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JUN 17 2005
BROWNING KALECZYC
BERRY & HOVEN, PC

MONTANA TENTH JUDICIAL DISTRICT COURT, FERGUS COUNTY

| | |
|---|---|
| MARTY PAULSON, WILLIAM J. HAUGEN, HARRY FELTON, RAY ROBISON and WARD BURLEIGH, President; BURLEIGH ANGUS RANCH, INC., Individually and For all Persons Similarly Situated,<br><br>Plaintiffs,<br><br>v.<br><br>MONSANTO CHEMICAL COMPANY n/k/a PHARMACIA, MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS, and JOHN DOE PAINT COMPANIES and DISTRIBUTORS I through X,<br><br>Defendants. | Cause No. DV-2004-55<br><br>Hon. Kurt Krueger<br><br>**PLAINTIFFS' THIRD SET OF DISCOVERY REQUESTS TO DEFENDANT, MONSANTO CHEMICAL COMPANY n/k/a PHARMACIA** |

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HARTOLDMON0029097

TO: PHARMACIA CORPORATION f/k/a MONSANTO CHEMICAL COMPANY and their attorneys, DANIEL HOVEN and CATHERINE LAUGHNER:

YOU WILL PLEASE TAKE NOTICE that Defendant, PHARMACIA CORPORATION, is hereby required, pursuant to Rules 33, 34 and 36 of the Montana Rules of Civil Procedure, to serve upon the undersigned within thirty (30) days after service of this notice, their answers in writing and under oath to the following.

The information requested herein is not restricted to your personal knowledge, but includes information in the possession of your attorneys and extends to information which you or your attorneys can obtain upon reasonable inquiry. These discovery requests shall be deemed continuing so as to require supplemental answers to be filed promptly upon obtaining further information between the time answers are served and the time of trial.

**GENERAL DEFINITIONS AND INSTRUCTIONS**

"**Defendant**" means PHARMACIA CORPORATION f/k/a MONSANTO CHEMICAL CO. and all other persons acting on their behalf. "Document" or documents" is used herein within its broadest sense as used in Rule 34(a)(1), and thus includes without limitation originals and non-identical copies of letters, telegrams, memoranda, reports, drafts, notes, summaries or records of conversations and interviews, minutes of meetings, diary entries, notebooks, agreements, printed publications, drawings and sketches, graphs, charts, photographs, brochures, intra and inter-company communications, marginal comments, sales literature, computer inputs, outputs and tapes, and all other writings, including tapes, phone records, and electronic and other data compilations from which information can be obtained, translated, if necessary, by plaintiff through detection devices into reasonably usable form.

"Communication" means the transmission, sending and/or receipt of information of any kind by and/or through any means including, but not limited to speech, writings, language (machine, foreign or otherwise), computer electronics of any kind, magnetic tape, video tape, photographs, graphs, symbols, signs, magnetic disks, sound, radio and/or video signals, telephone, teletype, telecommunication, telegram, microfilm, microfiche, photographic film of any type and/or other media of any kind.

"Identify" as applied to a communication means that the following information shall be provided:

(a) the date(s) on which such communication took place;

(b) the location(s) at which such communication took place;

(c) all persons having knowledge of such communication;

(d) the date, author, addressee and type of each document (e.g., letter, memorandum, telegram, chart, computer input and output, photograph, sound reproduction, etc.) referring and/or relating to such communication and the last known custodian(s) and location(s) of each document.

"Identify" as applied to a document means that the following information shall be provided:

(a) the date appearing on such documents, and if no date appears thereon, the answer shall so state and shall give the date or approximate date such document was prepared;

(b) the identifying or descriptive code number, file number, title or label of

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such document;

(c) the general nature or description of such document (i.e., whether it is a letter, memorandum, drawing, etc.) and the number of pages of which it consists;

(d) the name of the person who signed such document, and if it was not signed, the answer shall so state and shall give the name of the person or persons who prepared it;

(e) the name of the person to whom such document was addressed and the name of each person other than such addressee to whom such document or copies thereof were given or sent;

(f) the name of the person having possession, custody or control of such document;

(g) whether or not any draft, copy, or reproduction of such document contains any postscript, notation, change, or addendum not appearing on the original of said document, and if so, the answer shall give the description as herein defined of each such draft, copy or reproduction;

(h) if any such document was, but is no longer, in defendant's possession or subject to its control, state what disposition was made of it and when;

(i) if the person's present whereabouts are unknown to defendant, state all information known to defendant that reasonably may be helpful in locating said person (for example; spouse's name, children's names and addresses; and the names and addresses of other known relatives).

