IN THE FIRST JUDICIAL DISTRICT COURT, COUNTY OF SANTA FE
STATE OF NEW MEXICO

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Santa Fe County
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STEPHEN T. PACHECO
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THE STATE OF NEW MEXICO, ex rel. HECTOR BALDERAS, ATTORNEY GENERAL,	§	
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	§	
Plaintiff,	§	No.: D-101-CV-2019-01445
	§	Case assigned to Biedscheid, Bryan
v.	§	
	§	
MONSANTO CO., SOLUTIA, INC., and PHARMACIA LLC,	§	
	§	
	§	
Defendants.	§	
	§	**COMPLAINT WITH JURY DEMAND**
	§	

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I. INTRODUCTION

1. The State of New Mexico, by its Attorney General Hector Balderas ("Plaintiff" or "New Mexico" or the "State"), brings this action against Defendants Monsanto Company ("Monsanto"), Solutia, Inc. ("Solutia"), and Pharmacia LLC ("Pharmacia") (collectively, "Defendants"), for all damages to New Mexico recoverable at law or in equity, and for declaratory and injunctive relief, including civil penalties, to remedy Defendants' violations of law.

2. Polychlorinated biphenyls ("PCBs") are synthetic organic chemical compounds that were manufactured, marketed, sold, and distributed by Defendants in the United States from approximately 1929 to 1977. During that period, Defendants were responsible for the manufacture of 99% or more of all PCBs used within the United States. There are no known natural sources of PCBs in the environment.

3. Production and, with limited exceptions, use of PCBs was prohibited in the United States in 1979, when the U.S. Environmental Protection Agency ("EPA") promulgated final regulations banning PCBs under the Toxic Substances Control Act ("TSCA"), enacted by the U.S. Congress in 1976.

4. PCB production was banned under international law in 2004, when the Stockholm Convention on Persistent Organic Pollutants came into force.

5. Numerous governmental and intergovernmental agencies recognize PCBs as probable or confirmed human carcinogens. In particular, the U.S. EPA recognizes PCBs as probable human carcinogens, and the U.S. Department of Health and Human Services' National Toxicology Program ("NTP") considers PCBs to be "reasonably anticipated" carcinogens. The International Agency for Research on Cancer ("IARC") classifies PCBs as known human carcinogens.

6. Human exposure to PCBs is associated with cancer as well as adverse health effects on the endocrinal, nervous, immune, reproductive, neuropsychological, and other biological systems, even at very low levels of exposure. Fish, birds, and mammals that consume PCBs or PCB-contaminated water or food also suffer adverse health effects. PCBs have been detected in high concentrations in New Mexico waters and soils, among other natural resources.

7. New Mexico waters are "impaired" by PCBs if the concentration of PCBs in such waters exceeds the Water Quality Standards for PCBs established by the New Mexico Environment Department ("NMED"). High PCB concentrations are the cause of impairment of over 50 significant New Mexico waterbodies. In

addition, many other New Mexico waterbodies and waterways suffer PCB contamination at detectable levels below the threshold for impairment. According to the NMED's most recent Integrated Report on water quality (for 2018-2020), PCBs are one of the "three most common causes of water quality impairments in lakes and reservoirs" in New Mexico, resulting in the impairment of hundreds of miles of New Mexico rivers and streams as well as over 20,000 acres of lakes, reservoirs, and ponds, making New Mexico's PCB contamination problem among the most concerning in the country.

8. As a result of Defendants' misconduct, as alleged in more detail below, New Mexico residents and New Mexico natural resources are presently exposed to dangerous levels of PCBs manufactured, marketed, distributed, and introduced into commerce by Defendants.

9. At the time they manufactured, marketed, distributed, and sold PCBs—often under the trade name "Aroclor"—Defendants knew PCBs were highly toxic, harmful to human and animal health, and environmentally harmful. For example, an internal Monsanto memorandum from 1937 acknowledges that PCBs produce

"**systemic toxic effects**" resulting from prolonged exposure.[1] In the 1950s, Monsanto's Medical Office specifically advised workers not to eat lunch in the PCB department. In that connection, Monsanto's medical director openly declared that, "**[w]e know Aroclors are toxic**."[2]

10. Although they knew that their PCBs were contaminating natural resources and living organisms on a scale their personnel admitted was "**global**,"[3] and that PCBs were "**toxic**"[4] and indeed "**about the same as DDT in mammals**,"[5] Defendants embarked on a decades-long campaign of misinformation and deception in order to prolong the manufacture, sale, and use of PCBs in New Mexico and elsewhere.

11. Indeed, internal talking-points memos designed to assist Monsanto employees fielding questions and concerns from customers about PCB toxicity

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[1] *See* Exhibit 1 (MONS 061332). All in-text style modifications (bold and italics) are added unless otherwise noted.

[2] *See* Exhibit 2 (MONS 095196).

[3] *See* Exhibit 3 (MONS 030483).

[4] *See* Exhibit 2 (MONS 095196).

[5] *See* Exhibit 4 (MONS 098480).

remind those employees that Monsanto "**can't afford to lose one dollar of business**."[6]

12. The U.S. EPA finally banned PCBs in 1979, when the final rules implementing the TSCA came into force. For many years prior to the TSCA's enactment and the U.S. EPA's implementing regulations, Defendants vigorously denied in public statements that PCBs are harmful to human and environmental health, despite accumulating a wealth of knowledge contradicting such statements.

13. Defendants sold PCBs for a variety of commercial and industrial purposes. PCBs were sold for use in paints, caulks, inks, dyes, lubricants, sealants, plasticizers, coolants, hydraulic fluids, fireproofing, and industrial electrical equipment such as capacitors and transformers, among other applications. Defendants also manufactured and sold various products incorporating their PCBs.

14. As Defendants knew, PCBs regularly volatilize and leach, leak, off-gas, and escape their intended applications, contaminating runoff during naturally occurring storm and rain events and entering groundwater, waterways, waterbodies,

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[6] *See* Exhibit 5 (MONS 100123) at -24.

and other waters, sediment, soils, and plants, as well as fish and other wildlife throughout New Mexico.

15. Furthermore, as Defendants knew, PCBs disposed of in landfills and other types of waste facilities regularly leach, leak, off-gas, and escape their disposal sites, entering New Mexico waters, soils, and wildlife.

16. As Defendants also knew, PCBs substantially persist in the natural environment rather than breaking down over time. The environmental persistence of PCBs and their resistance to breaking down is highly correlated with their chlorine content: the higher the chlorine content in a given PCB formulation, the more persistent it is.

17. Compounding this hazard, as Defendants knew, PCBs bioaccumulate and biomagnify in animal tissue, including in fish tissue and human tissue. As a result, as time passes, PCB contamination poses an increasingly hazardous threat to New Mexico residents' health.

18. PCB contamination is responsible for an indeterminate number of adverse health consequences in New Mexico residents.

19. Defendants' PCBs are present and have impaired or contaminated the natural resources of New Mexico, including without limitation New Mexico waters

described above and in further paragraphs below, as well as other parts and natural resources of the State, including without limitation sediment, land and soil, submerged lands, groundwater, surface water, bedlands, tidelands, wildlife, fish, shellfish, aquifers, biota, and air.

20. Defendants' PCBs have caused and will continue to cause direct damage to New Mexico's natural resources.

21. New Mexico has incurred and will continue to incur significant costs to identify and reduce sources of Defendants' PCBs entering and contaminating natural resources within the State. New Mexico also has incurred significant costs in monitoring, investigating, analyzing, and remediating Defendants' PCBs in the environment. New Mexico and its residents have borne costs of treating and managing PCB-contaminated waters and soils.

II. JURISDICTION AND VENUE

22. The natural resources that are the subject of this suit all rest within the State of New Mexico. No federal subject-matter jurisdiction exists or is invoked herein.

23. Venue is proper in Santa Fe County pursuant to NMSA 1978 Section 38-3-1 because a plaintiff resides here and the defendants are foreign corporations.

24. This Court has subject matter jurisdiction over this case pursuant to N.M. Const. Art. VI, Sec. 13.

25. This Court has personal jurisdiction over Defendants pursuant to both NMSA 1978 Section 38-1-16(A) and New Mexico's "sufficient minimum contacts" test. *Sproul v. Rob & Charlie's, Inc.*, 2013-NMCA-072, ¶ 13, 304 P.3d 18. Defendants marketed, sold, and distributed commercial PCB formulations and/or products and materials containing PCBs to customers within New Mexico. In addition, Monsanto maintains at least one facility in New Mexico (Berino, NM).

III. PARTIES

A. PLAINTIFF

26. The State of New Mexico, by the Honorable Hector H. Balderas, Attorney General of the State of New Mexico, brings this suit pursuant to its inherent *parens patriae* authority to remedy an injury to its "quasi-sovereign interest" in the physical and economic health and well-being of a substantial segment of its population.

27. The Attorney General is authorized to act on behalf of the State in all actions when the interests of the State require action in his judgment, and is further empowered to prosecute all actions and proceedings brought by any State officer or

head of a State department, board, or commission, or any employee of the State in his official capacity. NMSA 1978 Section 8-5-2(B)-(C).

28. New Mexico enjoys *parens patriae* standing in this suit because its residents are adversely affected by the presence of PCBs in the State's natural resources, stormwater systems and other water systems, and/or suffer loss through monetary assessments or expenditures that contribute in part to the assessment, monitoring, analysis, remediation, and cleanup of PCBs.

29. Defendants' PCB contamination constitutes injury to New Mexico's natural resources, stormwater and other water systems, and other property of the State, for which New Mexico seeks damages and injunctive relief, including on behalf of itself and on behalf of its residents in its *parens patriae* capacity.

30. New Mexico has a quasi-sovereign interest in its natural resources, including air, soils, and lands, aquatic and submerged lands, waters, aquifers, wildlife, fish, shellfish, biota, and other natural resources, as well as stormwater and other water systems within the State.

31. New Mexico has a proprietary interest in protecting all property owned by the State and has an interest in remediating the contamination of its property and in preventing future contamination.

32. New Mexico has spent and will continue to spend substantial sums to remediate Defendants' PCBs.

33. Injury to natural resources and water systems caused by Defendants' PCBs has resulted in loss of public use and enjoyment of those resources. The economic value of these natural resources and water systems, as well as the cost of restoring them, is substantial.

34. Further, the Attorney General has the statutory authority to enforce the New Mexico Unfair Practices Act (hereafter, "UPA") (*see* NMSA 1978 Sections 57-12-1 to -26 (1967, as amended through 2009)) and the New Mexico False Advertising Act (hereafter, "FAA") (*see* NMSA 1978 Sections 57-15-1 to -10 (1965, as amended through 1967)) to ensure the protection of New Mexico residents and consumers.

B. DEFENDANTS

35. Defendant Monsanto Company is a Delaware corporation with its principal place of business in St. Louis, Missouri. Following a merger transaction that closed in 2018, Monsanto is a wholly-owned subsidiary of Bayer AG.

36. Defendant Solutia, Inc. is a Delaware corporation with its principal place of business in St. Louis, Missouri. Solutia is a wholly-owned subsidiary of Eastman Chemical Company.

37. Defendant Pharmacia LLC, formerly known as Pharmacia Corporation, is the successor to the original Monsanto Company ("Old Monsanto"). Pharmacia LLC is a Delaware company with its principal place of business in Peapack, New Jersey. Pharmacia is a wholly-owned subsidiary of Pfizer, Inc.

38. Old Monsanto operated an agricultural products business, a pharmaceutical and nutrition business, and a chemical products business. Old Monsanto began manufacturing PCBs in 1935 after acquiring Swann Chemical Company, which manufactured PCBs from 1929 to 1935. Old Monsanto continued to manufacture commercial PCBs until the late 1970s.

39. Through a series of transactions beginning in approximately 1997, Old Monsanto's businesses were spun off to form three separate corporations.

40. The corporation now known as Monsanto Company operates Old Monsanto's agricultural products business.

41. Old Monsanto's chemical products business is now operated by Solutia.

42. Old Monsanto's pharmaceuticals business is now operated by Pharmacia.

43. Solutia was organized by Old Monsanto to own and operate its chemical manufacturing business. Solutia assumed the operations, assets, and liabilities of Old Monsanto's chemical business.

44. Although Solutia assumed and agreed to indemnify Pharmacia (then known as Monsanto Company) for certain liabilities related to the chemicals business, Defendants have also entered into agreements to share or apportion liabilities, and/or to indemnify one or more entities, for claims arising from Old Monsanto's chemical business, including the manufacture and sale of PCBs.

45. In 2003, Solutia filed a voluntary petition for reorganization under Chapter 11 of the U.S. Bankruptcy Code. Solutia's reorganization was completed in 2008. In connection with Solutia's Plan of Reorganization, Solutia, Pharmacia, and Monsanto entered into several agreements under which Monsanto continues to manage and assume financial responsibility for certain tort litigation and environmental remediation related to the chemicals business.

46. Eastman Chemical Co. reported in its 2017 Form 10-K that it has "been named as a defendant in several [legacy tort] proceedings, and has submitted the

matters to Monsanto as Legacy Tort Claims [as defined in a settlement agreement with Monsanto arising out of Solutia, Inc.'s bankruptcy proceedings]. To the extent these matters are not within the meaning of Legacy Tort Claims, Solutia could potentially be liable thereunder. In connection with the completion of its acquisition of Solutia, Eastman guaranteed the obligations of Solutia and Eastman was added as an indemnified party under the Monsanto Settlement Agreement."

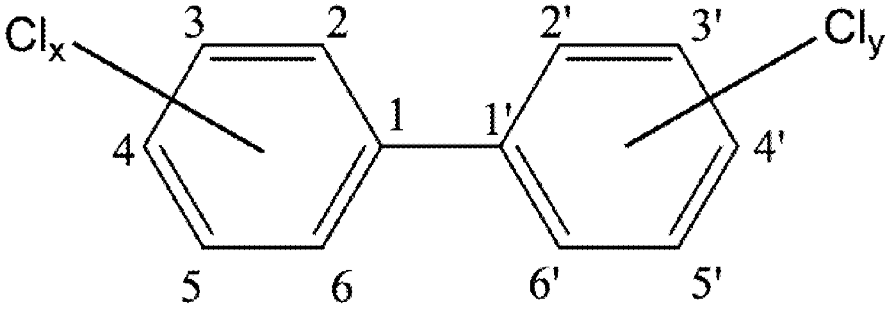
47. In its Form 10-K for 2017, filed with the U.S. Securities and Exchange Commission, Monsanto represented: "Monsanto is involved in environmental remediation and legal proceedings to which Monsanto is a party in its own name and proceedings to which its former parent, Pharmacia LLC or its former subsidiary, Solutia, Inc. is a party but that Monsanto manages and for which Monsanto is responsible pursuant to certain indemnification agreements. In addition, Monsanto has liabilities established for various product claims. With respect to certain of these proceedings, Monsanto has established a reserve for the estimated liabilities." The filing specifies that the company holds $277 million in that reserve as of August 31, 2017.

IV. FACTUAL ALLEGATIONS

A. PCBs Are Dangerous Chemicals That Threaten Human And Environmental Health and Safety

1. Physical and Chemical Properties of PCBs

48. PCBs are a class of synthetic organic chemical compounds in which a minimum of 2 and a maximum of 10 chlorine atoms are attached to the biphenyl molecule. The general chemical structure of chlorinated biphenyls is shown below (*source*: "Chemical and Physical Information," *in* U.S. Department of Health and Human Services, Toxicological Profile for Polychlorinated Biphenyls (PCBs) (December 2000), available at https://www.atsdr.cdc.gov/toxprofiles/tp17-c4.pdf).



49. There are no known natural sources of PCBs in the environment.

50. PCBs are either oily liquids or solids, and are colorless to light yellow. They have no known smell or taste.

51. Due to their chemical structure, a number of chlorinated compounds are possible. Defendants manufactured PCB compounds primarily under the "Aroclor" trade name. Aroclors are differentiated principally by the composition of chlorine by weight, so, for example, "Aroclor 1254" means the mixture contains approximately 54% chlorine by weight.

52. PCBs do not burn easily, are hydrophobic (i.e., they do not dissolve in water but rather cluster together), and bioaccumulate and biomagnify in living tissue.

53. PCBs entered the air, water, and soil during their ordinary use by Defendants and Defendants' commercial customers from 1929 to 1977. Applications containing PCBs, such as road paint and caulking, gradually release PCBs into the natural environment due to the chemical compound's tendency to volatilize. Moreover, PCBs and PCB-contaminated wastes generated during manufacturing processes were routinely disposed in landfills by Monsanto and its commercial customers. PCBs also entered the environment from spills or leaks during the transport of the chemicals, and from leaks or fires in transformers,

capacitors, or other products containing PCBs, and from the burning of wastes in some municipal or industrial incinerators.

54. Once in the environment, PCBs do not break down readily and may remain for decades absent remediation, cycling easily between air, water, and soil and traveling to distant locations as a result. In general, the more chlorine atoms the PCBs contain, the slower they break down.

55. PCBs are present as solid particles or vapor in the atmosphere. They eventually return to land and water by settling as dust or in rain and snow.

56. In water, PCBs travel along currents and attach to bottom sediment or particles in the water, and evaporate into air or settle into sediment. Sediments contaminated with PCBs also release PCBs into surrounding water.

57. PCBs stick strongly to soil and will not usually be carried deep into the soil with rainwater, but it is possible for PCBs to contaminate groundwater flows.

58. As a gas, PCBs can accumulate in the leaves and above-ground parts of plants and food crops.

59. PCBs are taken up into the bodies of small organisms and fish in water. They are also taken up by other animals that eat these aquatic animals as food. PCBs especially accumulate in fish and marine animals reaching levels that may be many

thousands of times higher than in water because PCBs bioaccumulate and biomagnify over time in living tissue. Indeed, PCB levels are highest in animals higher up in the food chain.

60. PCBs are inert in that they resist both acids and alkalis, and have thermal stability. These properties facilitated the use of PCBs as heat-resistant fluids in a variety of applications, including dielectric fluids in transformers and capacitors, heat-transfer fluids, and lubricants.

61. PCBs are soluble in lipids, including body fat.

2. Health effects of exposure to PCBs

62. Humans are exposed to PCBs primarily from eating contaminated food, breathing contaminated air, or drinking or swimming in contaminated water. The major dietary sources of PCBs are fish (especially sportfish caught in contaminated waterbodies), meat, and dairy products. PCBs also collect in milk fat and can enter the bodies of infants through breast-feeding.

63. Fetuses in the womb are also exposed to PCBs through their mothers. Studies show that babies born to mothers exposed to high concentrations of PCBs in the workplace or from eating PCB-contaminated fish suffer from lower birth weight than other babies. Babies born to women exposed to PCBs before and during

pregnancy showed abnormal responses to infant behavioral tests, including motor skills, and experienced short-term memory deficiencies.

64. Many studies have examined how PCBs affect human health. Human health effects associated with PCB exposure include without limitation liver, thyroid, dermal, and ocular changes, immunological alterations, neurodevelopmental and neurobehavioral changes, reduced birth weight, reproductive toxicity, and cancer.

65. Liver changes associated with PCB exposure include liver enlargement, microsomal enzyme induction (altered metabolism), increased levels of enzymes indicative of hepatocellular damage and serum and tissue biochemical changes indicative of liver dysfunction, and histopathological changes concerning fat deposition, as well as fibrosis and necrosis.

66. Thyroid changes associated with PCB exposure include goiter and increased thyroid gland volume, histological changes in the thyroid gland indicative of stimulation of the gland and disruption of the processing of follicular colloid needed for normal production and secretion of thyroid hormone, depressed thyroid hormone levels, and modified (increased or decreased) activity in producing and transferring enzymes necessary for thyroid hormone production. Due to the

importance of the thyroid to brain development, PCBs' effects on the thyroid produce neurodevelopmental effects.

67. Dermal changes associated with PCB exposure include skin irritation, chloracne (a dermatological condition starting with formation of keratin plugs and inflammatory folliculitis), and nail and skin pigmentation changes.

68. Ocular changes associated with PCB exposure include hypersecretion of Meibomian glands, abnormal pigmentation of the conjunctiva, and swollen eyelids.

69. Immunological alterations associated with PCB exposure include decreased antibody levels, changes in T cell subsets, and increased susceptibility to respiratory tract infections, infectious illnesses, and middle ear infections.

70. Neurological changes associated with PCB exposure include abnormal reflexes and deficits in memory, learning, impulse control, and IQ. Such changes impact infants and children more severely than adults.

71. Reproductive changes associated with PCB exposure include menstrual disturbances in women and effects on sperm morphology and production in men, all of which can result in difficulty conceiving.

72. PCBs are associated with a number of cancers, including cancer of the liver, biliary tract, intestines, and skin (melanoma).

73. Studies of workers routinely exposed to PCBs show that PCB exposure is associated with irritation of the nose and lungs, gastrointestinal discomfort, changes in the blood and liver, and depression and fatigue, as well as cancer of the liver and biliary tract.

74. The U.S. EPA has determined that PCBs are probable human carcinogens. In 1996, EPA reassessed PCB carcinogenicity based on data related to Aroclors 1016, 1242, 1254, and 1260. EPA's cancer reassessment was peer-reviewed by 15 experts on PCBs, including scientists from government, academia, and industry. All experts agreed that PCBs are probable human carcinogens.

75. The U.S. Department of Health and Human Services' National Toxicology Program considers PCBs to be "reasonably anticipated" carcinogens.

76. The International Agency for Research on Cancer, an intergovernmental agency forming part of the World Health Organization of the United Nations, concluded in March 2013, based on the assessments of 26 experts from 12 countries, that PCBs are known human carcinogens.

77. The IARC announced in March 2013:

> "On the basis of sufficient evidence of carcinogenicity in humans and experimental animals, the Working Group classified PCBs as carcinogenic to humans. The classification is based on consistent association between PCB exposure and increased risk of melanoma in humans. There is also limited evidence from some studies suggesting that exposure is linked to increased risks of non-Hodgkin lymphoma and breast cancer."

78. In its formal 2015 report, the IARC stated unequivocally, "There is sufficient evidence in humans for the carcinogenicity of [PCBs]. PCBs cause malignant melanoma. Positive associations have been observed for non-Hodgkin lymphoma and cancer of the breast. … PCBs are carcinogenic to humans. . . ."

79. In animal studies, PCBs were shown to be strongly associated with liver damage and death in rats; anemia, acne-like skin conditions, and liver, stomach, and thyroid gland injuries in rats, mice, and monkeys; and liver, kidney, and skin damage in rabbits and mice. Other effects of PCB exposure in animals include reduction in immune system function, behavioral alterations, and impaired reproduction.

80. Studies of rats exposed to PCBs showed that PCBs are associated with liver cancer.

81. Animal studies also show that exposure to PCBs causes an increased incidence of prenatal death and changes in the immune system, thyroid, and

reproductive organs. Studies in monkeys showed that young animals developed skin effects from nursing after their mothers were exposed to PCBs.

3. PCBs are global contaminants

82. PCBs have been released to the environment solely by human activity. PCBs are globally circulated and are present in all environmental media.

83. PCBs are predominantly redistributed from one environmental compartment to another—soil to water, water to air, air to water, sediment to water—so the majority of PCBs in the air, for example, results from volatilization of PCBs from soil and water.

84. The ordinary and intended application of PCBs (in, for instance, paints, caulks, lubricants, hydraulic and heat-transfer fluids, transistor and capacitor fluids, and so on) has resulted in the release of PCBs into New Mexico air, waters, and soils, due principally to the chemical compound's well-known tendency to volatilize or redistribute itself across different environmental compartments.

85. Moreover, PCBs may be released to the atmosphere from landfills and hazardous waste sites, incineration of PCB wastes, leakage and runoff from older electrical equipment in use or improperly disposed.

86. PCBs may also be released to water from spillage of PCB-containing hydraulic fluids, improper disposal, combined sewer overflows or storm water runoff, and from runoff and leachate from PCB-contaminated sewage sludge applied to farmland.

87. PCBs may further be released to soil from leaks and spills, releases from contaminated soils in landfills and hazardous waste sites, deposition of vehicular emissions near roadway soil, and land application of sewage sludges containing PCBs.

88. Due to their uncontrollable environmental circulation, which was known to Defendants, Defendants internally acknowledged that PCBs are "**global contaminants**"—even as they continued to **increase** their production of PCBs and to conceal or deny any association of adverse human health and ecological effects with PCBs.[7]

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[7] *See* Exhibit 3 (MONS 030483).

B. DEFENDANTS KNEW PCBS WERE DANGEROUS CONTAMINANTS AT THE TIME OF MANUFACTURE, MARKETING, SALE, AND DISTRIBUTION

89. Defendants developed an early, sophisticated understanding of PCB toxicity. For instance, in an October 1937 memorandum prepared by Old Monsanto personnel, Defendants already internally acknowledged that PCBs produce "**systemic toxic effects**" as a result of prolonged exposure to PCB vapors or oral ingestion, and that bodily contact with PCBs produces "an acne-form skin eruption."[8]

90. A year earlier, in 1936, many workers at a New York facility using PCBs and operated by Halowax Corporation were afflicted with severe chloracne. Three workers died and autopsies revealed severe liver damage in two of them.

91. Halowax Corporation asked Harvard University researcher Cecil K. Drinker to investigate the issue, and Dr. Drinker's analysis was presented at a 1937 meeting attended by personnel employed by Old Monsanto, General Electric, Halowax, the U.S. Public Health Service, and various state health officials.

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[8] *See* Exhibit 1 (MONS 061332).

92. Dr. Drinker's tests demonstrated that rats exposed to PCBs suffered severe liver damage. The results were published in a September 1937 issue of the *Journal of Industrial Hygiene and Toxicology.*

93. Old Monsanto retained Dr. Drinker to conduct further animal studies. In one report, dated September 15, 1938, a study confirms liver damage in rats exposed to various formulations of PCB compounds.[9]

94. As a further illustration of Defendants' knowledge of PCB toxicity, Old Monsanto Medical Director Dr. R. Emmet Kelly bluntly admitted in a September 1955 memorandum that, "**We know Aroclors are toxic**[.]"[10]

95. Dr. Kelly candidly observes in the same document that, "It does not make too much difference [that Monsanto has not yet identified the precise limit of exposure beyond which adverse effects develop in humans], it seems to me, because our main worry is what will happen if an individual develop[s] any type of liver disease and gives a history of Aroclor exposure. I am sure the juries would not pay a great deal of attention to [maximum allowable concentrate levels]."[11]

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[9] *See* Exhibit 6 (MONS 048123) at -27-30.

[10] *See* Exhibit 2 (MONS 095196).

[11] *See* Exhibit 2 (MONS 095196).

96. Before penning that damning 1955 admission that Defendants "know Aroclors are toxic" and are associated with "liver disease," Dr. Kelly acknowledged in February 1950 that when workers fell ill at an Indiana factory that used PCBs in the manufacturing process, he immediately "suspected the possibility that the Aroclor fumes may have caused liver damage."[12]

97. Indeed, an Aroclor manual prepared by Defendants plainly acknowledges that in the "early days of development," workers at a plant in Anniston, Alabama processing PCBs had developed chloracne and liver problems.

98. Old Monsanto's Medical Department prohibited workers from eating lunch in the Aroclor department in November 1955. The Department memorandum explains that "Aroclor vapors and other process vapors could contaminate the lunches unless they were properly protected," and that "[w]hen working with this material, the chance of contaminating hands and subsequently contaminating the food is a definite possibility." The memo also states, "It has long been the opinion of the Medical Department that eating in process departments is a potentially hazardous procedure that could lead to serious difficulties. While the Aroclors are

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[12] *See* Exhibit 7 (M11678).

not particularly hazardous from our own experience, this is a difficult problem to define because early literature work claimed that chlorinated biphenyls were quite toxic materials by ingestion or inhalation."[13]

99. Defendants attempted, but failed, to convince the U.S. Navy to use their PCB products in submarines. In January 1957, Dr. Kelly reported that, "No matter how we discussed the situation, it was impossible to change their thinking that Pydraul 150 [a PCB congener marketed by Old Monsanto] is just too toxic for use in a submarine."[14]

100. The first public warning that PCBs were becoming ubiquitous in the natural environment came when Søren Jensen, a Swedish chemist at Stockholm University's Institution of Analytical Chemistry, who was analyzing DDT accumulations in nature, accidentally found enormous quantities of unknown substances later identified as PCB compounds in wildlife.

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[13] *See* Exhibit 8 (Unlabeled memo from Jack T. Garrett to H.B. Patrick, Nov. 14, 1955).

[14] *See* Exhibit 9 (MONS 095640).

101. In 1966, *New Scientist* published a short article ("Report of a New Chemical Hazard"), estimating that PCBs may be spreading through environments in high volumes due to their use by manufacturing interests.

102. Dr. Jensen studied the compounds for years before positively identifying them as PCBs. His formal results, which were published in a 1969 issue of *Nature*, showed very high PCB concentrations in Baltic Sea fauna such as white-tailed sea eagles. As a recent commentator observed, summarizing the implications of Dr. Jensen's results, "PCBs had entered the environment in large quantities for more than 37 years and were bioaccumulating along the food chain."

103. Dr. Jensen presented his research to the scientific community in 1966, and Old Monsanto's Medical Director, Dr. Kelly, obtained a copy or transcript of Dr. Jensen's remarks in that time frame. Among other things, Dr. Jensen's presentation states that PCBs "appear[] to be the most injurious chlorinated compounds of all tested," and cites a 1939 study associating PCBs with the deaths of three young workers and concluding that "pregnant women and persons who have at any time had any liver disease are particularly susceptible." Dr. Jensen reports that the "main characteristic[s]" of PCBs include their "very high stability," lack of "metaboliz[ation] in living organism[s]," and their non-flammability. Kelly does

not dispute any of Jensen's remarks, noting only that "it is true that chloracne and liver trouble can result from large doses."

104. In December 1968, *Nature* published an article by Dr. Richard Risebrough of the University of California entitled, "Polychlorinated Biphenyls in the Global Ecosystem." The article assesses PCB presence in marine wildlife and reports high concentrations of PCBs detected in peregrine falcons and 34 other bird species, drawing an immediate connection between PCBs and the catastrophic decline of peregrine falcon populations in the United States.

105. Defendants' personnel took note of Dr. Risebrough's article, recognizing the public-relations disaster it portended. W.R. Richard, an Old Monsanto employee, wrote in early 1969 that the article shows not only that PCBs are "toxic substance[s]" but also that, since they are easily and broadly distributed in air and water, they are "an uncontrollable pollutant … causing [the] extinction of [the] peregrine falcon … [and] endangering man himself."[15]

106. Later that year, in September 1969, W.R. Richard wrote a memorandum titled, "Defense of Aroclor." Richard's memo notes that critics of

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[15] *See* Exhibit 10 (MONS 096509).

PCBs have raised a multitude of different issues with the compounds, so "[w]e can't defend vs. everything. Some animals or fish or insects will be harmed. Aroclor degradation will be slow. Tough to defend against. Higher chlorination compounds will be worse [than] lower chlorine compounds. Therefore we will have to restrict uses and clean-up as much as we can, starting immediately." Richard also observes that, when agencies or others test for PCBs in the Great Lakes region, "Aroclor 1254 will be found!" In the same document, Richard admits that PCBs will leak from virtually all applications, including such "closed" applications as air compressor, heat transfer, and capacitor fluids.[16]

107. An "Aroclor Ad Hoc Committee" was formed in that same month to strategize about saving Defendants' PCB business in light of the growing public outcry, and growing evidence of PCBs' toxicity and environmental harms. The meeting minutes observe that PCBs have been found in fish, oysters, shrimp, and birds, along the coasts of industrialized areas including Great Britain, Sweden, the Rhine River, Lake Michigan, Pensacola Bay, and in wildlife throughout the Western

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[16] *See* Exhibit 11 (DSW 014256) at -56-59.

hemisphere. The minutes acknowledge that PCBs may be considered "**a global contaminant**."[17]

108. The Committee acknowledged that normal and intended uses of PCB-containing products were the cause of the global contamination: "In one application alone (highway paints), one million lbs/year are used. **Through abrasion and leaching we can assume that nearly all of this Aroclor winds up in the environment**."[18]

109. The Committee attempted to formulate a response to growing concerns over PCBs, including those reflected by the U.S. Department of the Interior's Fish and Wildlife Service (which found PCBs in dead eagles and marine birds), the Bureau of Commercial Fisheries (which found PCBs in the river below Monsanto's Pensacola plant), and the U.S. Food and Drug Administration (which found PCBs in milk supplies). The Committee quickly abandoned any notion that Defendants could alleviate or discredit the public health and environmental concerns raised by

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[17] *See* Exhibit 3 (MONS 030483).

[18] *See* Exhibit 3 (MONS 030483) at -85.

the recent studies and governmental reports. Instead, the Committee focused on keeping the PCB business afloat *in spite of* these concerns.[19]

110. Indeed, the Committee's constitutive agenda is to: "1. Protect continued sales and profits of Aroclors; 2. Permit continued development of new uses and sales; and 3. Protect the image of the Organic Division and the Corporation as members of the business community recognizing their responsibilities to prevent and/or control contamination of the global ecosystem."[20]

111. As the minutes reflect, "There is little probability that any action that can be taken will prevent the **growing incrimination** of specific polychlorinated biphenyls … as nearly **global environmental contaminants** leading to **contamination of human food** (particularly fish), the **killing of some marine species** (shrimp), and the possible **extinction of several species of fish eating birds**." However, while "there is no practical course of action that can so effectively police the uses of these products as to prevent environmental contamination … **[t]here are … a number of actions which must be undertaken to prolong the**

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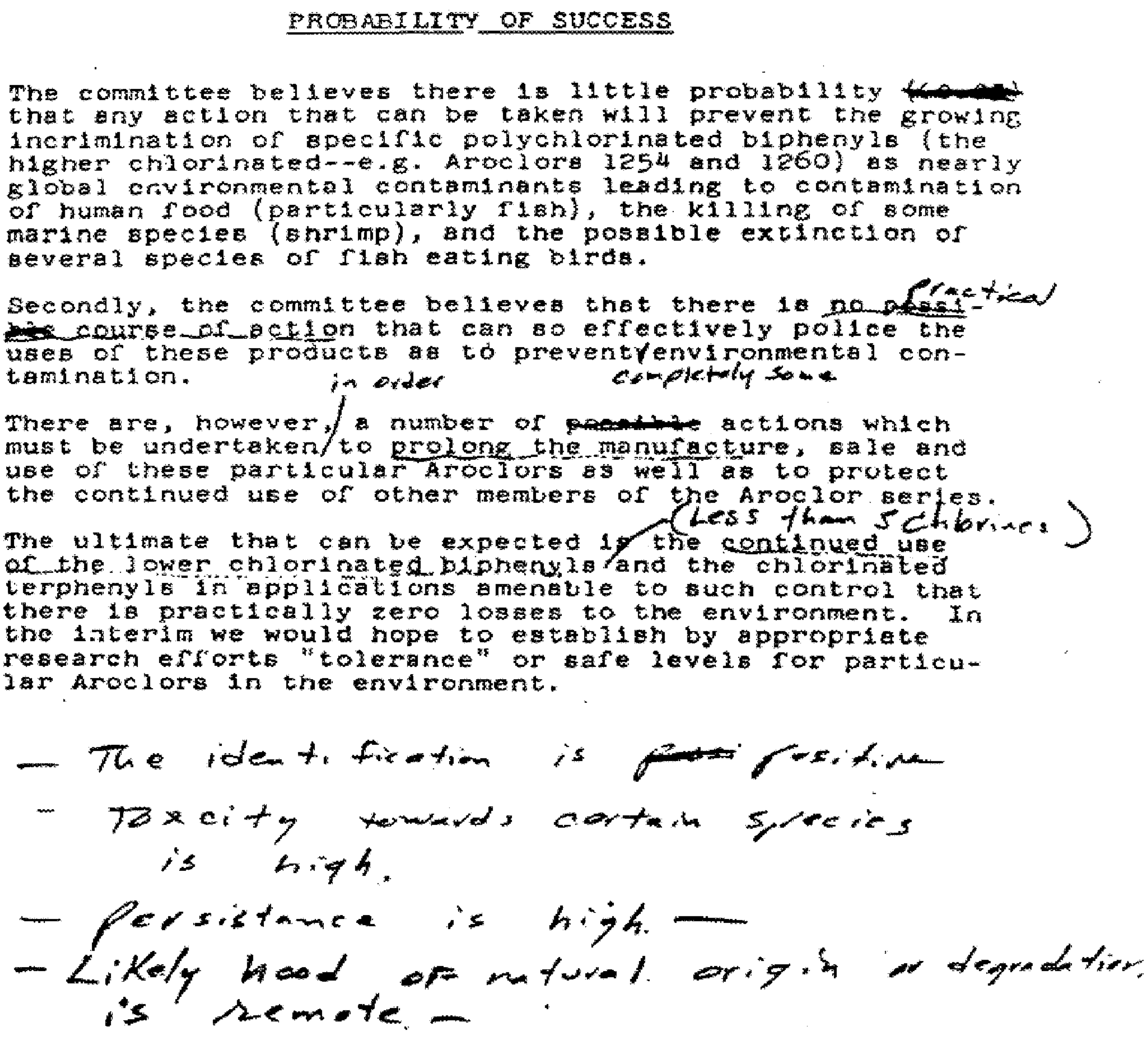
[19] *See* Exhibit 12 (DSW 014612) at -20.

[20] *See* Exhibit 12 (DSW 014612).

manufacture, sale and use of these particular Aroclors as well as to **protect the continued use of other members of the Aroclor series**."[21]



PROBABILITY OF SUCCESS

The committee believes there is little probability ~~[illegible]~~ that any action that can be taken will prevent the growing incrimination of specific polychlorinated biphenyls (the higher chlorinated--e.g. Aroclors 1254 and 1260) as nearly global environmental contaminants leading to contamination of human food (particularly fish), the killing of some marine species (shrimp), and the possible extinction of several species of fish eating birds.

Secondly, the committee believes that there is no ~~possible~~ practical course of action that can so effectively police the uses of these products as to prevent completely some environmental contamination.

There are, however, a number of ~~possible~~ actions which must be undertaken in order to prolong the manufacture, sale and use of these particular Aroclors as well as to protect the continued use of other members of the Aroclor series.

The ultimate that can be expected is the continued use of the lower chlorinated biphenyls (Less than 5 Chlorines) and the chlorinated terphenyls in applications amenable to such control that there is practically zero losses to the environment. In the interim we would hope to establish by appropriate research efforts "tolerance" or safe levels for particular Aroclors in the environment.

— The identification is ~~pos~~ positive

— Toxcity towards certain species is high.

— Persistance is high —

— Likelyhood of natural origin or degradation is remote —

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[21] *See* Exhibit 12 (DSW 014612) at -15.

112. Defendants not only continued producing Aroclors through 1969, but increased production that year and in 1970, which were the highest volume production years in the history of PCBs.

113. Elmer Wheeler, in Old Monsanto's Medical Department, circulated laboratory reports discussing results of animal studies in January 1970, in which Dr. Wheeler noted that, "**PCBs are about the same as DDT in mammals**."[22] Notably, Monsanto was also manufacturing DDT at the same time it was manufacturing PCBs, and had already compiled an extensive toxicological profile of DDT showing that it is extremely toxic to human and environmental health. Indeed, by the late 1940s, scientific researchers had established that DDT and other chlorinated hydrocarbons (a class of chemicals to which PCBs also belong) are absorbed and stored in fatty tissue of living organisms exposed to them, and pass these contaminants on to their offspring. For instance, the *American Journal of Public Health* published a 1950 report warning that "chlorinated hydrocarbons, such as DDT and chlordane, are soluble in fats and are stored in the fatty tissues of the body. These compounds possess a high order of toxicity, and their uncontrolled or unwise

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[22] *See* Exhibit 4 (MONS 098480).

use is not desirable." Extensive scientific research establishing the toxicity and bioaccumulative and biopersistent nature of DDT and other chlorinated hydrocarbons was published from the 1940s to the 1960s.

114. At the same time that it was internally acknowledging that PCBs are "about the same" as DDT, in January 1970, the journal *Environment* published a note authored by Old Monsanto: "Monsanto Statement on PCB." The company note acknowledges that recent studies, including Dr. Jensen's studies, indicate PCBs' widespread presence in the natural environment, and expresses the company's "concern[] over the situation."

115. However, the note defends PCBs by deploying a variety of flawed arguments and false statements that Old Monsanto used on multiple occasions in the late 1960s and early 1970s.

116. In particular, in the course of its regular business and in connection with the sale of its products Old Monsanto defends its PCB business by arguing, among other things, that (a) a "principal market" for PCBs is in closed electrical applications, where PCBs are "completely sealed in metal containers" and (the note implies) incapable of escape; (b) PCBs are also used in polymers meant for applications as adhesives, elastomers, and surface coatings, and so again are (the

note implies) incapable of escape; (c) PCBs are not "to our knowledge" used in "household products"; and (d) it is simply "not true" that PCBs are "highly toxic," but that Old Monsanto is conducting various research programs into PCB toxicity in fish and mammals and PCB presence in waters and soils, and "[v]ery early results of chronic toxicity studies confirm that PCBs are not highly toxic."

117. Defendants knew each of those statements was false or misleading at the time they were made.

118. Statements (a) and (b) are misleading because Defendants knew PCBs would leach, leak, off-gas, and escape their ordinary and intended applications, and/or would leach, leak, off-gas, and escape their disposal sites, regardless of the nature of the application. For example, as the Aroclor Ad Hoc Committee minutes prepared in September 1969 declare, "Through abrasion and leaching we can assume that nearly all of this Aroclor [used in surface applications] winds up in the environment."[23]

119. Statement (c) is false because Defendants themselves aggressively promoted the use of PCBs in "household products." For example, in a 1960

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[23] *See* Exhibit 3 (MONS 030483) at -85.

brochure, Defendants promoted the use of Aroclors not only in a variety of industrial or commercial applications (including transformers, capacitors, utility transmission lines, electric motors, fluorescent light ballasts, wire and cable coatings, impregnants for insulation, dielectric sealants, chemical processing vessels, drying ovens, furnaces, vacuum diffusion pumps, plasticizers, resins, aircraft parts, and wood and metal maritime equipment), but also in products with which ordinary consumers come into regular contact, such as home appliances, food cookers, potato chip fryers, thermostats, automotive transmission oil, insecticides, waxes used in dental casting, jewelry, lubricants, adhesives, moisture-proof coatings, printing inks, papers, sealants and caulking compounds, tack coatings, asphalt, paints, varnishes, lacquers, masonry coatings for swimming pools, stucco homes, and highway paints, and protective or decorative coatings for a number of other finishes.[24]

120. Moreover, a 1961 brochure published by Old Monsanto explains that Aroclors are presently being used in "lacquers for women's shoes," as a "wax for the flame proofing of Christmas trees," as "floor wax," as an adhesive for

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[24] *See* Exhibit 13 (LEXOLDMON004615).

bookbinding, leather, and shoes, and as invisible marking ink used to make chenille rugs and spreads.[25]

121. The messaging reflected in statement (c) in Old Monsanto's 1970 note published in *Environment* is of a piece with the company's broader defense of PCBs. In July of 1970, Old Monsanto issued a press release claiming that, "What should be emphasized … is that PCB was developed over 40 years ago primarily for use as a coolant in electrical transformers and capacitors. It is also used in commercial heating and cooling systems. **It is not a 'household' item**."[26] This messaging stands in stark contrast to the marketing and promotional statements Defendants issued for decades.

122. Statement (d) is false because Defendants knew PCBs were highly toxic well before January 1970, when the note was published, and that a number of studies, both internal and external, had already shown human and animal toxicity as well as prevalent contamination of waters and soils.

123. Moreover, as Old Monsanto's Elmer Wheeler wrote in the very month the "Monsanto Statement on PCB" was published in *Environment*, Defendants knew

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[25] *See* Exhibit 14 (0627503).

[26] *See* Exhibit 15 (Monsanto Press Release, July 16, 1970).

that "**PCB's are about the same as DDT in mammals**,"[27] i.e., toxic, harmful, and potentially lethal.

124. Indeed, in February 1970, Defendants' personnel circulated a talking-points memorandum to be used in engaging with customers raising concerns over PCB toxicity. Old Monsanto had reformulated certain high-chlorine congeners (Aroclor 1254 and 1260) but resisted any product returns, explaining that Defendants "**can't afford to lose one dollar of business**."[28] Accordingly, the memo instructs employees to advise customers to use up their existing Aroclor 1254 and 1260 stock before topping up with new fluids: "**We don't want to take fluid back**."[29]

125. Old Monsanto's sales force promoted its commercial PCB formulations by making sales calls directly to customer locations, as well as via telephone calls and written correspondence. Its salespeople used marketing resources, such as talking-point memoranda, technical product bulletins, and product brochures, in conveying the company's promotional messaging, which included unfair and deceptive representations about the safety of the products. Old Monsanto directed

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[27] *See* Exhibit 4 (MONS 098480).

[28] *See* Exhibit 5 (MONS 100123) at -24.

