Visit of

MR. MAURICE EASTIN

ENVIRONMENTAL
PROTECTION AGENCY

January 8-9, 1976

DSW 238357

JANUARY 8, 1976

DINNER MEETING

PRESENT FOR MONSANTO:

DSW 238358

JANUARY 9, 1976

INFORMATION PRESENTED:

1. Monsanto's program of sales restrictions on PCBs.

2. Environmental aspects of PCBs.

3. Monsanto's PCB replacement program.

4. Timetable for environmental acceptability data on Monsanto PCB replacements.

5. Monsanto's effluent control program.

LABORATORY TOUR:

- Biodegradation
- Analytical Methods for PCBs
- Measurement of dielectric properties of fluids
- Pilot plant for capacitor PCB replacement

W. G. KRUMMRICH PLANT TOUR:

- PCB production facilities
- PCB incineration

DSW 238359

JANUARY 9, 1976

MONSANTO INDUSTRIAL CHEMICALS COMPANY

8:30 - 10:30 A.M.

Earle H. Harbison - General Manager,
Specialty Chemicals Division

Robert G. Potter - Director, Functional Products Group,
Specialty Chemicals Division

William B. Papageorge - Manager, Product Acceptability
Process Chemicals Division

J. Coleman Weber - Manager, Product Acceptability
Specialty Chemicals Division

Dr. George J. Levinskas - Manager, Environmental Assessment
and Toxicology
Dept. of Medicine and Environmental
Health

David Wood - Dielectrics Manager
Functional Products Group

K. Warren Easley - Director Civic Affairs
Washington, D.C.

10:45 - 11:45 A.M.

Dr. William C. Hammann - Manager, Research Development,
Functional Products Group

2:00 - 4:00 P.M.

Robert W. Flint - Plant Manager, W. G. Krummrich Plant

Robert A. Pohl - Manager, Manufacturing
Functional Products Group

Arthur E. Leisy - General Superintendent, Manufacturing
W. G. Krummrich Plant

Desmond B. Hosmer - Utilities and Environmental Protection
Director, MICC

J. Coleman Weber - Manager, Product Acceptability
Specialty Chemicals Division

DSW 238360

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Monsanto Company Program for Controlling the

Entry of Polychlorinated Biphenyls into the Environment

Following the announcement by Swedish investigators that substances found in environmental samples were identified as polychlorinated biphenyls, Monsanto began intensive programs to develop accurate analytical methodology and to establish the toxicological effects with test animals.

Long before all the data became available Monsanto announced that in 1970 sales of polychlorinated biphenyls to applications which permitted easy entry into the environment would be discontinued. By mid-1971 sales were made only to heat transfer and electrical equipment, applications which were considered "closed systems" and in which fire-resistance offered by polychlorinated biphenyls was considered critical.

In late 1971, Monsanto further announced that sales to heat transfer applications would also be discontinued. Thus, starting in 1972, sales of polychlorinated biphenyls were and continue to be made only to manufacturers of sealed electrical equipment such as capacitors and transformers, applications for which no acceptable alternative fluids were available. In addition, the types of commercial mixtures sold are those which contained the lowest concentration of the more persistent polychlorinated biphenyls consistent with the fire resistance requirements of the applications. Approval by Monsanto of a customer is very carefully considered to establish actual use in sealed electrical applications.

In 1971, following Monsanto suggestions that a government agency be available as a spokesman for regulatory matters relating to polychlorinated biphenyls, the Interdepartmental Task Force for PCB's was formed. In its report, published in May, 1972, the Task Force supported Monsanto's sales policy and agreed that the continued use in sealed electrical systems was warranted pending the development of acceptable substitute materials.