"Identify" as applied to a natural person means to give the following information:

(a) full name;

(b) present or last known home address;

(c) present or last known business address and telephone number;

(d) title or occupation;

(e) present or last known employer;

(f) if the person had ever been employed by defendant, state all employment positions which the person has held with defendant and the dates of each such employment position; and

(g) if the person's present whereabouts are unknown to defendant, state all information known to defendant that reasonably may be helpful in locating said person (for example; spouse's name; children's names and addresses; and the names and addresses of other known relatives).

"Representative" as applied to a legal entity means any officer, agent, employer or other person acting on behalf of that legal entity.

If any document is not produced on the grounds of attorney-client privilege or attorney work product, please furnish the following information with respect to each such document:

(a) State the date of the document;

(b) State the subject matter of the document;

(c) Identify the persons who prepared the document;

(d) Identify all persons who received the document;

(e) Identify all persons who are in the possession or control of the document;

(f) State in meaningful terms the privilege(s) claimed.

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The terms "relating to" or "relate to" shall mean, consist of, refer to, reflect on, arise out of, or be in any way or manner legally, factually, or logically connected with the matter discussed.

The term "person" shall mean any natural person, governmental body, governmental agency, corporation, general or limited partnership, joint venture, and/or any other form of business organization or association, whether or not said person is a party to this action or in any way connected to a party in this action.

The term "nature" as in the nature of something shall mean the essence or characteristics of the thing.

The term "basis" or "bases" as in the bases for some allegation shall mean the cause, grounds or reasons for such allegation. When stating the basis or bases for any allegations, identify each and every communication and document and set forth each and every act and statement on which you rely. When stating the basis or bases for an allegation identify each person who possesses knowledge of facts, which relate to your answer and give the substance of the knowledge he possesses.

The term "meeting" shall mean and include any contemporaneous presence of any natural persons, whether or not such presence was by chance or prearranged, or whether or not the meeting was formal or informal or in connection with some other activity.

The term "communication" shall mean and include any transmission or exchange of information other than fact to face, between two or more persons, whether orally or in writing, and including without limitation any conversing, discussing or propounding of views or ideas by means of any document, telephone, telex, telecopies, cable, video or audio transmission device or some other electronic or other medium

Without limitation of the term "possession, custody, or control, "a document is deemed to be within your possession, custody or control if you physically possess the document or a copy thereof or if you have access to or the right to secure a document or a copy thereof from any other person or public or private entity having physical possession thereof.

Big Spring Creek means that water course that is the subject of this litigation as identified in the risk assessments done by Camp, Dresser & McKee.

REQUEST FOR ADMISSION NO. 1: Please admit or deny that the levels of PCBs in water and sediment are sufficient to adversely affect the survival, growth, or reproduction of fish in Big Spring Creek.

RESPONSE:

REQUEST FOR ADMISSION NO. 2: Please admit or deny that the levels of PCBs in water and sediment are sufficient to adversely affect the survival, growth or reproduction of benthic macroinvertebrates in Big Spring Creek.

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RESPONSE:

REQUEST FOR ADMISSION NO. 3: Please admit or deny that the levels of PCBs in water, sediment, soil and biota are sufficient to adversely affect the survival, growth and reproduction of sensitive semi-aquatic and terrestrial mammalian, receptors, represented by mink, utilizing Big Spring Creek and associated riparian area.