[29] *See* Exhibit 5 (MONS 100123).

the use of such representations with customers, as documents attached hereto demonstrate, and also published its own inaccurate, deceptive marketing statements in press releases and notes, such as the company note published in *Environment*. In addition, Old Monsanto published advertisements in trade publications—such as *Chemical & Engineering News*, *Adhesives Age*, and *American Paint Journal*, among others—since at least 1950, promising that its PCB formulations resist the effects of weather and refuse to volatilize, evaporate, or otherwise escape their applications, when, in fact, PCBs regularly and unavoidably escaped from applications of its PCB formulations even when used as intended.

C. DEFENDANTS FAILED TO WARN THE PUBLIC AND THEIR CUSTOMERS ABOUT PCB HAZARDS, AND PROVIDED IMPROPER DISPOSAL INSTRUCTIONS TO CUSTOMERS

126. Despite knowing that PCBs are toxic to human and environmental health, and that PCBs would leach, leak, off-gas, and escape their ordinary and intended applications and leach, leak, off-gas, and escape their disposal sites—regardless of the nature of the application—to contaminate waters, soils, and air, Defendants issued no public warning or instruction about PCBs or the health and environmental safety hazards they present. Indeed, as alleged above, in public statements, Defendants expressly denied the harmfulness and environmental toxicity

of PCBs. Although Defendants eventually (in the early 1970s) disclosed to at least some of their direct commercial customers certain hazards associated with long-term or high volume exposure to PCBs in the workplace, Defendants made no such public disclosure and instructed their customers to dispose of PCB materials and wastes in local landfills.

127. Despite the breadth of its knowledge of PCB contamination, even Old Monsanto itself failed to take adequate precautions in disposing of PCBs and PCB-contaminated waste that it generated. Its staff routinely disposed of PCB wastes in an unsafe manner. For example, sanitation staff handling on-site spills would routinely sweep PCB materials into the drainage system rather than collect it for proper disposal. Moreover, Old Monsanto operated an open outdoor dump site in which it would routinely dispose of PCB wastes, among other things.

128. Indeed, Old Monsanto executive William Papageorge wrote in a letter dated March 6, 1970 that, "All waste containing PCB's [sic] is at present hauled to the dumps the plants have been using for other plant waste. **We recognize this is not the ultimate, since PCB's [sic] could eventually enter the environment, but we will continue this practice until better methods of disposal are available**."

129. As Mr. Papageorge explained in testimony provided in 1975 to the Wisconsin Department of Natural Resources, Old Monsanto instructed its customers to dispose of PCB-contaminated wastes in landfills: "we have to reluctantly suggest, because we don't have a better answer, that they [i.e., Monsanto's commercial customers] find a well operated, properly operated landfill and dispose of the material in that fashion."

D. DEFENDANTS CONCEALED PCBS' TOXICITY FROM PUBLIC ENTITIES

130. As alleged above, Old Monsanto adopted a defensive posture in the late 1960s and early 1970s in response to growing public concern over the toxicity of PCBs. Even as governmental investigations and formal inquiries were launched, Old Monsanto doubled down on its campaign of misinformation and denial.

131. An internal memorandum prepared by Dr. Emmet Kelly and dated February 10, 1967, addressing the problem of "Aroclor in the air and in various fish and other living reservoirs," indicates that: "We are very worried about what is liable to happen in the [United States] when the various technical and lay news media pick up the subject. This is especially critical at this time because air pollution is getting a tremendous amount of publicity in the United States." The memo continues: "We have been receiving quite a few communications from our customers, but the most

critical one is NCR, who are very much involved with their carbonless carbon paper. … The consensus in St. Louis is that while Monsanto would like to keep in the background in this problem, we don't see how we will be able to in the United States. We feel our customers, especially NCR, may ask us for some sort of data concerning the safety of these residues in humans. This obviously might be opening the door to an extensive and quite expensive toxicological/pharmacological investigation."[30]

132. Old Monsanto's Aroclor Ad Hoc Committee, its mendacious company note in the *Environment* journal, its misrepresentations to public entities and customers, and other tactics alleged throughout this complaint were all designed to conceal the toxicity and hazardousness of PCBs to humans and the natural environment from the public.

133. In an internal presentation to the Corporate Development Committee, Old Monsanto personnel explained that Aroclors represent "one of Monsanto's most profitable franchises," generating $22 million in annual revenues and gross annual profits of $10 million. The presentation advises against exiting the Aroclor market, stating, "there is too much customer/market need and **selfishly too much Monsanto**

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[30] *See* Exhibit 16 (MONS 031358) at -58-59.

profit to go out."[31] As another internal Monsanto memorandum remarks, "There can not be too much emphasis given to the threat of curtailment or outright discontinuance of the manufacture and sales of this **very profitable** series of compounds."[32]

134. Adjusted for inflation, according to the methodology adopted by the U.S. Bureau of Labor Statistics' CPI Inflation Calculator, Old Monsanto's annual PCB revenues (circa 1969) are equivalent to roughly $157 million in late 2018, and its annual PCB profits (circa 1969) are equivalent to roughly $71 million in late 2018. Old Monsanto was plainly unwilling to abandon its hand-over-fist profiteering, even as its products endangered the natural environment and the lives of millions and, indeed, generations.

135. Defendants aggressively denied PCBs' toxicity in terms of both human and environmental safety in communications with regulators and public entities. For example, Howard S. Bergen, who worked in Old Monsanto's Functional Fluids division, sent a letter dated March 27, 1969, to the Regional Water Quality Control Board of the San Francisco Bay Region, in which he claimed that PCBs are

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[31] *See* Exhibit 17 (MONS 058730) at -33, -37.

[32] *See* Exhibit 12 (DSW 014612) at -24.

associated with "no special health problems," and that due to PCBs' chemical inertness, "we would anticipate no problems associated with the environment from refuse dumps."[33] Both of those statements were false.

136. Old Monsanto's Elmer Wheeler wrote in an internal memorandum dated May 26, 1969 to W.R. Richard, another Old Monsanto executive that he had spoken with a representative of the National Air Pollution Control Administration, who promised to relay to Congress the message that Old Monsanto "cannot conceive how the PCBs can be getting into the environment in a widespread fashion."

137. Old Monsanto delivered the same message to a number of other public entities, regulators, and authorities, including the New Jersey Department of Conservation in July 1969. Old Monsanto there claimed that, "Based on the available data, manufacturing and use experience, we do not believe PCBs to be seriously toxic," adding that, "[W]e are unable at this time to conceive of how the PCBs can become wide spread in the environment. It is certain that no applications to our knowledge have been made where the PCB's would be broadcast in the same

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[33] *See* Exhibit 18 (NEV 031051).

fashion as the chlorinated hydrocarbon pesticides have been."[34] Those statements were false.

138. Dr. Emmet Kelly, in correspondence dated March 30, 1970, wrote to William Papageorge, another Old Monsanto employee, about his communications with the Ohio State Board of Health. Dr. Kelly observes that a Dr. Hill of the Ohio State Board of Health

> has found PCB, particularly Aroclor 1254, in samples of milk from at least three herds in Ohio. He has traced this contamination back to silage from three different silos. Dr. Hill reported concentrations of 0.2 ppm of PCB in the silage in the center of the silo and up to 20 ppm in the material next to the walls. He also stated that concentrations in the milk were between 0.1 ppm and 0.6 ppm and that some of the milk had been destroyed.
>
> The silos are concrete silos whose interior surfaces were painted in 1967 using a formulation that contained [Aroclor] 1254. I don't know if there was any other Aroclor in the formulation nor do we know the coating manufacturer; although, this could be found out if important. The presence of PCB in the silage came from flaking off of the material and possibly from leaching out during the silage storage. At present they will have to destroy about 150 tons of silage which is valued at about $30 per ton. As a rough guess, they consider there may be 50 other silos involved in Ohio that were painted with the same formulation. They are also looking into the fat contamination of the cows themselves.

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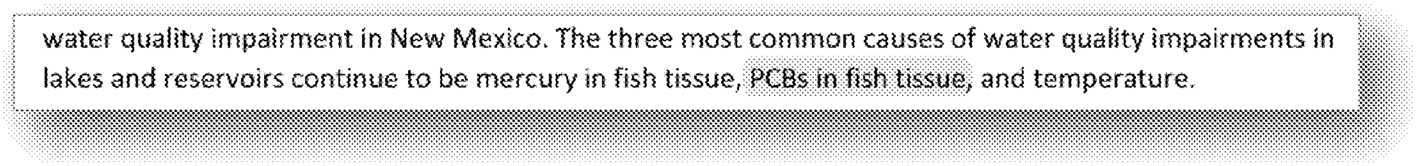
[34] *See* Exhibit 19 (NCR-FOX-0575899).

> All in all, this could be quite a serious problem, having legal and publicity overtones.
>
> This brings us to a very serious point. When are we going to tell our customers not to use any Aroclor in any paint formulation that contacts food, feed, or water for animals or humans? I think it is very important that this be done.[35]

139. Old Monsanto had a complete and comprehensive record of all PCB-related scientific research and general reportage during the relevant time period. Indeed, in an August 6, 1971 internal memorandum, Elmer Wheeler admits that, "we have probably the world's best reference file on the PCB situation. This includes reprints from the literature beginning in 1936 to reports issued last week."[36]

E. NEW MEXICO NATURAL RESOURCES HAVE BEEN DAMAGED BY DEFENDANTS' PCBS

140. The 2018-2020 Integrated Report, prepared by the NMED, states that PCBs represent one of the "three most common causes of water quality impairments in lakes and reservoirs" in New Mexico. Indeed, over 20,000 acres of New Mexico



water quality impairment in New Mexico. The three most common causes of water quality impairments in lakes and reservoirs continue to be mercury in fish tissue, PCBs in fish tissue, and temperature.

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[35] *See* Exhibit 20 (Unlabeled correspondence – Kelly to Papageorge).

[36] *See* Exhibit 21 (MONS 029656).

lakes, reservoirs, and ponds are impaired by PCBs, as are over 250 miles of New Mexico rivers and streams.

141. The quality of New Mexico's water resources directly affects the quality of life of New Mexico citizens.

142. The historical patterns of environmental impact in New Mexico are related to the geographical distribution of basic industries and land use as well as New Mexico's geology, land form, and other natural features, as these determine the basic characteristics and ecological potential of streams and rivers.

143. Between 1929 and 1977, Defendants sold a large volume of PCBs and PCB-containing products to various customers, including retail and secondary manufacturers, within New Mexico.

144. Defendants never advised their New Mexico customers that their PCBs are toxic to human and environmental health (beyond certain inadequate disclosures concerning workplace exposure to PCBs), and that PCBs would leach, leak, off-gas, and escape their ordinary and intended applications and leach, leak, off-gas, and escape their disposal sites, regardless of the nature of the application, to contaminate New Mexico waters, soils, and air. Defendants issued no public warning or instruction about PCBs or the health and environmental safety hazards they present

and indeed denied that such hazards exist. Nor did Defendants warn or instruct their commercial customers not to dispose of PCB materials and wastes in landfills, or to otherwise dispose of such materials in a manner calculated to avoid environmental discharge, leakage, leaching, off-gassing, or other form of contamination of New Mexico waters, soils, and air.

145. Instead, when Defendants provided any information concerning the use and disposal of PCBs, Defendants denied their toxicity and adverse human and environmental health effects, and advised customers that PCBs and PCB wastes should be deposited in landfills, despite knowing this would result in environmental contamination and human and ecological hazards, as alleged above.

146. As a result, New Mexico waters, soils, and air have become contaminated with Defendants' PCBs.

147. The NMED reports that the following waters are currently impaired by excessive levels of PCBs:

a. Conchas Reservoir;
b. Ute Reservoir;
c. Acid Canyon (Pueblo to headwaters);
d. Arroyo del Palacio (Rio Grande to headwaters);

e. Canada Agua (Arroyo La Mina to headwaters);

f. DP Canyon (Grade control to upper Los Alamos National Laboratory ("LANL") boundary);

g. DP Canyon (Los Alamos Canyon to grade control);

h. Graduation Canyon (Pueblo Canyon to headwaters);

i. Los Alamos Canyon (DP Canyon to upper LANL boundary);

j. Los Alamos Canyon (NM-4 to DP Canyon);

k. Pojoaque River (San Ildefonso boundary to Pojoaque boundary);

l. Pueblo Canyon (Acid Canyon to headwaters);

m. Pueblo Canyon (Los Alamos Canyon to Los Alamos wastewater treatment plant ("WWTP"));

n. Pueblo Canyon (Los Alamos WWTP to Acid Canyon);

o. Rio Grande (Ohkay Owingeh boundary to Embudo Creek);

p. Rio Grande (Santa Clara Pueblo boundary to Ohkay Owingeh boundary);

q. South Fork Acid Canyon (Acid Canyon to headwaters);

r. Walnut Canyon (Pueblo Canyon to headwaters);

s. Abiquiu Reservoir;

t. Arroyo del Toro (Rio Chama to headwaters);

u. Canada de Horno (Rio Chama to headwaters);

v. Rio del Oso (Perennial Portion Rio Chama to headwaters);

w. Ancho Canyon (North Fork to headwaters);

x. Ancho Canyon (Rio Grande to North Fork Ancho);

y. Arroyo de la Delfe (Pajarito Canyon to headwaters);

z. Canada del Buey (within LANL);

aa. Canon de Valle (LANL gage E256 to Burning Ground Spring);

bb. Canon de Valle (upper LANL boundary to headwaters);

cc. Chaquehui Canyon (within LANL);

dd. Mortandad Canyon (within LANL);

ee. North Fork Ancho Canyon (Ancho Canyon to headwaters);

ff. Pajarito Canyon (Lower LANL boundary to Two Mile Canyon);

gg. Pajarito Canyon (Two Mile Canyon to Arroyo de la Delfe);

hh. Pajarito Canyon (upper LANL boundary to headwaters);

ii. Rio Grande (Cochiti Reservoir to San Ildefonso boundary);

jj. Rio Grande (non-pueblo Angostura Diversion to Cochiti Reservoir);

kk. Sandia Canyon (Sigma Canyon to NPDES outfall 001);

ll. Sandia Canyon (within LANL below Signa Canyon);

mm. Santa Fe River (Guadalupe St to Nichols Reservoir);

nn. Ten Site Canyon (Mortandad Canyon to headwaters);

oo. Two Mile Canyon (Pajarito to headwaters);

pp. Water Canyon (within LANL below Area-A Cyn);

qq. Rio Grande (Isleta Pueblo boundary to Tijeras Arroyo);

rr. Rio Grande (Tijeras Arroyo to Alameda Bridge);

ss. Rio Grande (non-pueblo Alameda Bridge to HWY 550 Bridge);

tt. Elephant Butte Reservoir;

uu. Pecos River (Eagle Creek to Rio Felix);

vv. Pecos River (Rio Felix to Rio Hondo);

ww. Pecos River (Rio Hondo to Salt Creek);

xx. Pecos River (Rio Penasco to Eagle Creek);

yy. Lower Tansil Lake/Lake Carlsbad (Carlsbad Municipal Lake);

zz. Pecos River (Black River to Six Mile Dam Lake);

aaa. Pecos River (Brantley Reservoir to Rio Penasco);

bbb. Pecos River (Six Mile Dam Lake to Lower Tansil Lake):

ccc. Pecos River (Texas border to Black River);

ddd. Lake Farmington (Beeline Reservoir);

eee. Bill Evans Lake.

148. In this case, New Mexico does not seek damages or other relief concerning PCB contamination of any federal or tribal lands, waters, or other resources, including areas, sites, or resources within LANL, and areas, sites, or resources within the scope of an ongoing assessment by the LANL Trustee Council pursuant to federal regulations. The relief sought concerns only PCB contamination of New Mexico resources and water systems, pursuant to New Mexico law.

149. Further, PCBs currently contaminate an indeterminate number of other New Mexico waterbodies and waterways at levels that do not rise to the State's impairment threshold, as well as waters for which adequate PCB measurements are not currently available, such as aquifers.

150. Like New Mexico waters, New Mexico soils and air also suffer PCB contamination.

151. Comprehensive data showing aggregate PCB concentrations in New Mexico soils and air are not yet available.

152. PCB-contaminated sediments and soils have been the subject of numerous remediation actions taken or overseen by NMED and/or EPA.

153. For example, 5,100 cubic yards of PCB contaminated soil and debris were identified at the Pagano Salvage EPA site (ID# NMD980749980) in Valencia County and remediated.

154. New Mexico has invested significant sums in a variety of general and site-specific efforts to assess, investigate, strategize, and implement remediation plans designed to remove PCBs from New Mexico waters, soils, and air.

155. New Mexico and its residents have suffered loss of use of New Mexico natural resources, including without limitation catching, selling, and/or consuming fish within impaired or contaminated New Mexico waters.

V. CAUSES OF ACTION

FIRST CAUSE OF ACTION
PUBLIC NUISANCE

156. New Mexico realleges and incorporates the allegations set forth in paragraphs 1 through 155 as if fully stated herein.

157. New Mexico asserts this cause of action based on its inherent *parens patriae* authority, and does not here assert or usurp claims on behalf of any individual or non-State entity harmed in his or her person or property by Defendants' conduct.

158. Defendants manufactured, distributed, marketed, promoted, and sold PCBs and PCB-containing products in a manner that created or participated in the creation of a public nuisance that is harmful to human and environmental health and obstructs the free use of New Mexico natural resources and water systems.

159. Defendants intentionally manufactured, distributed, marketed, promoted, and sold PCBs and PCB-containing products with the knowledge that they were causing and would continue to cause environmental contamination of New Mexico natural resources and water systems, including waterways, waterbodies, aquifers, groundwater, lands and submerged lands, soils, sediments, fish and animal tissue, above-ground plants and food crops, biota, air, and stormwater systems.

160. Defendants knew that their PCBs would end up in New Mexico natural resources and water systems, including waterways, waterbodies, aquifers, groundwater, lands and submerged lands, soils, sediments, fish and animal tissue, above-ground plants and food crops, biota, air, and stormwater systems.

161. Defendants' conduct and the presence of PCBs annoy, injure, and endanger the comfort, repose, health, and safety of others.

162. Defendants' conduct and the presence of PCBs interfere with and obstruct the public's free use and comfortable enjoyment of New Mexico natural

resources for commerce, navigation, fishing, recreation, consumption, and aesthetic enjoyment.

163. The presence of PCBs also interferes with the free use of New Mexico natural resources for a healthy environment.

164. Defendants' conduct and the presence of PCBs in New Mexico natural resources and water systems are injurious to human, animal, and environmental health.

165. An ordinary person would be reasonably annoyed or disturbed by the presence of toxic PCBs that endanger the health of fish, animals, and humans, and degrade water quality and marine habitats as well as soils and sediments, above-ground plants and food crops, and air within New Mexico.

166. The seriousness of the environmental and human health risk far outweighs any social utility of Defendants' conduct in manufacturing, distributing, marketing, promoting, and selling PCBs and concealing the dangers posed to human and environmental health.

167. The rights, interests, and inconvenience to New Mexico and the general public far outweighs the rights, interests, and inconvenience to Defendants, who

profited heavily from the manufacture, distribution, marketing, promotion, and sale of PCBs, and which can no longer produce PCBs by law.

168. Defendants' conduct caused and continues to cause harm to the State and its citizens.

169. New Mexico suffered and continues to suffer damage from Defendants' PCBs, including costs to remove PCBs that have invaded New Mexico natural resources and water systems, to prevent PCBs from injuring additional New Mexico natural resources and water systems, and to restore those natural resources whose use has been lost. The injury to New Mexico natural resources and water systems is specially injurious to the State in its proprietary and public capacities.

170. The State is incurring and will continue to incur costs to investigate, monitor, analyze, and remediate PCB contamination in New Mexico natural resources and water systems.

171. Defendants knew, or in the exercise of reasonable care should have known, that the manufacture, distribution, marketing, promotion, and sale of PCBs was causing and would cause the type of contamination now found in New Mexico natural resources and water systems.

172. Defendants knew that PCBs would contaminate water supplies and waterbodies, degrade marine habitats and endanger fish, birds, and animals, and contaminate soils, sediments, above-ground plants and food crops, air, and stormwater and other water systems within New Mexico.

173. In addition, Defendants knew or should have known that PCBs are associated with serious illnesses, including liver, thyroid, dermal, and ocular changes, immunological alterations, neurodevelopmental and neurobehavioral changes, reduced birth weight, reproductive toxicity, and cancer, and that humans may be exposed to PCBs through ingestion of contaminated fish or water, breathing contaminated air, and/or dermal contact.

174. As a result, it was foreseeable to Defendants that humans may be exposed to PCBs through, e.g., swimming in contaminated waters, using contaminated beaches, or eating fish and shellfish from contaminated areas. Defendants thus knew or should have known that PCB contamination would seriously and unreasonably interfere with the ordinary comfort, use, and enjoyment of contaminated waters, soils, plants, food crops, air, and water systems.

175. Accordingly, Defendants had a duty to cease manufacturing, distributing, marketing, promoting, and selling PCBs but failed to do so, as alleged elsewhere herein.

176. Defendants also had a duty to warn about the dangers of PCBs but failed to do so, as alleged elsewhere herein.

177. Defendants are under a continuing duty to act to correct and remediate the injuries their conduct has introduced and to warn the State, their customers, and the public about the human and environmental risks posed by its PCBs, and each day on which it fails to do so constitutes a new injury to the State.

178. As a direct and proximate result of Defendants' creation of a public nuisance, New Mexico has suffered and continues to suffer monetary losses, including loss of value and loss of use of New Mexico natural resources and water systems, in amounts to be proven at trial.

179. As a further direct and proximate result of Defendants' creation of a public nuisance, New Mexico has suffered and will suffer monetary losses in the form of past, current, and forthcoming expenditures in assessing, monitoring, analyzing, remediating, and/or restoring New Mexico natural resources and water

systems injured by Defendants' misconduct, which is a further special injury to the State.

180. As a result of the foregoing, the State seeks monetary damages and injunctive relief.

SECOND CAUSE OF ACTION
DESIGN DEFECT

181. New Mexico realleges and incorporates the allegations set forth in paragraphs 1 through 155 as if fully stated herein.

182. New Mexico asserts this cause of action based on its inherent *parens patriae* authority, and does not here assert or usurp claims on behalf of any individual or non-State entity harmed in his or her person or property by Defendants' conduct.

183. Defendants' PCBs and PCB-containing products were not reasonably safe as designed at the time they left Defendants' control.

184. Defendants' PCBs' toxicity, bioaccumulativity, inability to be contained, and environmental persistence rendered them unreasonably dangerous at all times.

185. Defendants' PCBs were unsafe as designed, as demonstrated by numerous studies alleged hereinabove as well as the U.S. Congress' and U.S. EPA's prohibition on the production and sale of PCBs pursuant to the TSCA in 1979.

186. Due to their toxicity, bioaccumulativity, inability to be contained, and persistence, Defendants knew their PCBs were not safe at the time of manufacture because it was certain that the product would contaminate natural resources and water systems within the United States, including New Mexico, and cause toxic contamination of New Mexico natural resources and water systems.

187. Defendants knew their PCBs were unsafe to an extent beyond that which would be contemplated by an ordinary person because of the information and evidence available to them associating PCB exposure with adverse human and animal health effects as well as the overwhelming seriousness of creating global contamination.

188. Defendants manufactured, distributed, marketed, promoted, and sold PCBs despite such knowledge in order to maximize their profits despite the foreseeable and known harms.

189. Practical and feasible alternative designs capable of reducing the State's injuries were available. Such alternatives include mineral oils and nonfluid insulating chemicals, as evidenced by the rapid replacement of PCBs by such alternatives upon the prohibition of PCBs, as well as alternative chemical formulations and/or additional chemical processing measures Defendants could

have taken to enhance the safety of PCBs. Alternative chemical formulations that would have reduced the State's injuries include a reduction of chlorine content in all PCB products, which would have materially decreased the environmental persistence and toxicity of PCBs without eliminating their typical applications or utilities.

190. Defendants' conduct and the presence of PCBs in New Mexico caused and continue to cause injury to the physical and economic health and well-being of New Mexico citizens.

191. New Mexico has suffered and will continue to suffer injuries to its natural resources and water systems, and damages to its public treasury as a result of Defendants' conduct and the presence of PCBs within the State.

192. Defendants are under a continuing duty to act to correct and remediate the injuries their conduct has introduced and to warn the State, their customers, and the public about the human and environmental risks posed by its PCBs, and each day on which it fails to do so constitutes a new injury to the State.

193. Defendants are strictly liable for all damages arising out of their defective designs.

194. As a result of the foregoing, the State seeks monetary damages in amounts to be proven at trial.

THIRD CAUSE OF ACTION
FAILURE TO WARN AND INSTRUCT

195. New Mexico realleges and incorporates the allegations set forth in paragraphs 1 through 155 as if fully stated herein.

196. New Mexico asserts this cause of action based on its inherent *parens patriae* authority, and does not here assert or usurp claims on behalf of any individual or non-State entity harmed in his or her person or property by Defendants' conduct.

197. Defendants' PCBs and PCB-containing products were not reasonably safe at the time they left Defendants' control because they lacked adequate warnings.

198. At the time Defendants manufactured, distributed, marketed, promoted, and sold PCBs, they knew their PCBs were not safe because it was certain that the product would contaminate natural resources and water systems within the United States, including New Mexico, and cause toxic contamination of New Mexico natural resources and water systems.

199. Despite Defendants' knowledge, Defendants failed to provide adequate warnings that their PCBs would contaminate New Mexico natural resources and water systems.

200. Defendants could have warned of this certainty but intentionally concealed this information in order to maximize profits.

201. In addition, Defendants advised their commercial customers to dispose of PCBs and PCB wastes in landfills when Defendants knew that this method of disposal would lead to contamination of New Mexico natural resources and water systems.

202. Defendants continued to conceal the dangers of PCBs after they manufactured, distributed, marketed, promoted, and sold PCBs.

203. Without adequate warnings or instructions, Defendants' PCBs were unsafe to an extent beyond that which would be contemplated by an ordinary person.

204. Defendants knowingly failed to issue warnings or instructions concerning the dangers of PCBs, their volatilization risks, and proper disposal techniques, in the manner that a reasonably prudent manufacturer would act in the same or similar circumstances.

205. Defendants' conduct and the presence of PCBs in New Mexico caused and continue to cause injury to the physical and economic health and well-being of New Mexico citizens.

206. New Mexico has suffered and will continue to suffer injuries to its natural resources and water systems, and damages to its public treasury as a result of Defendants' conduct and the presence of PCBs within the State.

207. Defendants are under a continuing duty to act to correct and remediate the injuries their conduct has introduced and to warn the State, their customers, and the public about the human and environmental risks posed by its PCBs, and each day on which it fails to do so constitutes a new injury to the State.

208. Defendants are strictly liable for all damages arising out of their failure to provide adequate warnings and instructions as alleged above.

209. As a result of the foregoing, the State seeks monetary damages in amounts to be proven at trial.

FOURTH CAUSE OF ACTION
NEGLIGENCE

210. New Mexico realleges and incorporates the allegations set forth in paragraphs 1 through 155 as if fully stated herein.

211. New Mexico asserts this cause of action based on its inherent *parens patriae* authority, and does not here assert or usurp claims on behalf of any individual or non-State entity harmed in his or her person or property by Defendants' conduct.

212. Defendants failed to exercise ordinary care because a reasonably careful company that learned of its product's toxicity, carcinogenicity, harmfulness to humans, and harmfulness to the natural environment would not manufacture or distribute that product, or would warn of its toxic and environmentally hazardous properties, or would take steps to enhance the safety and/or reduce the toxicity and environmental persistence of the product.

213. Defendants failed to exercise ordinary care because a reasonably careful company that learned that its product could not be contained during normal production and use would not continue to manufacture or distribute that product or would warn of its dangers.

214. Defendants failed to exercise ordinary care because a reasonably careful company would not continue to manufacture or distribute PCBs in mass quantities and to the extent that Defendants manufactured and distributed them.

215. Defendants were grossly negligent because they failed to exercise even slight care, placing revenue and profit generation above human and environmental health and safety.

216. Defendants owed the State and its citizens a duty of care in the manufacture, distribution, marketing, promotion, and sale of PCBs because it was

foreseeable to Defendants that their PCBs would end up in New Mexico's natural resources, including waterways, waterbodies, aquifers, soils, lands and submerged lands, sediments, fish and animal tissue, above-ground plants and food crops, biota, air, and stormwater and other water systems.

217. Defendants' negligent conduct and the presence of PCBs in New Mexico caused and continue to cause injury to the physical and economic health and well-being of New Mexico citizens.

218. New Mexico has suffered and will continue to suffer injuries to its natural resources and water systems, and damages to its public treasury as a result of Defendants' negligent conduct and the presence of PCBs within the State.

219. Defendants are under a continuing duty to act to correct and remediate the injuries their conduct has introduced and to warn the State, their customers, and the public about the human and environmental risks posed by its PCBs, and each day on which it fails to do so constitutes a new injury to the State.

220. As a result of the foregoing, the State seeks monetary damages in amounts to be proven at trial.

FIFTH CAUSE OF ACTION
UNJUST ENRICHMENT

221. New Mexico realleges and incorporates the allegations set forth in paragraphs 1 through 155 as if fully stated herein.

222. New Mexico asserts this cause of action on its own behalf.

223. New Mexico has incurred and will continue to incur expenses in connection with PCB contamination within the State, including investigative, assessment, analysis, monitoring, and remediation or restoration costs.

224. Defendants are responsible for the PCB contamination that New Mexico has addressed and will address, and in fairness, Defendants should have paid these costs. It would be unjust for Defendants to retain the benefit of New Mexico's expenditures in connection with PCB contamination within the State.

225. New Mexico requests an injunction ordering Defendants to return all monies by which Defendants were unjustly enriched as a result of New Mexico's expenditures in connection with PCB contamination within the State.

SIXTH CAUSE OF ACTION
VIOLATIONS OF UNFAIR PRACTICES ACT
NMSA 1978 Sections 57-12-1, *et seq.*

226. New Mexico realleges and incorporates the allegations set forth in paragraphs 1 through 155 as if fully stated herein.

227. The Attorney General of the State of New Mexico asserts this cause of action based on his statutory enforcement authority under the Unfair Practices Act ("UPA," as defined above), NMSA 1978 Section 57-12-15.

228. The State of New Mexico is the real party in interest in this action, and no statute of limitations applies. *See State v. Roy*, 1937-NMCA-026, 41 N.M. 308.

229. The UPA was signed into law on April 4, 1967 (1967 N.M. Laws, ch. 268, codified as 1953 Comp., Section 49-15-1, *et seq.*).

230. The UPA, NMSA 1978 Sections 57-12-1, *et seq.*, prohibits "[u]nfair or deceptive trade practices and unconscionable trade practices in the conduct of any trade or commerce[.]"

231. Defendants are "persons" as defined in the UPA. Section 49-15-2(A) NMSA 1953; NMSA 1978 Section 57-12-2(A).

232. Defendants' conduct alleged herein occurred in "trade" and "commerce" as defined in the UPA. Section 49-15-2(B) NMSA 1953; NMSA 1978 Section 57-12-2(C).

233. The UPA's original prohibition on unfair or deceptive trade practices was broad, and included twelve enumerated classifications of conduct as well as a

thirteenth "catch-all" provision prohibiting companies from "engaging in any other conduct which similarly creates a likelihood of confusion or misunderstanding." Section 49-15-2(C)(13) NMSA 1953.

234. In 1971, the UPA's definition of "unfair or deceptive trade practice" was broadened substantially to include "any false or misleading oral or written statement, visual description or other representation of any kind knowingly made in connection with the sale … of goods or services … by any person in the regular course of his trade or commerce, which may, tends to or does deceive or mislead any person, and includes" an expanded list of enumerated offenses. *See* N.M. Laws 1971 Ch. 240.

235. The UPA's current prohibition on unfair or deceptive trade practices is broader still, and includes both "act[s] specifically declared unlawful pursuant to the [UPA]" and any "false or misleading oral or written statement, visual description or other representation of any kind knowingly made in connection with the sale … of goods … by a person in the regular course of his trade or commerce, which may, tends to or does deceive or mislead any person[.]" NMSA 1978 Section 57-12-2(D).

236. In addition to generally prohibiting any unfair or deceptive trade practices, and any false or misleading statement or other representation of any kind,

the UPA specifically prohibits, *inter alia*, "representing that goods … have … characteristics, … uses, [or] benefits … that they do not have" (Section 49-15-2(C)(5) NMSA 1953 (1967); NMSA 1978 Section 57-12-2(D)(5) (1995)); "representing that goods … are of a particular standard, quality or grade … if they are of another" (Section 49-15-2(C)(7) NMSA 1953 (1967); NMSA 1978 Section 57-12-2(D)(7) (1995)); and "using exaggeration, innuendo or ambiguity as to a material fact or failing to state a material fact if doing so deceives or tends to deceive" (Section 49-15-2(C)(14) NMSA 1953 (1971); NMSA 1978 Section 57-12-2(D)(14)).

237. The Attorney General finds that Defendants' conduct as alleged herein demonstrates that Defendants have used methods, acts, and practices that are unlawful pursuant to the UPA.

238. Among other things, Defendants marketed, promoted, sold, and distributed PCBs and PCB-containing products within New Mexico on the basis of unfair, deceptive, false, and misleading representations and omissions. As alleged in more detail above, Defendants carried out a decades-long campaign of deception in publicly denying and casting doubt on the toxicity of, and environmental hazards associated with, their PCB products—including failing to disclose that PCBs are

toxic to human and animal life, bioaccumulative in living tissue, extremely persistent in nature and resistant to degradation, and tend to escape their ordinary and intended applications to contaminate the natural environment and water systems.

239. Such statements and omissions were made by Defendants to the public in numerous public statements (such as press releases, advertisements, and the 1970 company note published in the journal *Environment*), to public authorities and regulators across the country, and to customers directly (as evidenced by sales manuals, talking-points memos, technical bulletins, and other documents attached to this complaint), among other audiences in New Mexico and elsewhere.

240. Actionable statements (in addition to omissions or failures to disclose) include, but are not limited to:

a. Advertisements published in trade publications, such as *Chemical & Engineering News*, *Adhesives Age*, and *American Paint Journal*, among others, since at least 1950 until an unknown end date, promising that its PCB products resist the effects of weather and refuse to volatilize, evaporate, or otherwise escape their applications;

b. The four false and misleading statements included in the company note appearing in the *Environment* journal in 1970;

c. The July 1970 company press release downplaying safety and environmental concerns by claiming that its PCB products are "not a household item."

241. Pursuant to NMSA 1978 Section 57-12-8(B), New Mexico seeks injunctive relief sufficient to remedy Defendants' violations of law, including an award of restitution and disgorgement of all moneys obtained by Defendants as a result of Defendants' violations of the UPA.

242. Pursuant to 1953 Comp., Section 49-15-9 (1967, as amended through 1970), and NMSA 1978 Section 57-12-11, New Mexico also seeks "a civil penalty of not exceeding five thousand dollars ($5,000) per violation."

JURY DEMAND

New Mexico respectfully requests trial by jury on all claims so triable.

PRAYER FOR RELIEF

New Mexico prays for judgment against Defendants, jointly and severally, as follows:

A. Damages according to proof;

B. Award of past, present, and future costs to abate the ongoing public nuisance and/or to investigate, assess, analyze, monitor, and remediate the contamination;

C. Award of restitution and disgorgement of all moneys obtained as a result of Defendants' violations of the Unfair Practices Act;

D. Any other damages or losses as permitted by law;

E. An injunction ordering Defendants to return all monies by which Defendants were unjustly enriched as a result of the State's expenditures in connection with PCB contamination within the State;

F. Civil penalties in an amount equal to $5,000 per violation of the Unfair Practices Act, pursuant to 1953 Comp., Section 49-15-9 (1967, as amended through 1970), and NMSA 1978 Section 57-12-11;

G. Litigation costs and attorneys' fees as permitted by law;

H. Pre-judgment and post-judgment interest on all monies awarded, as permitted by law;

I. Such other and further relief as the Court deems just and proper.

DATED: May __, 2019

HECTOR H. BALDERAS
ATTORNEY GENERAL OF NEW MEXICO

/s/ P. Cholla Khoury
P. Cholla Khoury
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EXHIBIT 1

October 11, 1937.

"Experimental work in animals shows that prolonged exposure to Aroclor vapors evolved at high temperatures or by repeated oral ingestion will lead to systemic toxic effects.

Repeated bodily contact with the liquid Aroclors may lead to an acne-form skin eruption.

Suitable draft ventilation to control the vapors evolved at elevated temperatures, as well as protection by suitable garments from extensive bodily contact with the liquid Aroclors, should prevent any untoward effect."

In talking with Dr. Kelly before these three paragraphs were written, we agreed that they might as well be phrased so that they could be used not only in the Aroclor booklet, but quoted in correspondence as that may be necessary.

L.A. Watt

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ALL-STATE LEGAL®

Attachment 3-2

3.2

CV96-J-0440-E
DATE 04/02/01

PLFF EXHIBIT NO. 877

EXHIBIT 2

COPY

Dr. D.V.N. Hardy ✓
Dr. H.R. Newman.

Monsanto Chemical Company

St. Louis, Missouri

September 20, 1955

Dr. J.W. Barrett
London

Your memo September 8 to Mr. Nason
AROCLOR TOXICITY

Howard Nason has given me your memo of September 8. I will be happy to discuss this with Dr. Newman during his visit here. I think, however, there are several points that I can answer you now.

You comment upon the difference in toxicity between Aroclor 1254 and 1242. This is not particularly surprising because in the earlier work it was found that toxicity increased with chlorination. Of course, from the standpoint of volatility in the case of inhalation or absorption from the gut from the point of view of ingestion are important. Frankly, there was not too great a difference between the two compounds, however. As you know, the maximum allowable concentrate is 0.1 ml/cubic meter in the case of 1254, and as high as 10.0 mgm in the case of 1268. I think the former is too low and the latter is too high. In this country they don't use the MACs very routinely, but certainly in England I think it would be alright to consider 0.2 mgm/cubic meter as perfectly safe.

I don't know how you would get any particular advantage in doing more work. What is it that you want to prove? I believe your work should be directed towards finding out what the concentrations are of Aroclor during different operations whether it is industrial or painting. The reports you have seen from Kettering Laboratory are the result of approximately $15,000 to $20,000 expenditure by MCC.

MCC's position can be summarized in this fashion. We know Aroclors are toxic but the actual limit has not been precisely defined. It does not make too much difference, it seems to me, because our main worry is what will happen if an individual developes any type of liver disease and gives a history of Aroclor exposure. I am sure the juries would not pay a great deal of attention to MACs.

PENGAD-Bayonne, N.J.
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COPY

We, therefore, review every new Aroclor use from this point of view. If it is an industrial application where we can get air concentrations and have some reasonable expectation that the air concentrations will stay the same, we are much more liberal in the use of Aroclor. If, however, it is distributed to householders where it can be used in almost any shape and form and we are never able to know how much of the concentration they are exposed to, we are much more strict. No amount of toxicity testing will obviate this last dilemma and therefore I do not believe any more testing would be justified.

Let's see what our discussions with Dr. Newman and yourself bring out.

R. Emmet Kelly, M.D.

REK:k

EXHIBIT 3

CONFIDENTIAL

MINUTES OF AROCLOR "AD HOC" COMMITTEE

First Meeting

Date: September 5, 1969

Present: M. W. Farrar
P. B. Hodges, Secretary
E. V. John
W. R. Richard
E. P. Wheeler, Chairman

Objectives: (Agreed to by the Committee)

Submit recommendations for action which will:

1. Permit continued sales and profits of Aroclors and Terphenyls.
2. Permit continued development of uses and sales.
3. Protect image of Organic Division and of the Corporation.

Background Discussion of Problem:

1. Agreed that we should concentrate on Aroclor 1254 and 1260. Aroclor 1242 has not yet been incriminated for these possible reasons:
    a. Nature of uses of 1242 minimizes environmental contamination.
    b. It may degrade biologically.
    c. Unless analytical techniques are performed carefully, 1242 can be destroyed by oxidation during the analyses.
2. PCB has been found in:
    a. Fish, oysters, shrimp, birds.
    b. Along coastlines of industrialized areas such as Great Britain, Sweden, Rhine River, low countries, Lake Michigan, Pensacola Bay, in Western wild life (eagles). It may be a global contaminant.
3. PCB has been tied to DDT in effects on disappearance of wild birds which have fish diets. Ratio of PCB to DDT has been about 40-50:1 generally. Dr. Reisboro reported almost 1:1 ratio. PCB may be contributing to or exaggerating the effects of other chlorinated aromatics.

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[illegible]

4. Sample acceptance from the numerous researchers was discussed. This has been done on a limited basis. Our corroboration of testing of their samples adds to our knowledge and demonstrates a willingness by Monsanto to help define the problem, but it is expensive and also tightens any possible legal cases against us-- it rules out possibilities that Aroclors are not involved.

5. Toxicity levels:

   Aroclors have been shown to be safe for man in reasonable exposure concentrations. We are testing 100 ppm in diet of rats and dogs on a rule-of-thumb basis that 1/100 of toxicity level is safe and 1 ppm is probably the upper limit in total diet.

   "Allowable levels" are probably lower than DDT. The worst example to date is the test at Pensacola where 5 ppb was found to be toxic to shrimp in 18 days exposure.

   One problem we are facing is to keep the "safe level" (?) for shrimp from being applied to e.g. Lake Michigan where more tolerant fish species probably exist. We need to show the safe level in shrimp, clams, oysters and several species of fish.

   Many toxicity studies on PCB are underway and it was agreed to be desirable to keep contact with all laboratories which have requested Aroclor samples. One-half to two-thirds of the sample requests have come from state labs (who would let us know what they are doing) and about 1/3 have come from universities (who may give us the "brush-off"). Question of who should call on the laboratories was not resolved.

6. Escambia River Problem:

   For a clearer understanding of the general problem, the situation at Pensacola was reviewed. From a relatively negligible discharge of 1-3 gal/day into a large river, 1/4 mile downstream levels of 42 ppb in water and 476 ppm in mud were found. Although use of Aroclor was halted immediately, we can expect the water contamination to continue for a lengthy period by leaching from the contaminated mud. No downstream samples have yet been taken to measure the decrease in contamination (as of 9/5/69).

7. Problem in Producing Plants:

P. Hodges reviewed what was being done to stop gross losses at Anniston and at WGK. Basically, the work to date consists of stopping or trapping any sewering of free Aroclor with return to process or land fill disposal of the trapped Aroclor. This will reduce levels in plant effluents to below solubility ranges, particularly as we move to install traps (or sumps) back into the waste source points where flows are small and as yet undiluted by Aroclor-free waste streams. The question of exactly how far to reduce (how much money to spend) is not yet clear and expenditures to date have been comparatively small. It was agreed that, until the problems of gross environmental contamination by our customers have been alleviated, there is little object in going to expensive extremes in limiting discharges from the plants.

One problem that has been interfering with logical development of our plant Aroclor waste reduction programs has been delays in obtaining analytical results from in-plant and ex-plant sampling. It was agreed that additional help was necessary in Dr. Tucker's lab but no specific actions were proposed. In addition to in-plant work, the plants are sampling the receiving streams.

Air pollution reduction has not been considered by the plants to date except as incidental prevention of product contamination during tank car and drum loading operations. Long range (1-2 year) improvements at Anniston are planned to reduce product contamination (and air emissions) in car loading operations. It was agreed that a comprehensive air sampling and testing program would be very expensive and is probably not justified at this stage of the problem.

8. Environmental Contamination by Customers:

Our in-plant problems are very small vs. problems of dealing with environmental contamination by customers. In one application alone (highway paints), one million lbs/year are used. Through abrasion and leaching we can assume that nearly all of this Aroclor winds up in the environment.

Because the rate of natural (bio-degradation) is very low, other degradation must destroy PCB equal to the rate of environmental exposure in order to avoid build-up of contamination.

A general discussion was held on philosophy of controlling sales or working with customers to prevent pollution by PCB.

Action Planned:

Each member of the group will submit to the other members for consideration possible ideas and programs to help accomplish the overall objectives set by the Committee. Following review of the suggestions, the Committee will meet again at an early date to be arranged by the Chairman.

P. B. Hodges
Secretary

:ju

EXHIBIT 4

Elmer P. Wheeler, Medical Department

January 29, 1970

J. S. Barrett, [redacted]
[redacted]
W. B. Papageorge, [redacted]

Status of Aroclor Toxicological Studies

D. S. Cameron
Brussels

Enclosed is a copy of the reports from our consulting laboratory indicating the status of the animal toxicity studies. I have summarized the pertinent findings separately and as indicated in the table.

We have given copies of these data to one U. S. customer, the U. S. FDA and one or two other state agencies. I don't see why this information cannot be released with discretion in Britain or Europe.

Our interpretation is that the PCB's are exhibiting a greater degree of toxicity in this chronic study than we had anticipated. Secondly, although there are variations depending on species of animals, the PCB's are about the same as DDT in mammals.

We have additional interim data which will perhaps be more discouraging. We are repeating some of the experiments to confirm or deny the earlier findings and are not distributing the early results at this time.