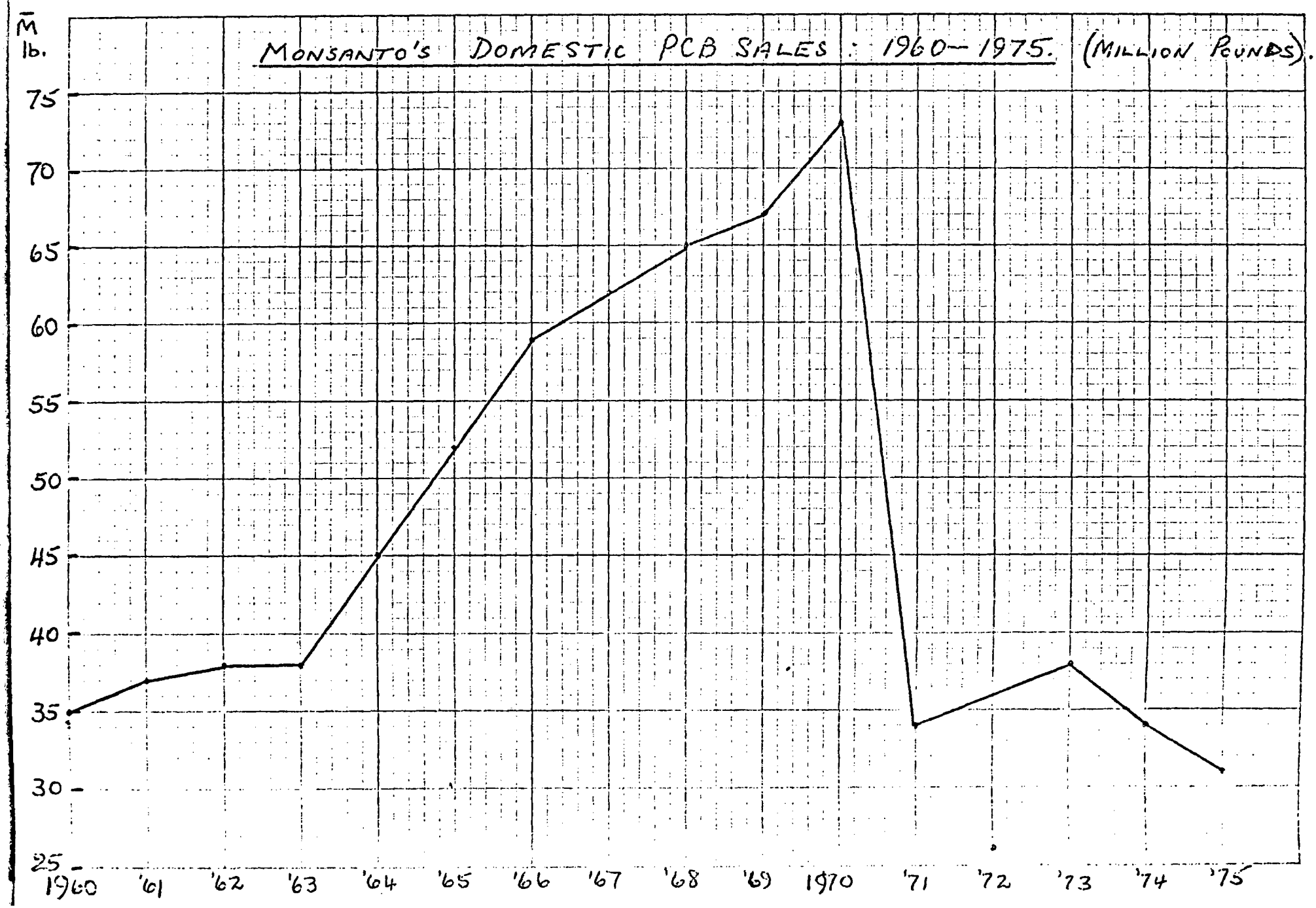
In February, 1973, the member nations of the Organization for Economic Cooperation and Development (OECD) published an agreement relating to the use of polychlorinated biphenyls which is less restrictive than the Monsanto policy but does include acceptance of the continued use of these materials in electrical systems.

The commitment of the manufacturers and users of capacitors and transformers containing polychlorinated biphenyls in the proper use and control of these materials is evident in the formation of an American National Standards Institute committee (ANSI C-107) to develop control guidelines. Guidelines were available in 1973 and final approval obtained in 1974.

DSW 238361

10 X 10 TO THE 1/4 INCH 359-30G
8 X 8 TO THE INCH

DSW 238362



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PENTA- & HIGHER CHLORINATED BIPHENYLS*

	MONSANTO DOMESTIC PCB SALES (MILLION POUNDS)	PENTA- & HIGHER CHLORINATED BIPHENYL CONTENT (MILLION POUNDS)
1970	73	21.7
1975	31	~5.7

*PCB residues found in wildlife are primarily penta- and hexachlorobiphenyls.

