Monsanto

FROM (NAME & LOCATION): H. S. Bergen - B2SL

DATE: March 8, 1974

SUBJECT: POLYCHLORINATED BIPHENYL EFFLUENT STANDARDS

REFERENCE:

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Since our Industry-Monsanto meeting on the PCB effluent standards, I have been trying to reconcile why the standards should be so tight in view of all that has gone on in the past, plus the facts that to my knowledge there have been

a) no reported deaths of fish, birds, etc. from their natural habitats due to PCB's (except lab controlled or contaminated commercial feeding), and

b) no factual data on fall off of species population due solely to PCB's (water, storms, starvation and other chemical contaminants have been sighted and PCB has been associated).

Also, I have gone through my files with a view of

1) developing theories as to why more disastrous events have not occurred

2) sight evidence in support of some of the theories and evidence which might be useful in our testimony and comments to the hearing clerk of the EPA.

Possible Theories Why More Has Not Happened and Why The Standards Might Be Too Tight

1. Not a high enough concentration of PCB's are available to the species to cause death or loss of significant reproduction.

2. The biocumulation and hence the toxic effects are not as bad as contemplated or indicated by lab pristine conditions tested.

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3. PCB's are degraded by some mechanism to less toxic items.

4. PCB's are mechanically and physically tied up in soil, sediment and other particulate matter.

5. The species adjust to their environment and to some extent select their environment.

6. PCB's are inert and not readily soluble in water.

7. PCB's are heavier than water and settle to the bottom.

8. PCB's are not that toxic compared to other things.

9. Survival of species are to a considerable extent dependent upon survival of the fittest.

Evidence to Support the Possible Theories and Evidence Useful in Our Testimony

A. PCB's Are Tied Up In Soil/Sediment Particulate Matter

The "Environment Reporter", dated August 24, 1973, pages 700-703 , speaks to the National Academy of Sciences' draft of "Water Quality Criteria - 1972" and quotes certain paragraphs of the NAS document as follows:

> "NAS said it is not practical to make recommendations for the relatively persistent organic pollutant based on water concentration, especially when partition coefficients are unknown." "NAS said knowledge of local environmental conditions is essential prior to application of any water quality recommendations for marine aquatic life and wildlife." NAS said application of recommendations to a local situation is unique because it requires an understanding of the circulation of water and the resultant mixing and dilution of pollutants, a knowledge of biological species and determination of the most sensitive species, and an evaluation of the transport of materials through the food web."

"Journal Research U.S. Geol. Survey", Vol. 1, No. 5, Sept.-Oct. 1973, pages 603-607, "A Study of the Distribution of PCB in the Aquatic Environment".

> Under discussion and evaluation the author stated "because of the low solubilities of PCB's in water, especially the higher chlorinated ones, the bulk of PCB residues in streams are associated with suspended-sediment and bottom material, therefore, PCB may be expected to vary directly with the suspended-sediment concentration in the cross section of the stream."

"Environmental Science and Technology", Vol. 8, No. 2, February 1974, pages 139-141, "Aqueous Solubility, Adsorption, and Vapor Behavior of Polychlorinated Biphenyl Aroclor 1254".

> In general, once PCB is introduced in the environment, the isomers will be transported in air, soil, water and biota. The concentration in each phase will highly depend upon the partition-coefficient---." "The concentration of PCB in water will be reduced whenever the water comes in contact with a solid surface or particular matter. The reduction in the concentration of PCB in water will depend upon the surface characteristics---." "A sand surface with few sites adsorbs relatively little, whereas a soil surface with high clay and organic content adsorbs a much larger amount."

"Science", Vol. 180, May 11, 1973, pages 643-644, "Polychlorobiphenyls in North Atlantic Ocean Water".

> "Concentrations of PCB's have been measured at the surface and various depths in the water of the North Atlantic Ocean between 26°N and 63°N. The concentrations average about 20 parts per trillion and amount to an estimated 2×10^4 metric tons of PCB's in the upper 200 meters of water. The average concentrations of PCB's in the surface water of the Sargasso Sea are lower than those in the northern North Atlantic---." "No relationship between PCB concentration and proximity to land was observed".

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"Pesticide Chemical News", New Mexico State University, Vol. 72-1, January 6, 1972, "The Truth About the California Brown Pelicans".

> Evidence is sighted that the embarrassing occurrence of 30,000 to 40,000 unexplainable "endangered brown pelicans" now threatens to expose the entire anti-DDT scheme as an incredibly indefensible plot."
> "When will the public and press become aware of the untruthful nature of the environmentalists' propaganda?"

"Environmental Science & Technology", Vol. 4, Number 10, October 1970, "PCB's - Prevalent and Persistent".

