2. Are PCDF's produced in transformers under normal operation? - when the transformer fails?
3. Can PCDF's be formed by UV initiated oxidation of PCB's exposed to air at room temperature?
4. Are PCDF's formed by metabolic oxidation of PCB's?

Dr. Renate Kimbrough discussed the pathological findings associated with chronic experimental exposure of PCB in rats. She found that the hepatic micropathology was extensive after 300 days feeding with 50mg/kg/day of Aroclor 1254. Dr. J.C. Calandra also reported the results of chronic feeding studies of PCB's in rats. He reported that the primary pathology was the observation of neoplastic lesions in the liver. (Note: neoplastic means new and abnormal tissue, it does not mean cancer). Calandra reported that no hepatocellular carcinogenicity was observed. All lesions except one were observed in females.

In the session on uses, sources and identification Dr. Robert L. Durfee presented data on production and use of PCB's in the USA. Domestic production is 40×10^6 lb/yr, of which 7×10^6 lb/yr are exported. The remaining 33×10^6 lb/yr are sold to transformer manufacturers, 12×10^6 lb/yr; and capacitor manufacturers 21×10^6 lb/yr. The USA imports 0.5×10^6 lb/yr of decachlorobiphenyl which is used in investment casting wax.

Mr. Thomas E. Kopp reported that the EPA criteria for water quality which is now circulating for comments, set a goal of 0.001 $\mu\text{g/l}$ (1 ppt) of PCB's in fresh water and marine aquatic environment. He also reported that there have been 23 PCB spills from transformers since 1972. Four of these from railroad transformer leaks.

Dr. Stephen Safe gave an overview of PCB analysis. He pointed to PCB metabolic products notably hydroxylated and methoxylated PCB's as new pollutants.

Mr. Stanton Kleinert discussed sources of PCB's in Wisconsin. His conclusion that fallout from air may be the primary source of PCB's in Wisconsin waterways raised two questions. First, how do the PCB's get into the air? Second, what is the value of point source control?

Dr. Charles Jelinik reported the levels of PCB's in the U.S. food supply. Since 1972 the levels in food have been decreasing except for fish where the levels have remained unchanged. Today freshwater fish are the only significant dietary source of PCB's. The average dietary exposure is 10ug/day. The problem however is more serious for people whose diet contains significantly more than the average content of fish. This also represents a serious threat to the commercial fishing industry.

Fish and birds appear more sensitive to PCB intoxication than most mammals and some species of fish eating mammals (mink) are also highly sensitive. Biomagnification indices in fish range from 10^4 to 10^5 .

PCB's do indeed appear to be ubiquitous. There is a suspicion that some deep water sediments are reservoirs of PCB's and will continue to leak to the surrounding areas for years to come. Dredging is not always advisable since often this succeeds only in dispersing the PCB's into the water.

The session on economics and substitutes contained no new information. Dr. Dean Branson, Dow Chemical, described their 4-year program with McGraw-Edison to develop butylated-monochlorodiphenyl oxide (XF 4169L) for capacitors. He compared only flash points to reach the conclusion that this liquid has a low risk of explosion and fire and implies that the liquid temperature must exceed the flash point to have a fire hazard. There is some concern about biodegradation of this material.

Mr. Richard Montgomery, Dow-Corning, described their 5-year program to develop silicone fluids for transformer use. Basically the presentation was the same one given by Mr. Montgomery at Pittsfield and Rome. Some points should be mentioned. He announced that Dow Corning has the capacity to handle the global transformer market. In the future Dow Corning will specify silicone filled transformers for their own use. He urged an evolutionary introduction of silicones over the next 3-5 years in order to gain experience in the risk of fire and explosion. He claimed that PCB filled transformers in service could be changed to silicone without problems. However, he cautioned against this on an allout basis due to the environmental hazards of shipping and handling the PCB's.

Mr. David Wood of Monsanto described MCS-1238 and MCS-1588 liquids for capacitor use. He mentioned the transformer candidates but gave no details. He did state the need for standards of flammability in this area. While Mr. Montgomery's appeal was directed to the consumer, Mr. Wood's appeal was to the manufacturers.

Mr. Bruno Rey-Coquais, Prodelec, claimed that a non-flammable dielectric liquid was absolutely necessary. He proposed the use of alkylated dichlorobiphenyl (an alkyl PCB).

Dr. E.J. Inchalik, Exxon, described di-isononyl phthalate for use in capacitors.

In the session on approaches to control three messages came through quite clearly. One, there will be some control of PCB's, if not by the pure waters act, then by the toxic substances control act (S.776) which is likely to be passed. The EPA still has no clear direction and is still trying to reach a decision. The EPA would like to see the problem disappear. That is, they would be delighted if the states took action or if the public utilities took the initiative and brought pressure on the manufacturers. To this end EPA speakers repeatedly encouraged the concerned parties to put pressure on their state legislators and on their public utilities to end the use of PCB's.

The Hon. Nathaniel Reed, Ass't. Sec. DOI, was probably the most eloquent and outspoken opponent of PCB usage. A couple of quotes will illustrate. "We must step back from industrial efficiency in order to step forward to environmental improvement." "We should cease to quibble over scientific niceties and respond to the wildlife needs before it is too late."

The overall tenor of the conference was good. I had expected a good deal of criticism directed at industry. This did not happen in general. Most of the critical commentary was directed at the EPA for doing nothing. As one speaker put it "the EPA should be congratulated for holding a conference at which they could not win." Overall however the conference could be characterized as a rational attempt to share the latest data and insight on the effects of PCB's. Unfortunately when all is said and done, more is said than done.

W.A. Fessler