RESPONSE:

REQUEST FOR ADMISSION NO. 4: Please admit or deny that the levels of PCBs in water, sediment, soil and biota are sufficient to adversely affect the survival, growth and reproduction of sensitive insectivorous and piscivorous avian receptors represented by the marsh wren, great blue heron, and belted kingfisher utilizing Big Spring Creek and associated riparian areas.

RESPONSE:

REQUEST FOR ADMISSION NO. 5: Please admit or deny that the PCB identified in Big Spring Creek by the Montana Department of Fish, Wildlife and Parks and the Montana Department of Environmental Quality is Aroclor 1254.

RESPONSE:

REQUEST FOR ADMISSION NO. 6: Please admit or deny that Aroclor 1254 was only manufactured by Monsanto Chemical Company.

RESPONSE:

REQUEST FOR ADMISSION NO. 7: Please admit or deny that the PCB Aroclor

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1254 has been found in paint on the lower hatchery raceways.

RESPONSE:

REQUEST FOR ADMISSION NO. 8: Please admit or deny that the PCB Aroclor 1254 has been found in fish in Big Spring Creek.

RESPONSE:

REQUEST FOR ADMISSION NO. 9: Please admit or deny that the PCB Aroclor 1254 has been found in Big Spring Creek sediment.

RESPONSE:

REQUEST FOR ADMISSION NO. 10: Please admit or deny that the Human Health Risk Assessment prepared by CDM for the MDFWP has determined that there is an excess cancer risk for sport anglers

RESPONSE:

REQUEST FOR PRODUCTION NO. 11: Attached to these discovery requests is a document produced by Pharmacia/Monsanto in this litigation bearing Bates numbers Mons 035054 to 035059. On the page bearing Bates number Mons 035057 is a reference that reads: "in 1969 an exhaustive survey of our PCB customers was made to determine exactly where these products were being used."

Please produce all documents comprising or relating to this 1969 "exhaustive survey" including all the results of said survey.

REQUEST FOR PRODUCTION NO. 12: Pharmacia/Monsanto has produced, in discovery, documents indicating that Aroclor 1254 was recommended for use in

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HARTOLDMON0029102

certain paint products that would come in contact with water. For example, attached to these discovery requests is a document bearing Bates No. DSW 150418 to DSW 150427 entitled "Aroclors – As Used in Chlorinated Rubber", that recommends the use of Aroclor 1254 in chlorinated paints.

Please produce all tests, reports or similar documents conducted or performed by Pharmacia/Monsanto or anyone acting on their behalf or by anyone whose tests, reports or similar documents became known to Pharmacia/Monsanto relating, in any way, to the leaching, dissolving, transfer, or movement of Aroclor 1254 from paint products containing Aroclor 1254 to water.

DATED this 16 day of June, 2005.

Torger Oaas

TORGER OAAS
Co-Counsel for Plaintiffs

///

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HARTOLDMON0029103

CERTIFICATE OF SERVICE

This is to certify that the foregoing was duly served upon the following counsel of record this 10 day of June, 2005 via:

☑U.S. Mail ☐Federal Express ☐UPS ☐Hand Delivery ☐Fax

Maxon R. Davis
Davis, Hatley, Haffeman & Tighe
P.O. Box 2103
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Catherine A. Laughner
J. Daniel Hoven
Browning, Kaleczyc, Berry & Hoven
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Helena, MT 59624

Jerry K. Ronecker
Husch & Eppenberger
190 Carondelet Plaza, Suite 600
St. Louis, MO 63105

By: [signature]

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HARTOLDMON0029104

## Plasticizers

Because all plasticizer uses of PCB were regarded as essentially "open" to the environment it was impossible to prevent the leaching and volatilization of PCBs.

Consequently Monsanto realized the untenable nature of these applications when the allegations concerning environmental contamination by PCBs were confirmed. We discontinued all sales of PCBs to domestic U.S. customers for plasticizer applications one year ago.

The type of application affected by the market withdrawal of PCBs were:

Surface Coatings

Sealants

Adhesives

Printing Inks

Miscellaneous (e.g. pesticide carriers, wax modifiers, catalyst carriers, etc.)