> "What is the fate of PCB's in natural waters? More needs to be known of their partition coefficients between bottom sediments and water. This is vital if we are to estimate how long it will take for a river bed to clean itself of contamination. It will also be useful when assessing the effects of PCB's on marine life that feed on the bottoms of lakes, rivers, and estuaries. We should also learn more about PCB solubility in water of various ionic strengths."

EVIDENCE, Cont.

B. Break-down of PCBs

PCBs break-down in the environment through biodegradation, photolysis, by chemical means, and in a species via metabolism. In addition, chemical methods have been announced for break down of PCBs.

Chemical & Engineering News, April 17, 1972 - Pg. 19

"There are about 20 types of common bacteria capable of degrading DDT in anaerobic sediments. In his tests at least 25% of the DDT was degraded within two weeks and more than half was degraded within two months." ------"He notes that the large decrease which was contrary to theoretical models coincides with recent restrictions on the use of DDT."

Information Bulletin, British Industrial Biological Research Association, Volume II, No. 1 - September 1972

"IF ALL THE SEA WERE PCB..."

"A most important result of this work, however, was the finding of PCBs with a relatively low degree of chlorination are fairly repaidly metabolized and are not as persistent as the more highly chlorinated compounds."

Science News, Volume 101, May 20, 1972 - Pg. 330

"Safe PCB's possible?"

"Reporting at the American Society for Microbiology annual meeting in Philadelphia, Ahmed stated that he and D.D. Focht determined that pure cultures of bacteria isolated from sewage are capable of breaking down unsubstituted biphenyl and monochlorobiphenyl molecules by attacking at a particular site of the molecule."

Bulletin of Environmental Contamination & Toxicology, Volume 10, No. 6; Pg. 372-377. (1973)

"Photodecomposition of Chlorinated Biphenyls and Dibenzofurans"

"The photodecomposition of the lower chlorinated PCB isomers in both polar and nonpolar solvents reveals the operation of environmental mechanisms which could effectively degrade these widespread contaminants." ----"Indeed, the notable absence of the lower chlorinated biphenyls from most environmental samples (PANEL 1972) is suggestive of an important role of photodecomposition in the environmental fate of PCB's, the interpretation of their source and movement, and prediction of toxic effects on aquatic life."

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Bulletin of Environmental Contamination & Toxicology, Volume 9, No. 4. - Pg. 204-211. (1973)

"Varying Persistence of Polychlorinated Biphenyls in Six California Soils under Laboratory Conditions"

"The greatest change in Aroclor 1254 composition in the soil was with Laveen loamy sand. After one year the characteristic Aroclor 1254 elution pattern was no longer readily recognizable. Although about 75% of peak 7 remained, almost all of the material comprising the first three peaks was gone, and losses of material from the next three peaks were evident." ----"Thus, the material remaining in our Laveen loamy sand after one year consisted of mainly penta- and hexachlorobiphenyl isomers."

Bulletin of Environmental Contamination & Toxicology, Volume 10, No. 2 - 1973 - Pg. 70-72.

"We had reported previously that certain mono and dichlorinated biphenyls were degraded readily by a species of Achromobacter PCB isolated from sewage effluent." (Reference, Ahmed, M.; Focht, D.D., Can. J. Microbiol (In Press). In the study of biodegradation of other isomers of PCBs with 2 to 5 chlorine atoms, the authors report "inasmuch as the bacterium was unable to dehalogenate any of the chlorinated biphenyls, as noted by the absence of chloride in all supernatants, it appears likely that increasing chlorine substitution renders the biphenyl molecule more resistant to microbial attack as the manometric results further indicate."

(7) Journal of Chromatography, 75 (1973) Pg. 219-226

"Elimination Pattern of Aroclor 1254 Components in the Bobwhite"

"Significant alteration of certain polychlorinated biphenyl isomers appeared to take place. Dechlorination was clearly apparent, and isomeric transformation is suggested."

U.S. Patent 3,779,866 0035031

"Microbial Degradation of Polychlorinated Biphenyls"

"Claim 1"

"A process for the microbial degradation of polychlorinated biphenyls which comprises treating said polychlorinated biphenyls with at least one microorganism selected from the group consisting of nonpathogenic, cell-mass producing, hydrocarbon-utilizing strains of Cladosporium cladosporiodes, Candida lipolytica, Nocardia globerula. Nocardia rubra and Saccharomyccs cerevisiae for sufficient time until the polychlorinate biphenyls have been substantially degraded.

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Monsanto interoffice memo - ES Tucker to WI Duffey - 9/11/73

"We do have a limited amount of tissue data that does dramatically demonstrate that Aroclor 1016 is not as bioaccumulative as Aroclor 1242."