Elmer P. Wheeler

EPW:ju

Enclosure

PLAINTIFF'S EXHIBIT
4A9

EXHIBIT 5

Monsanto

FROM (NAME & LOCATION) N. T. Johnson St. Louis

DATE February 16, 1970

SUBJECT

REFERENCE POLLUTION LETTER

TO

P. Craska - Wilmington
C. Clay - St. Louis
J.H. Davidson - Los Angeles
R.A. Damiani - Chicago
G.F. Fague - Detroit
R.A. Garcia - Akron
R. Garnsworthy - Melbourne
J.A. Heilala - Akron
R. Irwin - Houston
J.S. Pullman - New York
J.J. Roder - Chicago
R. Giles - Melbourne

CC:

P.J.A. Marsh - Brussels
R. Enrhardt - New York
T.W. Oneson - Montreal
J.N. Haggart - Brussels
V. Morse - St. Louis
J. Brydon - Montreal
R. Graham - New York
P.G. Benignus
J.G. Bryant
D.E. Roush
J.R. Fallon
D.A. Hall
D.R. Pogue
D.F. Smith
D.A. Olson

Attached is a list of questions and answers which may be asked of you by customers receiving our Aroclor-PCB letter. You can give verbal answers; no answers should be given in writing. If the customer asks a question you can't answer or if he wants an answer in writing, then send his questions to me and we will answer from here.

We want to avoid any situation where a customer wants to return fluid. The new reformulated products will be available within a month. We would prefer that the customer use up his current inventory and purchase Pydraul 625A, Pydraul ACA, Pydraul ACA Winter Grade and Pydraul 540A when available. He will then top off with the new fluid and eventually all Aroclor 1254 and Aroclor 1260 will be out of his system. We don't want to take fluid back. Sell him the replacement.

We must be very positive in our approach with each customer relative to our decision to eliminate the use of Aroclor 1254 and Aroclor 1260 in our Pydraul products. We (your customer and Monsanto) are not interested in using a product which may present a problem to our environment. We certainly have no reason to be defensive or apologetic about making this change. The decision to change makes good sense and our customers should commend us, not criticize our actions. No one has forced us to make this

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change. We have done it to keep our customers out of possible trouble. They should appreciate our effort, and stay with us as a customer on the reformulated Pydrauls. To make this change has cost us research monies and time. Fortunately, we possess the technical skills to make a change in our formulations without affecting the performance of products. Be positive, Take the offense. Don't let a customer or competitor intimidate you. I doubt if our competitors know whether their product could present a problem to our environment. You might ask your customer, if he has ever asked Houghton or Stauffer, Carbine, etc. about the effects of their products.

We should also recognize (point this out to your customer) we must clean-up. The Chemical Week article gives him an idea of laws in effect in his state. Read this yourself. Be familiar with the data on each state in which your customers are located. Use this in your discussions.

We have no replacement products for Aroclor 1254 and Aroclor 1260. We will continue to make these products; however, customers will have to use their own judgement on continued use.

We can't afford to lose one dollar of business. Our attitude in discussing this subject with our customer will be the deciding factor in our success or failure in retaining all our present business. Good luck.

(We have also attached a copy of the letter sent to transformer customers.)

N. T. Johnson

lb

EXHIBIT 6

Toxicity

REPORT TO THE MONSANTO CHEMICAL COMPANY

by

Cecil K. Drinker, M.D.
Dean and Professor of Physiology
Harvard School of Public Health, Boston, Mass.

September 15, 1938

EXHIBIT 10

I. EXPERIMENTS TO DETERMINE THE POSSIBLE TOXICITY OF THE FOLLOWING SUBSTANCES

1. CHLOROCOSANE

On July 14, 1937, we were informed by F. D. Smith that each 6 ounce bottle of a soft drink might contain 60 to 70 mgm. of chlorocosane. There was no pharmacological reason to believe the compound would be irritating or toxic in any way, and therefore it was decided to dose rats with it very heavily, the argument being that if they survived heavy dosage without any evidence of damage a verdict of no toxicity might be given and much time saved. If, on the other hand, the large doses proved poisonous it would be necessary to reduce dosage until a non-toxic level was reached. The first of these alternatives proved correct.

Experiments. — August 10, 1937. 20 adult white rats ranging in weight from 162 to 210 gm. were each fed 70 mgm. of chlorocosane in 1 cc. of olive oil daily by stomach tube. These animals showed no evidence of damage in any way attributable to chlorocosane. They were examined microscopically from the 35th to the 92nd day. The only constant change observed was a possible slight increase in the granularity of the cells of the liver cords, but the pathologist in charge felt this to be within normal limits. This finding is doubly reassuring since many of the animals developed a chronic suppurative lung condition very prevalent in Boston stock rats at the time. But even with this added handicap there was no evidence of damage and we thus conclude that chlorocosane even in enormous dosage is an inert material in the body and in all probability passes through the intestine unchanged.

2. DIPHENYL PHTHALATE

On August 23, 1937, we were informed by Dr. R. E. Kelly that diphenyl phthalate might be absorbed through the skin or might be inhaled and swallowed during spraying operations. After consultation it was decided to feed heavily, and if there were indications of toxicity to project other experiments.

Experiments. -- September 20, 1937. 20 adult white rats ranging in weight from 242 to 301 gm. were each fed 0.5 mgm. of diphenyl phthalate suspended in 1 cc. of water by stomach tube daily. The animals were from new stock and with one exception remained clear of the lung condition which existed in the chlorocosane group. During the period of experiment, which lasted 92 days, practically all the animals gained weight. Examination of 8 animals killed at intervals during this period of test resulted as follows:

The organs were normal grossly, and on microscopic examination the liver alone was of possible interest. The changes in the liver varied from those in which the cells of the liver cords were almost normal, having only a slight swelling and granularity of their cytoplasm, to those in which these changes were pronounced. In the latter there was a moderate degree of vacuolization and a rare hyaline body. These alterations it must be understood were the result of very certain dosage, since the compound was given by stomach tube and the animals had no possible way of avoiding it. Neither the pathologist nor myself was able to consider them of enough moment to cause us to make further experiments.

I am confident that with the ordinary precautions accompanying spray lacquering no possible harm could be done, even if the concentration of diphenyl phthalate in the lacquer was far above the 5 per cent figure given us by R. E. Kelly.

5. CHLORINATED DIPHENYL -- COMPOUND #1268

This material was furnished by the Monsanto Chemical Company. It was said to have a chlorine content of 68 per cent, the highest chlorine figure of any compound tested by us during the past three years. It had been our impression that toxicity and chlorine content followed one another closely, but this has not turned out to be the case for #1268. ~~in connection with~~ [illegible] Further discussion of this point will follow the description of the experimental observations and their results.

__Experiments.__ -- August 2, 1937. The compound #1268 was administered by inhalation, the technique being that described in the paper entitled __The Problem of Possible Systemic Effects from Certain Chlorinated Hydrocarbons__, Journal of Industrial Hygiene, 1937, __19__, 283. For the first observations 80 adult white rats were used. They were exposed as follows:

Group 1. -- 80 animals. Temperature to which the compound was heated to introduce fume into air line 140-190° C. Average concentration in air breathed by rats 0.53 mgm. per cubic meter. Average daily exposure 16 hours. The experiment was continued for 119 days, animals being sacrificed at intervals for pathological examination and for the carbon tetrachloride and alcohol test (see paper previously cited).

The conditions described above caused swelling and increase of granularity of the liver cells. Hyaline inclusions were rare. These changes were quite uniform in all animals examined after the 51st day, but were not certainly progressive. The rats were very healthy throughout the period and there was an almost uniform gain in weight. The carbon tetrachloride-alcohol test was positive after 52 days, which indicates that though liver damage was apparently slight some degree of harm had been done the organ. There was no evidence of damage in any part of the body except the liver.

At the end of 93 days 10 rats, apparently in excellent condition, were removed from the experiment and set aside for observations upon liver recovery. These recovery animals showed no clinical changes of any sort. When sacrificed 72 and 141 days after removal from exposure it was observed that the swelling of the liver cells had disappeared, but the granular and hyaline material remained in the liver cells and had apparently become permanent. There was absolutely no progression of damage after removal from exposure.

These changes may be compared with those produced in rats by inhalation of chlorinated diphenyl #4465, administered in a similar manner in concentrations of 0.57 to 0.93 mgs. per cubic meter over similar periods of time. In the case of this compound the conspicuous difference was the far greater incidence of hyalinization of the liver cells, which in our opinion was the characteristic lesion caused by #4465 and mixtures containing it. One can therefore conclude that #1268 in low concentrations is definitely less toxic than #4465.

Group 2. — After 119 days, the low concentration of #1268 having proved but slightly poisonous, it was decided to increase the concentration in the air breathed by the 54 rats then remaining. Temperature and other conditions were maintained as during the first 119 days, but by the use of 4 vaporizers instead of 1 the average concentration of #1268 in the air was brought to 6.23 mgs. per cubic meter of air. Exposure to this very high concentration was continued for 87 days.

Under these extreme conditions the animals again remained in perfect health. The carbon tetrachloride and alcohol test was positive but there was absolutely no other indication of liver damage and no evidence of disturbance to other organs.

When examined at autopsy at the end of 87 days -- the animals had experienced a total exposure of 206 days -- there were no gross evidences of abnormality in any part. On microscopic examination no organ showed changes except the liver. The number of cells containing hyaline and the amount of hyaline in the cells involved increased during this period of exposure to the higher concentration of #1268. The hyaline was most abundant in the portal zone of the lobule with very little in the central area. After 42 days of exposure 10 rats were set aside and were sacrificed 73 days later. They were in excellent condition when removed and did not change. Grossly, at autopsy, they showed nothing abnormal, and on microscopic examination the liver cells had lost their swelling but retained increased granularity and hyaline inclusions.

The experiments on inhalations of high concentrations of #1268 reenforce the conclusion that this compound is of low toxicity as compared with #4465 or with chlorinated naphthalenes above trichlornaphthalene. The question as to why #1268, the most highly chlorinated compound tested, proved but slightly harmful cannot be answered with any definiteness. It has been suggested that the toxicity of all these chlorinated compounds, even though of varied composition, may depend on the ability of the animal to decompose them after lodgment in the tissues, and that this decomposition might be shown by an increase in the chlorine in the urine in suitably conducted feeding experiments. In experiments upon this point we have shown a definite increase in the urinary chlorides when dogs and rats were fed a mixture of penta and hexachlornaphthalenes (#1000), a compound highly injurious to the liver and containing 62.6 per cent of chlorine, but similar observations have not been made with any of the chlorinated diphenyls or allied compounds. It may, however, be that when about 65 per cent chlorination is reached the substances formed are quite stable in the body and so cause a minimum of damage.

In conclusion, #1268, if handled with ordinary precautions as to ventilation should be entirely harmless to workmen. While it cannot be given an absolutely clean bill as to health, it is preferable to #4465 and #5460.

4. MIXTURE OF CHLORINATED DIPHENYL AND CHLORINATED DIPHENYL BENZENE -- COMPOUND #5460

This substance was furnished by the Monsanto Chemical Company and was said to have a chlorine content of 60 per cent, being in this respect below #4465 and far below #1268.

Experiments. -- The inhalation technique was used as in the case of #1268 and #4465.

August 2, 1937. 80 adult white rats were the subjects. Temperature to which the compound was heated to introduce fume into the air line 140-155° C. Average concentration in air breathed by rats 0.085 mgm. per cubic meter. Average daily exposure 16 hours. The experiment lasted 119 days. A certain number of animals were sacrificed for pathological examination, others were used for the carbon tetrachloride and alcohol test, and still others set aside for observations as to recovery from possible damage.

In spite of the fact that the concentration in the air breathed by the rats averaged about 1/6 that obtained at comparable temperatures from #1268, a number of these animals became sick and lost weight towards the end of the second month of exposure. When killed, such individuals showed gross mottling of the liver but no changes in other organs. On microscopic examination swelling of the liver cells, increased granularity and hyaline inclusions were noted in animals killed as early as the 16th day of exposure. These changes obviously occurred rapidly. Hyaline deposits were never as numerous as with #1268. Animals removed for recovery after 51 and 119 days of exposure did not gain markedly in weight, and one died for no obvious cause. When examined at autopsy the swelling of the liver cells had subsided, but abnormal granularity and hyalinization remained.

Needless to say the carbon tetrachloride and alcohol test was positive whenever used.

In view of the fact that #5460 in such low concentration proved so definitely toxic, no higher concentrations were tested. It seems imperative that whenever this compound is used in industry, great care be taken to keep concentrations in the air at an extremely low level. No liberties can be taken with it, as with #1268.

II. SOME GENERAL CONSIDERATIONS

In addition to these tests of compounds, certain experiments were done which are of interest to those manufacturing or using chlorinated hydrocarbons. Details as to these experiments are of course available but are not included in this report since they are not of direct industrial interest.

1. EVIDENCE FOR THE DESTRUCTION OF A MIXTURE OF PENTA AND HEXACHLORNAPHTHALENES (#1006) IN THE BODY

It has always been a question as to whether the chlorinated hydrocarbons which have been examined by ourselves and by others do harm *per se* or whether toxicity depends on their breakdown in the body with the liberation of something harmful to the liver. A partial answer has been obtained by feeding #1006 to rats and dogs which were on a low chloride diet with uniform excretion of chlorides in the urine. When these animals received the chlorinated hydrocarbon (#1006) the urinary chlorides rose. This indicates that the body certainly has power to detach chlorine from this compound, and it is probable that the same condition is true for allied toxic compounds. It would be most interesting to see whether ingestion of #1268 results in similar findings or whether in the case of this relatively non-toxic compound there is practically no splitting off of chlorine. Neither time nor our financial resources permitted such tests.

2. THE EFFECT OF INCREASING THE SODIUM CHLORIDE IN THE DIET UPON ANIMALS RECEIVING TOXIC DOSES OF #1006

On the ground that chlorides might be fundamentally associated with toxicity, a group of 15 rats was fed a low toxic dose of #1006 and compared with a similar group on the same dosage of #1006 plus a marked increase in chloride intake secured by giving 5 cc. per kilogram of body weight of 4 per cent NaCl solution daily.

No differences were found between the two groups, and it may be concluded that chlorine increase secured through the diet does not enhance toxicity. This experiment was done in order to find out whether increase in chloride intake during hot weather might be harmful.

A particular phase of the problem, the possible enhancement of typical skin lesions by increasing chloride intake, cannot be decided by experiments on fur-bearing animals with no sebaceous glands. All that can be said at the moment is that increased chloride intake does not increase systemic toxicity.

3. THE EFFECT OF HIGH AND LOW CALCIUM DIETS ON ANIMALS INHALING HIGH CONCENTRATIONS OF #1006

It is well known that a diet rich in calcium is markedly effective in preventing the acute yellow atrophy of the liver produced by carbon tetrachloride (The Prevention and Treatment of Carbon Tetrachloride Intoxication. By P. D. Lamson, M.D., A. S. Minot, Ph.D., and B. H. Robbins, M.S., Journal of the American Medical Association, 1928, volume 90, page 345).

To discover whether calcium in the diet would protect against liver damage from a toxic chlorinated hydrocarbon, 30 adult white rats were placed upon a diet of lean horsemeat, starch and lard, a combination adequate for maintenance but very low in calcium. Another group was given a diet consisting of dog chow, milk, lettuce and eggs, with added calcium lactate -- a ration very high in calcium.

Both groups were exposed simultaneously to inhalation of high concentrations of #1006, an average of 11.21 mgm. per cubic meter for 16 hours a day.

After 18 days, 12 high calcium diet rats were alive and 7 of the low calcium group. At intervals animals were killed for examination. In both groups the liver was abnormal grossly and microscopically, and in both groups animals died from liver damage. It was impossible to consider that the high calcium diet was in the least degree protective. It may, therefore, be concluded that adding calcium to the diet of workers either in the form of extra milk or of calcium lactate will not prevent liver damage.

4. THE EFFECT OF INJECTIONS OF XANTHINE ON ANIMALS INHALING HIGH CONCENTRATIONS OF #1006

In 1937, R. C. Neale published a brief paper (The Protective Action of Certain Purines against Liver Necrosis Produced by Carbon Tetrachloride and Chloroform. Science, 1937, volume 86, page 83). He claimed that rats injected with sodium xanthine became markedly resistant to carbon tetrachloride. This suggested that xanthine might have similar protective power over liver damage from the chlorinated hydrocarbons on examination in this laboratory.

Accordingly 38 adult white rats were caused to inhale #1006 in concentrations averaging 15 mgm. per cubic meter for 16 hours daily. One group of 20 rats was given 20 mgm. of xanthine subcutaneously every other day and 40 mgm.

of xanthine by stomach tube on the alternate days. The second group of 18 rats had the same exposure to #1006 without xanthine treatment. No differences were noted and one cannot expect any efficacy from xanthine either in the prevention or treatment of liver disease due to this chlorinated hydrocarbon, and in all probability the same negative result would be encountered in connection with allied toxic compounds.

EXHIBIT 7

EW

February 14, 1950

Dr. Louis W. Spolyar, Director
Division of Industrial Hygiene
Indiana State Board of Health
1098 West Michigan Street
Indianapolis 7, Indiana

Dear Dr. Spolyar:

I enclose an application bulletin on our Aroclors. On page 19, there is a summary of almost all our toxicology information on this compound.

If the case you refer to is in Brazil, Indiana, our company has had some contact with the problem. This particular installation used a temporary heat transfer system, and thus did not make the installation air tight. This is contrary to our expressed instructions when Aroclor is to be used at elevated temperatures. Upon hearing of the illness, one of our development engineers went to the plant and gave his recommendations, and then I called the plant physician to try to obtain some idea of what the illnesses were. As far as I could determine, two men suffered from gastrointestinal upset. I suspected the possibility that the Aroclor fumes might have caused liver damage, but was unable to obtain this information over the phone. I was also unable to contact the employee's physician.

The toxicology of Aroclors is somewhat confused. The experimental work was done by Dr. Drinker at Harvard about 12 years ago, and was done in connection with chlorinated naphthylene, chlorinated diphenyl, and chlorinated diphenyl high boiler. Both of these last two are Aroclors. In the particular work at Harvard, Dr. Drinker found that Aroclor 1268, which means diphenyl chlorinated to 68%, was of low toxicity. The confusion existed in his findings that Aroclor 1254, which is the diphenyl chlorinated to only 54%, was considerably more toxic on inhalation. We did not supply him with this material, and I was never convinced that some error might not have been made in the sample.

At any rate, we have advised protection against all Aroclor fumes when an elevated temperature is used. I will appreciate it if you will let me know the result of your investigation, if one is to be made.

Very truly yours

R. Emmet Kelly, M.D.
Medical Director

RFK:rg

B CC: Mr. Paul Benignus
St. Louis

From **MONSANTO CHEMICAL COMPANY**
At St. Louis

- 4 SEP 1953

Date September 1, 1953

cc Mr. T.K. Smith - 7
Mr. A.T. Beauregard - 7
Mr. P. G. Benignus - 7
Dr. J.W. Barrett - London
Dr. J.A. Gardner, - Fulmer
Mr. J.P. Stkickley - KXOK
Dr. N.B. Dyson - Newport

To Mr. E. Mather
At Ruabon

Reference Your memo to ATB - 8/11/53
Subject AROCLORS: TOXICITY

Mr. Beauregard has asked the Medical Department to comment on your letter referred to above.

As I am sure you know, Aroclors cannot be considered nontoxic. The interpretation of the toxic properties of a compound, however, determine whether or not there is any hazard associated with the specific use of a compound. To my knowledge, there is no hazard involved in the use of transformers containing Aroclors as a substitute for other materials. To my understanding, in the United States this application of Aroclors is widely accepted and has not resulted in any difficulty from a toxicological standpoint.

I cannot state whether or not a flash discharge might generate phosgene. I believe, however, that any phosgene so generated would be in a very small proportion to the total smoke and fumes resulting from the discharges. In instances where Aroclor, as a heat exchange medium, has been subjected to fire and high temperature after a leak in equipment, the clouds of breakdown products have been highly irritating but probably no more so than one would expect from the burning of any type of industrial oil or chemical.

I'm sure that Mr. Benignus will answer your questions relative to the effect of Aroclor on insulating materials, when he returns from his vacation next week.

As you indicated, we are watching the use of the Aroclors as plasticizers in emulsion paints. We do not recommend that they be used in paints which might be applied in confined or unventilated areas, particularly if the paints might be used on heated surfaces. As you stated, this is a case of worrying about the exposure of painters who might apply such materials day in and day out rather than the worrying about those who might occupy the room during or shortly after the paint has been applied.

EPW
Elmer P. Wheeler

RECEIVED
- 4 SEP 1953
RUABON

EPW:SMB

IBIT 12

EXHIBIT 8

From **MONSANTO CHEMICAL COMPANY**
At St. Louis

cc Mr. J. Cresce -Krumm. Plt
Mr. E. W. Lieben -" "
Mr. R. M. Webber -" "

CONFIDENTIAL

Date November 14, 1955

To Mr. H. B. Patrick
At Krummrich Plant

Reference

Subject DEPARTMENT 246 (AROCLORS)

It is the opinion of the Medical Department that the eating of lunches should not be allowed in this department for a number of reasons.

(1) Aroclor vapors and other process vapors could contaminate the lunches unless they were properly protected.

(2) When working with this material, the chance of contaminating hands and subsequently contaminating the food is a definite possiblity.

(3) It has long been the opinion of the Medical Department that eating in process departments is a potentially hazardous procedure that could lead to serious difficulties. While the Aroclors are not particularly hazardous from our own experience, this is a difficult problem to define because early literature work claimed that chlorinated biphenyls were quite toxic materials by ingestion or inhalation. In any case where a workman claimed physical harm from any contaminated food, it would be extremely difficult on the basis of past literature reports to counter such claims.

Jack T. Garrett
Jack T. Garrett

JTG:SMB

PLAINTIFF'S EXHIBIT
4403

PENGAD-Bayonne, N.J.

[ ] IN 10

EXHIBIT 9

Messrs.:
G. R. Buchanan - Robts.
R. E. Hatton - M.C.
F. H. Langenfeld-Robts.
H. E. Litzsinger-Robts.
G. R. Sido-Washington, D.

2/07-

St. Louis, Missouri

January 21, 1957

Mr. H. I. Armstrong
Roberts Building

PYDRAUL 150

Dr. Treon and I spent an afternoon with the Navy people to discuss Pydraul 150. Those present were Captain Shone, Captain Alvis, Captain Sessions, Commander Siegal and Mr. Mickey Albert. They discussed their information concerning Pydraul 150 which was obtained at the Naval Institute of Medical Research. While reports were not available, they had the following general data:

> Skin applications of Pydraul 150 caused death in all of the rabbits tested. (The amount administered was not given.) A like amount of Cellulube 220 did not cause any deaths.
>
> The inhalation of 10 milligrams of Pydraul 150 per cubic meter or approximately 2 tenths of a part of the Aroclor component per million for 24 hours a day for 50 days caused, statistically, definite liver damage. No matter how we discussed the situation, it was impossible to change their thinking that Pydraul 150 is just too toxic for use in a submarine. It may be that such concentrations would never be reached in the submarine but the Navy does not appear willing to even put the material in a trial run to see if it will work.

It would appear, therefore, that we should discontinue to sell Pydraul 150 for this particular application and try to develop a hydraulic fluid without Aroclor as one of its components. In this connection, Cellulube 220 is not used in a submarine but it was used in this test merely as a yardstick.

The Navy said they did not have any competitive fluid far enough along engineering-wise to even consider the toxicity of it.

R. Emmet Kelly, M.D.

REK:SMB

ALL-STATE LEGAL®
PLAINTIFF'S EXHIBIT
5A03P

EXHIBIT 10

[illegible]

W. H. Richard - Research Center

March 6, 1969

AROCLOR WILDLIFE ACCUSATIONS

TO : E. Wheeler - EWHEE

cc

H. Bergen	HBERG
J. Springate	JSPRI
W. Schalk	WSCHA
D. Olson	DOLSO
R. Kelly	RKELL
J. Garrett	JGARR
P. Hodges	PHODG
P. Park	PPARK
R. Keller	JFQ
E. Tucker	JFQ

Risebrough in a recent paper "Nature", Vol. 220, Dec. 14, 1968, has attacked chlorinated biphenyls in three ways:

(1) a pollutant - widely spread by air-water; therefore an uncontrollable pollutant.

(2) a toxic substance - with no permissible allowable levels causing extinction of peregrine falcon by induced hepatic enzymes which degrade steroids upsetting Ca metabolism leading to reproductive weakness, presumably through thinner egg shells.

(3) a toxic substance endangering man himself; implying that the peregrine falcon is a leading indicator of things to come.

As outlined in Science, Vol. 163, Pg. 548, Environmental Defense Fund (EDF) is attempting to write new legal precedents in conservation law by hearings and court action. In the Wisconsin case, water quality standards are at issue. "A substance shall be regarded as a pollutant if its use results in public health problems or in acute or chromic (injury) to animal, plant or aquatic life". Wisconsin is one of 7 states which now have federally approved water quality standards. According to Bern Wright, acting chief of the Federal Water Pollution Control Administration's Water Quality Standards Branch, DDT would fit the definition of a pollutant upon a showing that it is harmful to aquatic life.

These people in EDF are saying we must not put stress on any living thing through a change in air or water environment. Eagles, plant life, anything which lives or breathes. This group is pushing hard on the extension of the word harmful. They claim "enzyme inducer" activity is the real threat of DDT and PCB's and are using these arguments to prove that very small amounts of chlorinated hydrocarbons are "harmful".

Monsanto is preparing to challenge certain aspects of this problem but we are not prepared to defend against all of the accusations.

(a) Monsanto is preparing itself to identify trace ppb quantities of chlorinated biphenyls in water samples, in concentrated collected air samples, and in animal tissues. We will know whether we have been falsely identified and accused or not. We will eventually know where any pollution is taking place and the extent of the pollution.

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DATE 04/02/0[illegible]

PLFF EXHIBIT NO. 163

(b) We are not prepared to defend ourselves against the accusations made of enzyme and hormone activity, the isolation of enzymes or metabolic products, the indirect accusation of cancer, or the splitting of genes, when this accusation is made. Whether we can defend this route or not needs further discussion.

(c) Through the Industrial Bio-Test program we are to establish the long term allowable limits of chlorinated biphenyls for certain birds-fish-animals by feeding experiments, pathological examination, and tissue analysis for chlorinated biphenyls. We may be able to answer reproductive ability in some animals.

DDT has been under attack for some years because of its chlorine content, its persistent ability to be identified, and the wildlife problems attributed to it. We will still be under the same attack by the mechanisms listed in (b) even though we might establish safe operating limits for humans and certain animals.

Where does this leave us?

Under identification and control of exposure - we will be able to identify and analyze residues as well or better than anyone in the world. We will probably find residues other than DDT and PCB's. We will probably wind up sharing the blame in the ppm to ppb concentration level.

We can take steps to minimize pollution from our own chlorinated biphenyl plants, we can work with our larger customers to minimize pollution, we can continue to set up disposal and reclaim operations. We can work for minimum exposure in manufacture and disposal of capacitors, transformers and heat transfer systems, and minimize losses for large hydraulic users.

But, we can't easily control hydraulic fluid losses in small plants. It will be still more difficult to control other end uses such as cutting oils, adhesives, plastics and NCR paper. In these applications exposure to consumers is greater and the disposal problem becomes complex. If chlorinated biphenyl is shown to have some long term enzyme or hormone activity in the ppm range, the applications with consumer exposure would cause difficulty.

Risebrough has taken known Aroclor samples and claims to have evidence of enzyme and hormone change. Here there is no question of identification. Either his position is attacked and discounted or we will eventually have to withdraw product from end uses which have exposure problems. Since Risebrough's paper in "Nature", Dec. 1968 has just been published, it is timely, perhaps imperative, that this paper and its implications be discussed with certain customers. This is a rough one because it could mean loss of business on empty and false claims by Risebrough.

Well prepared discussions with Ind. Bio-Test, Monsanto biochemists, the medical and legal departments must take place now. The position of DDT manufacturers should be determined as a guide. We are being accused of the same things attributed to DDT.

I have written this memo to clarify some of the issues. May I please have comments.

Thanks,

W. R. Richard

ms

Att.

EXHIBIT 11

Monsanto

FROM (NAME & LOCATION): W. R. Richard - Research Center

DATE: September 9, 1969

SUBJECT: DEFENSE OF AROCLOR - F. FLUIDS

REFERENCE:

TO: E. Wheeler - EWHEE

cc P. Hodges PHODG
M. Farrar Res. 1
H. Bergen HBERG

General Policy

Make the Govt., States and Universities prove their case, but avoid as much confrontation as possible. Comply and work with public officials to meet or exceed requirements ahead of time. Adverse publicity and competition are the real weapons.

Analytical for Aroclor
- In Air - Which Aroclors are present? Where?
- In Water - Which compounds
- In Animals - interfere?

} Govt. Agencie

Keep track of how much contamination - which sources.

Prove Bioharmful - Let Govt. prove its case, on case by case basis

Monsanto Visit-Govt. Biolabs - in search of toxicological experiments and evidence vs. Aroclors to keep up with progress.

Monsanto Prove Bioharmless - Limited work at Ind. Bio-test -

"Safe" toxic level for { man, mammals, fish } via Rats, Chickens, Fish

Seek evidence of Biodegradation

Question evidence against us.

Question shrimp toxicology especially other toxic chemicals. If Aroclor bad, others must be worse.

Probable Outcome

We can prove some things are OK at low concentration. Give Monsanto some defense.

We can't defend vs. everything. Some animals or fish or insects will be harmed.

Aroclor degradation rate will be slow. Tough to defend against. Higher chlorination compounds will be worse than lower chlorine compounds.

Therefore we will have to restrict uses and clean-up as much as we can, starting immediately.

[illegible]?

Which one?

Therefore we will have to work for alternate products in end use applications; for Aroclor production facilities.

Clean Up Aroclors and substitute products where necessary and when required, before threats of publicity and competitive activity overwhelm us.

Water Pollution seems to be first issue

Aroclor product is refractive, will settle out on solids - sewerage sludge - river bottoms, and apparently has a long life.

Florida or Gulf Coast - Aroclor 1254 - Aroclor 1260 present issue.

40-200 ppb - causing problem at Pensacola (Monsanto) in plant effluent-causing " with shrimp.

- can't risk shut-down of plant.

Federal and State can extrapolate to other plants in Gulf area.

San Francisco - Aroclor 1254 and 1260

Reported Aroclor to be present in San Francisco Bay.

Reported to be thin egg shells in birds -

Lot of screaming -

Great Lakes Warf studies on DDT

Aroclor 1254 will be found!

Aroclor 1242 will be found?

Air Pollution - Possible spread - but less of an issue right now.
Analytical work more difficult.

[illegible]

Direct Contact with Product

Doesn't seem to be an issue - except for food heat transfer.

We don't believe Aroclor is being used as carrier for insecticide - sprayed around -

We are not positive but most uses are "closed" systems or products used in solid plastics, or adhesives, or sealants.

F. Fluids	Possible Pollution by Customers Plant Operation	Possible Pollut by Customers Pro
Product		
Hydraulic Fluids	Yes, leakage external	Possible - See Johnson Motors Castings.
Air Compressor Fluids	Yes, leakage external	Leakage into prod
Heat Transfer	Yes, leakage external	Leakage into produ
Capacitor Fluids	Yes, leakage from plant - Scrap materials.	In product but closed for end use
Transformer Fluids	No, Should be clean. Yes, Reworked transformers	In product but closed for end use

● Capacitors can go to land fill dumps. Probably not burned, in Al containers.

** Need to take care of Aroclor in discarded transformers. Product could be drained and reworked.

Probable Conclusions

Hydraulic Leakage	- Product could be caught at machines but will take a lot of clean-up work with customers. - Will have to have replacement product - with less-sensitive components. Work from this base on clean-up to prevent more pollution problems.
Air Compressor Fluids	"
Hydraulic Fluids	Must expect "shrimp" experiments, West Florida State, to be "aired" sometime soon; next few months. This will lead to bad publicity and competitive action vs. all Pydrauls. We will have to try to confine to Aroclor 1254 and Aroclor 1260.

We will have to take action before that time.

Gulf Coast -

Action	
W. Richard	Be able to replace Aroclor 1254 and Aroclor 1260 in Pydraul AC and 625 in 2 month's time before Nov. 15, 1969.
Fallon/ Richard	Have trial product in hands of Gulf Coast accounts and distributor before Dec. 15.
Fallon	Suggest possible buy of "all phosphate" ester from Food Machinery. Use this as one trial fluid MCS___ for insurance.
Richard/	Suggest possible substitution of Aroclor 5442 for Aroclor 1254 in hydraulic and compressor blends. E. Wheeler judges lower order of toxicity and solubility for 5442 series. Have to test product in pump test for deposits.
Fallon/ Richard	Suggest field trials of our own all-phosphate ester.
Fallon/ Kuhn/ Kountz	Work with large customers to clean-up streams. Bring in Findett as mfg. partner in the recycle business. Get money out of recycle operations.

Inland-Waterways-

Wheeler/ Richard	Be close enough to Great Lakes studies to judge situation. Are there animals which are being affected by the concentrations found?
Richard	Be prepared to replace Aroclor 1254 and Aroclor 1260 in 4 months in hydraulic fluids and in air compressor fluids.
Richard	Be prepared to replace all Aroclor 1242 or 1248 in 6 months in hydraulic fluids. This means replacement of Pydraul 312 series, and control of sale of Aroclor 1248 to other hydraulic accounts such as Cities Service and Mobil.

Heat Transfer

Fallon/ Roush/ Kountz	Systems will have some leakage depending strongly on engineering and maintenance. Need to work with customers on clean-up.
Fallon/ Roush	Need to replace FR especially in food or sensitive product areas where the product is getting into water. See dish washer compounds. See letter E. Wheeler to T. Fallon.

We have possible replacement products in Therminol 55.
Therminol 66.

Action

Kuhn

Try to assure adequate production of Therminol 66 in face of decreased Aroclor production. H_2 and terphenyl supply may become short.

Switch customers to Therminol 55
or Therminol 66
ahead of pollution problems in customers plant.

Work with customers on plant and dumping practices.

Kuhn/
Fallon

Findett already set up to rework. Need to make them a manufacturing arm. We get sale of recycle-rework fluid.

Capacitor Fluids

Capacitor plants have repurification and recycle systems but up to 5% of product can be lost by poor plant producers and off-quality material.

Mkt. Benignus/
Bryant

Eng.-Kountz/
Mfg-Hodges

5% of production could be 1M lbs/year. This is a big loss for the type of pollution we are trying now to guard against.

Action

Eng.,TSD-Plant Pollution Control

Hodges/
Kountz

Monsanto must start to work with capacitor people to clean up plant practices. We have set-up to accept material for rework into hydraulic fluid but this relocation is not a satisfactory solution. Material must be reworked to electrical grade or destroyed, whichever is more economical. Must start now to get control of off-grade material.

Capacitor products

Enclosed in Al or stainless steel for 5 to 25 year period.

Will ultimately have to dispose of capacitor products.

Recommend we try to save this product for a time.

Recommend replacement of future Aroclor business with other products. Have 2 years.

Action

Monsanto must help plant clean-up of customer plants decantation, coalescing, adsorption, disposal of adsorbent or recycle of adsorbents.
Monsanto badly needs "know-how" for clean-up.

Monsanto should seek Govt. contract money for clean-up research, (See MRC R. Binning, D. Nelson)

<u>Transformers</u>	Transformer Plant can operate in a clean, efficient manner with recycle of off-grade Aroclor.	Product transformer can remain closed no exposure for 3
<u>Action</u> Benignus/ Bryant	Should advise disposal of filter element materials so as to minimize chance of water pollution. Incinerate or dispose.	
	Reworked transformers pose a threat if the Aroclor is dumped into a water stream.	Should try to retai business by clean-u by education of cus tomers.
<u>Action</u> Benignus/ Bryant	Should try to minimize chance of dumping "old" fluid by reworking and by educating co. shops and collecting product for rework or disposal.	
	Dalton is set up in England to rework electrical grade fluid.	
Kuhn/Kountz Findett?	Need rework facility here + disposal scheme.	

<u>Monsanto Plants</u>

The Dept. of Interior and/or State authorities could monitor plant outfall and find ppm of chlorinated biphenyls at Krummrich or Anniston anytime they choose to do so. This would shut us down depending on what plants or animals they choose to find harmed.

In progress

<u>Action</u> - Take steps to see that every precaution is taken to prevent Aroclor entering water streams. Try to reduce to ppb level.

P.Hodges-Seek a Govt. contract on adsorption and incineration
TSD cycles - MRC.

Engrg.-
Kountz Take samples of streams and river water and mud evidence for before and after clean-up. Samples can be stored for further analysis if we can't keep up current with analytical determinations.

Apply Monsanto clean-up methods to customer plant clean up equipment and procedures.

<u>Action</u> -
Engrg. & Mfg.
Kountz and Kuhn

Evaluate liquid incinerators vs. solids handling incinerators for disposing of Aroclor and pentachlorophenol wastes. I estimate Aroclor disposal at 1-4M̅ lbs/year, exclusive of cleaning up river bottoms or outfall bottoms.

Hydraulics	20% of 4M̅ lbs	800,000 lbs
Heat Transfer	10% of 2M̅ lbs	200,000 lbs
Capacitors	5% of 20M̅	1,000,000 lbs
Transformers	5% of 15M̅	750,000 lbs
		2,750,000 lbs

Central Eng. & Mfg TSD
Kountz & Kuhn
Possible help from MRC

Set up an incinerator to handle Aroclor disposal - preferably one which will handle solids such as muds - slurries as well as liquids. Have in operation within 12 months. Ideally have incinerators available different sections for disposal.

<u>Chronic Toxicity Studies - Ind. Bio-Test</u>

Wheeler
Keller
Ind.Bio-Test

Continue studies to establish FDA type limits of toxicity on Aroclor 1242, Aroclor 1254 and Aroclor 1260.

Rework with R. Keller-S. Tucker the number of samples which are to be analyzed for Aroclor in tissue. Try to see if Aroclors are changed metabolically. Does concentration level off, decline if feeding is stopped?

Institute studies against the most limiting biological parameters. If shrimp are the most limiting species for Aroclor levels of toxicity, then we will have to have biological studies on these species to confirm or deny adverse findings.

Action -
Engrg. & Mfg. -
Kountz and Kuhn

Evaluate liquid incinerators vs. solids handling incinerators for disposing of Aroclor and pentachlorophenol wastes. I estimate Aroclor disposal at 1-4M lbs/year, exclusive of cleaning up river bottoms or outfall bottoms.

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Biodegradation Studies

Set up rate of biodegradation studies with Inorganic Div.
on Aroclor 1242 vs. Aroclor 1254
Aroclor 5442 vs. Aroclor 5460
Swisher Chlorinated diphenyl ether
Chlorinated paraffin vs. chlorinated naphthalene
Chlorobromo Aroclors 1242 and 1248

Baxter Contact Baxter and Lidgett at MCL regularly for results on
Lidgett Aroclor degradation. They are reported to be moving on
MCL laboratory experiments.

Establish contact with chlorophenol degradation studies of Cellu-Chem Group.

W. R. Richard

WRR:ms

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on Aroclor 1242 vs. Aroclor 1254
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Baxter
Lidgett
MCL

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W. R. Richard

WRR:ms

EXHIBIT 12

CONFIDENTIAL

Date: October 2, 1969

Subject: REPORT OF AROCLOR "AD HOC" COMMITTEE

To: Howard S. Bergen, Jr.
James E. Springate

From: M. N. Farrar
P. B. Hodges, Secretary
E. V. John
W. R. Richard
E. P. Wheeler, Chairman

CONTENTS

Summary of the Problem

on August 25,

OBJECTIVES

At a meeting of business group directors of Function Fluids and Plasticizers with Organic Division and Corporate Staff members, an "ad hoc" committee was appointed to prepare a resume of the situation concerning the environmental contamination through the manufacture and use of polychlorinated biphenyls (Aroclors).

The objective of the committee was to ~~prepare~~ recommend~~ed~~ action~~s~~ that will:

1. Protect continued sales and profits of Aroclors;
2. Permit continued development of new uses and sales, and
3. Protect the image of the Organic Division and the Corporation as members of the business community recognizing their responsibilities to prevent and/or control contamination of the global ecosystem.

PROBABILITY OF SUCCESS

The committee believes there is little probability ~~[illegible]~~ that any action that can be taken will prevent the growing incrimination of specific polychlorinated biphenyls (the higher chlorinated--e.g. Aroclors 1254 and 1260) as nearly global environmental contaminants leading to contamination of human food (particularly fish), the killing of some marine species (shrimp), and the possible extinction of several species of fish eating birds.

Secondly, the committee believes that there is no ~~possible~~ practical course of action that can so effectively police the uses of these products as to prevent completely some environmental contamination.

There are, however, a number of ~~possible~~ actions which must be undertaken in order to prolong the manufacture, sale and use of these particular Aroclors as well as to protect the continued use of other members of the Aroclor series.

The ultimate that can be expected is the continued use of the lower chlorinated biphenyls (Less than 5 Chlorines) and the chlorinated terphenyls in applications amenable to such control that there is practically zero losses to the environment. In the interim we would hope to establish by appropriate research efforts "tolerance" or safe levels for particular Aroclors in the environment.

- The identification is ~~pos~~ positive
- Toxcity towards certain species is high.
- Persistance is high —
- Likely hood of natural origin or degradation is remote —

RECOMMENDATIONS

OK 1. In view of legal and moral considerations, notify all Aroclor 1254 and 1260 customers of environmental contamination problem. + advising customers.

3, ~~2~~. Consult with appropriate federal agencies' headquarters in Washington to determine current status of concern and to inform appropriate individuals therein of Monsanto's research and control efforts.

4. ~~3~~. Personally contact all governmental and university laboratories which have requested Aroclor samples and indicated interest in the environmental contamination problem.

2, ~~4~~. Reduce losses of Aroclors in liquid wastes from Monsanto plants to ~~absolute~~ minimum. Goal ~~0~~ to < 5 ppb ~~10 parts per billion~~. For 1254 & 126.

5. Determine extent of atmospheric losses from Aroclors from Anniston and WGK Plants and develop plans for control.

6. Analyze in Organic Division laboratories (or by contract) selected appropriate samples from:

   a. Environment of Anniston and WGK Plants.

   b. Monsanto products where contamination is possible.

   c. Agencies and/or laboratories attempting to pinpoint specific sources of contamination.

   d. Customer plants' environments.

   e. Research efforts involved in biological studies--i.e. animal, bird and fish toxicity studies and biodegradation studies.

7. Expand analytical capabilities in conjunction with items 5. and 6. above.

RECOMMENDATIONS (Continued)

8. Assign one individual from the division full-time for three to six months to coordinate division and Corporate Staff department efforts.
9. Establish special budgetary account to allow implementation of these recommendations and the continuation of the toxicological research effort now underway and continuing until June, 1971.

BASIS FOR RECOMMENDATIONS

1. Notification of All Customers

On ~~September~~ Feb. 24, 1969 the San Francisco Chronicle published a "scare" story following an interview with Dr. Robert Risebrough of the University of California. The latter had recently published in Nature the finding of polychlorinated biphenyls in fish, birds and eggs in the California coastal areas.

On March 3, 1969, the Functional Fluids group sent a letter to the 31 major Aroclor customers in the transformer and capacitor applications. The letter included a copy of the Chronicle story and a Monsanto statement concerning the situation. This was intended to announce to these customers that the polychlorinated biphenyls might be in trouble and implied that the customers should make every effort to prevent loss of these materials to the environment. There has been subsequently some follow-up with at least General Electric and Westinghouse.

It has been recognized from the beginning that other functional fluid uses could lead to losses of the Aroclors to liquid waste streams from the customers' plants. Losses could occur from spills, unusual leakage of large volumes and daily losses of smaller volumes.

It has also been recognized that there could be vapor losses but it has been felt that these were perhaps of less significance than the vapor losses in plasticizer applications. The concern for vapor losses rises from the published proposed theory that even minute quantities of vapors are eventually transferred to the water environment and accumulated therein.

Another possible source of air environmental contamination is the eventual destruction of materials which have Aroclors in them. Of particular significance might be the burning or partial incineration of waste or used products containing the Aroclors.

BASIS FOR RECOMMENDATIONS (Continued)

As the alarm concerning the contamination of the environment grows it is almost certain that a number of our customers or their products will be incriminated. The company could be considered derelict, morally if not legally, if it fails to notify all customers of the potential implication.

A case in point is the recent determination (mid-~~August~~ Sept.) that milk to be marketed by the Maryland Cooperative Milk Producers, Inc. in Baltimore was contaminated with polychlorinated biphenyls. The source of the PCB's was isolated to six dairy herds in Martinsburg, West Virginia. Investigation by the Producers Association is continuing but to our knowledge the specific source of the PCB has not been pin-pointed.

When the Aroclors were indited as causing poisoning in cattle in the mid-1950's, chlorinated naphthalenes were eventually identified as the causative agent. The naphthalenes were used in greases or lubricants for cattle feed machinery and had contaminated the animal food. (Members of the Medical Department have been told that the Texas company "bought" 6,000 head of cattle around the country as a result of this incident. It is not known whether or not the suppliers of the naphthalenes to Texaco were brought into the settlement.) Are our customers selling grease or lubricants containing Aroclors that are now responsible for the milk contamination?