## Coatings

starting in the 1940s

Industrial (maintenance) coatings were the main outlet for PCBs in the surface coating industry. PCBs were chosen over other plasticizer candidates because of their outstanding chemical and moisture resistance. For example, PCB-plasticized coatings have enabled industrial equipment to withstand attack in strongly corrosive atmospheres.

At present alternates being offered to the coatings industry are chlorinated paraffins and chlorinated ~~diphenyls~~. Chlorinated paraffins are inferior (stability, chemical and moisture resistance) to PCBs. ~~Chlorinated terphenyls so far appear to be equivalent in performance to PCBs.~~

## Sealants

In the 1950s, synthetic elastomer sealants began to replace traditional putty-type caulks and sealants. One of the major synthetic elastomers was polysulfide. PCBs were used in these sealants to give excellent adhesion to a variety of substrates, moisture and chemical resistance, and for reducing hazards with the catalyst systems employed in curing the elastomer. These PCB plasticized polysulfide sealants were essential to meet the



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caulking and sealant needs of modern buildings and construction.

Our discontinuation of PCB sales to the sealant industry has created a very real technical problem for them. Totally satisfactory alternates do not yet seem to be available. ~~In fact it is reported that~~ PCBs are being imported from non-Monsanto sources for use in sealants.



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Adhesives

In the 1940s and 1950s, PCBs were used in adhesives to impart tackiness and because they exhibited excellent bonding power to many substrates. They also exhibited greater compatibility with a wide variety of the many resins used by the adhesives industry. In a word their versatility led to their wide usage. They were also chemical and moisture resistant and resistant to heat and oxidation. In the mid-1960s, however, a drop in their usage had already become evident. Adhesive suppliers were increasingly called upon to supply FDA-approved, low-odor products. PCBs did not satisfy these developing market needs. Even before the environmental pollution situation arose we were engaged in developing and supplying new plasticizers to meet the needs of the adhesive market. The new products are not PCB-based.



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Plasticizers -

Miscellaneous Uses

Monsanto's Aroclor® Plasticizer Bulletin O/PL-306 may appear to the layman to indicate that PCB found its way deliberately into almost every product produced in the nation. Applications such as dedusting agents, pesticide carriers, catalyst carriers, impregnating compounds etc. are listed as Aroclor® and have been so publicized by the press coverage given to PCBs. The fact is, however, that very few of these uses accounted for more than 4 or 5 drums of PCB per year and in many cases the Aroclor® used was not a PCB.

In 1969 an exhaustive survey of our PCB customers was made to determine exactly where these products were being used. An example from the survey may be of interest. We found only three customers in 1969 were using any PCB in pesticide formulations. Total consumption was between 5 to 10,000 pounds PCB per year. This application was developed by U.S.D.A. scientists at Beltsville, Maryland in the early 1950s.

The aim was to incorporate "chlorinated polyphenyls" into lindane and possibly chlordane to improve the residual effects. To Monsanto's knowledge there was never any recommendation by anyone for their use on food or other crops. The principal application was to spray metal or painted surfaces to increase the effectiveness of the active pesticide against flies, ants, roaches, etc. In April, 1970 we wrote to Dr. Hayes, Director, Pesticide Regulations Division, U.S.D.A. suggesting that no approvals should be given to pesticide formulations containing PCB.

All applications of a "miscellaneous" category uncovered during our 1969 survey of customers buying PCBs through the Plasticizer Business Group of Monsanto were included in the sales ban put into effect in August, 1970.

PCB APPLICATIONS IN PLASTICIZERS

U.S.A. Only (Prior to Discontinuation)

| | |
|---|---|
| Surface Coatings | 57% |
| Sealants | 20% |
| Adhesives | 17% |
| Miscellaneous | 6% |

MONS 035057

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Encapsulants

The use of PCB as a solvent for the encapsulation of dyes for carbonless carbon paper began in the 1960s. Factors which influenced the selection of PCB were:

dye solubility
U.V. light stability
intensity of color development
speed of color development
moisture resistance
non-reactive with dyestuffs

In spite of research efforts for the past ten years it has only been in the past two years that the promise of satisfactory alternates have been brought to light. Since 1970 we have been supplying non-PCB alternates to this industry. The search for even better replacements continues but none of these is based on PCB.