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EFFECT OF MONSANTO'S PCB SALES RESTRICTIONS

1. Domestic sales of PCBs are ~ 40 million pounds below 1969/1970 levels.

2. Monsanto's remaining product line has been changed to reduce penta- and higher chlorinated biphenyl homologs.

3. In 1970, ~ 22 million pounds of penta- and higher chlorinated biphenyls were present in PCBs sold domestically; in 1975 this was reduced to under 6 million pounds.

4. In 1975, all penta- and higher chlorinated biphenyls are sold only to sealed system uses in capacitors and transformers.

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Toxicity and Environmental Effects of Commercial PCBs

Introduction

Polychlorinated biphenyls (PCBs) are not a single chemical entity. They are produced by chlorinating biphenyl to acheive a final product with specified properties. These products, sold under the trade name AROCLOR by Monsanto, are mixtures of chlorine-containing biphenyls with different numbers and positions of the chlorine substituents.

Over the years, a series of investigations have been conducted to assess potential health and environmental hazards of PCBs. The 3 predominant commercial mixtures (AROCLORS 1242, 1254 and 1260) have been studied most intensively. Toxicity tests performed on these 3 commercial mixtures were typical in scope of those designed for the evaluation and establishment of the safety of direct and indirect food additives.

It may be noted that AROCLOR 1260 no longer is produced in this country since it does not meet the physical specifications for its restricted uses.

Conclusions Based on Monsanto Studies

1) As a class, the AROCLORS are relatively harmless materials for routine industrial handling under ambient conditions.

2) Threshold Limit Values of 1 mg/m^3 and 0.5 mg/m^3 have been established for materials containing average chlorine values of 42% and 54%, respectively, of the available sites.

3) The no-effect level for these materials in chronic

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rat and dog feeding studies is about 10 ppm in the diet. No hepatocellular carcinomas were present.

4) The no-effect level on rat reproduction is between 1 and 10 ppm in the diet since higher levels result in low mating indices.

5) No teratogenic or mutagenic effects were observed in studies with rats and mice.

6) In chicken reproduction and teratology studies, AROCLOR 1242, which produced the most severe effects, had a no-effect level of 2-4 ppm in the diet.

7) Acute toxicity to fish varies from less than 1 ppm to greater than 100 ppm depending on the specific AROCLOR and species of fish tested.

8) PCBs containing 3 or less chlorine substituents per molecule are reasonably biodegradable.

Summary of Monsanto's Long-term Toxicity Studies on Commercial PCBs.

These tests consisted of 2-year (lifetime) feeding to rats, 2-year feeding to dogs, 3-generation rat reproduction studies with 2 litters cast per generation, rat teratology studies and dominant lethal mutagenic studies in mice. Toxicity and reproduction studies in chickens were performed to evaluate possible untoward effects in birds such as decreases in eggshell thickness. In addition, biodegradation and tissue accumulation studies have been conducted.

The highest dietary level (100 ppm) in the lifetime rat feeding studies produced a weight depression at 24 months in females fed AROCLOR 1254 and liver weight increases in all

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groups except males fed AROCLOR 1242. As with other halogenated hydrocarbons, the important histopathologic changes were present in the livers of animals sacrificed at the end of the study. These consisted of hepatocellular alterations such as focal hypertrophy, cytoplasmic lipid changes and in some animals from the 100 ppm groups, hepatomas or cholangiohepatomas. No evidence of hepatocellular carcinogenicity of the AROCLORS was found.

In the dog 2-year studies, some slight decreases in body weight gain were noted. At the highest feeding level (100 ppm), AROCLOR 1260 produced an increase in serum alkaline phosphatase activity and liver weights without concomitant histopathologic changes. However, there was evidence of gastrointestinal inflammatory lesions and ulcerations which appear to be similar to those found by Allen in rhesus monkeys fed AROCLOR 1248. (AROCLOR 1248 was an experimental product which never was commercialized.)

In the rat reproduction studies, none of the AROCLORS produced adverse effects in the 2 litters of the first generation. In the second and third generations, there was a reduction in the mating index at the 2 highest feeding levels (10 ppm and 100 ppm). The ability of females to conceive, carry the delivery process to parturition, and to successfully nourish the young was not affected by the 3 AROCLORS. No changes were produced in the reproductive tracts of either male or female rats by any of the 3 AROCLORS.