In the plasticizer use area, the Aroclors may be used in rubber based paints or surface coatings. The uses for these surface coatings include the interior walls of potable water supply storage tanks in some communities. In Europe we have been told that similar paints are widely used for swimming pools. In spite of the low degree of solubility of the PCB's in water, there are sentiments among the European scientists (and our PCB competitive manufacturers) that such uses may be sources of pollution.

Other customer applications or uses which could be suspect include highway marking paints, ~~and~~ any of the oil and/or grease lubricant applications, caulking compounds & sealants,

BASIS FOR RECOMMENDATIONS (Continued)

2. Consultation with Federal Agencies

In August of 1968 when the current effort related to this problem got underway, the scientists at the U. S. Department of Interior, Fish and Wildlife Laboratories at Paturent, Maryland were visited. In the six to twelve months that the laboratory had been looking for PCB residues, they had identified such compounds in dead eagles as well as marine birds. At that time they did not report positive findings in fish, shell fish or other marine organisms. We know that their efforts have been continuing at an accelerated rate but the laboratory has not been revisited to learn of current developments.

The U. S. Food and Drug Administration in Washington called Dr. Kelly in June to report that the State of Georgia had found PCB's in milk (we had in April supplied samples of our Aroclors to the Georgia State Department of Agriculture Laboratories in Atlanta).

The analyses of milk from the Maryland co-op mentioned in 1. above were performed by an FDA laboratory.

On Friday, September 26, we were asked to send samples to the Atlanta Toxicological Branch of the FDA and to the Residue Chemical Branch Division of Pesticides, FDA in Washington. The stated reason for the request was for these laboratories to determine the "acute toxicity" of Aroclors 1254 and 1260.

In the past year we have had request for samples from five or six of the regional laboratories of the Federal Water Pollution Control Administration--an agency within the U. S. Department of Interior. We have not had an opportunity to follow-up with these laboratories as to their interest or concern.

In August a laboratory of the Bureau of Commercial Fisheries, Department of Interior, at Pensacola, Florida, reported finding PCB's in the river below our Pensacola Plant. Subsequently, they reported that 5 parts per billion of Aroclor 1254 killed baby shrimp in 18 days. There has been no follow-up by St. Louis based personnel since our Pensacola Plant discontinued the use of Pydraul AC.

BASIS FOR RECOMMENDATIONS (Continued)

Appropriate individuals in the parent federal agencies should be visited to determine their current activities and concern and, secondly to make these agencies aware of Monsanto's interest, research and control efforts.

3. Contact with other Governmental and University Laboratories

In addition to the above, Monsanto has provided samples of the Aroclors to 30 or 40 other governmental and university laboratories or scientists. It would be prudent and appropriate for someone from Monsanto to personally follow-up the supplying of the samples and determine the status of the efforts of these groups. For example, the State Department of Agriculture Laboratory in Hartford, Connecticut reported in July that they had found PCB in fish off the coast of Connecticut. This led to two articles in the Hartford Times and a five minute radio program through a syndicated outlet of 108 radio stations.

4. Losses from Monsanto Plants

Efforts to reduce the losses of Aroclors in liquid wastes from the Anniston and WGK Plants are completed or underway. It is impossible to establish a limit as to what can be discharged "safely". Investigation has shown that the waters in receiving streams below the Anniston Plant contain significant (parts per million) concentrations of PCB. More ominous perhaps is the fact that sediment in the bottom of these streams miles below our plants may contain up to 2% Aroclor.

To prepare for the eventual publication in the press of the discharge of PCB's in Alabama and to the Mississippi River, a significant effort must be made to determine the present levels of contamination and more importantly, determine the levels of contamination as "clean up" procedures begin to show an effect.

The incident at the Monsanto Plant at Pensacola indicates that all Monsanto Plants using Aroclors should be made aware of the potential problem and efforts made to eliminate any losses. The significance of "any losses" may be related to the one to three gallons per day which was being lost at the Pensacola Plant.

BASIS FOR RECOMMENDATIONS (Continued)

Hopefully research efforts will indicate that a "safe level" of losses would be higher in fresh water streams not adjacent to coastal estuaries. At the present time we know of no claims that the PCB's are "destroying" fish.

5. Atmospheric Losses at Anniston and WGK

The determination of atmospheric losses for our Aroclor manufacturing plants will be more tedious and time consuming than in the case of liquid wastes. We will never be prepared to discuss intelligently potential problems of our customers where there may be atmospheric losses until we have some data on our own plants. This is particularly true if we ever expect to recommend to our customers measures for control of atmospheric losses.

6. Analytical Capabilities (a. through e. inclusive)

In each of the recommendations 2. through 5. above, there is the implication that Monsanto's best interest could be served by appropriate sampling and analysis. In connection with any of the governmental and other laboratories, we must accept their reported analytical results or in specific instances offer to run duplicate analyses to confirm for ourselves the validity of the reported results.

The committee agrees that to perform analyses that would confirm all of the reported findings represents an unreasonable cost in terms of personnel and facilities. At the same time there appears to be no alternative to the acceptance in the last three months that confirmation analysis in selected cases should be done. This has led to an accumulation of a backlog of samples which need attention. Delays in analysis are occurring because of shifting priorities for samples as they are received or as they have been retained.

A case in point is the delay in analyzing thirteen samples from the Inorganic Division. Samples were submitted following the finding that five of five commercially available electric dishwashing compounds analyzed showed the presence of PCB's. The Inorganic Division can not exonerate the products it sells to the detergent manufacturers until it has some data showing whether or not Monsanto supplied materials are contaminated. In the meantime Inorganic Division Quality Control has

BASIS FOR RECOMMENDATIONS (Continued)

suggested to its Division Engineering that future designs for making detergent components insure that the use of Aroclors will not permit contamination. Secondly, it is obvious that the Division cannot approach its detergent manufacturing customers about their potential problem until the above data indicate that "our own skirts are clean".

This week it was agreed that milk and water samples from the Maryland co-op in Baltimore should take precedence over other samples which had been scheduled.

In summary, the committee believes there will be a growing number of samples from the following:

a. Environment of Anniston and WGK Plants.
b. Monsanto products where contamination is possible.
c. Agencies and/or laboratories attempting to pin-point specific sources of contamination.
d. Customer plants' environment.
e. Research efforts involved in biological studies--i.e. animal, bird and fish toxicity studies and biodegradation studies.

7. Expansion of Analytical Capabilities

The recommendation to expand the analytical capabilities is a necessity in view of the preceding recommendations.

8. Assignment of Full-Time Effort

Up to this time the coordination of the Division effort has been principally the responsibility of W. R. Richard and E. P. Wheeler with support from R. E. Keller and Cumming Paton. Each of these individuals has other responsibilities to the extent that, although the Aroclor problem may have been a predominant issue, other areas of interest could not be slighted.

The committee believes that the problem is of sufficient seriousness to warrant the full concentration of at least one individual for the next three to six months. Those who have been involved up to this point would obviously continue in their

BASIS FOR RECOMMENDATION (Continued)

supporting efforts where the individual's background or expertise would make it appropriate. For example in connection with the follow-up with the federal agencies in Washington, Dr. Kelly would expect to be present for any contact with USFDA officials.

Other members of the Medical Department would be made available for contacts with the pollution control agencies or those laboratories or universities where toxicity appears to be of interest or concern.

Certainly Dr. Keller and Scott Tucker should accompany anyone making visits where the specific question of analytical techniques was to be discussed.

This still leaves a number of man months to be devoted to the other laboratories or agencies which have up to this point not made their specific interest known.

Equally if not more important is the effort which must be made relating to the contacts with customers. The committee does not believe that this can be handled by district marketing representatives without supplying such "local" individuals with a complete background of the problem.

9. Budgetary Considerations

The committee recognizes the restrictions placed on those currently involved by mandates to operate within normal or proposed reduced budgets. It should be clear, however, that the product groups, the Division and the Corporation are faced with an extraordinary situation. There can not be too much emphasis given to the threat of curtailment or outright discontinuance of the manufacture and sales of this very profitable series of compounds. If the products, the Division and the Corporation are to be adequately protected, adequate funding is necessary.

EXHIBIT 13

DEPOSITION
EXHIBIT
5
6/26/14 LG

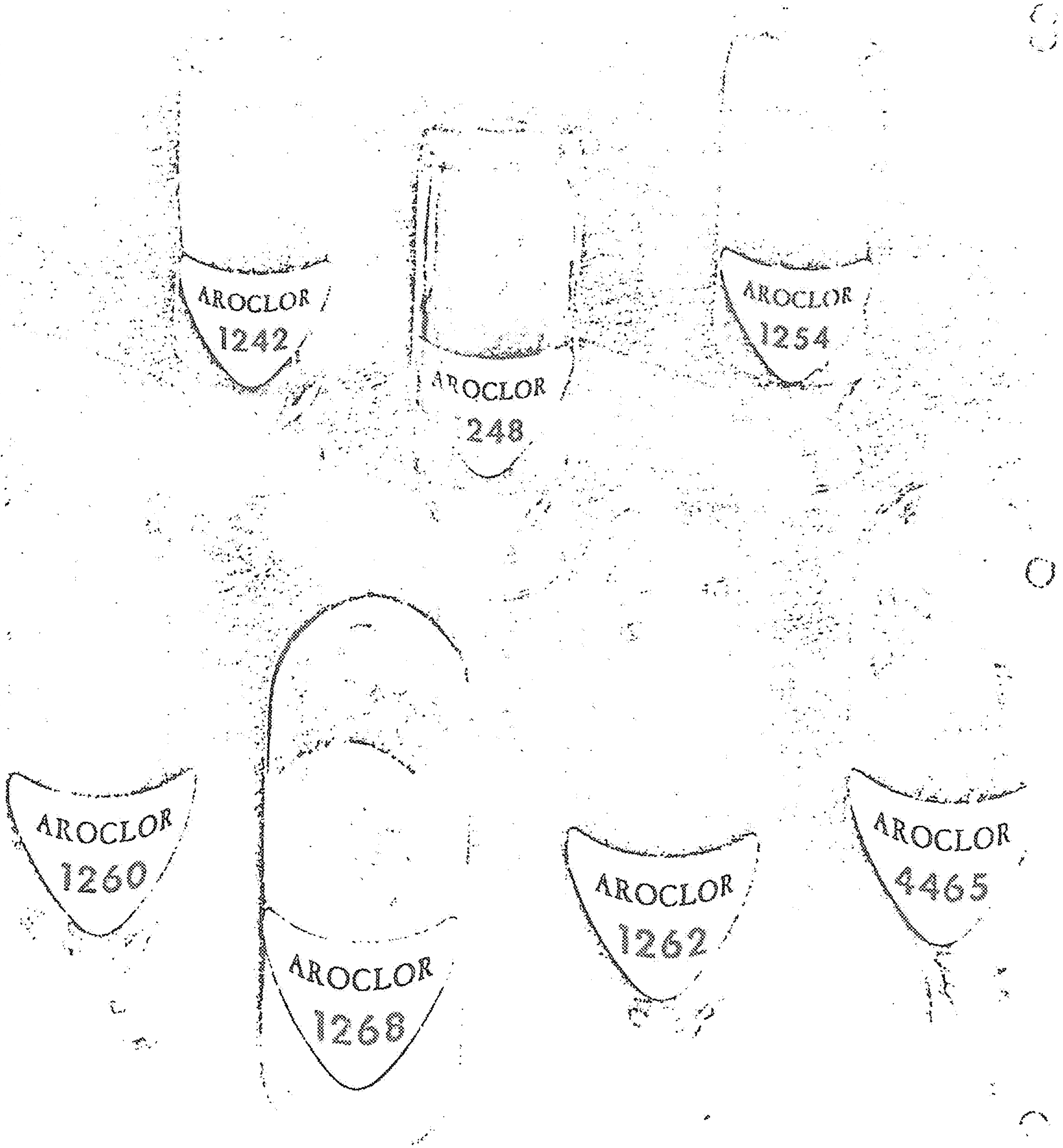
5,160
5,000 reprinted
5/62

obsolete

THE aroclor COMPOUNDS

Monsanto

0509820


AROCLOR 1242
AROCLOR 248
AROCLOR 1254
AROCLOR 1260
AROCLOR 1268
AROCLOR 1262
AROCLOR 4465

The Aroclor* compounds are among the most unique, most versatile chemically-made materials in industry. Aroclors are so useful in so many ways in so many different applications, primarily because of one outstanding characteristic: *inertness.*

The Aroclors do not burn . . . and they impart fire-retardance to compositions in which they are mixed. The Aroclors do not "break down" under mechanical stress; therefore, they make good lubricants, sealants, and expansion media. The Aroclors are not decomposed by, nor do they conduct even tiny amounts of, electricity; therefore, they are outstanding dielectrics. Heat has little effect on the compounds, hence the Aroclors are excellent heat transfer fluids. Since they are compatible with a wide range of synthetic resins, Aroclors make excellent plasticizers. Because Aroclors in formulations "trap" and hold more volatile ingredients, they make volatile insecticides and repellents "last longer" in residual activity.

And, important too, Aroclors are low in cost. Examination of their properties will show literally scores of uses in which no other material can serve.

The following pages describe the physical properties of the Aroclors and some of their many applications. These remarkable materials are manufactured exclusively by Monsanto.

refer to technical
bulletins

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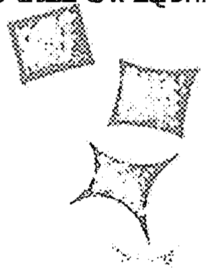
*Aroclor is a trademark of Monsanto Chemical Company for its chlorinated aromatic hydrocarbons and their derivatives, including chlorinated diphenyl, Reg. U. S. Pat. Off. In this brochure, Aroclor is frequently used as a plural noun solely to improve the ease of reading and as a convenience to the reader. In every instance of such use, however, the usage refers to Monsanto Aroclor brand of polyphenyl compounds.



THE aroclors...

Aroclor compounds are a series of chlorinated biphenyls and chlorinated polyphenyls. They range in form and appearance from mobile oily liquids to fine white crystals and hard transparent resins. Aroclors are non-oxidizing, permanently thermoplastic, of low volatility, and non-corrosive to metals. Aroclors are not hydrolyzed by water, alkalis, or acids. The viscous liquids and resins will not support combustion when heated alone, and they impart fire retardance to other materials.

The crystalline Aroclors are relatively insoluble, but the liquid and resinous compounds are soluble in most of the common organic solvents, thinners and oils. All Aroclors are insoluble in water, glycerine or the glycols. Aroclor 5460 is insoluble in the lower molecular weight alcohols; "4465" is only partly soluble in the lower alcohols.

The following table describes the properties of twelve Aroclors, each of which is representative of a series. For almost every Aroclor shown, there is a dark-colored grade of approximately the same physical and chemical characteristics. These darker products are less pure but are lower in price.

Aroclors are used alone for particular physical jobs, such as insulating, heat transfer, sealants and expansion media; and they are used as components or extenders in elastomers, adhesives, paints, lacquers, varnishes, pigments and waxes. The properties imparted by Aroclors (and their usefulness in particular applications) vary in regular gradient over the series. Selection of the right Aroclor for a particular use can generally be made by comparision of the properties, by "blending" two or more, and by adjusting the percentage used in the particular mixture in which the Aroclors will be formulated.

which are green?

general physical properties (

Form	Aroclor 1221 Colorless mobile oil	Aroclor 1232 Practically colorless mobile oil	Aroclor 1242 Practically colorless mobile oil	Aroclor 1248 Colorless to light yellow-green, clear, mobile oil	Aroclor 1254 Light yellow viscous oil
Color	100 Max. (APHA)	100 Max. (APHA)	100 Max. (APHA)	100 Max. (APHA)	100 Max. (APHA)
Acidity—Maximum (Mgm. KOH per Gm.)	0.014	0.014	0.010	0.010	0.010
Average Coefficient of Expansion . . cc/cc/°C	0.00071 (15°-40°C)	0.00073 (25°-100°C)	0.00068 (25°-65°C)	0.00070 (25°-65°C)	0.00066 (25°-65°C)
Typical Density Specific Gravity	1.182-1.192 (25°/15.5°C)	1.270-1.280 (25°/15.5°C)	1.381-1.392 (25°/15.5°C)	1.405-1.415 (65°/15.5°C)	1.495-1.505 (65°/15.5°C)
Pounds per Gallon—25°C (77°F)	9.85	10.55	11.50	12.04	12.82
Distillation Range—ASTM D-20 (Mod.) Corr. °C	275°-320°	290°-325°	325°-366°	340°-375°	365°-390°
Evaporation Loss—%—ASTM D-6 Mod. 163°C . . . . 5 hrs.	—	—	3.0 to 3.6	3.0 to 4.0	1.1 to 1.3
100°C . . . . 6 hrs.	1.0 to 1.5	1.0 to 1.5	0.0 to 0.4	0.0 to 0.3	0.0 to 0.2
Flash Point—Cleveland Open Cup . . . . °C	141°-150°	152°-154°	176°-180°	193°-196°	None
°F	286°-302°	305°-310°	348°-356°	379°-384°	
Fire Point—Cleveland Open Cup . . . . °C	176°	238°	None*	None	None
°F	349°	460°			
Pour Point—ASTM D-97 . . . . °C	Crystals at 1°C	−35.5°	−19°	−7°	10°
°F	Crystals at 34°F	−32°	2°	19.4°	50°
Softening Point—ASTM E-28 . . . . °C	—	—	—	—	—
°F	—	—	—	—	—
Refractive Index—D-line—20°C	1.617-1.618	1.620-1.622	1.627-1.629	1.630-1.631	1.639-1.641
Viscosity—Saybolt Universal 210°F (98.9°C) Sec. (ASTM—D-88)	30-31	31-32	34-35	36-37	44-48
130°F (54.4°C)	35-37	39-41	49-56	73-80	260-340
100°F (37.8°C)	38-41	44-51	82-92	185-240	1800-2500

*NONE indicates—"No fire point up to boiling temperature"

0509825

Some of the aroclor compounds

Aroclor 1260 Light yellow soft sticky resin	Aroclor 1262 Light yellow sticky clear resin	Aroclor 1268 White to off-white powder	Aroclor 4465 Light-yellow, clear, brittle resin	Aroclor 5442 Yellow transparent sticky resin	Aroclor 5460 Clear, yellow-to-amber, brittle resin	Aroclor 2565 Black, opaque, brittle resin
150 Max. (APHA)	150 Max. (APHA)	1.5 Max. NPA (molten)	2 Max. NPA (molten)	2 Max. NPA (molten)	2 Max. NPA (molten)	—
0.014	0.014	0.05	0.05	0.05	0.05	1.4
0.00067 (20°-100°C)	0.00064 (25°-65°C)	0.00067 (20°-100°C)	0.00061 (25°-65°C)	0.00123 (25°-99°C)	0.00179 (25°-124°C)	0.00066 (25°-65°C)
1.555-1.566 (90°/15.5°C)	1.572-1.583 (90°/15.5°C)	1.804-1.811 (25°/25°C)	1.670 (25°/25°C)	1.470 (25°/25°C)	1.670 (25°/25°C)	1.734 (25°/25°C)
13.50	13.72	15.09	13.91	12.24	13.91	14.44
385°-420°	395°-425°	435°-450°	230°-320° at 4 mm. Hg.	215°-300° at 4 mm. Hg.	280°-335° at 5 mm. Hg.	—
0.5 to 0.8	0.5 to 0.6	0.1 to 0.2	0.2 to 0.3	0.2	0.03	0.2 to 0.3
0.0 to 0.1	0.0 to 0.1	0.0 to 0.06	0.0 to 0.02	0.01	1.5 to 1.7 (at 260°—5 hr)	—
None	None	None	None	247°	None	None
				477°		
None	None	None	None	>350°	None	None
				>662°		
31°	35°-38°	—	—	46°	—	—
88°	99°	—	—	115°	—	—
—	—	150° to 170° (hold pt.)	60° to 66°	46° to 52°	98° to 105.5°	66° to 72°
—	—	302° to 338° (hold pt.)	140° to 151°	115° to 126°	208° to 222°	149° to 162°
1.647-1.649	1.6501-1.6517	—	1.664-1.667	—	1.660-1.665	—
72-78	86-100	—	90-150 (266°F or 130°C)	300 400	—	—
3200-4500	600-850 (160°F or 71°C)	—	—	—	—	—
—	—	—	—	—	—	—

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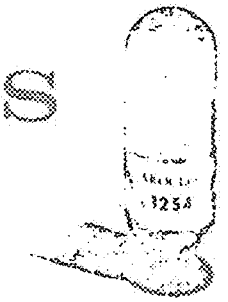
PROPERTIES THAT "MAKE JOBS" FOR THE aroclors



"NON-DRYING"

Aroclors are non-drying. Even when exposed to air in the form of thin films, no noticeable oxidation or hardening takes place. However, when used as components of paints, varnishes or lacquers, they do not retard the rate of drying of the films. Quick drying varnishes and paints can be made using Aroclors in the formulation.

"NON-FLAMMABILITY"

The viscous, oil-like Aroclors and the resins do not support combustion when heated alone, even at their boiling points — temperatures in excess of 350°C. Most of the Aroclors flux readily with other resinous and pitch-like materials to make mixtures that gain in fire retardance properties. Even when incorporated in nitro-cellulose films and rubber foams, Aroclors will retard the rate of burning.

"ADHESIVENESS" AND "THERMOPLASTICITY"

The Aroclor resins adhere strongly to smooth surfaces such as glass, metal, varnished or lacquered coatings.

The Aroclors are permanently thermoplastic. They apparently undergo no condensation or hardening upon repeated melting and cooling. Clear Aroclor resins can be supplied with softening points up to 105°C. Opaque, crystalline Aroclors can be supplied with initial melting points up to approximately 290°F.

STABILITY

Toward Alkalies — The Aroclors are remarkably resistant to the action of either hydrolyzing agents or high temperature. They are not affected by boiling with sodium hydroxide solution.

Toward Acids — Experiments were made to determine whether hydrogen chloride is evolved during the treatment of Aroclors with sulfuric acid. Aroclor 1254 (selected as typical) was stirred with an equal volume of ten per cent sulfuric acid for a period of 150 hours. Any gases escaping from the reaction flask had to pass through a trap filled with silver nitrate solution, which solution would give a precipitate of silver chloride if any HCl came in contact with it. After 150 hours of treatment, neither the trap solution nor the acid layer in the treating flask showed any hydrogen chloride present.

Even prolonged treatment (255 hours) with concentrated sulfuric acid indicated negligible effect.

Toward Heat — Because of their stability to heat, the Aroclors are useful heat transfer media. Aroclor 1254 and particularly the less viscous Aroclor 1248 are recommended for this purpose because they may be heated at temperatures up to 315°C (600°F) in a closed system for long periods without appreciable decomposition and they are, at the same time, fire resistant.

Toward Oxidation — When Aroclors are subject to a bomb test at 140°C with 250 pounds oxygen per square inch, there is no evidence of oxidation as judged by development of acidity or formation of sludge.

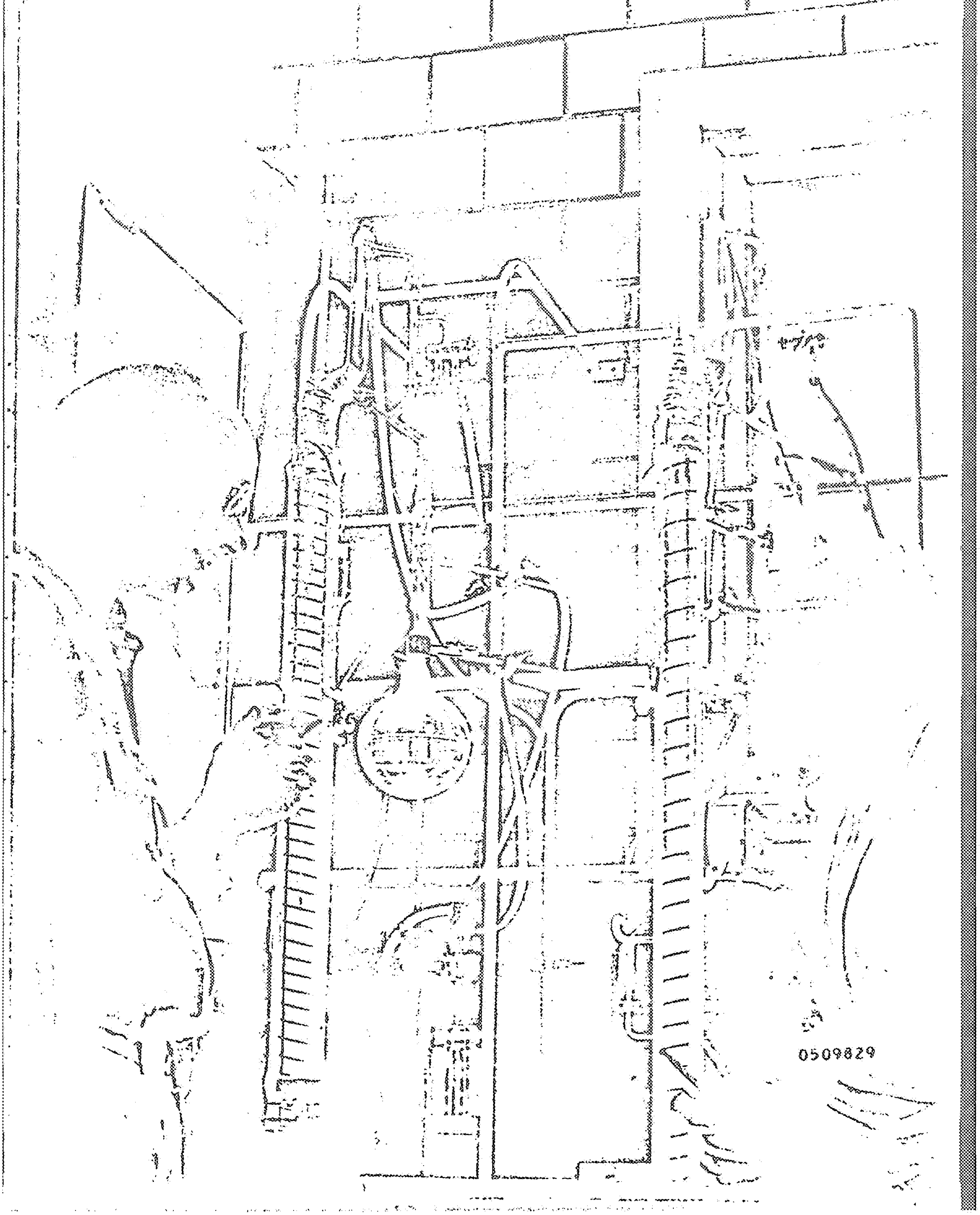
ELECTRICAL RESISTIVITY

The Aroclors have extremely interesting electrical characteristics: high resistivity and dielectric strength and low power factor. The dielectric constant ranges from 3.4 to 5.0 at 100°C and 1000 cycles, depending upon the particular Aroclor.

SOLUBILITY

All Aroclors are insoluble in water. They are soluble, however, in most of the common solvents, plasticizers, and resins.

The Aroclor oils and resins are readily soluble in most of the common organic solvents and drying oils. The hard crystalline Aroclors are in general less soluble than the liquids or softer Aroclor resins. All the Aroclors are heavier than water, a valuable property for many applications.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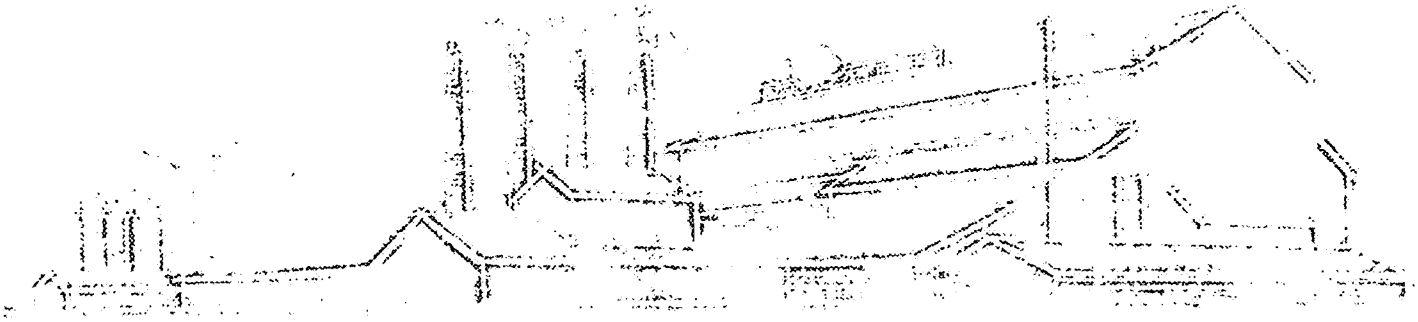
industrial applications of the aroclors



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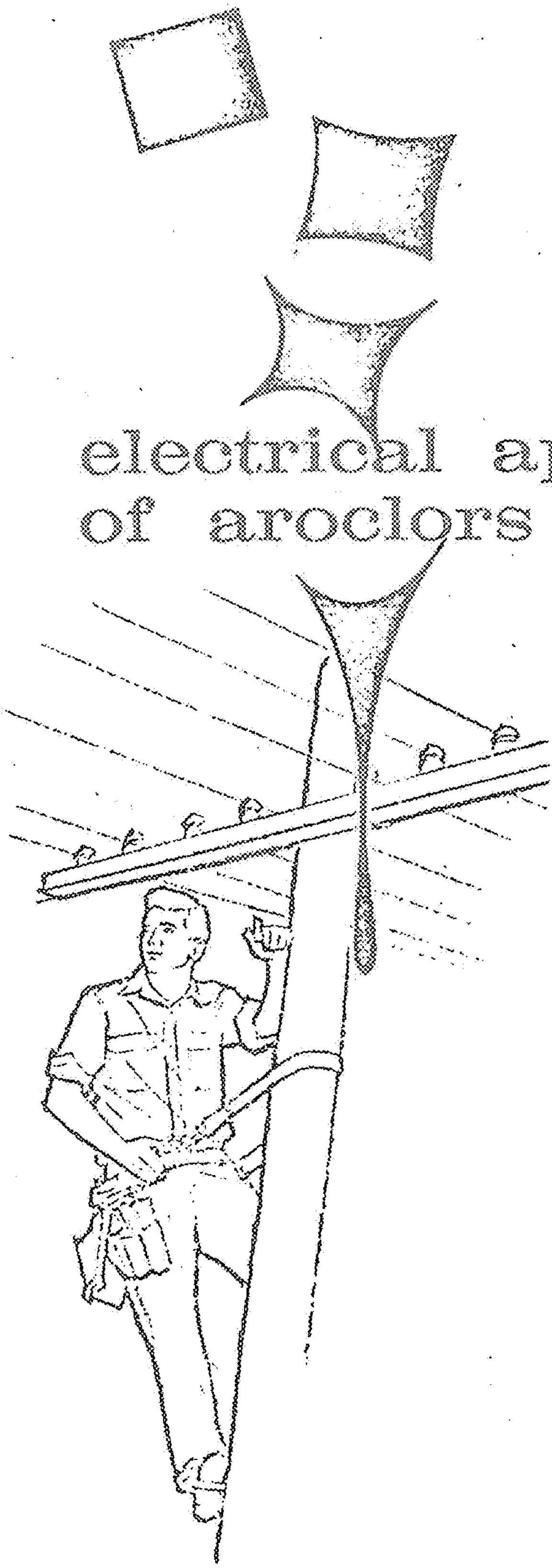


Aroclors are among the purest commercial chemical compounds, virtually free of even traces of conducting impurities. For this reason, the Aroclors' dielectric properties closely approximate the theoretical maximum for the particular organic compound. With their stability, heat resistance and flame resistance — Aroclors can be used for a variety of heavy-duty dielectric applications.

electrical applications of aroclors

DIELECTRICS FOR ASKAREL TYPE TRANSFORMERS AND CAPACITORS

Monsanto Aroclors are used *per se* and are formulated for the liquid coolant-insulation fluids in transformers and capacitors. Such dielectrics must be highly pure with dependably minimal traces of electrolytes. They must be chemically stable and non-corrosive to a wide variety of structural materials. Most important, the dielectric fluid must be fire-resistant.

Aroclors are the only liquids in low cost commercial supply that meet these exacting requirements.

Liquid Aroclors "1242," "1248," "1254," and "1260" are used directly, or these are carefully formulated with chlorinated benzene and other additives to make askarel fluid for particular needs. Typical formulated askarel fluids are shown on the following pages.

Aroclors "1242" and "1254" themselves or in special formulations are used as the dielectric in fixed paper capacitors, for the power factor correction in utility transmission lines; for home appliances such as air conditioners, furnaces, washers and driers; for electric motors; and for ballast in fluorescent fixtures. There are also a number of applications in DC systems, in condensers, and the new energy storage capacitors.

The Aroclor fluids can be used in a wide variety of applications requiring a specialized dielectric. Monsanto works closely with electrical equipment makers to develop the proper dielectric with the exact physical properties required by the engineering of the equipment.

IMPREGNATING COMPOUNDS

Because of their nonflammability, high resistivity, and dielectric strength and low power factor, the liquid and resinous Aroclors are extremely useful materials for many applications as impregnating compounds. An important application of Aroclors in the electrical field is the use of Aroclors 1260, 4465 and 5460 in wire or cable coatings and as impregnants for cotton and asbestos braided insulation. Because they possess high purity and excellent electrical resistance, Aroclor 1254, 5460 and 1268 make excellent dielectric sealants: to close the pores of carbon resistors, and to seal electrical bushings and terminals.

Since the liquid Aroclors will absorb sufficient moisture from the atmosphere to impair the electrical characteristics, it is customary to treat Aroclor intended for this application before use with a dehydrating clay. An effective product for this purpose is Attapulgus clay 80/300 mesh dried for 4 hours at 400°C. and used at the rate of 0.10% based on the weight of Aroclor, followed by filtration. Treatment is improved if the Aroclor is heated to 50-55°C.

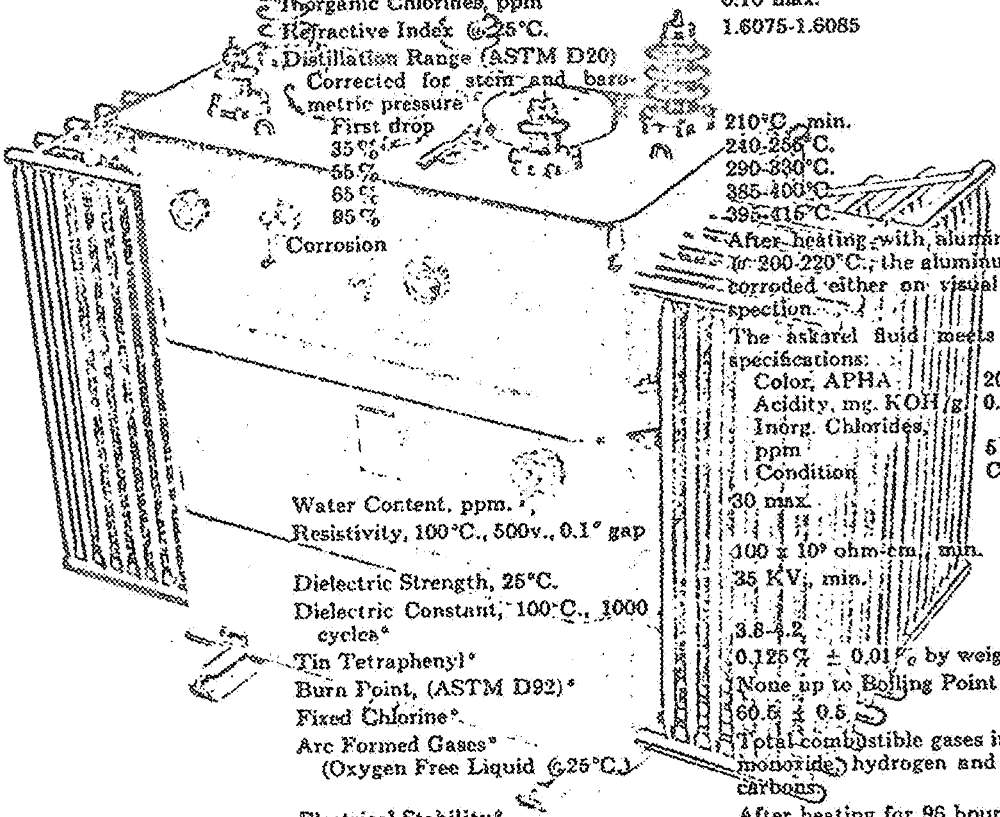
ELECTRICAL PROPERTIES

Dielectric Constant at 1,000 Cycles (1)			Volume Resistivity (2) Ohm-cm at 100°C, 500 Volts D.C.	Dielectric Strength (3)	Power Factor (4) 100°C, 1,000 Cycles
Aroclor	25°C	100°C			
1232	5.7	4.6			
1242	5.8	4.9	Above 500x10^{9}	Greater than 35KV	<0.1%
1248	5.6	4.6	Above 500x10^{9}	Greater than 35KV	<0.1%
1254	5.0	4.3	Above 500x10^{9}	Greater than 35KV	<0.1%
1260	4.3	3.7	Above 500x10^{9}	Greater than 35KV	<0.1%
1268	2.5	—			
5442	3.0	4.9	Above 500x10^{9}		
5454	2.7	4.2			
5460	2.5	3.7			
4465	2.7	3.3			

(1) ASTM D-150-47T
(2) ASTM D-257-46
(3) ASTM D-149-44
(4) ASTM D-150-47T

TYPICAL TRANSFORMER ASKAREL

(MIXTURE OF AROCLOR AND CHLOROBENZENES)



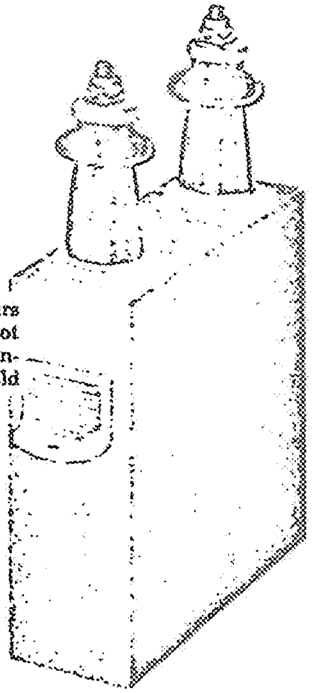
Property	*Typical*
Visc. @ 37.8°C. (ASTM D88)	41-45 Sec. Saybolt Univ.
Spec. Gravity @ 15.5/15.5°C., (ASTM D287)	1.563-1.571
Color, APHA	150 max.
Condition	Clear
Acidity, mg. KOH/g.	0.01 max.
Pour Pt., °C., (ASTM D97)	−44°C., or lower
Inorganic Chlorides, ppm	0.10 max.
Refractive Index @ 25°C.	1.6075-1.6085
Distillation Range (ASTM D20) Corrected for stem and barometric pressure	
First drop	210°C. min.
35%	240-256°C.
55%	290-330°C.
65%	385-400°C.
85%	395-415°C.
Corrosion	After heating with aluminum for 6 hrs. @ 200-220°C., the aluminum must not be corroded either on visual or weight inspection. The askarel fluid meets the following specifications: Color, APHA 200 max. Acidity, mg. KOH/g. 0.01 max. Inorg. Chlorides, ppm 5 max. Condition Clear
Water Content, ppm.	30 max.
Resistivity, 100°C., 500v., 0.1" gap	100 x 10^9 ohm-cm., min.
Dielectric Strength, 25°C.	35 KV., min.
Dielectric Constant, 100°C., 1000 cycles*	3.8-4.2
Tin Tetraphenyl*	0.125% ± 0.01% by weight
Burn Point, (ASTM D92)*	None up to Boiling Point
Fixed Chlorine*	60.5 ± 0.5
Arc Formed Gases* (Oxygen Free Liquid @25°C.)	Total combustible gases including carbon monoxide, hydrogen and volatile hydrocarbons.
Electrical Stability*	After heating for 96 hours @ 100°C in a closed container, the resistivity should not decrease more than 10%.

TYPICAL CAPACITOR AROCLOR

Property	*Typical*
Visc. @ 37.8°C. (ASTM D88)	82-92 seconds Saybolt Univ.
Specific Gravity @ 25/15.5°C (ASTM D287)	1.381-1.392
Color, APHA	60 max.
Condition	Clear
Acidity, mg. KOH/g.	0.01 max.

*Determined by special request.

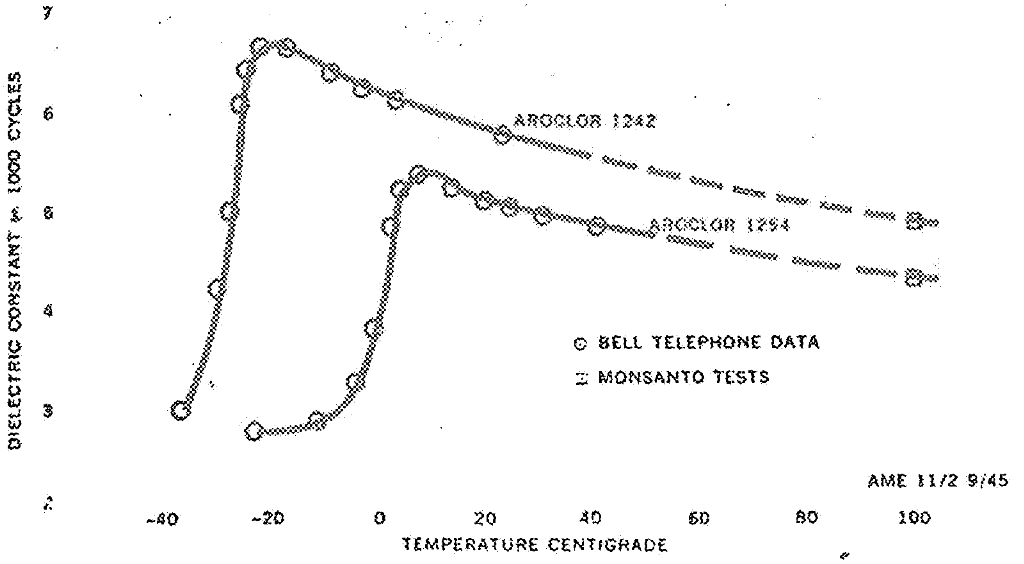
Typical Capacitor Aroclor *(continued)*



Property	*Typical*
Pour Pt., °C. (ASTM D97)	−14 or lower
Inorganic Chlorides, ppm.	0.10 max.
Refractive Index @ 25°C.	1.6240-1.6260
Distillation Range (ASTM D20) Corrected for stem and barometric pressure	10% 325°C. min. 90% 360°C. max.
Corrosion	After heating with aluminum for six hours at 210°C ± 10°C the aluminum must not be corroded either on visual or weight inspection and the Aroclor 1242 should meet the following specs.: Color, APHA 60 max. Acidity, mg. KOH/g. 0.01 max. Inorg. Chlorides, ppm 0.10 max. Condition Clear
Water Content, ppm	35 max.
Resistivity 100°C. 500 volts DC @ 0.1" gap	500 x 10^9 ohm-cm., min.
Dielectric Constant 100°C. @ 1000 cycles (ASTM D924)	4.7-4.9
Flash Point Cleve. Open Cup*	170°C., min.
Fire Point °C.*	None to boiling point
Sulfates (ASTM-D117-31)*	None
Fixed chlorine content (Carius)*	41.5-42.5%
Specific Heat @ 25°C.*	0.29
Evaporation @ 100°C for 6 hrs.*	0.4% max.
Dielectric Strength (KV) (ASTM D877)*	35 Min.

*Determined by special request.

DIELECTRIC CONSTANT VS. TEMPERATURE
AROCLOR 1242 & AROCLOR 1254



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AND BELL TELEPHONE LABORATORIES

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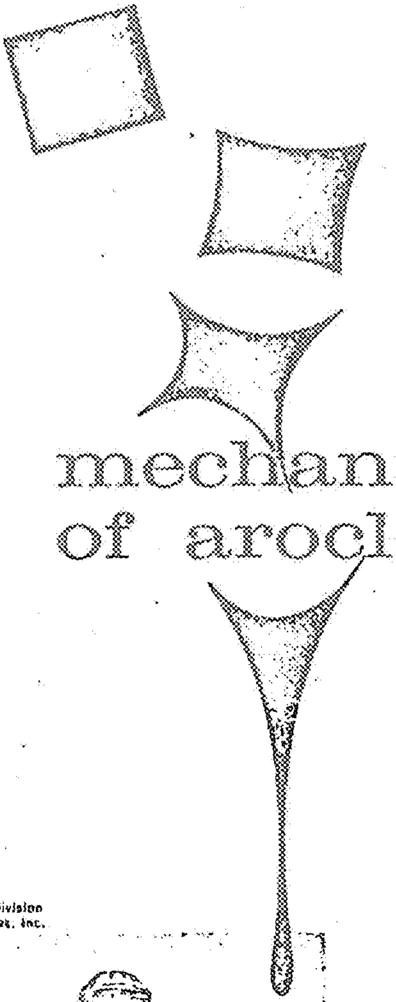
Because Aroclors have excellent shear resistance, heat stability, and are chemically stable . . . they can serve in dozens of mechanical applications for transferring mechanical power, heat, and variable pressures. Aroclors do not attack metals even at high temperature; they resist oxidation, chemical and mechanical breakdown under a wide variety of environmental conditions. In addition, the Aroclor liquids used as lubricants impart a high degree of extreme pressure lubricity.