ENCAPSULANTS

U.S. SALES OF MONSANTO PCB

| | |
|---|---|
| 1965 | 3.5 M lb. |
| 1966 | 4.1 |
| 1967 | 4.4 |
| 1968 | 6.0 |
| 1969 | 6.5 |
| 1970 | 6.7 |
| 1971 Estimate | 1.2 |
| 1972 Projection | 0 |

do not release

3.3 M

MONS 035058

HARTOLDMON0029109

do not disclose

Dye Carriers

Polyester fibers are notoriously difficult to dye and hence a usage of specialty dye-carriers has built up. Historically this has been based on biphenyl (i.e. a non-chlorinated product). In 1969 there was a trend toward the use of low chlorine content PCB. Biodegradation and medical feeding studies have shown this particular PCB to be non-hazardous to the environment. However, even this use is being discontinued within the next two months in favor of a monochlorinated product.

DYE CARRIERS

U.S. SALES OF MONSANTO PCBs

| | |
|---|---|
| Prior to 1969 | 0 |
| 1970 | 1.0 M lb. |
| 1971 Estimate | 1.1 |
| 1972 Projection | 0 |

MONS 035059

HARTOLDMON0029110

MONSANTO TRADE LITERATURE
PERMANENT FILE

PF-241-

MONSANTO CHEMICALS

# AROCLORS* As Used in Chlorinated Rubber

Monsanto Technical Bulletin No. P-124 January 1, 1948

Monsanto Chemical Company, St. Louis 4, Mo.

★ ★ ★ ★

AROCLORS, chlorinated biphenyl and chlorinated poly-phenyls, are effective plasticizers and resins for chlorinated rubber base lacquers, varnishes and paints.

These protective coatings are used where flame resistance, corrosion resistance, chemical resistance, i.e., resistance to acids, alkalies and water, and good electrical insulating properties are required.

Some of the important applications for these protective and decorative coatings for wood, metal, brick, stone, concrete and fabric surfaces include:

1. Wood and metal used in the construction of yachts, barges and other marine craft.
2. Structurel steel for bridges, buildings, roofs and power-line structures.
3. Structural materials used at chemical plants, pulp and paper mills, textile mills, petroleum refineries and gas works where protection against acid fumes, alkalies and gas is essential.
4. For the protection of tank cars and other rolling stock and construction machinery against corrosive materials and weathering.
5. To protect equipment used in electroplating and as stop-off lacquers in this industry.
6. Masonry floors and walls. Concrete swimming pools and traffic paints.
7. As cable coatings requiring nonflammability, chemical resistance, water resistance and excellent electrical properties.
8. Coatings for cloth to impart "waterproofing" qualities as well as chemical and flame resistance.

*AROCLOR-Reg. U.S. Pat. Off.

★ ★ ★ ★

The information contained in this bulletin is, to the best of our knowledge, true and accurate, but all recommendations or suggestions are made without guarantee, since the conditions of use are beyond our control. The Monsanto Chemical Company disclaims any liability incurred in connection with the use of these data or suggestions. Furthermore, nothing contained herein shall be construed as a recommendation to use any product in conflict with existing patents covering any material or its use.

AROCLORS As Used in Chlorinated Rubber
MONSANTO TECH. BUL. No. P-124
JANUARY 1, 1948

DSW 150418

HARTOLDMON0029111

# AROCLORS AS USED IN CHLORINATED RUBBER

## I. INTRODUCTION

Aroclors, chlorinated biphenyl and chlorinated poly-phenyls, are used effectively as resins and plasticizers to impart desired qualities to chlorinated rubber, such as Hercules' Parlon.

Parlon is made by chlorinating natural rubber, yielding a mixture of two polymers possessing an average chlorine content of 67 per cent.