There was no evidence of teratogenic or mutagenic changes with any of the PCBs at maximally tolerated dose levels in

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rats and mice.

In the chicken toxicity/reproduction study, AROCLOR 1260 was without effect at all test levels. AROCLORS 1242 and 1254 at 100 ppm in the diet decreased egg hatchability. In fact, poor hatchability of eggs was found from hens fed 8 ppm of AROCLOR 1242. In addition, AROCLOR 1242 at 10 and 100 ppm and AROCLOR 1254 at 100 ppm were associated with reduced eggshell thickness. Chick viability was affected by both substances at a dietary level of 10 ppm.

Biodegradation studies were conducted using semi-continuous activated sludge systems and tissues of rats fed PCBs were analyzed to measure accumulation and retention of these materials. These factors are influenced by the number and position of the chlorine substituents. Higher chlorine-containing members are more resistant to biodegradation and they accumulate more readily and are less readily metabolized and/or excreted from lipoid tissue in animals. PCBs containing 3 or less chlorine substituents per molecule are reasonably biodegradable.

Comments

The conclusion that "No evidence of hepatocellular carcinogenicity of the AROCLORS was found" in the 2-year rat feeding study was reached only after extensive re-evaluation of the original liver slides as well as additional liver sections from all of the animals after the Kimbrough results on AROCLOR 1260 became known to us. The slides were read

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independently by Dr. D. Gordon of Industrial BIO-TEST Laboratories, Professor W. Richter of the University of Chicago, and by Professor P. Pour of the Eppley Institute for Research in Cancer. In addition, Dr. Pour evaluated the Kimbrough slides and does not agree with the reported findings.

Barsotti and Allen have reported that 2.5 ppm of AROCLOR 1248 in the diet of rhesus monkeys adversely affected reproduction. This approximates a dosage of 100 μg/kg/day. It is higher than the safe human intake (1 μg/kg/day) estimated by FDA from human data when it promulgated its tolerances for PCBs in food.

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MONSANTO PCB REPLACEMENT PROGRAM

INTRODUCTION

Key Stages

1) Voluntary termination of sales to open and semi-closed applications.

2) Transition to more biodegradable Aroclor 1016 for capacitor industry.

3) Closely monitored sales to closed electrical system applications.

→ 4) Allocation of increased research resources since 1969 to seek and develop effective replacements for capacitor and transformer use.

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CAPACITOR PROGRAM

A. Research objectives must relate to beneficial characteristics of chlorinated biphenyls.

Dielectric Constant and Dielectric Strength

Affect - Size of capacitor - Design of equipment using capacitors - availability of other components, e.g., paper/foil.

Stability (Thermal/Chemical/Oxidative/Hydrolytic)

Affect - Reliability and life of capacitors.

Fire Resistance

Affect - Safety

Consistent International Quality and Availability

Affect - Worldwide solution of PCB replacement.

Applicable in all existing PCB applications

Affect - Complete solution.

AND

Good Environmental Compatibility.

B. RESULT

MCS-1238, a blend of synthetic hydrocarbon with a dielectric constant modifier.

1. Dielectric Constant/Strength - Equivalent Aroclor 1016. ✓
2. Stability - Sufficient to give long capacitor life. ✓

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3. Fire resistance - Not flammable, but less fire resistant than Aroclor.

4. International Quality/Availability. ✓

5. Span of existing PCB applications. Theoretical ✓

6. Environmental Compatibility. To Date ✓

C. FURTHER DEVELOPMENT

1. Monsanto - Complete Environmental Screen.

   - Establish Production.

2. Capacitor Industry
   - Complete Capacitor trial programs.

3. Capacitor Users/Capacitor Industries/Agencies

   - Accomodate by modification of capacitor design/system design reduced liquid fire resistance.

TRANSFORMER PROGRAM

(Askarel usage approx. 1 M gals. per year vs. Mineral Oil 75-90 M gals per year)

A. Research objectives relate to benefits of chlorinated biphenyls.

Fire Resistance

Affect - Safe installation of 100-1,000 gallons of liquid under thermal/electrical stress.
a) inside buildings
b) in underground urban substations
c) in generating stations (electrostatic precipitators)
d) under railroad cars, e.g., rapid transit systems.