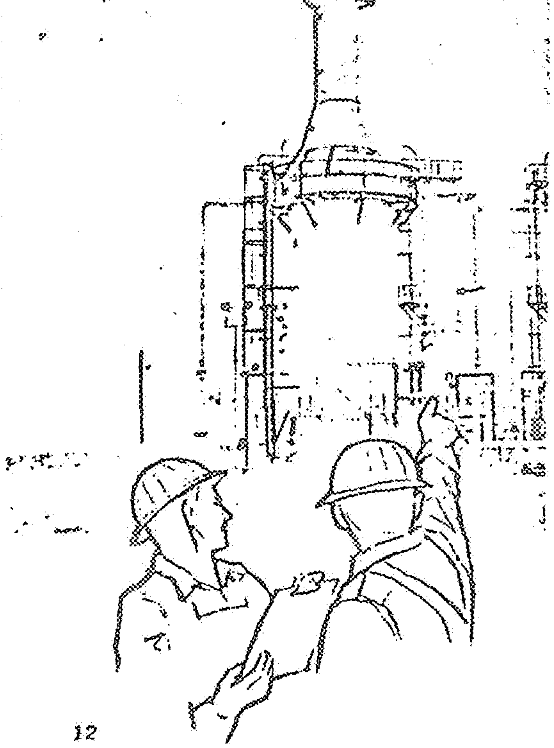
mechanical applications of aroclors

HEAT TRANSFER

Aroclors are outstanding for use as the heat transfer liquids in indirect heating systems. Aroclor systems can transfer closely controllable, uniform heat to chemical processing vessels, food cookers, potato chip fryers, drying ovens and other installations where the fire source must be removed from the point where the processing heat is used. Aroclor 1248 is used most frequently in such indirect heating systems.

Heat transfer with Aroclors has many advantages. Processing heat up to 600°F. can be delivered in a *non-pressurized* system, reducing the construction costs of the heating system. The fluid in properly engineered systems will last without significant degradation for from five to seven years. The systems present no fire or explosion hazard, since the Aroclor does not support combustion. In addition, there is no day to day conditioning of boiler water, inasmuch as the Aroclor requires no conditioning, and Aroclor systems require a minimum amount of insulation. Aroclor systems operating at atmospheric pressure have been used successfully since 1941. Aroclor systems can operate safely and efficiently on gas, oil or electricity.

Photo courtesy of
Petro-Chem Development Division
Yuba Consolidated Industries, Inc.



Aroclors 1242, 1248 and 1254 are used as a circulating heat transfer medium with great success. Good circulation and a well designed heating system are necessary to prevent local overheating. Aroclor 1248, however, is recommended for universal use up to 315°C (600°F) because of its fluidity at low temperatures and its fire-resistance. The liquid Aroclor 1248 is readily pumpable with centrifugal pumps to temperatures as low as 50°F.

In processes where a cooling cycle must also be introduced, provision can easily be made for shunting circulating Aroclor through a water cooled heat exchanger, thus employing one medium for both heating and cooling.

In special cases, Aroclors 1242 and 1232 can be substituted for the Aroclor 1248. If low outside temperatures are encountered, the less viscous Aroclor 1242 can be used.

Aroclor 1232 may be used where outdoor temperatures as low as 20°F are encountered. While Aroclor 1232 is serviceable for unpressurized heat transfer, this Aroclor compound is not quite as fire resistant as "1248" or "1242."

Monsanto has available an "Engineering Heat Transfer Data" booklet that gives design guidance on Aroclor systems. In addition, Monsanto can suggest sources for Aroclor heaters and equipment.

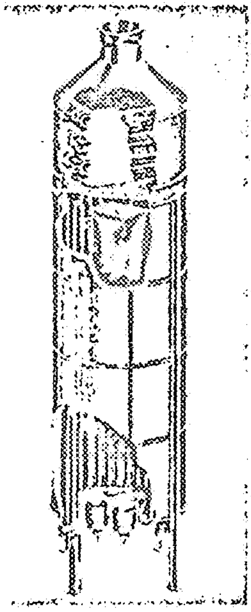


Photo courtesy of
Western Precipitation Corp.

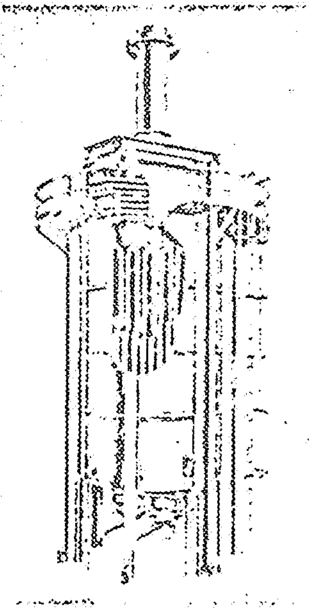


Photo courtesy of
Struthers Wells Corp.

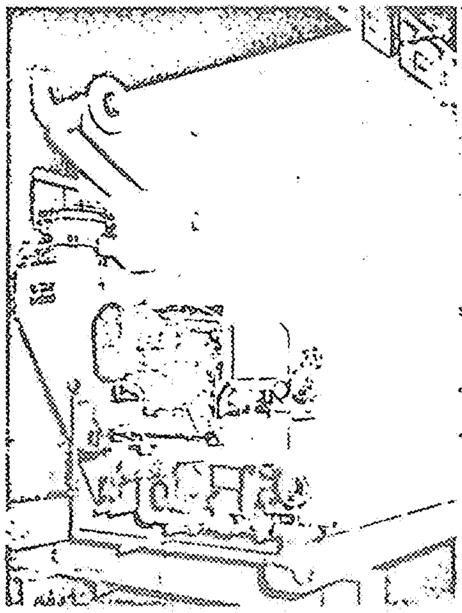


Photo courtesy of
Union Iron Works

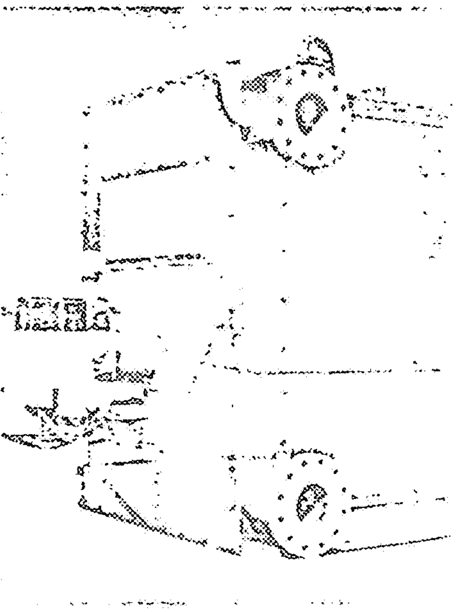


Photo courtesy of
The International Boiler Works Co.

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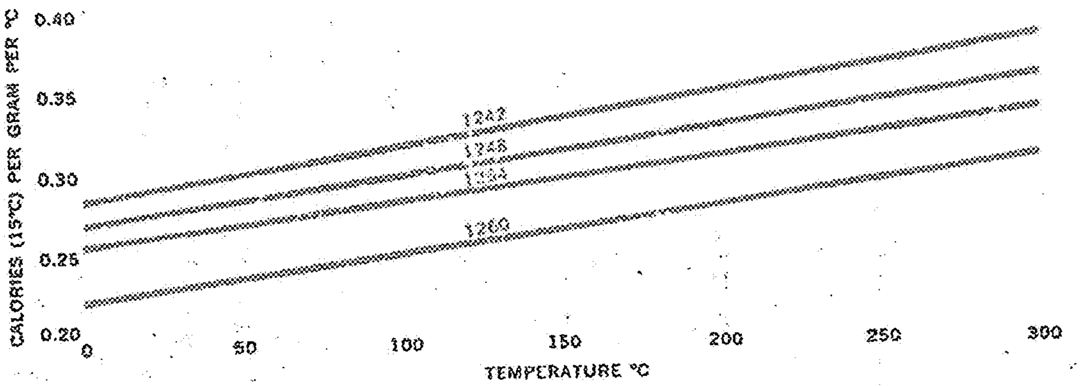
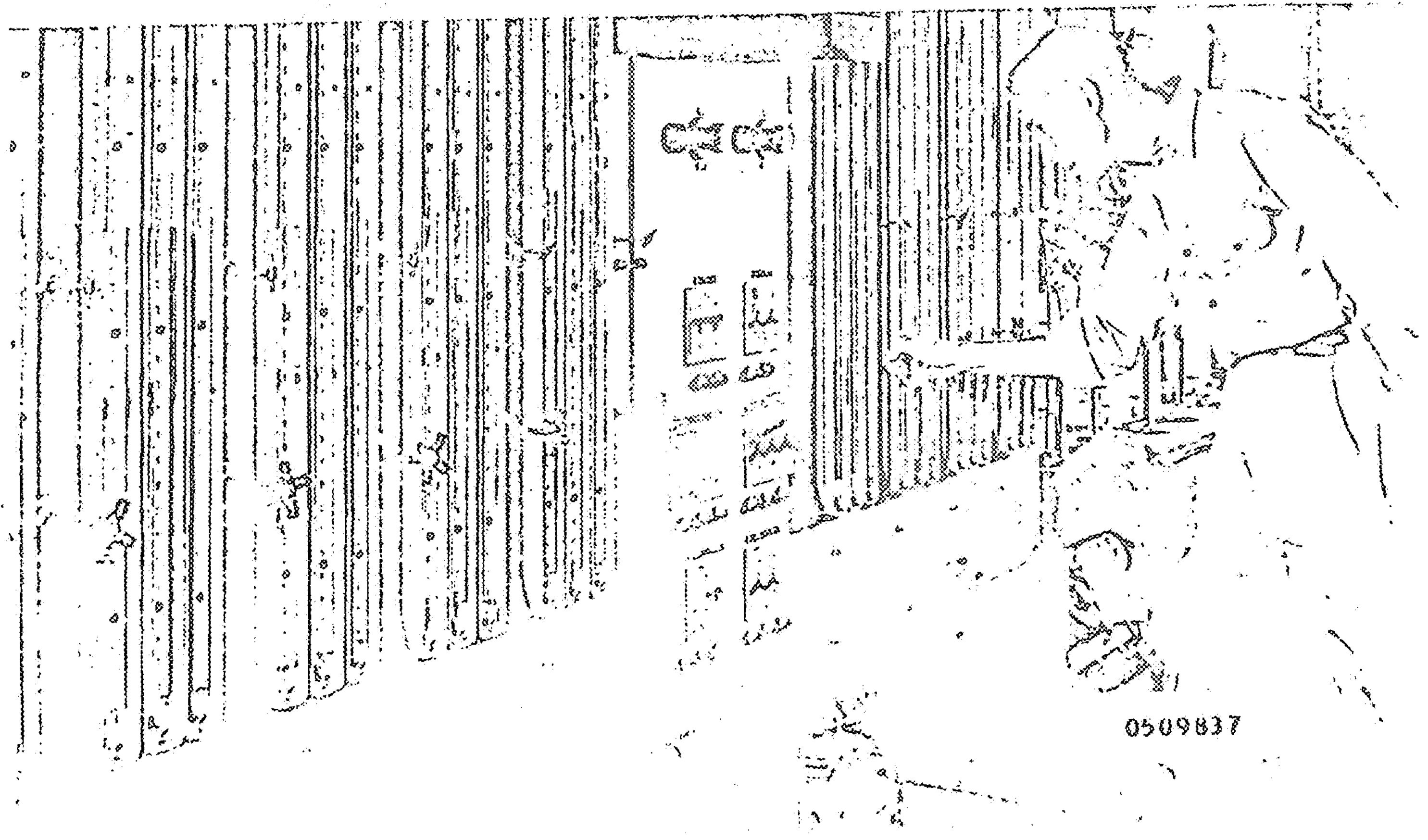
HEAT CAPACITY OF AROCLORS

AT VARIOUS TEMPERATURES



THERMAL CONDUCTIVITY OF AROCLOR 1248

Temperature °C.	Temperature °F.	BTU./Hr./Sq. Ft./°F./Ft.	Calories, gram/Sec./Sq.Cm./°C./Cm.
30	86	0.0570	236×10^{-6}
60	140	0.0564	233×10^{-6}
100	212	0.0555	229×10^{-6}



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EXPANSION MEDIUM

Because of their stability at high temperatures and ability to withstand frequent temperature cycles without gum formation, the liquid Aroclors are used as the actuating medium in bellows controls, thermostats, industrial temperature control regulators and other kinds of automation equipment.

The average coefficient of expansion of Aroclor 1248 per degree F. within the various temperature ranges indicated in the table below was determined by using the simple formula $Vt = Vt^1\,[1 + a\ (t - t_1)]$. The coefficient, a, has been calculated at 100°F increments, as follows:

Temp. Range F	Average Coefficient of Expansion cc/cc/F
0 to 100	0.00037
100 to 200	0.00039
200 to 300	0.00040
300 to 400	0.00046
400 to 500	0.00048
500 to 600	0.00051

The specific volume of Aroclor 1248 at different temperatures is as follows:

Temp. °F.	Specific Volume ml/gm
0	0.674
100	0.699
200	0.726
300	0.755
400	0.790
500	0.828
600	0.870

LIQUID SEALANT FOR FURNACE ROOFS

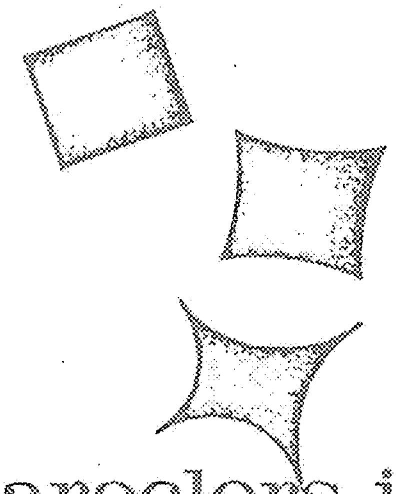
The liquid Aroclors 1248 and 1254, because of their low vapor pressures and fire-resistance, make excellent liquid sealants. These non-evaporating fluids have good flow at slightly elevated temperatures and are chemically stable at elevated temperatures. Consequently, the liquid Aroclors make excellent fluid sealants for any application where the use of oil would create a fire hazard. In the trough of annealing furnaces, for example, Aroclors make dependable fire-safe roof seals.

VACUUM DIFFUSION PUMP OIL

The fluid Aroclors 1248 and 1254 are highly stable to air; they make good oils for vacuum pumps at a much lower cost than high priced silicone type oils. These Aroclors operate efficiently in vacuum diffusion pumps used to pull high vacuum for metalizing plastics; dehydrating foods, medicinals; and for drying capacitor cones.

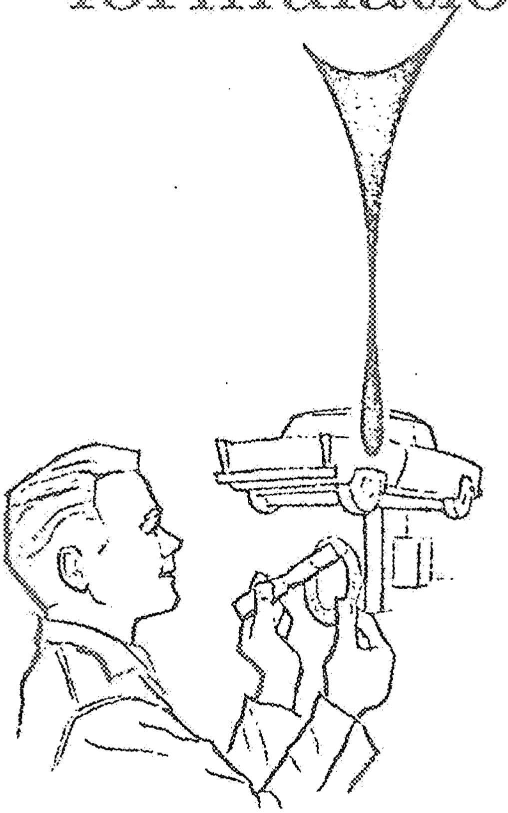
DUST ENTRAPMENT

Because Aroclors are non-drying and tacky, they make excellent coatings for capturing dust, lint and other fine air-borne particles. Aroclors 1260 and 5460 are used successfully to coat fibrous glass air filter pads, metal mesh and other materials used for filtering air and gas streams.



With their wide range of physical properties, their inertness, lubricity, and vapor-suppressing characteristics — Aroclors can be valuable ingredients in an extraordinary variety of formulated products. They are compatible with a variety of solvents, oils, resins. They are virtually non-volatile and permanently thermoplastic; they will not react with other chemicals in the formulation. In addition, their low cost makes their use for special purposes eminently practical and economical.

aroclors in special product formulations



SEALERS FOR GASKETS

Aroclors — particularly when hot — swell rubbers like Hycar, Koroseal, PerBuna N, and Neoprene. Wherever seals and gaskets of natural or synthetic rubber tend to shrink under heat and use, Aroclors 1232, 1242 or 1254 can be used as a swelling agent to tighten the shrunken seal. An example is in automotive transmission oil: a small amount of Aroclor in the oil swells the seal *in place*, saving the cost of tearing down the equipment to replace the seal or gasket. Aroclors can be used in gasket sealing compounds to swell the rubber after the gasket or seal is in place.

DEDUSTING AGENT

Aroclor 1254 is a low cost dedusting agent which can "hold down" the dusting of a variety of chemical products. Because Aroclor 1254 resists both combustion and oxidation, it can be used to control dusting of highly reactive compounds. As a typical example,* a few tenths of one percent will control the dusting of calcium hypochlorite.

*Covered by U. S. Patent No. 2,921,911, issued January 19, 1960, and assigned to Pennsalt Chemicals Corp.

Aroclor 5460 and 1254 act as vapor suppressants. The United States Department of Agriculture scientists reported that the inclusion of from 5 to 25 parts per hundred by weight of Aroclor increased the effective kill-life of a lindane spray up to ten times. A painted or metallic surface sprayed with certain chlorinated insecticides fortified with Aroclor will remain toxic to flies, ants, roaches, silverfish up to 2 to 3 months. The Aroclor resins suppress the rapid evaporation of the volatile insecticides without adding odor or other objectionable residue. Formulation into insecticides is quite simple; the Aroclor is dissolved in a suitable solvent compatible with the insecticide formulation, and mixed in. The most pronounced effect for increasing the kill-life of the insecticide is obtained with lindane, chlordane and BHC. Aroclors are recommended for chlorinated insecticide formulations to be used for non-crop spraying. Their low cost makes this use a most practical way to lower the ultimate cost of insect control.

Aroclors are compatible with various natural waxes, such as carnauba and others, including those used to formulate casting wax. Aroclors help impart to the finished casting wax a number of desirable properties: hardness without brittleness; resistance to shrinking; sharp definition; sharp melting point; and fire-resistance. Waxes formulated with Aroclors are non-tacky and highly stable. Aroclor-containing waxes are widely used in making dental castings, in the precision casting of aircraft parts, and for casting costume jewelry. Aroclors 1254, 4465 and 5460 are the ones most frequently used, the proportions dependent upon the properties required in the finished wax. Much of the highest quality precision casting wax used in the "lost wax" process is formulated with Aroclors.

Aroclors 1254, 1268 and 5460 are used in the manufacture of specialized abrasives. Because of their excellent bonding characteristics, high thermal stability and resistance to oxidation and corrosion — Aroclors are used as the carriers for abrasive materials. A major use is as part of the bonding agent in specialized grinding wheels.

For specialized lubricants requiring good extreme pressure (EP) characteristics, the liquid Aroclors make excellent additives. The Aroclors impart high temperature stability, excellent lubricating qualities, and weather and corrosion resistance. As an example, Aroclors are used to formulate grease and pipe thread compounds for use in oxygen systems. Greases formulated with Aroclors have a high chemical resistance, are suitable for use in contact with corrosive chemicals. Gear oil lubricants containing Aroclors have good resistance to sheer degradation and high temperature stability. Added in small amounts to railroad car journal box oils, Aroclors impart better extreme pressure lubricity and reduce the incidence of "hot boxes."

The heat-resisting, nonflammable characteristics of the Aroclors make them attractive in themselves as lubricants under conditions of high temperature. As an example: in governor systems of central power stations, Aroclor 1248 is well suited to this lubricating application.

Straight Aroclor 1254 gives excellent results on a roller bearing test operating at 255-260°F with much less carbonization or decomposition than the usual spindle oil under the same conditions.

As an extreme pressure (EP) lubricant base added to a petroleum hydrocarbon oil in amounts up to approximately 15% by weight, Aroclors 1248 and 1254 materially increase the load-carrying properties without reducing the viscosity of the resulting composition. These two Aroclors represent one of the more satisfactory carriers for the element chlorine as an extreme pressure base, possessing the following advantages:

1. STABILITY . . . even at higher temperatures, which assures there will be neither separation of components nor appreciable change in physical or chemical properties during long periods of operation.
2. NON-VOLATILE. Many other types of chlorine bearing compounds are so volatile as to render them unfit for long periods of service. The Aroclors are non-volatile at normal temperatures.
3. NON-OXIDIZING. Aroclors do not oxidize nor "thicken up" to an objectionable degree.
4. NON-CORROSIVE . . . toward metal surfaces.
5. NON-ABRASIVE. Aroclors exerts no abrasion on the machined surfaces.
6. NON-HYDROLYSIS. Aroclors do not hydrolyze in the presence of water, thus avoiding the generation of hydrochloric acid.
7. COMPATIBILITY. Aroclors are completely miscible with mineral oils.
8. COLOR. Aroclors do not darken or change the color of lubricating oil.

Submerged Lubrication

Under conditions of lubrication subjected to exposure to water displacement such, for example, as lubrication of bridge rollers, a heavier-than-water lubricant can be prepared from mixtures of Aroclor and oil, of which the following are typical examples:

	% by weight			Gravity at	Approx.
Mix No.	Oil*	Aroclor 1248	Pour Pt.	15.5°C.	Pounds Gal.
1	50	50	0°F	1.1263	9.4
2	25	75	+5°F	1.2703	10.6

Viscosity 210°F-160 Saybolt Secs.
Color ASTM 7-8
Flash Point 545°F.
Pour Point 15°F.

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*Bright Stock: Gravity API 22-23

Aroclors in Industrial Cutting Oils

Aroclor 1254 is used to formulate the finest quality "straight" and "soluble" or emulsifiable-type cutting oils. The Aroclor functions as an excellent extreme-pressure lubricant and it is far superior to aliphatic chlorinated hydrocarbons because of its higher order of thermal stability. The heat resistance is most important in cutting oils for machining high grade steel. With Aroclor cutting oils there is a lower degree of hydrolysis which minimizes the staining of the metal.

AROCLORS IN ADHESIVES

Aroclors are outstandingly useful ingredients in the formulation of various types of adhesives. Besides a plasticizing action on the adhesive's resin base, they add valuable properties to the adhesive bond. Aroclors offer a variety of property improvements to adhesives based on polyvinyl acetate, to rubber cements and to hot melt adhesives.

Aroclors strongly resist attack by water, acids, alkalies and other common corrosive influences, as well as microorganism attack. By proper selection of materials, adhesives containing Aroclors can have outstanding resistance to most of the destructive factors that injure bonding properties.

Hot-Melt Adhesives

A typical starting formulation for a cellulose acetate butyrate hot melt adhesive with Aroclor 5460 is:

	Parts by Weight
Half-second cellulose acetate butyrate	35.00
Aroclor 5460	30.00
Dioctyl phthalate	15.00
Newport V-40	19.89
Santonox*	0.1
Syn Fleur #6	0.01

The above coating can be applied at about 350°F. Ventilation should be provided.

A typical starting formulation for an ethyl cellulose hot melt adhesive with Aroclor 5460 is:

	Parts by weight
Ethyl cellulose, 50 cpr	24
Aroclor 5460	7
Lopor No. 45 Mineral Oil	57
Bakers No. 15 Castor Oil	5
Epoxy soybean oil	3
Paraffin wax (m. p. 135°F)	3
Santonox*	1

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*Santonox: Monsanto Chem. Co. trademark, Registered U. S. Pat. Ofc.

Heat Sealing Adhesives

Chlorinated rubber and Aroclors 1254 and 1260 make excellent heat sealing and label adhesives. These adhesives have high chemical resistance and extremely low moisture vapor transmission. A typical starting formulation is:

	Parts by weight
Parlon (125 centipoise type)	20
Aroclor 1254	6
Aroclor 5460	6
Toluene	68

PVAc Emulsion Adhesives

Aroclors 1221, 1232, and 1242 impart excellent tack and strong bonding power to polyvinyl acetate emulsion adhesives. They readily blend with simple stirring and since they are liquid at room temperature no pre-melting is required. The hardness required in the adhesive's end use can be varied to suit simply by selection of the Aroclor without materially changing other properties. The Aroclors are compatible with PVAc emulsions at a level of up to 11 parts of Aroclor in 100 parts of PVAc emulsion.

An excellent type of hot melt book binding adhesive can be made as follows:

	Parts by weight		
	Formula 17	Formula 18	Formula 19
Gelva polyvinyl acetate resin V-7	100	65	—
Ethyl cellulose	—	15	—
Gelva C-SV-16R	—	—	100
Santicizer 160	—	16	—
Rosin WW	75	—	75
Dibutyl phthalate	30	—	30
Aroclor 1254	55	4	55

By changing the type of polyvinyl acetate resin utilized in the hot melt, the viscosity of the melt can be increased or decreased without changing the ratio of resin to plasticizer.

Polyurethane Resin Adhesives

An excellent flocking adhesive containing Aroclor 1254 can be made as follows:

		Parts by weight
Part A —	Multranil FLD*	100
	Aroclor 1254	20
	Mondur *C	5
Part B —	Multranil FLD*	100
	Mondur C*	5-10

Part A is applied to the fabric by knife coating and allowed to dry thoroughly. The fabric is then coated with Part B, and the material is flocked immediately.

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*Mobay Chemical Co. trademark, Registered U. S. Pat. Off.

Epoxy Adhesives

Aroclors can be used to extend epoxy resin adhesives. The extending greatly reduces the formulation cost with a minimum effect on the bonding characteristics of the adhesive.

Aroclors can be used to extend or substitute Carnauba Wax and reduce the cost of the wax formulation. Several practical formulas are available using Aroclors to make wax blends that possess the qualities of Carnauba Wax. These blends can be used for automobile, wood, leather and linoleum polishes.

Selected Aroclors such as 5460 used in conjunction with various waxes make excellent impregnating compounds for furniture drawers, etc., to prevent sticking.

Resinous Aroclors used in combination with waxes make excellent and inexpensive sealers for concrete and masonry surfaces, wood, fiber board and paper products.

The Aroclors may be used to impregnate cloth, paper, wood or asbestos in order to impart moisture and gas resistance, adhesion, insulating properties, alkali or other chemical resistance, flame resistance, or lubricating qualities. For this type of formulation they are used in combinations with other materials such as waxes, inorganic pigments, asphalt, tars, aluminum stearate, sulphur, etc., in order to obtain exactly the physical characteristics desired for the specific purpose. Aroclors 1254, 4465 and 5460, or the corresponding dark-colored products, are suggested as most applicable.

Wood impregnated by vacuum-pressure method with the following mixture:

Aroclor 4465	70%
Microcrystalline Wax	20%
Sulfur	10%

. . . is definitely tougher, harder and more moisture resistant than untreated wood. This coating is very resistant to acids and alkalies but will be attacked by aromatic, aliphatic or chlorinated hydrocarbons. The surface is not appreciably discolored and can be painted. Various degrees of hardness and adhesion can be obtained by varying the Aroclor: wax: sulfur ratio.

For use as moisture-proof coatings on wood, paper, concrete and brick, the Aroclors are best combined with waxes, especially paraffin or Carnauba, oils such as mineral oil or drying oils, and synthetic resins including modified alkyds, phenolics, chlorinated rubber, polystyrene, styrene-butadiene co-polymers, ethyl cellulose, cellulose acetobutyrate, benzyl cellulose or vinyl resins. Selection of materials for use in combination with Aroclors depends on end use requirements of the specific application.

The simplest compositions contain only Aroclor and paraffin. A moisture proofing compound composed of 96% (by weight) of Aroclor 5460 and 4% paraffin (melting point 54°C) has an ASTM softening point of about 82°C and is very efficient. Substituting Aroclor 4465 for Aroclor 5460 produces a compound with a softening point of about 58°C.

Softening point and viscosity when melted may be further decreased by using mixtures of Aroclors. For example, a composition containing 40% of Aroclor 1260, 56% of Aroclor 5460 and 4% of paraffin will be very soft at ordinary temperatures. Increased proportions of paraffin will also produce softer compounds.

An excellent melt coating for paper and cloth was reported by W. M. Gearheart and F. M. Ball, OFFICIAL DIGEST, Vol. 343, 1953:

Half-second Butyrate	50%
Dioctyl phthalate	9.9%
Aroclor 1260	40%
Ionol	0.1%

This coating may be applied by knife or roller at 350°F; the applicatio requires no solvent. This coating on paper or fabric has extremely good flexibility.

[illegible]

Aroclor 4465 is a useful resin for compounding rotogravure and other printing inks. A mimeograph ink suitable for use on bond paper contains the following ingredients:

Aroclor 4465	40%
Lubricating Oil (SUV 1200 @ 100°F)	35%
Paraffin Oil (SUV 76 @ 100°F)	20%
Carbon Black	4%
Oil Soluble Dye	1%

Aroclor 4465 may also be used in the preparation of imitation gold leaf. A thin coating of the Aroclor is applied hot to one side of paper. While it is still hot, bronze powder is spread upon the coating. The bronze powder adheres to the Aroclor completely covering the paper. This product is used in making the "gold leaf" letters on books, etc. The paper treated with Aroclor and bronze powder is placed upon the book binding. A hot die is pressed upon it. The Aroclor softens and sticks the bronze to the binding and forms a coating over it to protect it from tarnishing.

The Aroclors are also used as vehicles for carrying the pigments used in glass decoration. When the decorations have been applied and the glass is fired, the Aroclors volatilize without carbonization and thus avoid discoloration of the glass. Aroclors 1254 and 4465 are used for ceramic decoration.

PAPER TRANSPARENTIZER

A treating liquid that makes paper transparent for use as tracing paper, window envelopes, and special packaging can be formulated with Aroclor 5460 and polybutenes. A typical economical formulation is:

Aroclor 5460	30%
Indopol H-300	25%
Toluene	45%

In the paper treating formula, the proportions of Aroclor to Indopol may be varied from 2:1 to 1:2 respectively.

MASTICS, SEALING AND CAULKING COMPOUNDS

Aroclors and polybutenes can be blended with inorganic fillers to make excellent sealing and caulking compounds. A typical "filler" would be:

Whiting	50%
Talc	30%
Lithopone	10%
7 M Asbestos	10%

By combining selected Aroclors and Indopol polybutenes, it is possible to produce a wide range of hardness, viscosity, flow and bonding characteristics in durable sealing and caulking compounds.

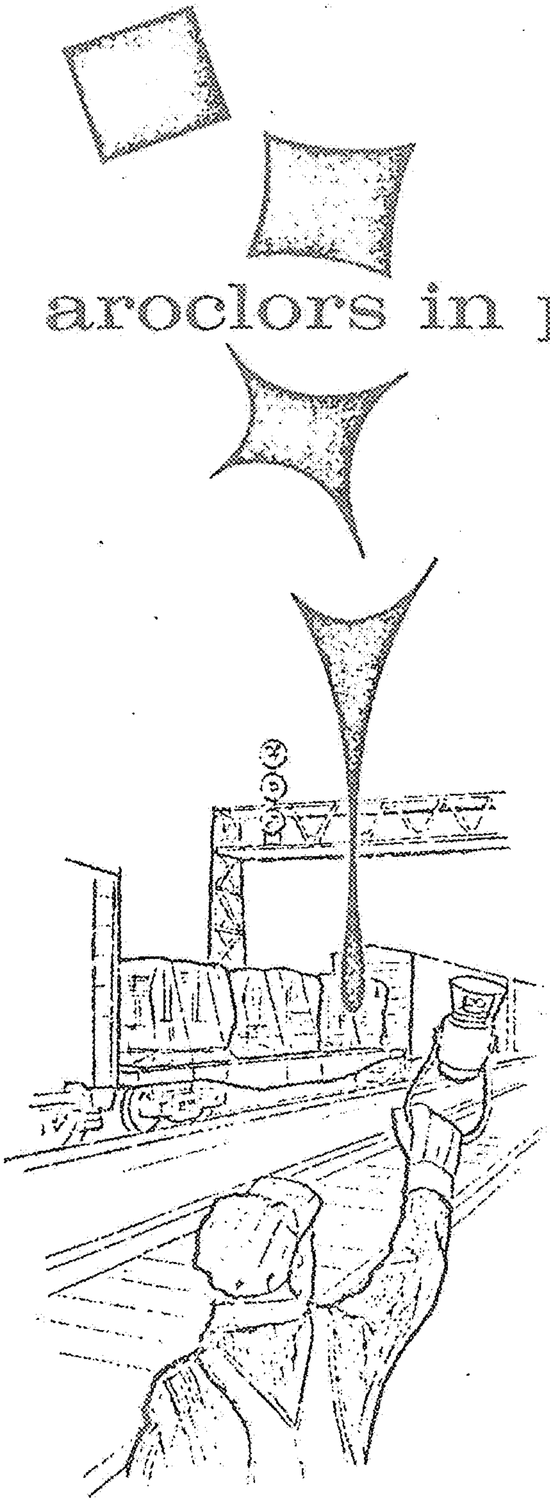
Excellent mastics, too, can be prepared by blending selected Aroclor resins with Indopol polybutenes. The mastics have good adhesive qualitites for specialized uses such as sealing of automobile body construction.

PERMANENT TACK COATINGS

Aroclors and Indopol polybutenes can be blended in a variety of proportions to make permanently tacky coatings. These coatings may be applied to fabric or paper to provide a permanently "sticky" surface. Insecticides, for example, can be blended into such coatings to make insect traps or insect barriers on tree trunks for tree foliage or fruit protection. These coatings can also be used for tapes and sign backing.

Aroclors are valuable as low cost plasticizers for a variety of applications. Aroclors improve chemical resistance, flame retardance, oxidation resistance, and reduce the cost of plasticized elastomers. Depending upon the use, the various Aroclor compounds offer a number of benefits to the user.

aroclors in plastics



In almost all formulations, the use of a selected Aroclor as a plasticizer reduces the cost per pound of the formulation.

Another valuable use of Aroclors in the plastics field is as a grinding and dispersing medium for pigments.

The Aroclor compounds are compatible with most common plastic materials; they are compatible to the extent of practical use with the following:

Asphalt
Benzyl Cellulose
Carnauba Wax
Cellulose Acetate Butyrate
Chlorinated Rubber
Coumarone-Indene Resins
Dammar Resin
Ester Gum
Ethyl Cellulose
Epoxy Resins
Manila Gum
Nitrocellulose
Paraffin
Phenolic Resins
Polyethylene
Polyester Resins
Polystyrene Resins
Polyiso-Butylene
Polyurethanes
Polyvinyl Acetate
Polyvinyl Chloride and
  Polyvinyl Butyral
Polyvinylidene Chloride
Rosin
Rubber
Styrene Butadiene Co-Polymers
Vinyl Resins

Aroclors are not compatible with cellulose acetate or with phenolic resins in the final stage of condensation.

In selecting the proper Aroclor for a given use, the degree of *flexibility* imparted increases progressively in the order of: hard resinous Aroclor, soft resinous Aroclor, liquid Aroclor. Conversely, the *hardness* of the plasticized elastomer increases progressively with the choice of: liquid Aroclor, soft resinous Aroclor, hard Aroclor resin.

POLYVINYL CHLORIDE

The Aroclors are valuable as secondary plasticizers, or plasticizer-extenders for polyvinyl chloride formulations. The Aroclors impart greatly improved chemical resistance over conventionally ester-plasticized compositions. For example, a formulation plasticized with 3 parts of DOP and 1 part of Aroclor 1254 shows the best chemical resistance of any plasticized polyvinyl chloride formulation evaluated to date.

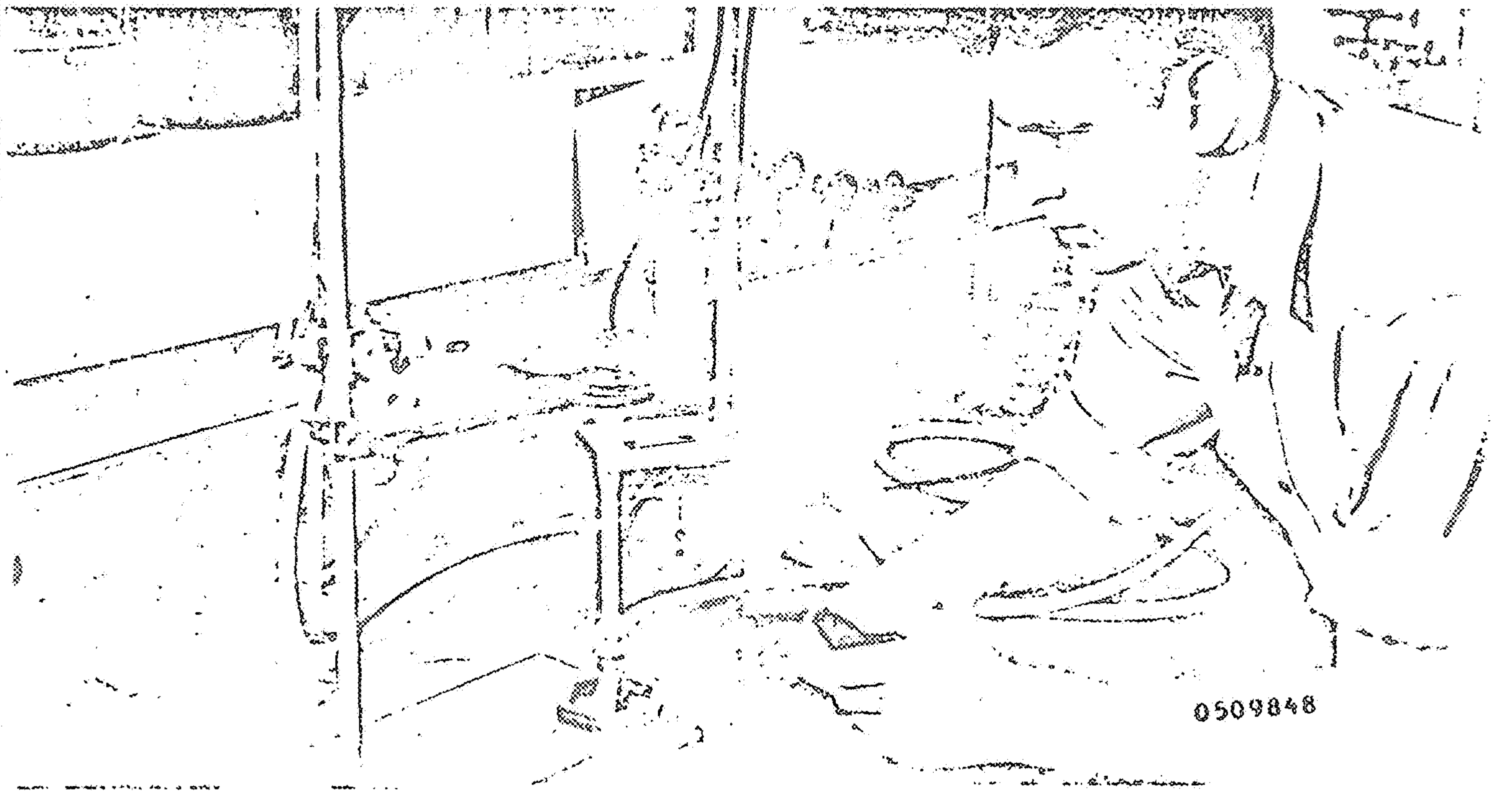
Aroclor 1268 —
40PHR —
velvet finish

Aroclor 1262, when used as a co-plasticizer with DOP, greatly reduces the amount of migration of the plasticizer to nitrocellulose lacquers. Aroclor 5460 is frequently used as a plasticizer-resin-extender to make flameproof vinyl tiling compositions.

In vinyl chloride co-polymer resins for solution application, the combination of Aroclor 5460 and Aroclor 1254 is widely used because of its outstanding chemical resistance.

RUBBER—NATURAL AND SYNTHETIC

The liquid Aroclor compounds — 1221, 1232, 1242 and 1248 — have a strong plasticizing action on rubber, both natural and synthetic. Aroclors 1254 and 1260,



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Aroclor 1268 flame-retardant in silicone rubber (GE call report [illegible] 7/15/59)

when milled into rubber, impart permanent tackiness and adhesion to the composition.

Aroclors 2565, 4465, 5460 and 1268, when incorporated in neoprene rubber in amounts as high as 40 parts per 100 parts of rubber make compositions that are extremely flame retardant.

[illegible]

The Aroclors generally show a high degree of compatibility with epoxy resins; this group of materials is one of the very few plasticizers that possess such high compatibility with these materials. The lower Aroclor numbers, 1221 and 1232, impart a high degree of flexibilizing to epoxy compounds. The more resinous and solid Aroclors have little effect on the flexibility of the compound; in fact, they tend to act as reinforcing materials. Aroclors have little effect on epoxy resins' hardness, tensile or compressive yield strength. The ultimate compressive strength can be improved by using solid Aroclors in phthalic anhydride cured systems.

All of the Aroclors, when used at a rate of 15 to 20 parts per hundred of resin, greatly retard the burning rate of epoxy compositions. If a small amount of antimony oxide is added in addition to the Aroclor compounds, the materials then become non-burning.

[illegible]

Aroclor 5460, when used in low density polyethylene to the extent of 20% — in combination with 10% antimony oxide — makes the compound self extinguishing. Compared to other materials that make polyethylene self extinguishing, Aroclor 5460 has much less effect on tensile, yield and elongation properties. In addition, the heat stability of the Aroclor compound is greatly superior to the other materials commonly used to make polyethylene self-extinguishing.

[illegible]

Incorporation of the solid, resinous Aroclors will make asphalt self extinguishing. Possible applications of this type of formulation include caulking compounds, roofing compounds and sound-deadening coatings. Normally, 30% of an Aroclor such as 5460 will make an asphalt mixture that is self extinguishing.

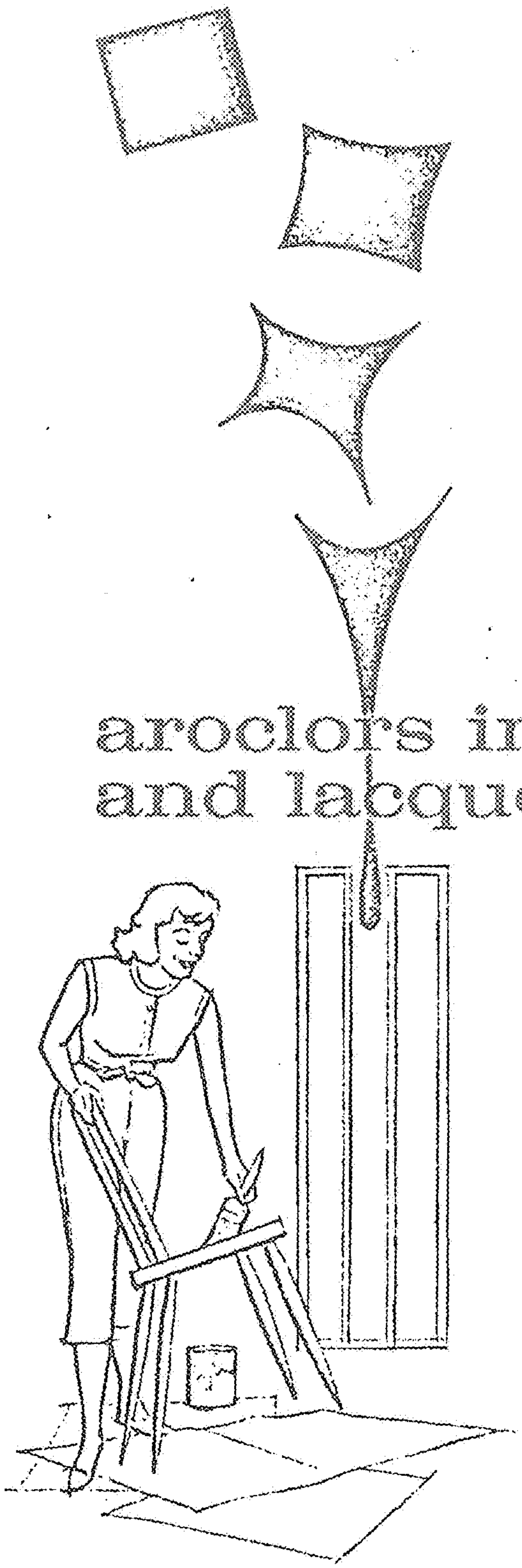
[illegible]

Incorporation of Aroclor in a polyester resin in combination with antimony oxide greatly reduces the burning rate of polyester resins. A mixture of sufficient amounts of selective Aroclors will produce polyesters that are self extinguishing.