We also have considerable biodegradation and soil entrapment data which should be published and made part of our testimony.

The Japan Economic Journal, 9/5/72

"Irradiation Process is Invented to Make PCB into Harmless Elements"

A method was announced by the Isotope Center, Bureau of Economic Affairs of the Tokyo Metropolitan Government for breaking down polychlorinated biphenyl into harmless elements by irradiation. The irradiation was with gamma rays of cobalt 60.

Japan Chemical Week - November 9, 1972

"PCB May Get Harmless"

"The scientist, Assoc. Professor M. Eto of Kyushu University's Agricultural Faculty, says he has successfully removed chlorine 100 per cent from PCB after applying high-intensity mercury-lamp light for 10 hours to PCB."-----"Eto also said another experiment to dechlorinate PCB by exposing it to sunlight had been conducted by his students. The experiment, the first of the kind in Japan, has been 12.9 to 16 per cent successful depending on different solvents used."

C. Are PCBs found in the Environment from DDT, DDE, & 4,4'-dichlorobenzophenone? Also, do some PCBs contain tetrachlorodibenzofurans which are more toxic?

Presentation at the 165th National Meeting, American Chemical Society; Dallas, Texas - April 10,1973

"Vapor phase photodecomposition of p,p' DDT"

"When DDT vapor is exposed to sunlight it will be rapidly converted to DDE which will accumulate because its rate of photodecomposition is much lower. -----"The major photoproducts of DDE, 4,4'-dichlorobenzophenone and DDMU, are formed in high enough yields that they could be detected in air samples containing DDE. Since dichlorobiphenyl is formed from dichlorobenzophenone and is resistant to further breakdown, it would be expected to accumulate, but the probability of detecting it in air samples containing DDE is remote. However, its gradual formation in air combined with its detection in such places as oil slicks or suspended organic matter. The trichlorobiphenyl and tetrachlorobiphenyl were formed in much lower yield than the dichlorobiphenyl, but again their resistance to further degradation may result in their accumulation and detection in organic matter.-----
"On the other hand, if the DDE remains airborne long enough, substantial amounts of it could be converted to the di- tri- and tetrachlorobiphenyls, which being resistant to further degradation, would mean that one environmental contaminant has been replaced by another."

Science, Volume 180 - Pg. 578 (1973)

"DDT vapor can be converted to PCBs by irradiation with ultraviolet light of the same wavelengths present in sunlight in the lower atmosphere." (This is a report of the work of Crosby of the University of California at Davis before the 165th National meeting of the American Chemical Society.)

Chemical & Engineering News, April 17, 1972; Pg. 27

"At the time he tested European products, Dr. Vos did not find the substance in the Monsanto product (Aroclor 1260) he tested. In fact, even to date tetrachlorodibenzofurans have not been identified conclusively in Monsanto's PCB's."
----"A contaminant has already been identified as tetrachloroparadibenzofuran in two European PCB's - a French product and a West German product - by Dr. Vos and coworkers at the Institute of Veterinary Pathology, Utrecht, the Netherlands."

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D. Background Levels of PCB's

One of the most difficult points of monitoring the EPA standards will be the background levels of PCB's which exist. Following are some references which substantiate this:

Report by Drs. Nisbet and Sarofim of the OST panel studying PCB's -- approximately January 10, 1972.

"Rates and Routes of Transport of PCBs in the Environment"

"According to the estimates made in this paper, the PCBs released into the North American environment in the past are now concentrated in three major compartments in the environment:

(a) Buried in landfill dumps (roughly 3×10^5 tons, without allowing for degradation);

(b) Attached to sediments in rivers and the Great Lakes (roughly 2×10^4 tons);

(c) Attached to sediments on the continental shelf (roughly ___ 10^4 tons).

A further substantial quantity (of the order of 2×10^4 tons) has been widely distributed over the land and sea by aerial fallout and by disposal from ships. All the numerical estimates are expected to be valid."

The following aspects of environmental transport of PCBs should have high priority for future research:

"Properties and Rates: Data are needed on the solubilities and vapor pressures of individual isomers; on the partition coefficients between water and sediments, water and fats; on the rate of photochemical decomposition and aerobic and anaerobic biodegradation; diffusion coefficients in sediment."

Quarterly Research Report - March 31, 1973

National Water Quality Laboratory
Duluth, Minnesota

U.S. Environmental Protection Agency
National Water Quality Laboratory

Grant R800675 - Chlorination and Ozonation Products of Municipal Sewage

"Biphenyl, phenols, 2-4-D, and terpenes were all chlorinated to some extent when subjected to the conditions of aqueous disinfection using chlorination. The toxicity of all the mixtures increased with chlorine incorporation, in some cases as much as twenty-fold."----"These data show that super-chlorination of acidic wastes which contain aromatic compounds will produce significant concentrations of toxic poly-chlorinated compounds.