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Environmental Compatibility

Heat Transfer Characteristics

Electrical Insulation Properties

Dielectric Strength

Stability

Compatibility with Chlorinated Biphenyl

B. RESULT

MCS-1839 blend - a synthetic hydrocarbon with a viscosity modifier.

C. FURTHER DEVELOPMENT

Monsanto is just beginning to submit evaluation quantities of this material to the transformer industry and starting environmental screening program.

D. MAJOR PROBLEM

Objective quantitative assessment of the relationship between fluid properties and the "fire safety" of the transformer installation.

There is a need for cooperation in this area between:

- Transformer manufacturers
- Transformer users
- Insurance groups
- Department of Transportation
- Building code regulators
- Fluid suppliers, etc.

Government support would be helpful in resolving this problem.

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Monsanto

SPECIALTY CHEMICALS DIVISION

MONSANTO INDUSTRIAL CHEMICALS CO.
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
Phone: (314) 694-1000

MONSANTO'S MCS 1238
HEALTH AND ENVIRONMENTAL ASSESSMENT SUMMARY

Acute Tests
- LD_{50} Male and Female Rats — 3800 milligrams/kilogram
- Skin - Albino Rabbits - 24 hours exposure
  - Absorption - Non Toxic
  - Irritation - Moderate irritant
- Eye - Albino Rabbits - 24 hours exposure
  - Slight eye irritant

Vapor Inhalation (Male Rats) - Ambient Temperature
- 6 hour Exposure Period - No observable effect

Sub Acute
- 28 day Feeding Study Rats - Pilot Study - No problems indicated

Bio Accumulation Rats - MCS 1238 residue rapidly metabolized and/or excreted

Toxicity - Aquatic Organisms

96 hr. TL 50 Bluegill	$\geq$1.0ppm< 10ppm
96 hr. TL 50 Trout	$\cong$1.5ppm

Biodegradability
- Primary Biodegradation (Simulation of a Secondary Sewage Treatment Plant)

after 1 day	60%
after 3 days	75%
after 7 days	87%

- Ultimate Biodegradation
  - CO_2 Evolved in 35 days is 52% of theory

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MCS 1238
Environmental Test That Will Be Completed

Study	Projected Date For Receipt of Final Report
8-day LC50 Bobwhite quail	3/76
8-day LC50 Mallard ducks	3/76
Chick Edema Factor Bioassay	2/76
Microbial Mutagenic Plate Assay	3/76
Mouse Lymphoma Mutagenicity	3/76
Rat Teratogenicity	3/76
Human Skin Patch Test	3/77
90-day Rat Feeding	*
*Tie into 2-year Rat Feeding Study	
2-yr. Rat Feeding	6/78

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W. G. KRUMMRICH DISCHARGE PCB STATUS

A. LOSS

1. Our current measurable losses from the plant to the environment are approximately one to two pounds per day. This equates to approximately 1 to 2 parts per trillion PCB's in the Mississippi River at average flow rates. Level of PCB's into the ambient atmosphere are less than Threshold Limit Values ("TLV refers to airborne concentrations of substances and represents conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effects") using sampling and analytical techniques currently available. Presently we are manufacturing at a rate of 70,000 to 100,000 pounds per day PCB's.

2. The EPA presently has no formal PCB discharge limits although it has proposals under consideration which call for ambient water concentrations (i.e., if you sampled a natural body of water at random) at levels not to exceed 1 part per trillion.

B. PREVENTATIVE MEASURES

1. In our manufacturing area, we have acted to prevent loss of PCB's in the environment by literally making the department a "concrete bathtub". Drainage is collected in an isolated PCB sewer system with settling basins to insure PCB containment in case of accidental spill or equipment failure with the capability of monitoring the effluent from the department.

2. Storage tanks are blanketed with nitrogen to eliminate tanks "breathing", and mist eliminators have been installed in vapor lines to eliminate the possibility of PCB's leaving the manufacturing area.

3. An incinerator was installed to safely dispose of PCB's.

4. The key to our continued success in controlling PCB's is in our maintaining a high housekeeping level.

5. A Monsanto chemical waste treatment plant is under construction to be completed fourth quarter 1976 which should further lower the PCB's to the environment by adsorption.

6. Completion of a planned community regional waste treatment plant designed to service larger east side area including communities and industries should reduce PCB's to the environment to potentially a negligible value. Estimated completion of the project is 1982-1983.

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RAP
1/5/76