[illegible]

Considerable interest has been displayed in the use of Aroclors in phenolic laminating resins, to make compounds that are flame resistant. Normally, the higher molecular weight Aroclor, such as Aroclors 1260, 1262 and 5460 are evaluated for this purpose.

Aroclor 5460 in polystyrene & resin in lighting fixtures



Aroclors are soluble in paint and varnish oils and solvents and are compatible with most film-forming coating resins. The Aroclor compounds improve adhesion to the substrate. Adding Aroclors to paint, varnish or lacquer formulations imparts properties to the film that correspond to the particular character of the Aroclor used. The hard, resinous Aroclors tend to give increased hardness to films; the viscous Aroclors impart flexibility.

Aroclors are excellent grinding and dispersion media for pigments used in paints and varnishes. Aroclor 1254 is used to disperse aluminum powder in a paste form which can be incorporated easily into paints and varnishes. The Aroclor imparts excellent leafing qualities, brightness or luster and does not tarnish the aluminum pigment on aging. Moreoever, the coating composition does not support combustion.

aroclors in paint, varnish and lacquer formulations

VARNISHES AND ALKYDS

Aroclors 4465 and 5460 will produce paints that are very quick drying and yet have excellent durability. The weight of Aroclor used may be from 30% to 50% of the weight of the oils.

The Aroclors do not react chemically with oils, hence there is no advantage in heating together in making a varnish. They are best added as a "chill back" or as a cold cut in the thinning operation. As far as incorporation of the Aroclors is concerned, the only reason for heating is to make the Aroclors liquid so they can be more readily mixed with the oils.

Aroclor 1260 is best for short oil varnishes that are required at the same time to be flexible. The Aroclors impart water and alkali resistance, and with these qualities enhance the value of the other resins used in the varnish. The suggested starting formulation is two parts by weight of oil, one part of Aroclor 1260 and one part of other resin. These

Aroclor 1254 in yellow traffic paint.

proportions can be varied as required. The Aroclor may be considered to function in the formulation as an oil, with the difference that it does not oxidize and lose its flexibility.

Resins of the alkyd, phenolic or ester gum type, with a harder Aroclor such as 5460, may also be used in making varnish formulations.

EPOXY RESIN COATINGS

The high compatibility of Aroclor compounds with epoxy resins makes these materials of great value in formulating epoxy coatings. Normally, 10 to 15% of Aroclor 1260 or 1262 is added to the epoxy composition to improve flexibility with a minimum effect on the corrosion resistance and adhesive characteristics of the film.

NITROCELLULOSE COATINGS

In pyroxylin or nitrocellulose lacquers, the Aroclors can function both as plasticizers modifying the properties of the film and as film-forming bodying resins. Aroclors are highly compatible with nitrocellulose and with other resins and plasticizers commonly used in lacquer formulating. They impart weather resistance, luster, adhesion and decreased burning rate. The Aroclors' excellent electrical characteristics (high dielectric strength and resistivity and low power factor) and their property of retarding the passage of moisture and gases through nitrocellulose make the Aroclors of special value in coatings for electrical insulating materials.

To illustrate the modification possible to obtain by changes in formulation, three lacquer formulas are given below. All have excellent durability but the third is much softer and more flexible than the other two. Only the solids contents are given. The amounts tabulated are parts by weight.

Aroclor Lacquers

	No. 1	No. 2	No. 3
½ second Nitrocellulose (dry)	100	100	100
Dammar resin	80	—	—
Ester Gum	—	80	—
Aroclor 1260	20–39	20	30–70
Dibutyl Phthalate	20–0	20	—
Tricresyl Phosphate	—	—	39–70

No. 1 and No. 2 have excellent sanding and polishing qualities. No. 3 is very flexible but too soft for sanding.

Where extremely high flexibility is desired, as for example in lacquers for high tension automotive cables, the following composition is suggested:

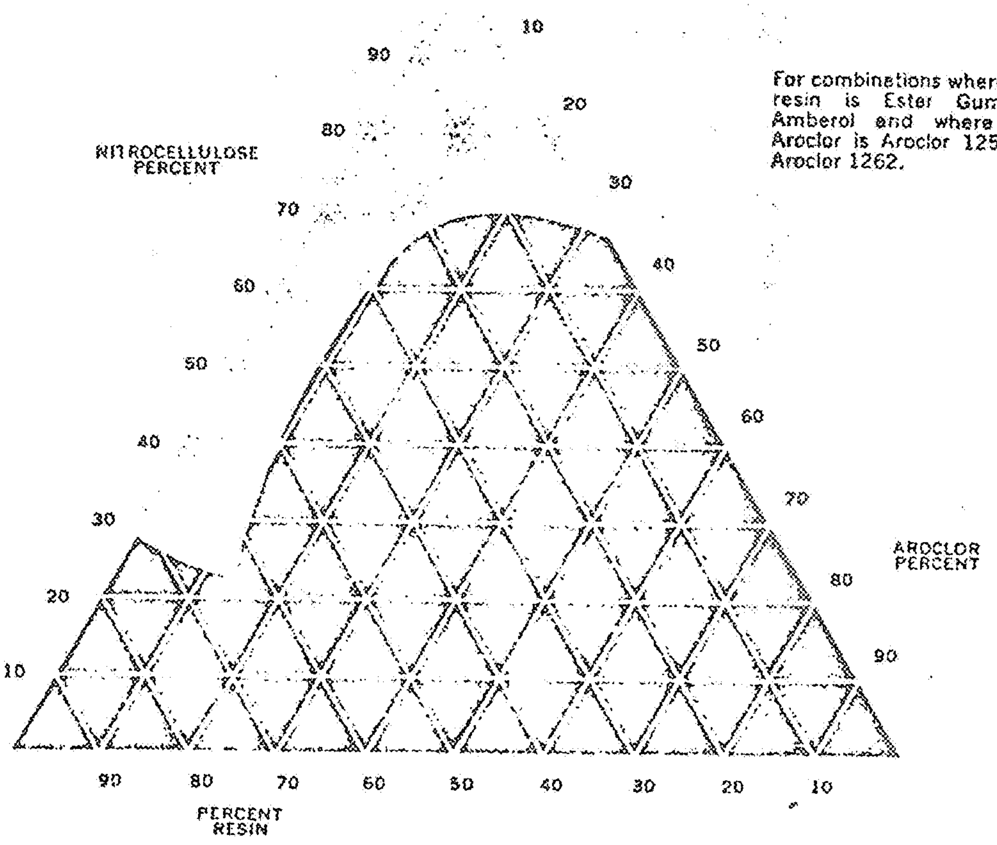
15-20 second R. S. Nitrocellulose	100 parts by weight
Tricresyl Phosphate	120 parts by weight
Aroclor 1242	80 parts by weight

The accompanying trilinear diagrams show the practical compatibility limits of Aroclors 1254 and 1262 when used in combination with some other resins and plasticizers. Aroclor 1260 gives values almost the same as those shown for 1262. The less viscous Aroclors have greater compatibility; the more resinous Aroclors have less compatibility than the ones shown.

In the trilinear diagrams, the compositions, represented by any point in the unshaded areas, are those which produce homogeneous lacquer films. On the other hand compositions represented by points in the shaded areas produce impractical, segregated, brittle or soft films. For detailed information as to the derivation and use of these diagrams reference is made to the following articles:

Jenkins & Foster, "Compatibility Relationships of the Aroclors in Nitrocellulose Lacquers," Ind. Eng. Chem. 23, 1362 (1931).

Hofmann & Reid, "Graphical Methods in Lacquer Technology," Ind. Eng. Chem. 20, 431 (1928); "Formulation of Nitrocellulose Lacquers," Ind. Eng. Chem. 20, 687 (1928).

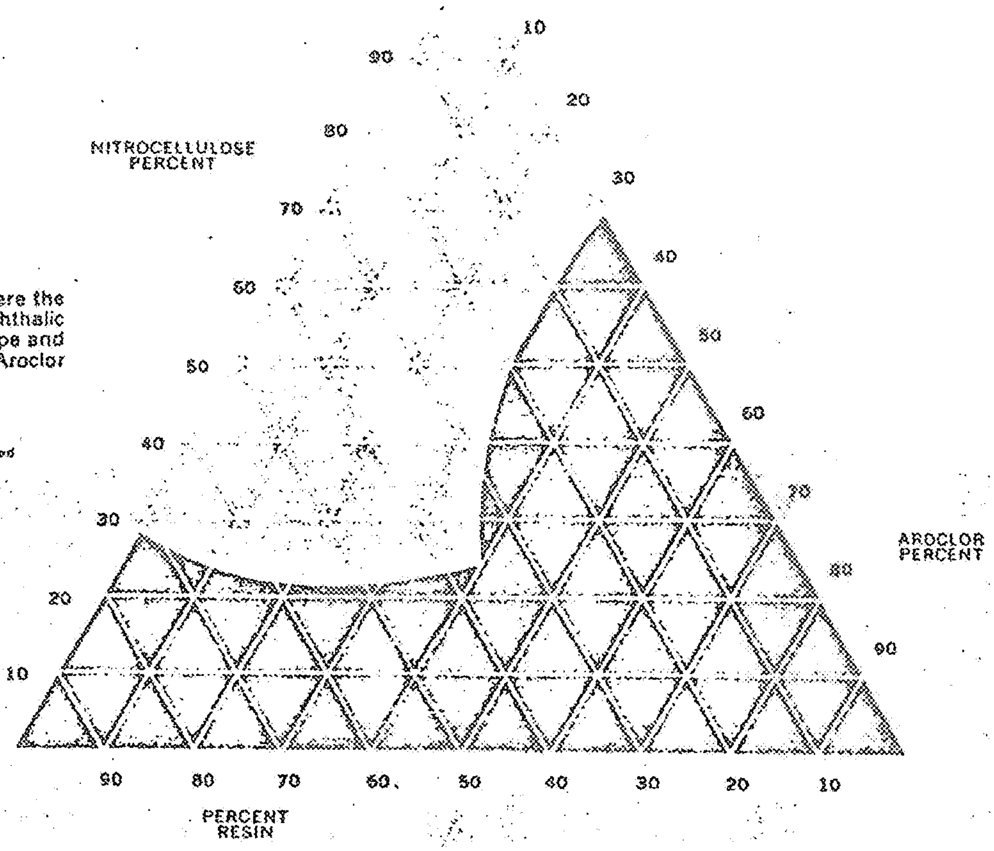


For combinations where the resin is Ester Gum or Amberol and where the Aroclor is Aroclor 1254 or Aroclor 1262.

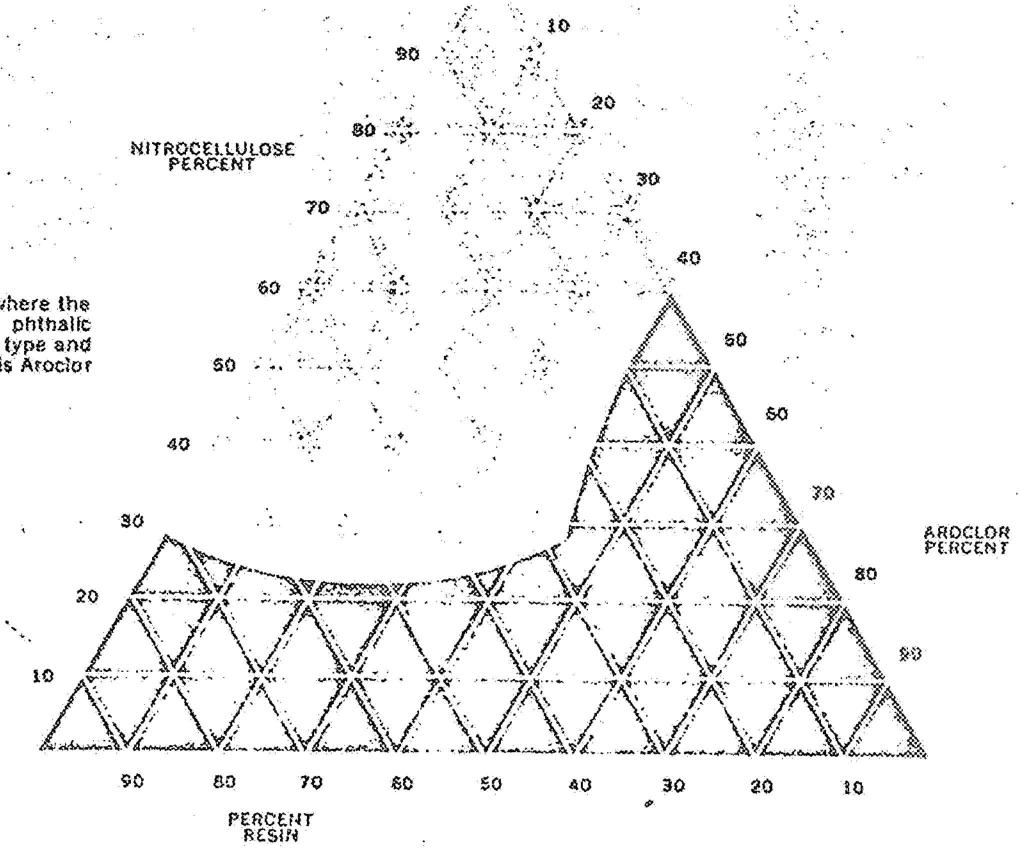
0509852

For combinations where the resin is of the phthalic anhydride-glucerol type and where the Aroclor is Aroclor 1252.*

*Aroclor 1260 may be substituted without material change.



For combinations where the resin is of the phthalic anhydride-glycerol type and where the Aroclor is Aroclor 1254.



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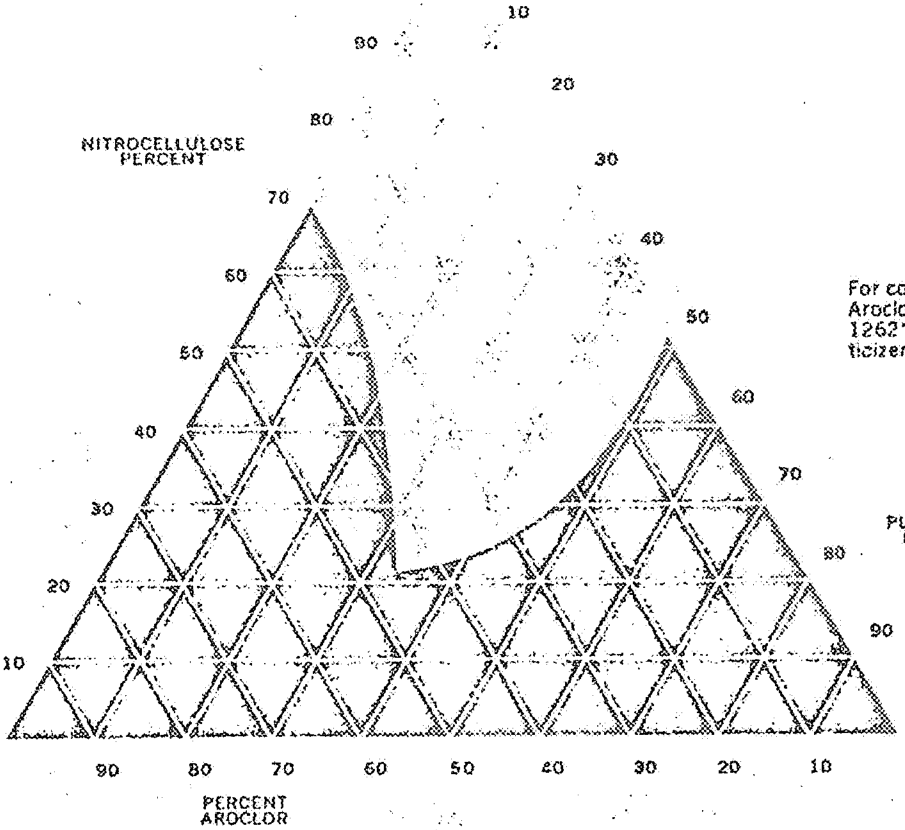
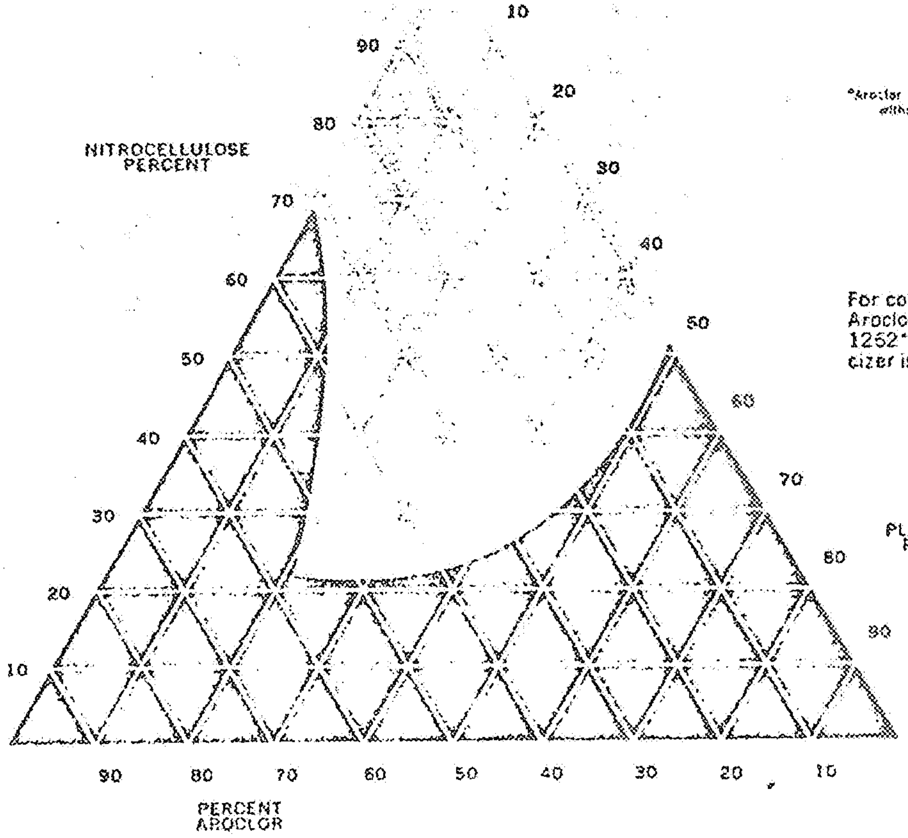


For combinations where the Aroclor resin is Aroclor 1262* and where the plasticizer is Dibutyl Phthalate.

*Aroclor 1260 may be substituted without material change.

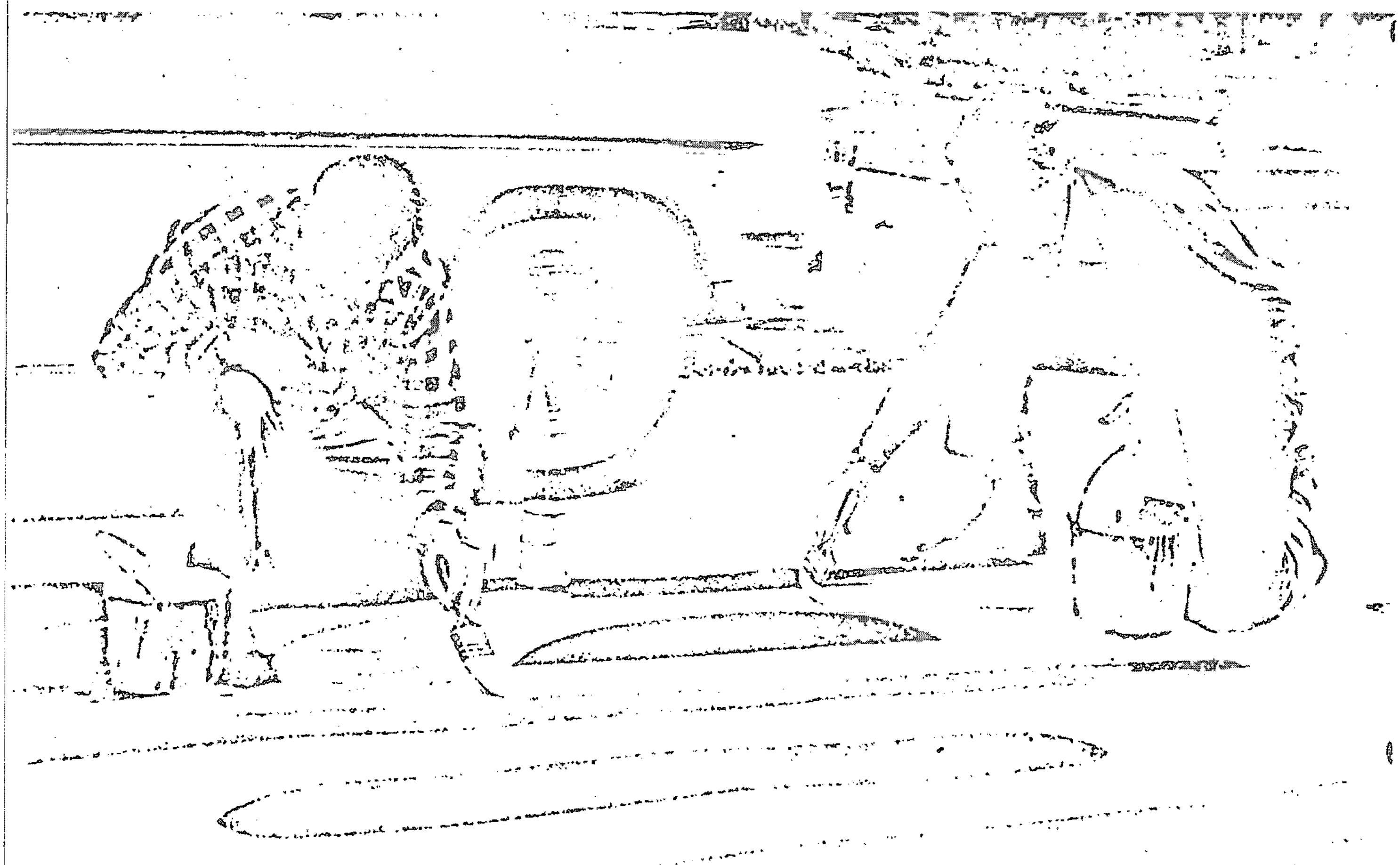


For combinations where the Aroclor resin is Aroclor 1262* and where the plasticizer is Tricresyl Phosphate.

CHLORINATED RUBBER AND STYRENE-BUTADIENE COPOLYMERS

Aroclors are outstanding for compounding modified rubber finishes. They impart exceptional corrosion resistance, chemical resistance, oxidation resistance to these coatings, and improve adhesion. Typical applications include masonry coatings for swimming pools, stucco homes and highway paints, as well as protective and decorative coatings for steel structures, railway tank and gondola cars, wood and metal maritime equipment.

In rubber base coatings, Aroclor 1254 is used as a liquid flexibilizing plasticizer and commonly used in combination with Aroclor 5460 which serves as a resin fortifier. The outstanding chemical resistance, corrosion resistance and oxidation resistance of rubber base Aroclor coatings make them outstanding protective coatings for chemical plants, boats, highway marking, and masonry. Monsanto Technical Bulletins No. PL-306, PL-311, and PL-326 cover the use of Aroclors in rubber-base coatings.



CELLULOSE ACETATE-BUTYRATE LACQUERS

The higher Aroclor compounds are widely used with cellulose acetate butyrate, in the manufacture of low-cost lacquers that are flame resistant. Typical uses for this type of lacquer include paper coating, lacquers for plastics and strippable coatings for paint booths.

A typical paper lacquer with minimum tendency to curl is reported* to contain the following:

	By Weight
Half-second Butyrate	20%
Aroclor 1260	20%
Acetone	10%
Isobutyl Acetate	10%
Ethyl Alcohol	10%
Toluene	30%

ETHYL CELLULOSE COATINGS

The Aroclors are highly compatible with ethyl cellulose. The liquid Aroclors impart great flexibility, the resinous Aroclors impart great hardness. For example, 75 parts by weight of Aroclor 1242 with 100 parts of ethyl cellulose produces great flexibility and a slight tackiness. Aroclor 5460 on the other hand — in the same proportion — produces a very hard and somewhat brittle composition.

For coatings of high gloss and exceptional weathering properties to be applied to rigid surfaces, compositions containing equal parts by weight of Aroclor 5460 and ethyl cellulose are recommended. For more flexibility in the coating one of the softer Aroclors should be used — either alone or as a partial replacement for the Aroclor 5460.

Ethyl cellulose formulations plasticized with Aroclors find end use applications as protective lacquers, adhesives, and as strippable coatings.

The solid Aroclor compounds, such as Aroclor 5460 are widely used in hot melt applications for the protection of tools and metal parts. They are normally used with ethyl cellulose or cellulose acetate-butyrate resins.

CREPE RUBBER COATINGS

Aroclor 1262 is used as a low cost plasticizer for crepe rubber in paint compositions. Used in concentrations of 5 to 50% based on the weight of the rubber polymer, it increases the gloss and alkali resistance of the film and strengthens the adhesion of the film to steel.

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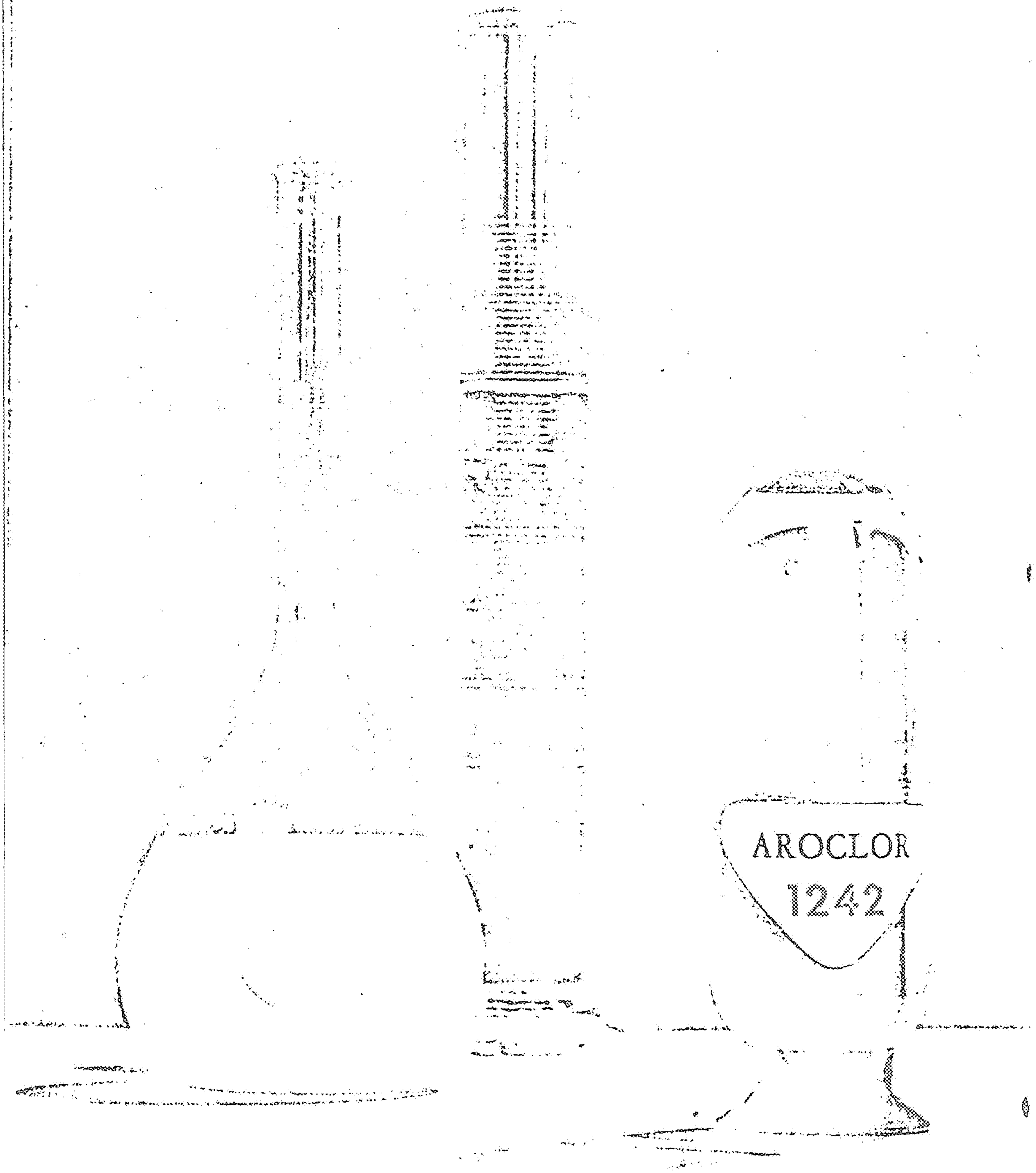
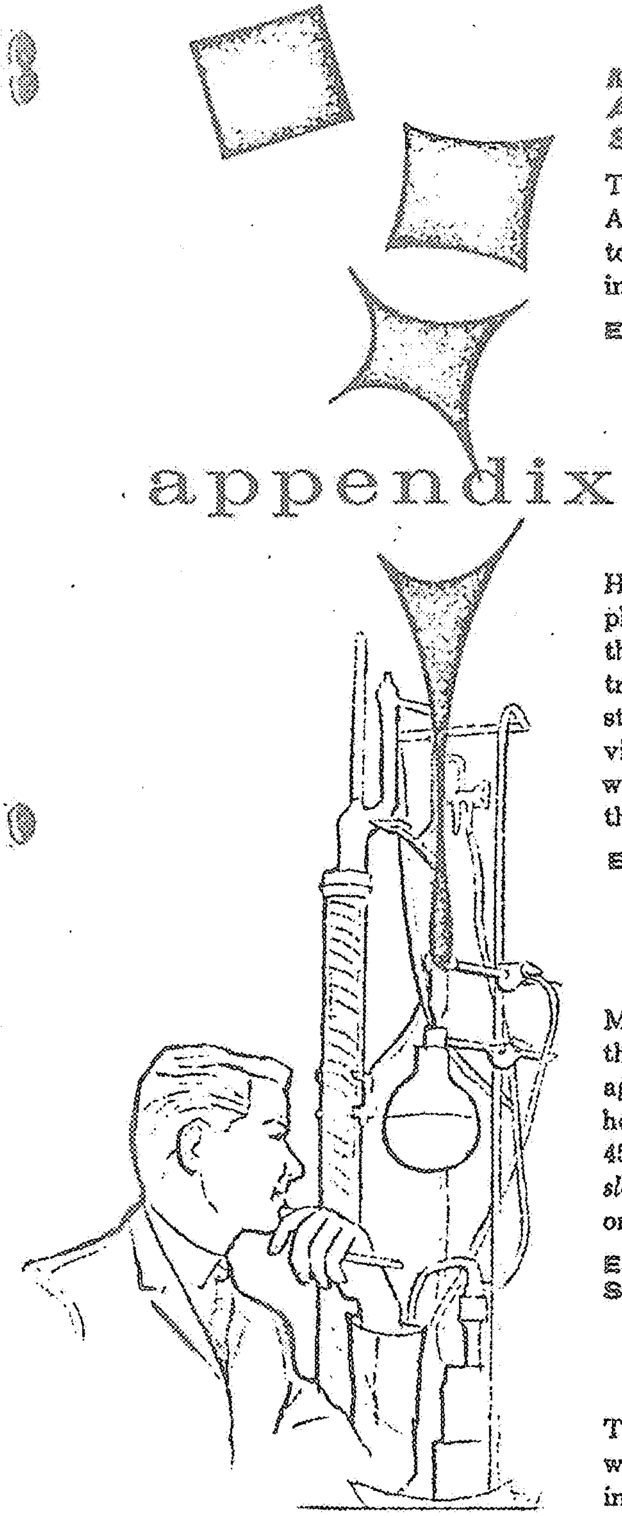
*W. M. Gearhaart and F. M. Ball, OFFICIAL DIGEST, Vol. 343, 1953.


AROCLOR
1242



appendix

METHODS FOR EMULSIFYING AND MAKING STOCK SOLUTIONS OF AROCLORS

There are several simple methods for making Aroclor emulsions; the one used may be selected to suit the kind of Aroclor and type of formulation in which it will be used.

Emulsifying Viscous Aroclors

(Portion 1)	16 lbs. of Aroclor 1 lb. of Stearic Acid
(Portion 2)	8 lbs. of water 4 oz. Triethanolamine

Heat the Aroclor to a workable viscosity (180°F plus) and stir in the stearic acid thoroughly. Heat the water to almost boiling (207°F) and stir in the triethanolamine thoroughly. Pour the Aroclor-stearic acid portion *into* the water portion agitating vigorously. Then process the combined portions with a high-speed emulsifying stirrer . . . or process through a colloid mill.

Emulsifying Liquid Aroclors

(Portion 1)	100 parts Aroclor 1254 4 parts Oleic Acid
(Portion 2)	92 parts water 2 parts Ammonium Hydroxide (28%) 2 parts Lustrex* X-810

Mix the ammonium hydroxide and Lustrex X-810 thoroughly in the warmed water, using vigorous agitation. Mix the Aroclor 1254 and Oleic Acid, heat to 45°C and agitate vigorously. Maintain the 45°C temperature and agitation — and add in *slowly* the water portion. Continue agitation for one-half hour till phase inversion is complete.

Emulsifiable Concentrated Stock Solutions of Aroclors

79 parts of Aroclor
16.70 parts of toluene
3.55 parts of isopropyl alcohol
1.00 parts of Sterox* CD (non-ionic emulsifier)
0.75 parts of Santomerse* #3 (anionic wetting agent)

The above formulation is readily emulsifiable with water. If the more resinous Aroclors are used, increase the amount of toluene (or xylene) as needed to dissolve the Aroclor resin.

*Trademarks Monsanto Chemical Co., Reg. U. S. Pat. Off.

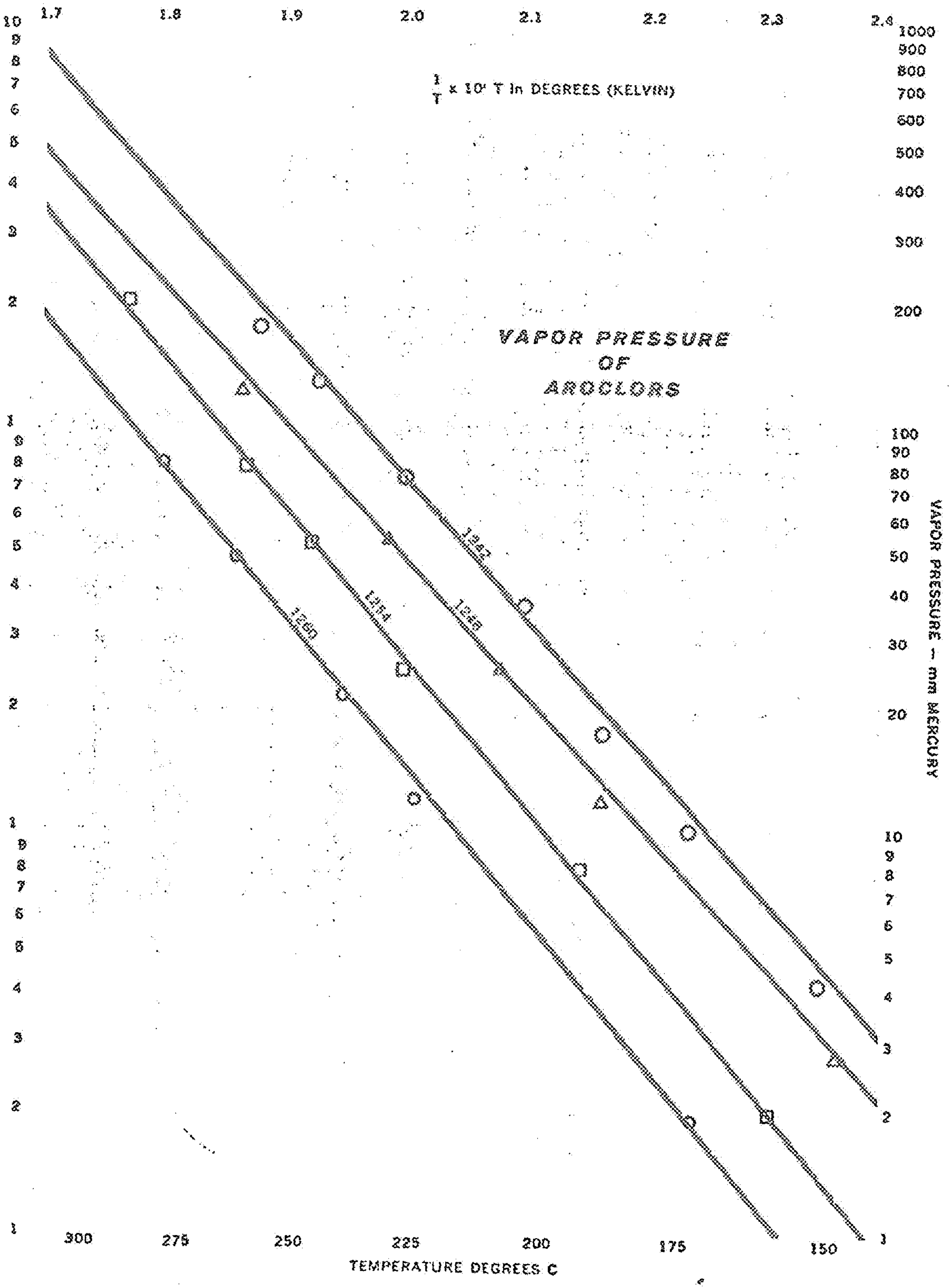
0509858

SOLUBILITY OF AROCLORS IN 100 MILLILITERS OF VARIOUS SOLVENTS

Aroclor	1242		1248		1254		4465		5460
Type of Solvent	25°C	Hot	25°C	Hot	25°C	Hot	Cold	Hot	25°C
Acid									
Acetic Acid	S	S	—	—	S	S	SS	S	—
Oleic Acid	S	S	—	—	S	S	S	VS	—
Benzoic Acid	$10.0^{31^\circ\mathrm{C}}$	—	$10.0^{32^\circ\mathrm{C}}$	—	—	—	—	—	—
Aldehyde									
40% Formaldehyde	I	I	I	I	I	I	I	I	—
Furfural	VS	VS	VS	VS	VS	VS	VS	VS	—
Amine									
Aniline	S	S	—	—	S	S	VS	VS	—
Pyridine	$132.5^{30^\circ\mathrm{C}}$	$440^{99^\circ\mathrm{C}}$	—	—	$114^{31^\circ\mathrm{C}}$	$425^{100^\circ\mathrm{C}}$	VS	VS	—
Chloro — derivatives									
Amyl chlorides—mixed	S	S	S	S	S	S	VS	VS	—
Carbon Tetrachloride	S	S	S	S	S	S	VS	VS	156
Chloroform	S	S	S	S	S	S	VS	VS	—
Dichlorethylene	—	—	—	—	—	—	VS	VS	—
Ethylene Dichloride	S	S	S	S	S	S	VS	VS	—
Monochlorobenzene	S	S	S	S	S	S	VS	VS	—
Orthodichlorobenzene	—	—	—	—	—	—	VS	VS	—
Tetrachlorethane	S	S	S	S	S	S	VS	VS	—
Trichlorethane	S	S	S	S	S	S	VS	VS	—
Trichlorethylene	S	S	S	S	S	S	VS	VS	—
Drying Oil									
Tung Oil	S	S	S	S	S	S	VS	VS	—
Linseed Oil	S	S	S	S	S	S	VS	VS	—
Ester									
Amyl Acetate	S	S	S	S	S	S	VS	VS	—
Butyl Acetate	S	S	S	S	S	S	VS	VS	—
Cellosolve Acetate	S	S	S	S	S	S	VS	VS	—
Cottonseed Oil	S	S	S	S	S	S	S	VS	—
Dibutyl Phthalate	S	S	S	S	S	S	S	VS	—
Diethyl Phthalate	S	S	S	S	S	S	S	VS	—
Ethyl Acetate	S	S	S	S	S	S	S	VS	—
Ethyl Lactate	S	S	S	S	S	S	VS	VS	—
Ethylene Glycol Diacetate	S	S	S	S	S	S	VS	VS	—
Methyl Acetate	S	S	S	S	S	S	S	S	—
Tricresyl Phosphate	S	S	S	S	S	S	SS	S	—
Ether: Ethyl Ether	S	S	S	S	S	S	S	—	—
Ether Alcohol									
Carbitol	$224^{31^\circ\mathrm{C}}$	$307^{99^\circ\mathrm{C}}$	VS	VS	$173^{26^\circ\mathrm{C}}$	$259^{98^\circ\mathrm{C}}$	SS	—	—
Cellosolve	S	S	S	S	S	S	S	—	—
Diethylene Glycol	—	—	—	—	—	—	S	—	—
p-p′ Dihydroxy Ethyl Ether	$16.9^{23^\circ\mathrm{C}}$	$19^{99^\circ\mathrm{C}}$	SS	SS	$8^{30^\circ\mathrm{C}}$	$10^{100^\circ\mathrm{C}}$	SS	—	—
Hydrocarbon									
Benzene	VS	VS	VS	VS	VS	VS	VS	VS	143
Gasoline	VS	VS	VS	VS	VS	VS	VS	VS	—
Kerosene	VS	VS	VS	VS	VS	VS	VS	VS	—
Mineral Spirits	VS	VS	VS	VS	VS	VS	VS	VS	—
Paraffin	$2.0^{27.5^\circ\mathrm{C}}$	S	$2.0^{28^\circ\mathrm{C}}$	S	—	S	<5.0	S	—
Pine Oil	S	S	VS	VS	S	S	S	S	—
Toluene	VS	VS	VS	VS	VS	VS	VS	VS	142
Turpentine	VS	VS	VS	VS	VS	VS	VS	VS	—
Xylene	VS	VS	VS	VS	VS	VS	VS	VS	178
Hydroxy — derivatives									
Amyl Alcohol	S	S	—	—	S	S	S	S	—
n-Butyl Alcohol	S	S	—	—	S	S	SS	S	—
Ethyl Alcohol (3-A)	$23.3^{29^\circ\mathrm{C}}$	$80.0^{70^\circ\mathrm{C}}$	—	—	$10^{27^\circ\mathrm{C}}$	$28^{75^\circ\mathrm{C}}$	SS	—	—
Glycerine	I	I	I	I	I	I	I	I	—
Methyl Alcohol	$42.5^{29^\circ\mathrm{C}}$	$88.5^{60^\circ\mathrm{C}}$	—	—	$15^{26^\circ\mathrm{C}}$	$22.2^{65^\circ\mathrm{C}}$	SS	—	—
Phenol—90%	$194^{30^\circ\mathrm{C}}$	S	—	—	SS	S	S	S	—
Ketone									
Acetone	S	S	—	—	S	S	S	S	260
Miscellaneous									
Carbon Disulfide	S	S	—	—	S	S	VS	VS	—
Nitrobenzene	S	S	—	—	S	S	VS	—	—
Water	I	I	I	I	I	I	I	I	—

I—Insoluble S—Soluble SS—Slightly Soluble VS—Very Soluble

Figures show grams of Aroclor per 100 milliliters of solvent at 25°C unless otherwise indicated.



1.7
1.8
1.9
2.0
2.1
2.2
2.3
2.4
$\frac{1}{T}$ x 10³ T in DEGREES (KELVIN)
VAPOR PRESSURE OF AROCLORS
1242
1248
1254
1260
VAPOR PRESSURE – mm MERCURY
1000
900
800
700
600
500
400
300
200
100
90
80
70
60
50
40
30
20
10
9
8
7
6
5
4
3
2
1
300
275
250
225
200
175
150
TEMPERATURE DEGREES C

VAPORIZATION RATES

At 100°C and 760 mm. Hg.

Sample	Wt. Loss Gms.	Hours Exposure	Surface Area Cm.²	Vaporization Rate gms./cm.²hr.
Aroclor 1221	0.5125	24	12.28	0.00174
Aroclor 1232	0.2572	24	12.28	0.000874
Aroclor 1242	0.0995	24	12.28	0.000338
Aroclor 1248	0.0448	24	12.28	0.000152
Clorafin-42-S	0.0745	48	12.28	0.000126
DOP (dioctyl phthalate)	0.0686	48	12.28	0.000117
Dutrex 25	0.0256	24	12.28	0.000087
Aroclor 1254	0.0156	24	12.28	0.000053
Dutrex 20	0.0047	24	12.28	0.000016
Aroclor 1262	0.0039	24	12.28	0.000013
Aroclor 1260	0.0026	24	12.28	0.000009
Aroclor 4465	0.0064	72	12.28	0.000007
Aroclor 1270	0.0045	72	12.28	0.000005
Aroclor 5442	0.0039	72	12.28	0.000004
Aroclor 5460	0.0032	72	12.28	0.000004
Tricresyl phosphate	0.0010	24	12.28	0.000003

APPROXIMATE VAPOR PRESSURES CALCULATED AT 100° F (37.8° C)

Aroclor 1232	0.005 mm. Hg.
Aroclor 1242	0.001 mm. Hg.
Aroclor 1248	0.00037 mm. Hg.
Aroclor 1254	0.00006 mm. Hg.