Archives of Environmental Contamination and Toxicology Volume 1, No. 1, 1973

"Polychlorinated Biphenyls in Solid Waste and Solid - Waste - Related Materials

Municipal refuse along with various solid-waste processing samples indicated that PCBs were present in several of the sample analyses. "These results are consistent with findings, by other investigators, that there is PCB contamination in many parts of the environment and they indicate that the disposal of solid waste contributes to this contamination."

E. Toxicity

Others in Monsanto have reported on this toxicity section as well as the biogradation effects and literature references on this subject are in need here.

F. Economic Impact and U.S. Government Trade Balance

In Monsanto's letter of January 18,1974 to the Hearing Clerk, we objected to the lack of a published statement containing a full and complete assessment of the economic impact of the effluent standards.

The EPA did write an impact statement and all that is stated on PCBs is as follows:

> "The discharge of PCB's from the one PCB manufacturing location in the United States has been stopped. Discharges from electrical equipment manufacturers are suspected to be small and readily controllable. Utilities are considered to experience only non-point source discharges. In summary, the economic impact is expected to be minor."

Obviously, the EPA has not listened to any of the written statements by our customers (specifically G.E.).

Business Week, January 23, 1971 - Pg. 72

"Trade Collides with Ecology"

"If major trading nations get too far out of step in regulations that affect the design of products and equipment, the result could be to fragment world markets." ----"Environmental controls affect international investment patterns, by making it costlier to build and operate plants in one country than in another."-----"American companies fear that other governments will pick up more of the cost of cleaning up industrial pollution, thus putting U.S. concerns at a competitive disadvantage."----"One answer to such problems is for industrial nations to coordinate their policies on protecting the environment in order to avoid distortions of world markets", said Henry Fowler, former U.S. Treasury Secretary and now a partner in the New York investment firm of Goldman, Sachs & Co.----- "The OECD recently set up a committee on environment in Paris."

Meanwhile, the United Nation's Economic Commission for Europe has scheduled a conference to lay the groundwork for coordinating environmental policies of member governments.

Environmental Health Perspectives - October 1972 - Pg. 81-102

"Use and Replaceability of Polychlorinated Biphenyls"

This is a comprehensive survey of the many uses of biphenyls and it also publicizes the Monsanto production figures which were announced in late 1971. This paper may be useful as a reference paper as an ex-Monsanto source.

The Monsanto News Release (1971) on PCB Production Figures

We should add up Monsanto production for the last 20 years and estimated world production for the last 20 years and then show the business that we went out of and the rest that remains in sealed capacitors and transformers. The staggering amount of material which has come out in the past in open systems is a mind boggling fact and raises the question - 'Why hasn't there been more impact of PCBs on the environment and various species than there has been?'

Decision of OECD Council - Paris - February 20, 1973

"Council Decision of the Council on Protection of the Environment by Control of Polychlorinated Biphenyls"

The OECD has agreed on policies and procedures for continuing PCBs which are acceptable and approved adequate for the rest of the world. Monsanto is active in participating in this, both in the UK and in the USA. The question is what affect would very tight EPA standards have on the U.S. economic and trade position versus the ROW which are operating under the OECD guidelines?

Arthur D. Little Report - American Paper Institute - July 1972 C-74730

"The Potential Economic Impact on the Combination Board Industry of Compliance with Proposed PCB Tolerance"

This report drew specific conclusions on (1) Analytical Considerations and (2) Cost Considerations.

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They also came to an overall conclusion that compliance with the proposed regulation would result in a total additional cost of $12.60 per ton and a net residual cost of $8.61 per ton. They further believe that this added cost would cause mills to close within the next two years and result in a loss of 800-1600 jobs.

A law suit resulted and the government recently came to a settlement with the American Paper Institute and the Box Board Association on which they should control and monitor the background level of PCB in recycled paper. Thus, we seem to have arrived at a government and legal interpretation on background levels for PCBs and it also clearly establishes the fact that there can be a severe economic impact due to PCB regulations in spite of their later statement on the economic impact of the EPA standards.

Conclusions:

In my opinion, there is enough evidence sited that there are many things going on in the ecological system which we do not know and which preclude the setting of as tight a standard as the EPA is now promoting.

We at Monsanto believe that PCBs should be contained in closed systems and we endorse the clean up program --- but, there certainly is a real and economic limit to which we can go and, in my opinion, we have already stated what these limits are.

H. S. Bergen

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