RESISTANCE OF STRUCTURAL MATERIALS TO AROCLORS

Aroclor Number

Metals	1248		1254		4465	5460
	25°C	125°C	25°C	125°C	125°C	125°C
Aluminum	R	R	R	R	*RR	RR
Copper	R	D	R	D	D	D
Magnesium	RR	R	R	R	RR	*RR
Nickel	RR	R	R	RR	RR	R
Silver	R	R	R	R	R	R
Tin	R	R	R	R	R	R
Zinc	R	R	R	R	R	RR
Mild Steel	RR	R	RR	RR	R	RR
Phosphor Bronze	R	D	R	R	R	R
Red Brass	D	D	R	D	R	De
Stainless Steel (Type 316)	RR	RR	RR	RR	RR	RR
Yellow Brass	R	Re	R	De	Re	Re
Plastics						
Alkyd Resin No. 46594-12	*P	P	*P	P	P	P
Alkyd Resin No. 46594-13A	*D	P	*D	P	P	P
Cellulose Acetate (Fibestos)	D	P	D	P	P	P
Durite Phenol Furfural Resin	*D	P	*R	P	D	P
Formvar Highly Plasticized	De	T	Pe	T	T	T
Formvar Low Plasticized	PS	T	PS	T	T	T
Glyptal 1276	R	P	D	P	P	P
Glyptal 7136	*D	T	*R	T	T	T
Maleic Resin No. 46594-13B	P	P	*P	P	P	P
Maleic Resin No. 46594-13C	P	P	*R	P	P	P
Plexiglas (Methyl Methacrylate)	*D	P	*D	P	P	P
Polystyrene (Lustron B)	P	T	P	T	T	T
Resinox Mineral Filled Melamine Resin	*D	*P	*R	R	*P	*D
Resinox Wood Flour Filled Melamine Resin	*D	P	*R	D	R	P
Resinox Mineral Filled Phenol Formaldehyde	*D	D	*D	D	R	P
Resinox Wood Flour Filled Phenol Formaldehyde	*D	P	*D	*R	D	P
Resinox Rag Filled Phenol Formaldehyde	*D	D	*D	*D	*D	P
Urea Formaldehyde Resin (Plaskon Co.)	*D	P	*D	*P	P	P

Meaning of Abbreviations:

*—Based on weight gain calculated as penetration value shown.

RR—Excellent resistance—less than 1.0 x 10^{-6} cm/day penetration or .00014 in/yr.

R—Good resistance—has penetration between 1.0 x 10^{-6} and 10 x 10^{-6} cm/day or between 0.00014 and 0.0014 in/yr.

D—Doubtful resistance, penetration between 10 x 10^{-6} cm/day and 100 x 10^{-6} cm/day or between 0.0014 and 0.014 in/yr.

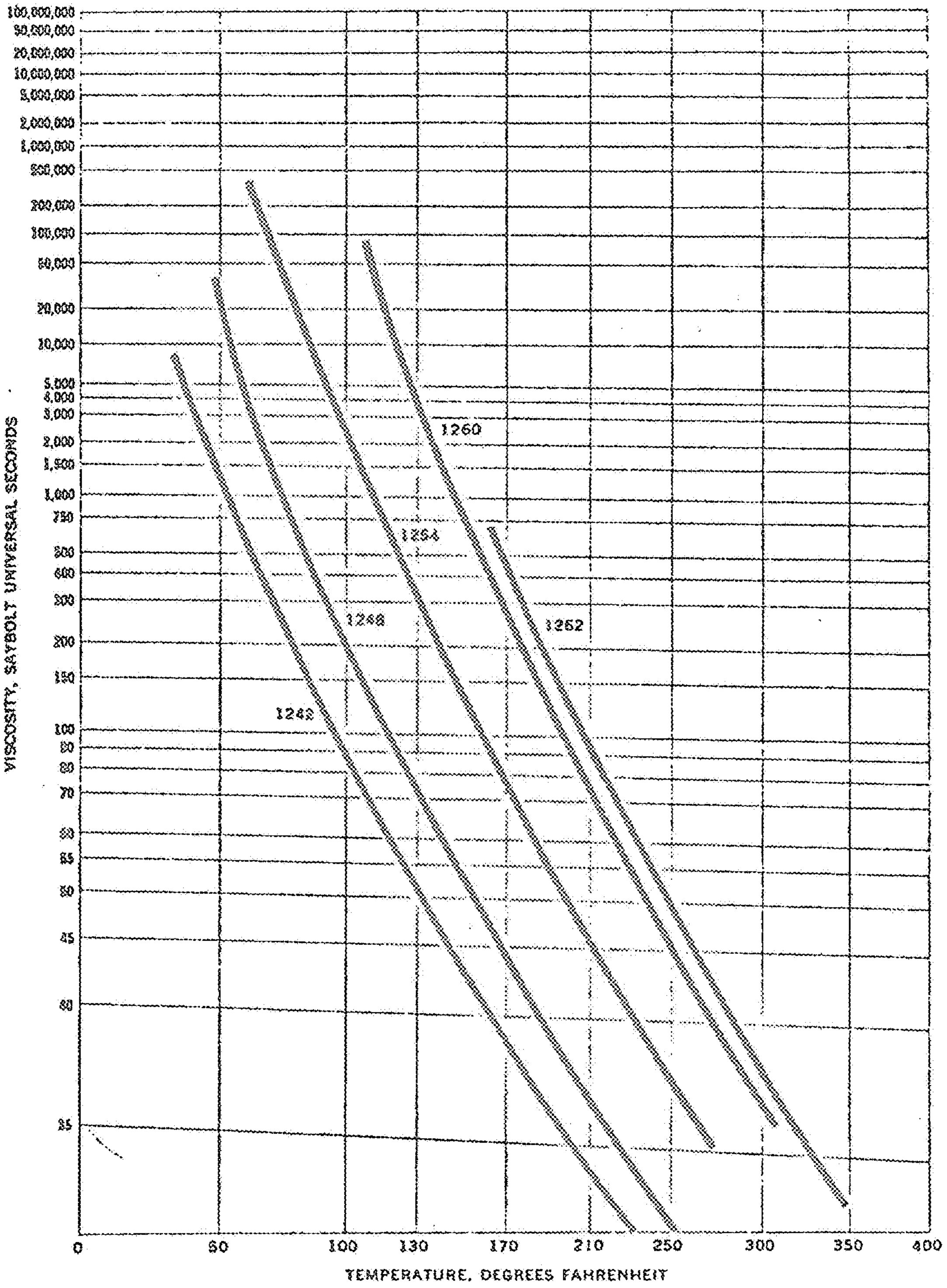
P—Poor resistance—penetration greater than 100 x 10^{-6} cm/day or 0.014 in/yr.

PS—Poor resistance due to visible local action although weight change indicates greater resistance.

e—Following the letter indicating resistance signifies material may be better than indicated if totally immersed since weight loss is believed to come from oxidation of the part of test strip exposed to air.

T—Material alone will not stand temperature.

VISCOSITY RANGES OF SOME OF THE AROCLORS



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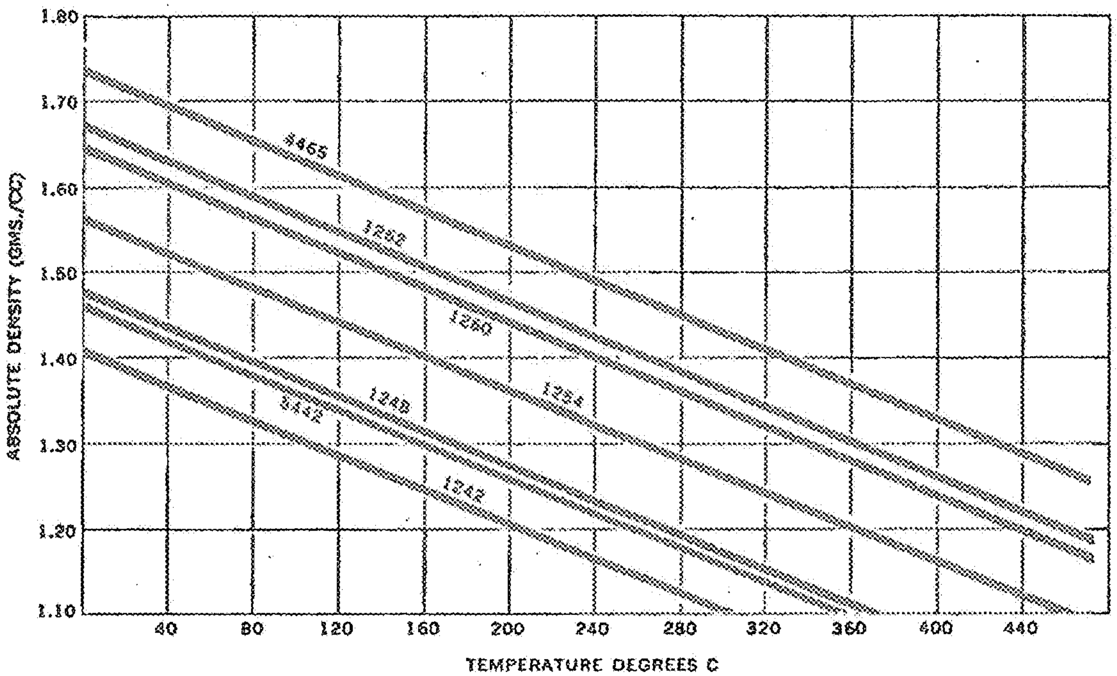
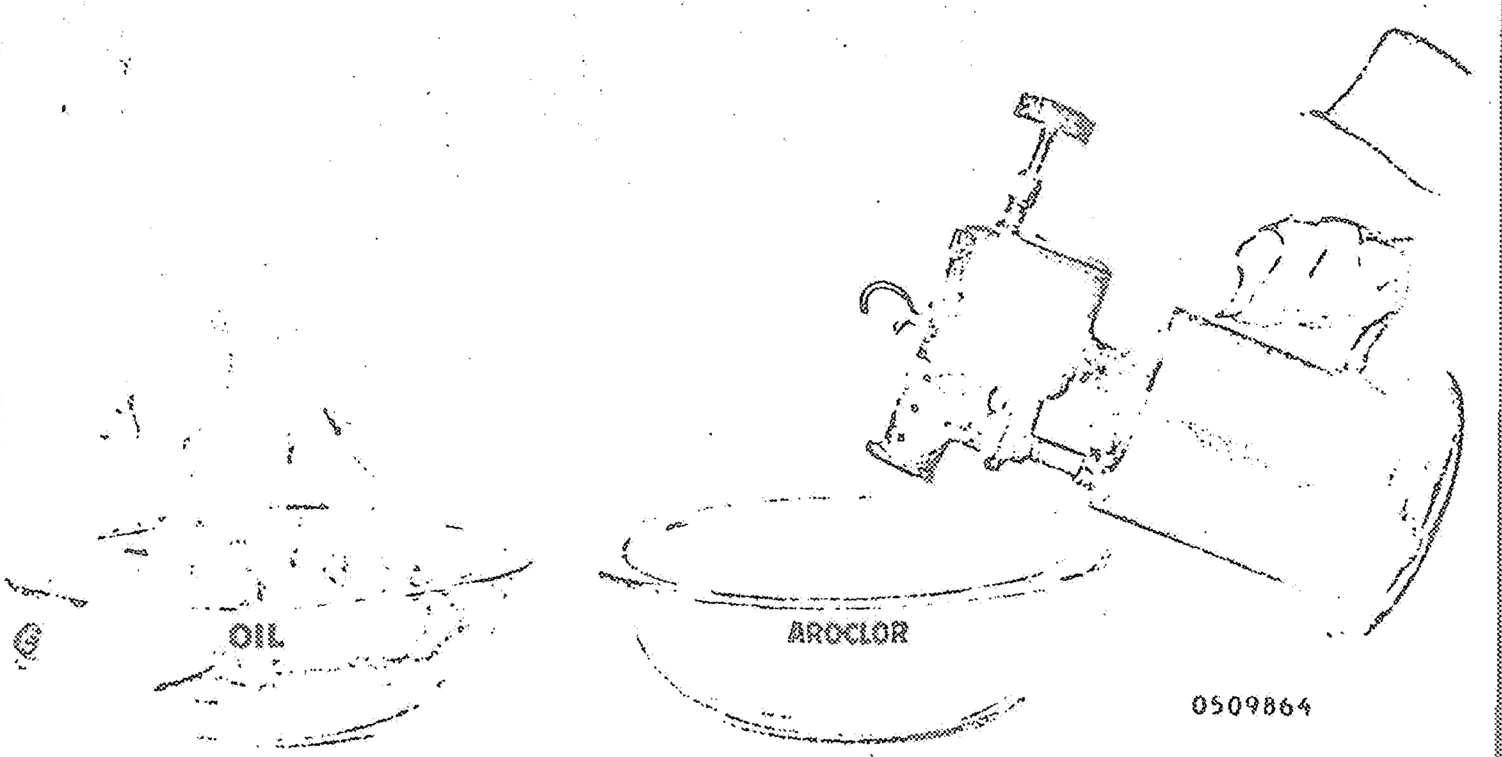
DENSITIES OF AROCLORS AT VARIOUS TEMPERATURES





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[illegible]

At ordinary temperatures Aroclors have not presented industrial toxicological problems. Where Aroclor vapors may be encountered in workrooms, local exhaust ventilation together with general workroom exhaust is recommended.

Skin patch tests with a polyvinyl chloride free film plasticized with 11.5% by weight of Aroclor 1254 (about 25% based on the weight of the vinyl resin) and a similar amount of dioctyl phthalate showed that this film was not a primary irritant or a sensitizer. Skin patch tests with Aroclor 1254 alone applied to gauze and placed in contact with the skin showed no primary irritancy or sensitization. Other skin patch tests using canvas coated with Aroclor 5460 and an oil modified alkyd resin, in such a manner that the Aroclor concentration in the paint film on the fabric was about 17% by weight of paint solids and the finished coated fabric contained approximately 7% by weight of Aroclor 5460 showed that this painted fabric did not produce a primary irritancy or sensitization of the skin.

If Aroclors are spilled on the skin, the skin should be washed in the usual manner with soap solutions. If accidental burns occur from contact with hot Aroclors, the burn should be treated the same as any ordinary burn. Aroclor adhering to the burned area need not be removed immediately unless treatment of the burn demands it, in which case use soap and water or repeated washings with a vegetable oil.

Monsanto

fire retardant
inert
shear resistant
heat stable
lubricating

aroclors for...

physically "adjustable"
adhesive
non-volatile
low cost
thermoplastic

FILM FORMING
IMPREGNATING
INSULATING
HEAT TRANSFER
DEDUSTING
INERT MATRIXES
PLASTICIZING
BULKING
COATING
"TACKIFYING"
REDUCING VOLATILITY

Aroclors are the only low cost, inert, inter-compatible liquids and solids whose intermixing can provide insulating, lubricating, fire retardant liquids ranging from the consistency of light mineral oil to the most viscous syrup (or solid resin) which will do so many jobs in industry.

Division • 800 North Lindbergh Blvd. • St. Louis 66, Missouri

0509866

2-SCC-55/60-53

EXHIBIT 14

PLASTICIZER
SALES
DEPARTMENT

Monsanto

PLASTICIZER PATTER

MONSANTO CHEMICAL COMPANY
ORGANIC CHEMICALS DIVISION
ST. LOUIS 24, MISSOURI

J. R. Darby
Res-JFQ

MONSANTO TRADE LITERATURE
PERMANENT FILE

#-399-

February, 1961

END USES FOR AROCLOR COMPOUNDS

INDEX

FOR SALESMEN'S USE ONLY

END USES FOR AROCLOR COMPOUNDS

GENERAL

You remember some time ago you cooperated with us in supplying information about where your customers are using Aroclor compounds and the reasons why they were using them. This survey covered all accounts that purchased over 5,000 pounds of Aroclor annually. Your aid in this project was deeply appreciated. We have now compiled these results and this is the way it stacks up. We hope this will be useful to you in suggesting new uses or applications for the Aroclors and increasing your sales of these products.

SURFACE COATINGS are the largest single outlet for the Aroclor compounds. The adhesion, cost, chemical resistance, and flame resistance of these Aroclors are of tremendous importance.

The ADHESIVES Industry also consumes large quantities of Aroclors. In the adhesive field the adhesion, cost, and flame retardancy are the three most commonly mentioned reasons for the use of these products.

The PLASTICS Industry also consumes sizeable quantities of Aroclors depending upon the type of end application. The reasons most commonly mentioned for using the Aroclors are adhesion, cost, flame retardancy.

The miscellaneous category includes all types of applications, some of which are large, some of which are very small. However, we have outlined these applications in the attached sheets.

The attached write-ups are for your own use only, and not to be shown to customers. You will note we have shown four categories in order to give you an idea of our volume in each field. The break down on these is shown below.

Large	500,000 pounds and over
Good	250,000 - 500,000 pounds annually
Fair	100,000 - 250,000 pounds annually
Minor	Less than 100,000 pounds annually

You will note a practical potential figure. This is an indication of the number of times we could probably expand our participation in this field with effort.

We have shown products used. These are in descending order of use in the field of application.

We have shown the number of customers for each particular application and the number of bulk and truckload customers to give you a better understanding of the field; as well as the number of times a reason for using the Aroclors appeared in this particular field.

In addition to giving you a summary page on the entire field, we are backing this up with a list of patents that have appeared in each field and slants from your call reports. We hope this will aid you greatly in getting a better understanding of the Aroclor field, plus aiding you in your sell-more Aroclor program.

SURFACE COATINGS

TYPE	VOLUME	POTENTIAL	AROCLOR PRODUCTS USED	# Customers	# Bulk or TL Cost	Adhesion	Cost	Oxidation	Chem. or Corrosion Resistance	Flame Resistance	Melt Point	Viscosity	Extraction	Water Resistance
Chlorinated Rubber	Large	1.5	1252, 5460, 1260, 1248, 1242	31	5	7	13	4	13	6	1	5	4	-
Nitrocellulose	Large	2	1254, 5460, 1260, 4465	13	1	4	12	2	--	1	-	-	1	1
Polyvinyl Chloride	Large	3	1254, 5460, 1260	7	3	2	3	-	4	4	-	-	-	-
Styrene-Butadiene	Good	6	5460, 1254, 1242	10	1	2	2	-	-	3	-	1	-	1
Epoxy	Fair	5	1242, 1260, 1254 1248, 1268, 5460	7	0	3	6	-	3	2	-	1	1	-
Silicone	Minor	5	1242, 5460, 4465	3	0	-	-	-	-	-	-	-	-	-
Polyvinyl Acetate	Minor	5	1260, 1254, 5460	4	0	4	3	-	-	2	-	-	-	-
Asphalt	Minor	10	1254, 1248, 1260	3	0	2	1	1	1	1	1	1	1	-
Phenolic	Minor	5	5460, 4465	3	0	2	1	-	1	2	-	-	2	-
Alkyd	Minor	10	1254, 5460	2	0	1	1	-	1	1	-	1	-	-
CA/Bu	Minor	15	4465, 5460	1	0	-	1	-	-	1	-	-	-	-
Ethyl Cellulose	Minor	20	1260	1	0	-	-	1	-	-	-	1	-	-

CHLORINATED RUBBER

Chlorinated rubber (Parlon) is used in many fields of applications. Of the thirty-one accounts, we find that chemical resistance coatings, and masonry paints are the two most common uses. However, traffic paints, marine type paints, and shingle coatings also get a good play in this field.

A FLAME-RESISTANT, WATERPROOFING impregnating compound for asbestos cloth used in locomotive cabs contains chlorinated rubber, an Aroclor compound, and a wax. U.S.P. 2,145,235 by Robert E. Cryor assigned to Union Asbestos and Rubber Company, Chicago, Illinois.

Liquid Aroclor Compounds plus chlorinated rubber and pigments are used in a coating to protect and COLOR CONCRETE. U.S.P. 2,306,570 by Edward W. Scripture Jr., Skaker Heights, Ohio.

NITROCELLULOSE COATINGS

We find that our Aroclor compounds are being sold in Nitrocellulose lacquers for the following applications.

1. Electrical Appliance cable finish for dielectric properties of the finished cable.
2. Heel lacquers for women's shoes.
3. Lacquers for fiber seat covers for automobiles.
4. Overprint varnishes.
5. Wire cable coatings.
6. Metallic lacquers.

While Nitrocellulose is an old product, there are constantly new applications for the use of Aroclors popping up in this field.

POLYVINYL CHLORIDE

In totaling up the amount of Aroclors sold in polyvinyl chloride surface coatings, we were surprised to find that it was so large. Among the interesting applications are flame proof acoustical tile finishes and metal coatings where the Aroclor contributes adhesion.

A COATING FOR BARRELS and similar metallic surfaces composed of a vinyl chloride/vinyl acetate copolymer, an Aroclor compound, plasticizer and pigments. U.S.P. 2,111,395 by Otto J. Hartwick assigned to Pittsburgh Plate Glass Company, a corporation of Pennsylvania.

A METAL COATING that can be later pressed and formed has a finish lacquer over it for chemical resistance composed of polyvinyl chloride and an Aroclor compound dissolved in suitable solvents. U.S.P. 2,293,420 by Geory Wick, seized by Alien Property Custodian.

AN ELECTRICAL INSULATING MATERIAL for exposed bus bars comprised of a vinyl chloride/vinyl acetate copolymer, Tricresyl Phosphate, an Aroclor compound, and stabilizer. U.S.P. 2,183,811 by Edward C. Homan assigned to Irvington Varnish and Insulator Company, Irvington, New Jersey.

AN IMPREGNATING AND INSULATING MATERIAL for filling interstices for embedding or covering objects is composed of a small amount of polyvinylcarbozole and a large amount of an Aroclor compound. U.S.P. 2,227,637 by Rudolf Engelhardt assigned to I. G. Farbenindustrie Aktiengesellschoft, Frankfort-on-the-Main, Germany.

A METAL COATING composition capable of being bent after baking is composed of a vinyl chloride/vinyl acetate copolymer and an Aroclor compound dissolved in suitable solvents. U.S.P. 2,115,214 by Clifford Jay Rolle assigned to Ault and Wiborg Corporation, New York, New York.

STYRENE-BUTADIENE

In Styrene Butadiene coatings, which are commonly used in masonry paints, and metal paints we find one unique characteristic of the Aroclor compounds is their improved anti-tarnish characteristic compared to Chlorinated Paraffins when metallic pigments are used.

RANDY GRAHAM reports the reason they switched from Chlorowax to Aroclors 1254 and 5460 in their Pliolite S-5 traffic paint was because Chlorowax 70 precipitated from the formulation. When the paint was applied the precipitated Chlorowax was pressed out of the film and it affected the drying time. He talked with Goodyear about this problem and they ran a series of tests. Their findings verified test results which he had obtained where precipitation of Chlorowax took place. He said Goodyear's new technical bulletin will probably call for Aroclors in Pliolite formulations for traffic paints.

EPOXY RESINS

As you know, we have a big push on for the use of Aroclor compounds in epoxy plastics and surface coatings. Shown below are three references which may be of value to you.

JOE HENNINGER contacted Mr. _____ to follow up his purchase of 300 pounds of Aroclor 5460 in late November. This material is being used in epoxy resin coatings. Mr. _____ said that he very much approves of the flaked material over the old Aroclor 5460 which he had previously evaluated.

ED FORDING reports a customer using Aroclor 1254 in self-extinguishing epoxy coatings. The Aroclor 1254 produces an excellent gloss with a great depth.

They are currently using Aroclor and Mod Epox in an epoxy terrazzo. JOHN ELWOOD says that this is a relatively new product with them and seems to be going over very well. They expect their purchases to increase greatly in 1961.

POLYVINYL ACETATE

In polyvinyl acetate coatings the Aroclor compounds are used primarily in concrete or stucco paints plus one account that is using them in a paper coating.

ASPHALT COATINGS

In the asphalt coating field the Aroclor surface coatings are used primarily to impart flame retardancy and good corrosion resistance

F

JOHN LONSBERG has an account that uses Aroclor 1254 in conn coatings on pipes, underground and above ground.

PHENOLIC SURFACE COATINGS

Phenolic surface coatings seem to find their greatest play in masonry and marine coatings.

JIM COMPTON reports that a p-tert-amyl phenolic type marine varnish containing 40 parts of Aroclor 1268 showed up very well in exposure tests of fourteen months at 45° angle in Florida. The Aroclor 1268 is used to give a velvet-like appearance to low-gloss varnish, probably by recrystallization of Aroclor as varnish dries. Varnish is 50% solids with 50 parts mineral spirits, 50 parts turpentine, 50 parts Celite 110, 6 parts Bentone, 40 parts Micromica (C-300 English Mica Company) and 3 parts anti-skinning agent. Also used is Cobalt drying agent and zirconium dry catalyst. Expected use is a varnish for cedar or redwood.

ALKYDS

JOHN ELWOOD has an account that uses Aroclor 1254 and 5460 in an alkyd in combination with a wax for the flame proofing of Christmas Trees.

The use of Aroclor compounds increases the adhesion of SHORT OIL varnishes. National Paint, Varnish, and Lacquer Association. Science Section Circular #555, 100-103 (1938)

MISCELLANEOUS

In looking over the miscellaneous category, which is too minor to report, we find that Aroclors are being used in both ETHYLCELLULOSE and CELLULOSE ACETATE BUTYRATE for CABLE LACQUERS.

WALLY HILLIARD reports he has a customer using Aroclors in a floor wax in combination with other waxes because of the melting point of the Aroclor 5460.

FRANK GUIGNON reports he has a customer that uses Aroclor 5460 as a sole binder with metallic pigments because of the excellent resistance of the Aroclor compounds with regards to anti-tarnishing properties on the pigments.

The use of Aroclor compounds in ALLYL STARCH emulsions including preparation and hardness is discussed in U.S.D.A. ---- Circular AIC - 351 (1953).

BILL DAMRON has a customer using Aroclor 1254 in a new non-flammable thermoplastic icicle for Christmas Trees.

A WATERPROOFING composition for wood is composed of Aroclor 5460 plus other ingredients dissolved in solvent. The coating drys to a tack-free, easily-painted surface. U.S.P. 2,549,127 by Donald D. Pew assigned to Stopall Waterproofing Manufacturers Inc., Kalamazoo, Michigan

AN ANTI-STATIC coating for plastics is made of acrylic pol Aroclor compound dissolved in suitable solvents. U.S.P. 2,64 Eleanor G. Sheridan, Luther L. Yeager, and John Bjorksten assi Nash-Kelvinator Corporation.

JAKE ARBOGAST gave figures on availability of Montars. This is all going into sealing compounds for automotive use.

The technology employed by one of WALLY SCHALK'S accounts was so unlike other aspects requiring plasticizer usage, he was at a loss to recommend plasticizers. Instead, he sent the customer one of our Aroclor booklets. Subsequently, the customer requests samples and informed Wally that the Aroclors imparted some rather unusual and some highly desirable artistic effects to this system.

JOHN LONSBERG has an account that uses Aroclor 4465 in a special floor paint which is mixed with an abrasive to give non-slip properties. The majority of this is for government use at present.

AN AEROPLANE PROPELLER ICE PREVENTING coating composed of polyisobutylene and an Aroclor compound. U.S.P. 2,434,208 by Richard S. Gaugler and Hugh W. Guenther assigned to General Motors Corporation, Dayton, Ohio.

A SEALANT OR COATING for sealing an anodized oxide coating formed on aluminum is made by dissolving 1%-5% of an Aroclor compound in a suitable solvent. U.S.P. 2,698,262 by Frederic Balmar, Versailles, France.

ADHESIVES AND SEALERS

TYPE	VOLUME	PRACTICAL POTENTIAL	AROCLOR PRODUCTS USED	# Customers	# Bulk or TL Customers	Adhesion	Cost	Oxidation	Chem. or Corrosion Resistance	Flame Resistance	Melt Point	Viscosity
POLYVINYL ACETATE EMULSION	Large	2	1232, 1254, 1248, 1221, 1242, 1260	19	7	17	19	1	1	3		5
POLYVINYL ACETATE HOT MELT	Large	4	1248, 1254, 5460	4	2	3	3	-	-	-	1	-
RUBBER	Good	5?	1254, 1262, 5460, 1260	7	1	6	6	-	-	5	-	-
RUBBER (THIOKOL)	Good	3	1254, 1260, 1221	2	1	-	1	-	-	1	-	1
ASPHALT	Minor	20	Montar, 1254, 5460	3	0	1	1	-	-	-	-	-

POLYVINYL ACETATE EMULSION ADHESIVES

The Aroclor compounds are widely used in emulsion adhesives. If you will remember we used to make Ortho-Nitrobiphenyl. When this product became unavailable, we ran a program to try to replace it with Aroclor compounds. In this we were highly successful. The Aroclor compounds offered the advantage of being liquid, low in color, and easy to mix into the vinyl acetate emulsion. We find customers using them for adhesives, for cartons, envelopes, industrial equipment, and paper board boxes.

POLYVINYL ACETATE HOT MELT

Here is a large field that is growing rather rapidly. This type of hot-melt adhesive is used to bind the quarter paper, back novels, Reader's Digests, etc. It has offered real economies to the publisher because of its rapid set characteristics. The solid Aroclor 5460 is used to make a formulation that is non-tacky at room temperature and is a fluxing aid. The liquid Aroclor plasticizes the composition.

A SEALING COMPOUND for cans to contain alcohols is comprised of a vinyl chloride/vinyl acetate copolymer, an Aroclor compound, Santicizer B-16, and suitable solvents and pigments. U.S.P. 2,392,412 by John E. Robinson and Paul W. Millilot, Jr. assigned to American Can Company.

RUBBER ADHESIVES

We were surprised to find out the amount of Aroclor compounds that are being sold in rubber adhesives. Here the low cost, the adhesion and flame retardancy of the Aroclor is of prime importance. With regards to end applications, we find that Aroclors are being used in rubber adhesives for rug backings, flooring adhesives, and tape mastics. In addition, one company is making an emulsion adhesive based upon polyisobutylene and Aroclor.

RUBBER (THIOKOL)

Here is another sleeper. The quantity that we are moving in this field once again caught us by surprise. Evidently, the Aroclor compounds are one of the few materials that give high compatibility and flame retardancy with the Thiokol material. The primary end use is in sealing compounds for aluminum windows, industrial applications, curtain wall construction, etc. The normal range of application will be anywhere from 10 parts of Aroclor up to 50 parts of Aroclor.

FRANK GUIGNON has a customer currently working on a polysulfide synthetic rubber development. The end product will contain about 50% Aroclor 1221. The finished product is to be used for flexible molds, electronic potting, and building sealants. Aroclor functions as a plasticizer in the formulation.

MISCELLANEOUS

The Aroclor compounds are used in a variety of miscellaneous adhesive applications. The following references may prove valuable talking points at specific accounts.

A SEALING COMPOUND for the joints of conduits and contains effective form -67°F to 212°F is made by mixing approximately equal parts of amorphous graphite and an Aroclor compound. U.S.P. 2,471,010 by Laurence L. Rector, Fort Worth; and Charles L. Cron, Houston, Texas.

A SEALING AND ANTI SEIZE pipe joint compound is made of powdered graphite, an Aroclor compound, and a small amount of solvent. U.S.P. 2,508,596 by Clarence H. Cox, Clayton, Missouri.

A BOOKBINDING hot-melt adhesive composed of a viscous linear polyamide resin and an Aroclor compound (40%-65% chlorine). U.S.P. 2,612,463 by Rodney G. Brown assigned to E.I. DuPont de Nemours and Company, Wilmington, Delaware.

LEATHER and SHOE heat activated adhesive composed of Butadiene-Acrylonitril rubber copolymer, basic zinc carbonate, a vinyl chloride/vinyl acetate copolymer, and a solid Aroclor compound dissolved in a suitable solvent. U.S.P. 2,685,572 by John L. Perkins and Edwin E. Sylvester assigned to B. B. Chemical Company, Boston, Massachusetts.

METAL FOIL adhesives that can be applied hot or cold comprised of 25% of a liquid Aroclor compound, 50% of a solid Aroclor compound and 25% of a para coumarone-indene resin. U.S.P. 2,096,110 by Harry Kittredge and Sylvester J. Broderick assigned to Foilfilm Inc., Dayton, Ohio.

A HEAT ACTIVATED adhesive showing resistance to cold flow composed of approximately 100 parts of paraffin wax, 96 parts of Aroclor 5460, 45 parts of coumarone resin, and other ingredients. U.S.P. 2,376,778 by Ernest L. Kallonder assigned to Dennison Manufacturing Company, Framingham, Mass.

PUTTY made with the Aroclor compounds are non-hygroscopic, flame resistant, have excellent adhesion and remain flexible, soft and usable indefinitely. U.S.P. 2,743,188 by Samuel N. Hunter assigned to Hunter Metallic Products Corporation, East St. Louis, Illinois.

JOHN OREM reports that Jack has evaluated many plasticizers and finds Aroclor 1254 to be about the best with the epoxy systems. He has formulated a soft epoxy plasticized with about 30% of Aroclor 1254. Its use would be for a socket sealer. The epoxy cures at 350°F in one hour with an amine curing agent; will set up at room temperature in two days. Jack finds this formulation very stable in the presence of high heat of about 350°.

A thermosetting OPTICAL cement composed of dialkyl phenyl phosphonate and a viscous liquid Aroclor compound. U.S.P. 2,678,586 by John J. Lugert assigned to Eastman Kodak Company, Rochester, New York.

POLYSTYRENE WALL TILE EMULSION ADHESIVE composed of polystyrene emulsion, clay, Aroclor compounds, and other ingredients. The resultant adhesive has excellent adhesive characteristics and is waterproof. U.S.P. 2,486,756 by John F. Murphy and Russell Omadahl assigned to Monsanto Chemical Company, St. Louis, Missouri

PLASTIC APPLICATIONS

TYPE	VOLUME	PRACTICAL POTENTIAL	AROCLOR PRODUCTS USED	# Customers	# Bulk or TL Customers	Adhesion	Cost	Flame Resistance	Extraction	Chem. or Corrosion Resistance	Viscosity
EPOXY	Fair	5	1248, 1262, 5460	2	1	-	-	-	-	-	-
PVC PLASTISOL	Fair	3	1254, 5460, 1262	7	0	4	5	6	-	1	1
PVC COMPOUND	Minor	3	5460, 1254, 1268, 1260	3	1	-	2	2	1	-	-
PHENOLIC	Minor	10	2565, 1268	2	0	1	1	1	-	-	-
CELLULOSE ACETATE BUTYRATE	Minor	15	5460, 1254	2	0	1	2	2	1	-	-
POLYESTER	Minor	40	1268, 5460	3	0	-	-	3	-	-	-
SARAN	Minor	20	1254	1	0	-	-	-	-	-	-
CHLORINATED RUBBER	Minor	5	1232, 1254	1	0	-	-	-	-	-	-

PLASTIC APPLICATIONS

The low cost flame resistance and adhesion characteristics of the Aroclor compounds were most commonly mentioned in the plastic applications.

EPOXIES

Once again we are pleasantly surprised to find the volume of Aroclor that was moving in epoxy resin applications. Specific details on how these products were being used and the type of end applications were not available. The plasticization and the flame retardancy plus chemical resistance were the three most important reasons.

One of NORM JOHNSON'S accounts is planning to manufacture a coil from a flame retardant epoxy formulation utilizing Aroclor 1260. This flame retardant epoxy formulation has passed their customer's requirements in initial testing.

BILL DAMRON reports the customer is using Aroclor 1254 in a self-extinguishing laminated phenolic and epoxy application for printed circuit work.

POLYVINYL CHLORIDE

In the PVC plastisol field and in the compound field we find sizable volumes of Aroclors being used. The solid Aroclors are used in compounding primarily for processability while the liquid Aroclors are used in plastisols for viscosity stability and flame resistance. Also, in plastisols the solid Aroclors are used because of their low volatility and excellent adhesion.

Vinyl resins modified with Aroclor compounds are usable in making molds for thermosetting resins. U.S.P. 2,525,177 by William Lockwood assigned to Calresin Corporation of Culver City, California.

CURT SINGLETON passed along one of Bill Grosse's tip items. The tip of using 40 PHR of Aroclor 1268 was successful in a problem they have had wherein a prospect wanted a plastisol for dipping gloves but wanted a velvet feel to the coating.

Aroclors are used in foamed plastisols to control the blowing of the foam and in glove dipping to impart chemical resistance.

PHENOLIC MOLDING

In phenolic molding the Aroclor compounds are utilized as flow aids in grinding wheels and in brake linings.

CELLULOSE ACETATE BUTYRATE

In cellulose acetate butyrate the Aroclors are commonly used in hot melt applications. Here we would recommend adequate ventilation, of course. The solid Aroclor melts at the dipping temperature, but does not cause excessive tackiness when the part is cooled.

A HOT MELT coating comprised of high butyryl cellulose esters and Aroclor compounds. U.S.P. 2,481,687 by Martin Salo and Harold F. Vivian assigned to Eastman Kodak Company, Rochester, New York.

A TRANSLUCENT PAPER BASE is made by impregnating the paper with a hot melt containing a high percentage of an Aroclor compound plus resin and overcoating with plasticized hot melt. U.S.P. 2,635,970 by Martin Salo and Harold F. Vivian assigned to Eastman Kodak Company, Rochester, New York.

MISCELLANEOUS COMPOUNDS

Of course, the Aroclor compounds are widely used in a lot of miscellaneous resins. Some of these applications involve only one or two customers of rather insignificant nature. However, we thought the following references might be of interest to you.

POLYVINYL BUTYRAL resins modified with Montars show good heat and humidity stability. U.S.P. 2,506,014 by Francis J. Curtis assigned to Monsanto Chemical Company, St. Louis, Missouri.

POLYSTYRENE molding products made non inflammable with a solid Aroclor compound possesses good electrical properties. U.S.P. 2,454,255 by Joseph R. Mores assigned to Monsanto Chemical Company, St. Louis, Missouri.

A FUNGICIDAL HOT MELT INSULATING compound composed of resins, an Aroclor compound, a fungicide and other materials. U.S.P. 2,556,451 by Howard E. Smith assigned to Insul-X Corporation, Brooklyn, New York.

BILL MADDOX reports that Aroclor 1268 is, apparently, doing quite a job thus far---used as a flame retardant in their silicone rubbers.

A customer of LEE JOHNSON is using regularly a combination of Aroclor 1254 and Aroclor 1268 in asphalt as a flame retardant. The combination of Aroclor and asphlat is eventually coated onto paper.

Aroclor compounds are used in the colloid layer of PRINTING FORMS U.S.P. 2,291,673 by Fritz Albers and Edward Schloemann assigned to General Analine and Film Corporation.

A HOT MELT coating for webs of paper or textiles composed of polyethylene, terpene resins, an Aroclor compound, and paraffin. U.S.P. 2,453,644 by Walter C. Steinkraus, Chicago, Illinois.

One of BILL DAMRON'S customers said Aroclor 1254 was used because of its fire resistance into resin material products. They are using it in two applications: wax paper coatings for paper converters and manufacturing liquid wax compounds for treating electrical component parts.

A RUBBER composition with good mechanical properties and improved fire resistant properties is made by adding 20 parts of chlorinated rubber to 80 parts of Aroclor 1260. Heat until the rubber is dissolved. Cool and add to 100 parts of rubber plus fillers and curing agents. U.S.P. 2,143,470 by Wilhelm Becker and Albert Kock assigned to I.G. Farbenindustrie Atkiengesellschaft, Frankfort-on-the-Main, Germany.

A HEAT RESISTANT INSULATION compound composed of rubber and Aroclor compounds show good properties. U.S.P. 2,416,955 by Samuel J. Rosch assigned to Anaconda Wire and Cable Company, a corporation of Delaware.

Aroclor compounds are used to plasticize POLY p XYLENE compounds and filaments. U.S.P. 2,763,630 by James K. Hubbard assigned to E.I. DuPont de Nemours and Company, Wilmington, Delaware.

Aroclor 1260 is used in a low flammable, STERILIZABLE HAIR BRUSH made from Ethylcellulose. U.S.P. 2,326,811 by David R. Wiggam and William Koch assigned to Hercules Powder Company, Wilmington, Delaware.

MISCELLANEOUS

APPLICATION	VOLUME	PRACTICAL POTENTIAL	AROCLOR PRODUCTS USED	# Customers	# Bulk or TL Customers	Adhesion	Cost	Extraction Resistance	Melting Point	Flame Resistance	Moisture Resistance	Oxidation Resistance
HOT MELT WIRE COATING	Large	1.2	5460, 5060, 4465, 1260	4	3	-	1	-	-	3	1	-
CARBONLESS CARBON PAPER	Large	1.5	1262	1	1	-	-	-	-	-	-	-
CASTING WAX	Good	4	5460, 4465, 1254	7	1	-	2	1	2	-	-	-
CARBON IMPREGNANT	Minor	3	5460, 1268	2	0	-	-	2	-	-	2	-
TACK RAGS	Minor	1.5	1262, 1254	1	0	-	1	-	-	-	-	1
ASPHALT ROOFING	Minor	15	Montars 3,4,5	1	1	-	1	-	-	1	-	-
CLOTH IMPREGNANT	Minor	10	1254, 5460, 1268	2	0	-	-	-	-	1	-	-
INSECTICIDE CARRIER	Minor	10	5460	2	0	-	-	-	-	-	-	-
PRINTING INK	Minor	30	5460, 1254, 1221	3	0	-	-	-	-	-	-	-
PIGMENT GRINDING	Minor	30	1254, 4465	2	0	-	-	-	-	-	-	-
PIGMENT CARRIER	Minor	30	1248	1	0	-	-	-	-	-	-	-
AIR FILTER MEDIUM	Minor	5	1254	1	0	-	1	-	-	1	-	1
DUST SUPPRESSANT	Minor	30	1254	1	0	-	-	-	-	-	-	-
FLOW STUDY	Minor	3	4465	1	0	-	-	-	-	-	-	-

The miscellaneous applications for Aroclor cover a wide variety of applications.

HOT MELT WIRE COATINGS

In this application the market, while huge, is limited to a few companies that seem to control the bulk of the business. Here the Aroclors are blended with wax and phosphate esters to make hot melts that are then used to flame-proof cables. Unfortunately as vinyls increase in volume in the electrical trade, the application for Aroclors as an impregnant decrease.

CARBONLESS CARBON PAPER

This is an application that is patented. However, we have many other requests for Aroclors in carbon paper applications, some of which seem to be showing a fair deal of success.

CASTING WAX

The investment casting field is one that has been reborn. It is sometimes called the "lost wax" technique. We have made a sizable survey and you will be hearing more about this later. As it now stands, however, you can see we have a good many customers and the current volume is good. The flame resistance, the high impact strength, short melting point, and other desirable characteristics imparted by the Aroclors will enable us to give you a full story as soon as we are able to contact a few more people and verify their requirements.

AN ELECTRICAL INSULATING material is made by impregnating the base material with a mixture of styrene monomer and an Aroclor compound followed by polymerization. U.S.P. 2,147,824 by John Krauss Webb assigned to International Standard Electric Corporation of New York, New York.

CLOTH IMPREGNANT

Aroclors are used to impregnate felts for the Navy, for sound deadening characteristics in ships; they are also blended with wax to impregnate asbestos cloth to impart electrical properties. Other applications for Aroclors as impregnants are as follows:

SILICA TEXTILE materials that have been leached and then coated with a solution of Aroclor 5442 show improved abrasion resistance. U.S.P. 2,686,954 by Leon Parker assigned to the H.I. Thompson Company, Los Angeles, California.

RANDY GRAHAM has a customer currently using a mixture of Aroclor 5460 and Aroclor 1254 as an impregnant for welding cloths which are used in fabrication plants. He said that he actually flame proofs these cloths so that when sparks from welding hits the cloth no holes are burnt through. He is currently selling this to a steel company for their welding rooms which use these canvas cloths as walls to cut down on the amount of flying molten metal which occurs when welding. It might be that it could be extended to pup tents and the tent industry and maybe added in combination with some waterproofing chemical.

GEORGE STEWART recommended the use of Montars to a customer who felt some of the air-conditioning companies such as Carrier plan to specify FIRE-RESISTANT ASPHALT FELT in 1961 for use in all air conditioning equipment.

A composition to give good resistance to both flame propagation and after flow is made by a combination of Aroclor compounds plus aldehyde condensation resins. U.S.P. 2,461,538 by Earl K. Fisher assigned to Interchemical Corporation, New York, New York.

A flameproofing composition is based on a mixture of a thermally unstable chlorinated resinous material, zinc carbonate, and other ingredients plasticized with a flameproofing plasticizer such as an Aroclor compound. U.S.P. 2,378,714 and U.S.P. 2,326,233 to Martin Leatherman, Hyattsville, Maryland.

INSECTICIDE CARRIERS

There has been a number of government articles which appeared on the use of Aroclors to extend the life of volatile insecticides for non-food prompt uses. Shown below are a series of references which may be of interest to your insecticide potentials:

Chlorinated Polyphenyls to improve Lindane Residues. W. N. Sullivan and I. Hornstein in Journal of Economic Entomology Volume 46, February 1953, Pages 158-159.

Improving Deposits for controlling insects outdoors. W. N. Sullivan, Irwin Hornstein, A. H. Yeomans, and Ching-Hsi Tsao, Journal of Economic Entomology, Volume 48 No. 2, Pages 153-154.

Aroclor 5460 extends life of Aldrin and Lindane but not DDT. Thought more volatile first two slowly escapes to surface. Thought DDT is marked by Aroclor 5460. Residual Effectiveness of Mixtures of Organic Phosphorous Insecticides with Chlorinated Terphenyls. Irwin Hornstein, William N. Sullivan, and Ching-Hsi Tsao in Journal of Economic Entomology, Volume 48 No. 4, August, 1955, Pages 482-483.

Lowering the Volatility of Lindane Cuttle Sprays by Addition of Film Forming Material. Irwin Hornstein, W. S. McGregor, and W. N. Sullivan in Agriculture and Food Chemistry, Volume 4, No. 2, February 1956, Pages 148-149.

The Use of Chlorinated Polyphenyls to Increase the Effective Insecticide Life of Lindane. Edward J. Duda - Journal of Entomology Soc, 218-219, (April 1957). Aroclor 5460 and Lindane may exhibit a synergystic effect in controlling elm leaf beetle.

PRINTING INKS

How many times have all of us thought that more Aroclors should be used in printing inks. At the present time a rather small amount is consumed in this field. Although as the following references show, there is considerable interest:

PRINTING INKS for metal application are prepared by dispersing pigments in EPOXY resins and Aroclor compounds. The inks show no discoloration upon baking and provide a smooth strong film. U.S.P. 2,736,719 by Hugo

P. Stockmayer assigned to Sun Chemical Corporation, Long Island, New York.

A WET FINISHING varnish composed of an alkyd resin in solvent modified with a liquid Aroclor compound and polymethyl silicone. U.S.P. 2,736,355 by Jerome A. Ryan assigned to the The Sherwin Williams Company, Cleveland Ohio.

For Dick Tracy fans, JIM COMPTON has a customer currently using Aroclor 1221 at about a 1% level in an invisible ink formulation used to trace cutting pattern on Chenille rugs and spreads. Recently had to switch dye ingredients and Aroclor 1221 would not work with new dye, but Aroclor 1262 did work.

PIGMENT GRINDING AND CARRYING

This is a natural application for the Aroclor compounds. The customer by his choice of Aroclor can develop the type of viscosity he desires. The Aroclors give rapid wetting action into most pigments.

BILL MORLOCK has an interesting application where the customer is dispersing pigment and catalyst in Aroclor for polyester applications.

Aroclor 5460 is an excellent "wax" for DISPERSING PIGMENTS in solvents. U.S.P. 2,772,982 by Vincent C. Vesce assigned to B. F. Goodrich Company, New York, New York.

Aroclors are excellent wetting agents for the preparation of METALLIC PASTE PIGMENTS. U.S.P. 2,713,006 by Samual N. Hunter assigned to Hunter Metallic Pigments, East St. Louis, Illinois.

MISCELLANEOUS

The Aroclors also find a lot of miscellaneous applications, some of which are discussed briefly below:

Solid powdered Aroclor compounds are used as a DELUSTERING AGENT for rayon. U.S.P. 2,111,449 by James W. Humphrey and John W. Pedlow assigned to American Viscose Corporation

This company using Aroclor 1248 to thicken ceramic slurry reports JOHN ELWOOD.

RAY GREENE reports a metals laboratory has a rather unique use of Aroclor 1268. It is melted and then used to fill the pores of nickel sponge. The sponge can then be machined without destroying the cell structure. After it has been fabricated, it is brought to a high temperature and the Aroclor is probably vaporized off.

A WATER SOLUBLE SOIL-POISON concentrate is made by blending an Aroclor compound, trichlorobenzene, pentachlorophenol, isopropyl alcohol, and other materials. U.S.P. 2,588,318 by Paul G. Benignus assigned to Monsanto Chemical Company, St. Louis, Missouri.

EXHIBIT 15

NEWS

Monsanto

FOR RELEASE IMMEDIATELY 1970

E. V. John
(314) 694-2891
PUBLIC RELATIONS DEPARTMENT
Monsanto Company
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166

MONSANTO CITES
ACTIONS TAKEN ON
ENVIRONMENTAL ISSUE

ST. LOUIS, July 16 -- Monsanto Company, sole U.S. producer of an industrial chemical called polychlorinated biphenyl (PCB), today said recent political charges and sensational headlines about the chemical causing "a major ecological crisis" completely ignore voluntary actions the company has taken to restrict use of the material.

"Our program began back in 1968 with the proper identification and measurement of PCB in the environment and will conclude this year by our unilateral action to restrict its use," Howard L. Minckler, company vice president and general manager of its Organic Chemicals Division, said.

He added that Monsanto had not been pressured into action by any legislation or organized group. "We have taken decisive action based on evidence that PCB is a persistent chemical which builds up in the environment."

-more-

Commenting on a recent report that PCB can induce birth defects in animals, Minckler said, "Monsanto is not aware of any scientific data that indicates polychlorinated biphenyls may cause birth defects. The results of comprehensive toxicity studies, sponsored by Monsanto and using the usual species of laboratory animals, have failed to produce such effects.

"Scare tactics and sensational reporting do not serve the public interest nor solve ecological problems," he said. "Only a few reports have stated why PCBs were ever developed and why they are used today. Nor have the consequences of not using PCB been explained.

"What should be emphasized," Minckler continued, "is that PCB was developed over 40 years ago primarily for use as a coolant in electrical transformers and capacitors. It is also used in commercial heating and cooling systems. It is not a 'household' item.

"Anyone who lives in a large city is familiar with power failures. During periods of peak power needs, air conditioning and refrigeration fail, lights go out and commuters are stranded. If power companies were to remove PCB from equipment, we have been told that major blackouts would occur throughout the world.

-more-

"PCB is used in electrical equipment as a safety fluid. It has replaced combustible oil products which have, on many occasions, exploded and burned, causing deaths and injury to human life. Today state and local laws all over the country require the use of non-flammable fluids in certain electrical equipment as a safety feature. At the moment, there are no substitutes available which equal the safety performance of PCB."

Monsanto said it intends to continue selling PCB for "closed-system" uses such as electrical components and heat-transfer systems. "With rigid control over where the product goes, how it is handled and disposed of, we believe the safety functions of the product can continue to serve society and the environment can be protected," Minckler said. "We are discontinuing sales into 'open systems' -- adhesives, sealants, chlorinated rubber, specialty paints, etc.

"For other uses, such as fire-resistant hydraulic fluids, where PCB cannot be strictly controlled, we have reformulated some fluids and they are on the market. The new products contain other fire-resistant ingredients. We will continue to develop alternate formulations which do not contain persistent PCB. We will not abandon hydraulic fluid users," Minckler commented, "as has been reported."

-more-

Monsanto has also established a new system for disposal or recycle of spent PCB. A special high-temperature incinerator will break down PCB into harmless materials. The company also regenerates spent fluids for reuse. The incinerator will be offered to customers who cannot otherwise destroy or regenerate their old fluids.

"Although loss of PCB from our manufacturing plants has been negligible, we have further tightened up our production techniques and installed new pollution abatement devices," the Monsanto executive said.

"I repeat," Minckler concluded, "our program was initiated and conducted by Monsanto alone. It will be concluded this year. We believe it is a position any responsible company would take."

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EXHIBIT 16

St. Louis

February 10, 1967

FILE
Dept.
JTG
WMH
[illegible]
[illegible]
RAM
EPW

G. R. Buchanan - GBUCH
J. Filer - BRUSSELS
D.V.N. Hardy - LONDON
Eugene Wilde - EWILD

Mr. D. ~~Wood~~
~~LONDON~~ Brussels

We have had a rather extensive meeting, which included the St. Louis individuals receiving copies of this memorandum, on Aroclor in the air and in various fish and other living reservoirs.

The decision was that more information had to be gained, and whether this would necessitate a trip from someone in the Medical Department to the various agencies working on this problem in Europe would depend upon how easily obtainable these gaps in our knowledge are by other means than personal communication.

We are very worried about what is liable to happen in the states when the various technical and lay news media pick up the subject. This is especially critical at this time because air pollution is getting a tremendous amount of publicity in the United States.

We have been receiving quite a few communications from our customers, but the most critical one is NCR, who are very much involved with their carbonless carbon paper.

I have listed a number of points referring to information I would like to have. Some of these may be easy to answer; others might take a little bit of investigation and some might not be feasible to answer at this time. However, please let me know your ideas on each one of the following items:

1. Can we get the original articles in the Swedish press, including Dagens Nyheter? I have a good fluent Dane who translates Swedish very well and is a physician and investigator, so nothing will be lost in the translation.

2. Who were the participants in the conference referred to in your memorandum to Mr. Buchanan of January 26? Under whose auspices was it held and were there any reports issued? What were the conclusions of the conference and was any action decided upon?

3. What was the medical institute in Sweden that was going to do the toxicological work referred to in the same memorandum to Mr. Buchanan? Who was going to pay for it and what was the scope of the investigation?

4. In LKB press release of January 10, they stated that 12 OECD nations were going to do work on this problem. Can anything be found out about the extent of this work? Who is doing it, and at what institutes?

No planned work not specifically stated.

5. What is known about the work in England at the Monks Wood Experimental Station and the Laboratory of Chemists in London? How long has this gone on? Is it an ongoing study? What are the perimeters of the study?

6. Do we have the complete paper in Swedish of Jensen and Widmark entitled "Pesticide Analysis--Presence of Polychlorinated Biphenyls and Residual Analysis of Biological Samples"? This was referred to in D.V.N. Hardy's letter of January 12, 1967. I would like to get this original paper with the bibliography in Swedish.

7. Can I have more information about the Carlin Institute of Toxicology which was referred to in Mr. Widmark's letter to Mr. Ford of December 29, 1966? What do they intend to do? Who is the contact, and is it located in Stockholm?

Not yet been funded

By copy of this memorandum, I am asking Dr. Hardy to find out what the situation is in the two English contacts referred to in item 5.

The consensus in St. Louis is that while Monsanto would like to keep in the background in this problem, we don't see how we will be able to in the United States. We feel our customers, especially NCR, may ask us for some sort of data concerning the safety of these residues in humans. This obviously might be opening the door to an extensive and quite expensive toxicological/pharmacological investigation. Before starting this, we certainly want to find out what is going on and not duplicate any of the work. I have tried to call you for the last two days and I will be out of town next week, but I would like to call you the week of the 20th. Perhaps by then you might have some answers to some of the questions.

R. Emmet Kelly, M. D.

REK/ln

1. PCB-A NEW FISHDEATH?

2. Picture: The young salmons die in the salmons station at Älvkarleö. The Fish Pathologist, Mr. N. Johansson suspects that this is caused by PCB. A loophole in the law prevents the Authorities to take any action.

3. We have got a new environmental poison - PCB. On July 26th Småland and Östergötland (counties in Sweden) were hit by a soot and oil rain. Analysis shoe that such a rain contains among other things PCB. PCB is rather like DDT, but probably more poisonous. By eating PCB-poisoned rise-oil many people in Japan have died. In Sweden "Folhälsan" have found PCB in almost all the fish and meat they have analysed.
From 1968 to 1969 the PCB-content in analysed samples increased by 50 %. Last year 80-100% of roe and young salmons died at the Salmon Research Institute at Älvkarleö. The fishes had high PCB-content. PCB is very stable. It cannot be destroyed by living organisms and is spread in nature in higher and higher concentrations. PCB is found in fishes, birds and people all over the world.
PCB is used as cooling-oil and insulating fluid in high tension transformers and as plsticizer and alga-killer in paint and sealing compounds. Because of a loophole in the law the use of PCB cannot be stopped.

4. Investigations show that soot and oil rains of the kind that hit the coast of Småland and Östergötland on Sunday contain PCB. PCB is a environmental poison that slowly steal upon us. It cannot be destroyed by living organisms. PCB is sold without limitations. A loophole in the law prevents the Authorities from doing anything against the use of it.

5. Life-dangerous environmental poison new DDT-threat.

6. In roe and young salmons at the Salmon Research Institute in Älvkarleö the percentage of death usually is about 10-29%. High content of PCB (polychloribated biphenyls) has been found in the roe. In Sweden "Folkhälsan" has found PCB in almost all the fish and meat they have analysed.PCB is rather like DDT but perhaps it is more poisonous that DDT. "Naturvårdsverket" has done a first review of the use in Sweden. It has been classified as strictly confidential. Because of a loophole in the law neither "Naturvårdsverket" nor "Giftnämden" can stop the use of PCB. PCB is an environmental poison which slowley but surely steals upon us. The content is closed to, is on a level with, or is above the content of DDT. The use of PCB is free. What is PCB?
It is a group of chridizing hydrocarbons, a group of clorinated biphenyls tightly tied together in a syntetic way. This is manufactured by having chlor to react with biphenyl, on aromatic hydrocarbons.

In Sweden they sell three products: The Frenchmade Pydralén, the American Aroclor and the German Clophen. The most common kind here in Sweden is Clophen which is manufactured by Bayerische Anilin in Leverkusen. Two fields of application dominate: as cooling-oil and insulation-fluid in high tension transformers and condensors and as plasticizers and alga-killers in paint - and sealing compounds.

All over the world:
It seems strange that the leakage from these rather special fields of application can be the reason for nos finding PCB in fish, birds and peolple all over the world. But PCB cannot - as far as they know - be destroyed by living organisms. If it gets in us or in nature it will circulate while the quantities increase.
A practical thing in a few technical situations becomes a grewing environmental danger.
Assistant Prof. S. Odén at "Lantbrukshögskolan" "takes finger prints" of the cities in Sweden from the environmental poison point of view by researching the content of poison in sludge of the cleaning plants. They looked for PCB in 63 cleaning plants and found it in all of them. The content was highest in the industrial areas. The content has increased with ca 50% between the tests in 1968 and 1969. Mr. Odén says that htere is no other reason for this than that PCB has been used more and more.
"Naturvårdsverket" has no right to demand the PCB-consumers to put their cards on the table.

The customer list tells:
Manager General V. Paulsson says: "Against promise of secrecy we succeeded in taking part of the Swedish PCB-sellers' customer list. I am afraid we are not allowed to publish this material".
"Naturvårdsverket" asked Ing. A. Kjällman to visit the companies which use PCB. We wrote to about 20 paint companies and electrical industries and visites some of them.
This is the quantity used in Sweden every year: 500 tons in condensors and transformers, 55 tons in PVC - and rubber paint, 15 tons in shipbottom paint, 35 tons in sealing compounds.
-"At some companies they throw it in a dump, at other places they throw it in the waste-water," Ing. Kjällman says.You notice PCB in paint, when you wash dishes and when you scrape boats.
PCB is undestroyable through burning. It cannot be disolved even if you boil it in concentrated Nitric Acid.

The transformers leak:
In electrical works they use it in a closed system. No oil or cooling fluid will leak out. When they change the oil they return the old oil to the manufacturer. But sometimes there are interuptions of the service in the transformers. "Some time ago we were warned that 3 tons transformer-oil had leaked out into a lake" says Mr. S. Jensen at "Naturvårdsverkets specialanalytiska laboratorium", Uppsala It was mineral oil. But it could as well have been PCB-oil.

At the Salmon Research Institute in Älvkarleö breeding salmons swim in the water from Dalälven river. Last year they found that a great number of the roe and the young salmons died. Alanysis at "Naturvårdsverket" showed high content of PCB in the progeny.
-"We are very worried about what will happen in the future," N. Johanson says, but we have not enough material yet to be sure it is PCB that kills the salmon progeny. What we know for sure is that the older the salmon female are the higher the PCB-content is in the roe and in the young salmons who die.

Less in wild salmons:

The wild salmons - who give material to the big salmon station - show a much smaller content of PCB. Anyway the death at some stations is as high as 35-40%. Instead of PCB there are high contents of DDT in the progeny of wild salmons, but they have not proved any connection between DDT adn the death of roe.
The environmental keepers who are more prophets than scientists say that it sure will be a day when we know that the salmons die of PCB. What else can you expect when the outleaks are free to continue? Third part of all the salmons in Östersjön lake come of the stations ashore. To poison the progeny meens the end of salmonfishing. Even if the content in salmon not has to be so high - and today it absolutely is not - that we cannot eat the salmons.
"Folkhälsan" finds high content of PCB in the fishes from almost all the waterstreams they have analysed and even in meat, but the content in metat is lower. In Japan people have died by eating poisoned rise-oil. They know hardly anything about the Toxicological risks for human beings of the content they have now found in Swedish food. The content they have found in Japan is higher than the content here.

Might be serious:

-"The spread of these very stable poisonous materials is not enough analysed from the foodhygiene point of view", Miss G, Westöö "Folkhässan" says. PCB might become a serious problem.
The lawmakers could never imagine that small shares of chemical and technical products from isdustries leaking out, could stay, circulate in living organisms until they (perhaps) reached highly dangerous concentrations. This is what the President of the Poison Committe, Pharmacist R. Lönngren said when he informed the Govermental Authorities for Environmental Health about this: "PCB belongs to a group of materials with qualities simular to DDT and sometimes worse that that and I think they are a problem we will have reason to analyse more. But there is as far as I know no part of the law that gives any Authority the right to take any action. This is absolutely one of the loop-holes in our law regarding the protection of environmental poisons.

The investigation takes time:
An investigation is working on a law that will stop the loopholes in our law but it will still take time. Meanwhile there is this possibility: The paint companies and the leaders of electrical idustries can take the chance to act in an environmental-kind of way themselves. For example the manufacturer of sealing compunds that leaks out 200-300 kilos PCB in Öresund every year. (Cidfish and plaice in Öresund have very high content of PCB). This also holds for the big paint company in Stockholm which is responsible for the fact that the cleaning plant in Åkeshov (near Stockholm) has to take more PCB than any other cleaning plant in Sweden.

EXHIBIT 17

PCB PRESENTATION

TO

CORPORATE DEVELOPMENT COMMITTEE

I. INTRODUCTION:

We are here today to acquaint you with the PCB (Aroclor) pollution problem and to secure your guidance and approval on a recommended plan of action.

The problem is that Certain PCB's have recently been identified by various scientists along with DDT in fish, birds, and other wildlife.

From the standpoint of reproduction, the PCB's are highly toxic to birds. In a few moments, Elmer Wheeler will describe the problem in detail.

Our objective is to describe for you the basic problems, the issues involved, review alternative courses of action, and suggest an action plan program for your approval.

This is a serious matter, not only from the pollution viewpoint, but also because of the $22 M worldwide customer business involved with resultant gross profits of $10 M and a net investment of approximately $9 M. In addition, there could be possible adverse legal and public relations problems leveled against Monsanto.

Our Agenda will be as follows:

ALL-STATE LEGAL®
PLAINTIFF'S
EXHIBIT
3D002

CV96-J-0440-E
DATE 04/02/01

PLFF EXHIBIT NO. 105

PCB AGENDA REVIEW

I. INTRODUCTION

II. THE PROBLEM

- DEVELOPMENTS INCRIMINATING PCB's
- COMPLEXITY OF IDENTIFICATION
- NATURE OF
- SERIOUSNESS

III. LAW DEPARTMENT VIEWPOINT AND RECOMMENDATIONS

IV. EFFECT ON MONSANTO AND ALTERNATIVES

V. FUNCTIONAL FLUID BUSINESS GROUP DISCUSSION

- MARKETS, USES
- SOURCES OF POLLUTION
- CUSTOMER EFFECT

VI. PLASTICIZER BUSINESS GROUP DISCUSSION

- MARKETS, USES
- SOURCES OF POLLUTION

VII. RECOMMENDED ACTION PLAN

VIII. SUMMARY

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By way of introduction, the Organic Division and the Medical Department has been actively engaged for the last 18 months in developing facts and knowledge on this subject by personal visits to Universities and Industrial test laboratories, other worldwide producers, and other industrial collaborators, as well as keeping abreast of all literature and news sources on the subject as well as funding a toxicological and analytical test program in excess of $200 M. We established an Ad Hoc Committee of both Business Groups and Medical which recently issued a report - much of which will be discussed today. We have learned a lot, but there is much yet to learn as you will hear.

What are PCB's? They are polychlorinated biphenyls - better known to us as Aroclors. The next slide will quickly re-familiarize you with our Aroclor business.

MONSANTO WORLDWIDE AROCLOR BUSINESS

POUNDS/YEAR	104 M (70 M in Functional Fluids 34 M in Plasticizers)
SALES/YEAR	$22 M ($16 M in Functional Fluids $ 6 M in Plasticizers)
GROSS PROFIT/YEAR	$10.0 M ($7.5 M in Functional Fluids $2.5 M in Plasticizers)
GROSS INVESTMENT	$13 M ($8.8 M net investment)
ROI	10.5%
WORLDWIDE M/I	62%
MONSANTO PRODUCTION LOCATIONS:	USA (2 plants, Anniston, Alabama Sauget, Illinois) UK (Newport) JAPAN (Yokkaichi)
OTHER PRODUCERS:	Bayer, Prodelec, Caffaro, Flick, Kanegahuchi, and several Eastern European producers (all ex-USA) [illegible] UK

THE AROCLOR PRODUCT LINE

CHEMICAL NAME	TRADE NAME	NATURE OF MATERIAL	
MONOCHLOROBIPHENYL	AROCLOR 1221	THIN LIQUID	
DICHLOROBIPHENYL	AROCLOR 1232		
TRICHLOROBIPHENYL	AROCLOR 1242		OILY LIQUID
TETRACHLOROBIPHENYL	AROCLOR 1248		
PENTACHLOROBIPHENYL	AROCLOR 1254		HEAVY MOLASSES
HEXACHLOROBIPHENYL	AROCLOR 1260		THICK TAR
HEPTACHLOROBIPHENYL	AROCLOR 1262		
OCTACHLOROBIPHENYL	AROCLOR 1268	↓	
DECACHLOROBIPHENYL	AROCLOR 1270	SOLID	
TERPHENYLS —	SANTOWAX	↓	
CHLORINATED TERPHENYL	AROCLOR 5460	SOLID	

There are theoretically 210 different isomers of chlorinated biphenyls.

Monsanto entered the Aroclor market in 1930 by acquiring Swan Chemical Company. The first load of Aroclor went out of Anniston, Alabama to General Electric in 1931. Since then, the market has grown to one of Monsanto's most profitable franchises. This franchise is now being threatened not by competition bu by recently found pollution problems which Elmer Wheeler will now discuss.

II. The Problem (Wheeler) - see attached Appendix A

III. Law Department Viewpoint and Recommendations (French)

IV. Effect on Monsanto and Our Alternative Courses of Action

As discussed, Aroclors 1254 and 1260 -- the 5 and 6 Cl ringed biphenyls are the ones most seriously involved in the pollution problem. Both Plasticizers and Fluids Groups are involved as shown:

AROCLOR SALES

(M POUNDS)

	FLUIDS	PLASTICIZERS	TOTAL
AROCLOR 1254	1.45	5.4	6.85
AROCLOR 1260 & ABOVE	3.7	1.7	5.4
	5.15	7.1	12.25

We considered 4 alternative courses of action:

(Slide)

Alternative 1: Do nothing was considered unacceptable from a legal, moral, ~~and~~ customer, public relations & company policy viewpoint. This is also the quickest route to being forced out of business.

Alternative 2: Go out of total Aroclor business was considered unacceptable from a Divisional viewpoint, but from a Corporate viewpoint may be necessary. ~~Only you can make that decision.~~ All Aroclor products are not serious pollutants - many degrade; there is too much customer/market need and selfishly too much Monsanto profit to go out. To go out would require a write off of Aroclor net investment of $7 M (10¢/share) or if biphenyl included $8.8 M (12¢/share). In addition, inventory disposition, continuing cost of utilities, and back-up capital and serious manpower & resources reallocation at Anniston.

Alternative 3: Go out of Aroclor 1254 and 1260. This was seriously considered and may eventually occur by our actions and customer actions, nevertheless, we feel that segments of this business are defensible or are so "confined" in use that specific plans of action are called for this portion. Our reasons for eliminating this alternative will become clearer as we outline our action plans.

ALTERNATIVE COURSES OF ACTION

1. DO NOTHING - JUST REACT TO LEGISLATION AND EMOTION.
2. GO OUT OF TOTAL AROCLOR BUSINESS.
3. GO OUT OF AROCLOR 1254 AND 1260 PRODUCTION
4. DEVELOP SPECIFIC ACTION PLANS "TAILORED" TO EACH BUSINESS GROUP AND EACH CUSTOMER/MARKET SITUATION TO "CLEAN UP" THE MESS.

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Alternative 4: Develop specific action plans tailored to each Business Group and each customer/market situation, - was the alternative selected at this point of time and based on our knowledge from a Divisional viewpoint as making Monsanto act in the most positive, responsible way to society and our customers, as well as our interests.

However, because of the magnitude and seriousness of this problem and its total implications for of our plan Corporate Monsanto,
your guidance and approval is needed.
~~The final decision~~ on this matter must be ~~made by the CBC~~.

V. Functional Fluids Business Group Discussion:

Aroclors are used widely in 3 of our 4 market areas in the Fluids Group:

FLUIDS USE OF AROCLORS BY MARKET AREA

	DOMESTIC MARKET AREA			
AROCLOR PRODUCT	INDUSTRIAL	HEAT TRANSFER	ELECTRICAL	TOTAL
1242	4.1	1.1	36	41.2
1248	1.2	1.0	-	2.2
1254	-	0.1	0.8	0.9
1260 & Above	0.6	-	3.5	4.1
	5.9	2.2	40.3	48.4

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SOURCES OF FLUIDS POLLUTION

APPLICATION	INTENSITY OF POLLUTION	
INDUSTRIAL FLUIDS	GREATEST	(DIRECT)
DIELECTRICS	↓	(INDIRECT CONTAINED)
HEAT TRANSFER	↓	(INDIRECT CONTAINED)
PRODUCING PLANTS	LEAST	(DIRECT)

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FLUIDS CUSTOMER ALTERNATIVES

AREA OF APPLICATION	PRODUCT OF CHOICE	CUSTOMER OPTIONS
Industrial Fluids	Pydraul 312/F-9/ A-200/Phosphate Esters/ Water Glycol	Customer could get along without us, but Pydraul 312 favored. H_2O Glycol has some pollution problems. Phosphate ester route ok at present.
Transformer	Air/Oil/Aroclor/Gas	Could drop Aroclor at sacrifice of safety, cost or size of equipment or noise level.
Capacitors	Aroclors	No immediate replacement available. Longer term - oil at expense of size and cost of efficiency and redesign of equipment.
Heat Transfer	Therminol	No option for FR liquid market. Other system possibility.
	Oil/Dowtherm/T66 T55 T77 T88	Liquid systems favored. T66 and T55 increasing rapidly in use. Oil also a pollution problem.

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Customer Choices & Alternatives & Penalties:

Summarizing, some of our customers have no immediate alternative, some could change only at sacrifices of safety, or cost or various technical factors. Only in the Industrial field could the customer make an immediate conversion.

PCB Threat to Functional Fluids Business and Profit:

FLUIDS BUSINESS THREATENED

(1970 BUDGET)

PROBLEM	SALES	GROSS PROFIT
1. Confined to A-1254/ 1260 only.	$ 3.0 M	$1.36 M
2. Spreads to A-1242 and 1248		
First to: a) Industrial Fluids	$ 4.0 M	$1.6 M
Then to: b) Dielectric Fluids	$ 8.0 M	$3.8 M
Then to: c) Heat Transfer	$ 1.0 M	$ .6 M
	$16.0 M	$7.36 M

— Turn over to Jim Springgate

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15 +1
ek

VI

PLASTICIZERS
(WORLD-WIDE)

	ALL AROCLORS	AROCLOR 1254/1260 TYPE
1969 SALES, DOLLARS	$ 6.0 M	$1.7 M (28%)
POUNDS	34.0 M	9.5 M (28%)
1969 GROSS PROFIT	$ 2.5 M	$0.8 M (32%)

COMMENTS: DISTINCTIONS FROM F.P.

1. Large number of direct U.S. customers - 570.
2. Customers are small: 23 direct customers - 47% A-1254/1260 sales.
3. 50% domestic A-1254/1260 sales through distributors - difficult to police.

MARKETS	1968 SALES	MAJOR AROCLOR USED
Carbonless Carbon Paper	8.8 M lb.	Aroclor 1242
Hot Melt Adhesives	5.7 M lb.	Aroclor 5460
Swimming Pool Paints	1.7 M lb.	Aroclor 1254) Aroclor 5460)
Protective Coatings	5.3 M lb.	Aroclor 1254) Aroclor 5460)
Emulsion Adhesives	1.5 M lb.	Aroclor 1254) Aroclor 1260)
Sealants	3.0 M lb.	Aroclor 1254) Aroclor 1262)
Wax Modification	2.0 M lb.	Aroclor 1254) Aroclor 5460)
Miscellaneous	5.0 M lb.	Aroclor 1248) Aroclor 1254)

COMMENTS: 1. NCR major customer (85% of Aroclor 1242 sold).

2. [illegible] of domestic Aroclors sold through distributors.

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POSSIBLE CONTAMINATION SOURCES

(PLASTICIZERS)

DEGREE OF CONTAMINATION	MARKET	APPLICATION	SOURCE	IS A-1254 /1260 USED?
Most	Coatings	Marine Paints Water tank linings	Leaching	Yes
	Coatings	Swimming Pool Paints	Leaching	Yes
	Carbonless Carbon Paper	-	Vaporization	No
	Wax Modification	-	Vaporization	Yes
	Emulsion Adhesives	-	Contact with product via packaging. Incineration.	Yes
	Hot Melt Adhesives	-	Contact with product via packaging. Incineration.	No
Least	Sealants	Automotive Construction joint sealants	Long-term leaching	Yes

COMMENTS:

1. Unlike fluids, Aroclor plasticizers are combined into plastics to produce the final product - therefore, far less mobile.
2. Problems such as wastes from our manufacturing plants, customers plants and and leasing of drums common to both groups.
3. Exterior protective coatings are not considered a high pollution source.
4. Vaporization of Aroclors during plant processing or the product. Rain will wash vapors back to earth.

PLASTICIZER BUSINESS THREATENED

PROBLEM	SALES RETAINED*	$ G.P. RETAINED (LOST)
1. Confined to A-1254/1260 type only.	$4.3 M	$1.7 M (-$0.8 M)
2. Spreads to all chlorinated biphenyls.	$2.0	$0.6 M (-$1.9 M)
3. Spreads to all PCB's and all chlorinated terphenyls	0.0	0.0 (-$2.5 M)

*Based on [illegible] prospects.

COMMENTS Plasticizers sell Aroclor 1262/4465 which are very close to A-1254/1260 and these have been included as A-1254/1260.

RECOMMENDED ACTION PLAN

THE JOINT ACTION PLAN DEVELOPED BY THE FUNCTIONAL FLUIDS AND PLASTICIZER BUSINESS GROUPS, AND THE MEDICAL AND LAW DEPARTMENTS IS AS FOLLOWS:

1. Appoint a Project Manager - responsible for the overall management of the Aroclor pollution problem. He would be assisted by a Task Force from members of each Business Group plus Medical, Law, Engineering and Manufacturing.
2. Notify all Aroclor customers of PCB problem and relabel containers - within 60 days.
3. Clean up Monsanto plants' effluents within 12 months.
4. Develop and implement new packaging systems for Aroclor 1254/1260 - within 6 months.
5. Educate customers on need for clean-up at their plants - within 4 months.
6. Introduct to market, replacement products for Aroclor 1254/1260 - beginning 1/1/70 (Fluids), 4/1/70 (Plasticizers).

RECOMMENDED ACTION PLAN

7. Continue and expand biodegratation test program with Aroclor series, particularly 1242, 1248 and 1254.

8. Continue toxicological test program.

9. Accelerate present analytical test program.

10. Determine feasibility and cost of eliminating 5/6 Cl_2 in Aroclors 1242 and 1248. (3/70)

11. Study incineration products. (3/70)

12. Develop business plan to offer:

    Monsanto Fluid Reclamation and Recovery
    with Enviro Chem (4/70). (Reclamation
    already underway at Pindett.)

S

WHAT COULD WE EXPECT FROM THIS PROGRAM?

Through this action program, Monsanto would expect to:

1. Retain or convert a good portion of our business and profits:

PROBLEMS	CONVERT OR RETAIN	$M SALES OUT OF PRESENT	ODDS OF SUCCESS
a. Confined to A-1254/ 1260.	$20.3 M	$22 M	70%
b. Spreads to A-1248 and 1242.	$10 M	$22 M	60%

2. Gain further valuable knowledge and time to:
    a. Learn more facts.
    b. Protect our position.
    c. Make further decisions regarding our program.
    d. Contribute to overall pollution knowledge.
3. Clean-up the major contributing PCB pollution factors.
4. Minimize customer complaints and hardships.

The Program Would:

1. Cost some money.

   Est. SARE - $400-500 M

   Est. Capital - $700 M

   $1.1 M - 1.2 M

2. Expose us to continued adverse publicity and possible law suits.

3. Cause some customer discontent - but much less than an abrupt termination of production.

EXHIBIT 18

Monsanto

ORGANIC CHEMICALS DIVISION

Monsanto Company
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
Phone: (314) 694-1000

March 27, 1969

Mr. Fred H. Dierker
Executive Officer
State of California-Resources Agency
San Francisco Bay Region
Regional Water Quality Control Board
364 Fourteenth Street
Oakland, California 94612

Ref: File No. 2119-1075

Dear Mr. Dierker:

This letter is written in response to your letter dated March 7, asking several questions concerning polychlorinated biphenyls ("PCB") manufactured by Monsanto. Responses to each of your questions are set forth below, numbered in accordance with your letter.

1. We have recently contracted with a consulting laboratory to undertake fish toxicity studies on PCB's. Because of the low solubility of PCB in water, it may be difficult to obtain a 96-hour TL_m. Depending upon the results of the initial studies, we may conduct 30-day exposure experiments.

2. Attachment A shows the general physical characteristics of PCB. Information set forth on the bottom of these pages shows the results of acute animal toxicity studies showing the oral LD_{50} in rats and the minimum lethal skin dose when applied to rabbits. You will note that these results were obtained using undiluted samples or as a corn oil suspension solution depending on the viscosity and solubility of the materials.

3. & 5. Attachment B shows the results of studies of chronic inhalation. You will note in the table describing the properties of various PCB's that the liquid materials have extremely high distillation ranges and that waxy or resinous materials have to be distilled under high vacuum. These data attest to the low vapor pressure of the materials at ambient temperatures.

PCB finds primary use in applications requiring chemical stability, good dielectric properties, fire resistance, low volatility and water insolubility. When used in dielectric fluid, PCB is hermetically sealed in capacitors and transformers, designed for 20 to 30 years life at temperatures at or near ambient temperatures.

Plasticizer PCB is found primarily as a plasticizer for surface coatings such as corrosion resistant paints, industrial adhesives and as a sealant such as window sealants. These applications do not include automobile tires, or floor tile. These applications of PCB emphasize its inertness and low volatility to provide long service life for the product without loss of flexibility. In normal use, PCB plasticizer applications are ambient temperature environments presenting no special health problems. In view of PCB's chemical inertness, we would anticipate no problems associated with the environment from refuse dumps.

PCB finds further application in industrial (excluding aviation) hydraulic and heat transfer systems. As in the case of dielectric applications, these systems are designed for essentially indefinite fluid life.

4. PCB is essentially insoluble in water, which is a property valued for most of its industrial applications. The solubility of PCB varies with the number of chlorine atoms. Solubility in tap water at 25°C. is as follows:

Material	Solubility in Water
PCB - (42% chlorine by weight)	203 ± 10 ppm
PCB - (48% " " "	106 ± 14 ppm
PCB - (54% " " "	50 ± 2 ppm

This data indicates that the most highly chlorinated PCB's are the least soluble in water. Annual consumption in the Bay Area is less than 500,000 pounds for all PCB applications.

6. It is a long standing policy at Monsanto not to disclose information concerning our customers, including the customer's name. However, we desire to cooperate with you to the fullest extent practicable in this matter. Should you desire to visit typical PCB users we will be happy to approach our customers to arrange a visit.

7. We advise persons using PCB products to take normal precautions associated with handling most synthetic materials. If accidentally spilled on hands, no serious skin irritation should occur. However, PCB has a solvent action (similar to paint thinner) on the fats and oils of the skin and prolonged contact may lead to drying and chapping of the skin.

   In the event of contact, the skin should be washed with soap and water. Saturated clothing should be removed and dry cleaned. Spills may be cleaned up with rags, sawdust or absorbent clay. Eye contact may result in painful irritation but should cause no permanent damage to tissues. In the event of eye contact, the eye should be flushed with large amounts of water. As with all eye first-aid, a physician should be consulted. To relieve irritation, physicians have used a 1% Pontocaine as well as ophthalmic cortisone acetate solution, or castor oil.

   Infrequent exposure to PCB vapor should not cause ill effects. However, prolonged exposure to high vapor concentrations should be avoided.

> After many years of experience with PCB, it is our understanding that cases of harmful effects resulting from the industrial use of PCB have been extremely rare. We believe this is due largely to low volatility which reduces possible inhalation at ambient temperatures.

We sincerely trust that this answers the questions contained in your letter. As further information becomes available in which we feel you might be interested, we will pass such information on to you.

Yours very truly,

for Howard S. Bergen
Director, Functional Fluids

HSB:pep
Attachments
BCC: F. S. Park
E. Wheeler/J. Garrett
D. A. Olson
P. Benignus
W. Waycheff
D. Pogue
N. T. Johnson
W. R. Richard

P. S. to H. S. Bergen only: Howard - Some ideas for your consideration may be appropriate based on my discussions with Phocion Park, J. Garrett and Bill Richard while preparing this response.

1. **Phocion emphasizes that nothing should be volunteered on these type requests unless specifically requested, because of mis-interpretations and needless chances for confusion. We can always add but never subtract from something written.**

2. **We may want to consider, when appropriate, a personal visit in lieu of written communications. Personnel from Monsanto at such visits should not be our**

technical experts but a responsible management representative who can relate critical questions. This permits time for preparing answers that will not allow mis-interpretation.

3. Anticipating negative impact of the Time Magazine article and continued negative comments by Riseborough at UC, a personal visit by such a person may help clear the air and solidify our image of cooperation before publicity expands via partially informed sources.

4. Estimated Bay Area Aroclor usage of 500M lbs. derived from following:

Plasticizers (per C. Paton)	48M lbs.
*Dielectrics	300M
Heat Transfer	100M
Hydraulic	50M
Total	498M lbs.

*Denotes usage for initial fill of new transformers. Actual consumption in Bay Area would be significantly less, perhaps 50-90% less.

I hope the above may be of value to you.

D. M. Pogue

/pep

EXHIBIT 19

July 23, 1969

Mr. A. Bruce Pyle
Assistant Bureau Chief
Department of Conservation
and Economic Development
P. O. Box 1809
Trenton, New Jersey

Dear Mr. Pyle:

In connection with your recent request for more specific information on PCB, I have enclosed several items that may be of interest.

The first is a table showing the physical characteristics and properties of our Aroclors, the trade name for our polychlorinated biphenyls.

The numerical designation of these materials is meaningful. The 1200 series are biphenyls chlorinated to the extent indicated by the last two numerals. For example, Aroclor 1242 is biphenyl chlorinated to the extent of 42%; Aroclor 1254 is biphenyl chlorinated to 54%.

The 5400 series are terphenyls chlorinated to the extent of the last two numerals. Thus Aroclor 5460 is terphenyl chlorinated to 60%. The 2500 and 4400 materials are mixtures of biphenyls and terphenyls chlorinated to 65%.;

We have typed on the bottom of the table the results of acute toxicity studies. These indicate the approximate lethal dose in rats when administered orally and the minimum lethal dose when the samples were applied to the unbroken skin of rabbits. You will note that the samples were administered undiluted or as various concentrations in corn oil depending on the physical form and solubility of the sample.

The second enclosure refers to the only published data that we now have concerning possible toxicity to fish. This enclosure is a 1957 report from the U. S. Fish and Wildlife Service showing the results of studies to determine the possible effects of chemicals to larval lampreys and fishes. The enclosure includes a copy of the title page, the page explaining the table and that portion of the table which indicates that four of the Aroclors have no effect on trout, bluegill and larval lampreys at a concentration of 5 ppm in a 24 hour test period.

The only chronic toxicity data that we have refers to the inhalation of vapors of Aroclor 1242 and 1254. Enclosure three is a reprint describing the chronic inhalation studies and enclosure four is a Hygiene Guide published by the American Industrial Hygiene Association which prescribes safe handling techniques for the use of these materials in industry.

Based on available data, manufacturing and use experience, we do not believe the polychlorinated biphenyls to be seriously toxic. At the same time we have also recommended precautions to avoid repeated and prolonged skin contact and secondary avoidance of inhalation of vapors when the materials are heated. As indicated by the distillation ranges in enclosure one, these products have extremely low vapor pressure and thus present little vapor inhalation hazard at ambient temperatures.

I don't know that I can add a great deal to your question to the use of these materials without repeating the comments in the statement which Tom Ford sent you. Their dielectric characteristics lead to usage as insulating fluids for transformers and capacitors. Transformer application is in sizes applicable to sub-stations rather than the small transformer on lines for reducing voltage for household use.

The plasticizer type application PCB's are incorporated into a polymer as an integral part of the solid material. This is the case whether the polymer is then used as an adhesive special elastomer or individual surface coating.

Contrary to some reports from the press, the PCB's are not used in rubber tires, lipstick, or the common plastic containers or films used for industrial or household packaging.

We have a considerable research effort underway to determine the toxicity of several of the PCB's in rats and dogs. We are also including three generation reproduction studies in rats. Also underway are studies with fowl to determine the possible chronic effect on the birds themselves, egg size and production, hatchability of the eggs and viability of the chicks. We will also do studies to determine any possible effect on egg shell thickness and calcium and phosphorus metabolism.

We have attempted to establish a program for determination of the possible biodegradation of the polychlorinated biphenyls but research of this type is not yet underway.

Re-emphasizing a point we attempted to make in the statement Tom sent you, we are unable at this time to conceive of how the PCB's can become wide spread in the environment. It is certain that no applications to our knowledge have been made where the PCB's would be broadcast in the same fashion as the chlorinated hydrocarbon pesticides have been. I am sure there will be much more research undertaken to clarify some of the questions that early research efforts have raised and you may be sure that we will participate in a number of these.

If I can be of any further assistance after you have reviewed this letter and the enclosures, please let me know.

Sincerely,

Elmer P. Wheeler
Manager, Environmental Health

EPW:ju

EXHIBIT 20

Monsanto

FROM (LOCATION) St. Louis

DATE : March 30, 1970

SUBJECT

REFERENCE :

CC: H. S. Bergen - HBERG
H. L. Minckler - HMINC
P. S. Park - PPARK
J. E. Springgate - JSPRI

TO : W. B. Papageorge
WPAPA

We have been in communication with a Dr. Hill of the Ohio State Board of Health. He has found PCB, particularly Aroclor 1254, in samples of milk from at least three herds in Ohio. He has traced this contamination back to silage from three different silos. Dr. Hill reported concentrations of 0.2 ppm of PCB in the silage in the center of the silo and up to 20 ppm in the material next to the walls. He also stated that concentrations in the milk were between 0.1 ppm and 0.6 ppm and that some of the milk had been destroyed.

The silos are concrete silos whose interior surfaces were painted in 1967 using a formulation that contained 1254. I don't know if there was any other Aroclor in the formulation nor do we know the coating manufacturer; although, this could be found out if important. The presence of PCB in the silage came from flaking off of the material and possibly from leaching out during the silage storage. At present they will have to destroy about 150 tons of silage which is valued at about $30 per ton. As a rough guess, they consider there may be 50 other silos involved in Ohio that were painted with the same formulation. They are also looking into the fat contamination of the cows themselves.

All in all, this could be quite a serious problem, having legal and publicity overtones.

This brings us to a very serious point. When are we going to tell our customers not to use any Aroclor in any paint formulation that contacts food, feed, or water for animals or humans? I think it is very important that this be done. It may be that some of the customers will assure themselves on the basis of non-extractability that a particular formulation might be safe but I think we should make a blanket recommendation against these uses.

R. E. Kelly

R. Emmet Kelly, M. D.

REK/ln

PLAINTIFFS
EXHIBIT
ZA[illegible]25

EXHIBIT 21

Monsanto

FROM (NAME & LOCATION) Medical Department - A2SA

DATE : August 6, 1971 cc G. L. Bratsch - 1740

SUBJECT : PCB Literature Search

REFERENCE : Your memo to Dr. Kelly - 8/3/71

TO : Don Otto
Krummrich - 1740

Dr. Kelly is away from the office for the next two weeks. In his absence, I can say that we have probably the world's best reference file on the PCB situation. This includes reprints from the literature beginning in 1936 to reports issued last week.

The question of whether or not we should be doing anything different in terms of clinical or physical exams I will leave to Dr. Kelly to answer. We have discussed in the past two years the pros and cons of some special studies but have not reached any decision as to what might be in order.

Elmer P. Wheeler

/bks

CV96-J-0440-E
DATE 04/02/01

PLFF EXHIBIT NO. 561