## II. PROPERTIES OF CHLORINATED RUBBER

The typical properties of Parlon as given by Hercules Powder Company, Wilmington, Delaware, are listed in the following Table I:

TABLE I. TYPICAL PROPERTIES OF PARLON

| | | |
|---|---|---|
| **General** | | |
| Form as shipped | White granular powder | |
| Color of film | Water white | |
| Odor | None | |
| Clarity of film | Good | |
| Taste | None | |
| Moisture, per cent as shipped | 0.5 maximum | |
| **Physical** | | |
| Specific gravity | 1.64 | |
| Specific volume, as shipped, in cubic inches per pound | 16.9 | |
| Bulking value, gallons per pound | 0.0735 | |
| Index of refraction | 1.554 | |
| **Electrical (clear unplasticized film*)** | | |
| Specific surface resistance, ohms x $10^{10}$ | 2,000 | |
| Dielectric strength, volts per mil (A.S.T.M. method) | 2,300 | |
| Dielectric constant at 25°C. and 1,000 cycles | 3.1 | |
| Power factor at 25°C. and 1,000 cycles | 0.0015 to 0.0030 | |
| Power factor at 25°C. and 1,000 cycles, after immersion in water for 140 hours and surface wiped dry | 0.0027 | |
| **Mechanical (clear unplasticized film*)** | **20-cp. type** | **1,000-cp. type** |
| Tensile strength, pounds per square inch, dry | 4,270 | 4,850 |
| Tensile strength, pounds per square inch, wet | 4,100 | 4,360 |
| Elongation, per cent, dry | 3.6 | 3.3 |
| Elongation, per cent, wet | 3.8 | 3.4 |
| Modulus of elasticity, pounds per square inch | 1.4 x $10^5$ | |
| Hardness, Sward index, per cent of glass | 90 | |
| Flexibility of Parlon film increases with viscosity of Parlon used. | | |
| **Thermal (clear unplasticized film*)** | | |
| Burning rate | nonflammable | |
| Effect of dry heat on film | stable up to and at 125°C. | |
| Softening point | decomposes at 135 to 150°C. | |
| **Physical-Chemical (clear unplasticized film*)** | | |
| Sunlight, effect of | Discolors and embrittles | |
| Aging, effect of | Very slight | |
| Water, hot, effect of | Blushes | |
| Water, cold, effect of | None | |
| Moisture absorption (80% relative humidity for 24 hours), per cent | 0.27 | |
| Moisture vapor permeability of 0.003-inch film (grams water/square centimeter/0.01 centimeter/hour at 21°C.) | 0.2 x $10^1$ | |

* Films used in tests were laid down from a toluene solution.



DSW 150419

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General resistance to:

| | |
|---|---|
| Acids, weak | excellent |
| Acids, strong | excellent |
| Alkalies, weak | excellent |
| Alkalies, strong | excellent |
| Salt spray | good |
| Alcohols | excellent |
| Ketones | soluble |
| Esters | soluble |
| Hydrocarbons, aromatic | soluble |
| Hydrocarbons, aliphatic | good |
| Oils, mineral | good |
| Oils, animal | poor |
| Oils, vegetable | poor |

Different viscosity types of Parlon and suggested uses are given in Table II.

TABLE II. PARLON VISCOSITY TYPES

| Viscosity Type | Viscosity Range (in centipoises) |
|---|---|
| 5-cp. | 5 to 7 |
| 10-cp. | 8 to 12 |
| 20-cp. | 16 to 25 |
| 125-cp. | 110 to 190 |
| 1,000-cp. | 800 to 2,000 |

Examples of actual or suggested applications of the several viscosity types are given:

| Type | Use Examples |
|---|---|
| 5-cp. | In printing inks and as a fortifier for alkyd resin enamels. |
| 10-cp. | In high-solids finishes and as a fortifier for alkyd resin and oleoresinous varnishes and enamels. |
| 20-cp. | As a film-former in protective coatings and as a fortifier in enamels and varnishes. |
| 125-cp. | As a film-former in protective coatings, in paper lacquers, adhesives, and textile finishes. |
| 1,000-cp. | As a film-former in adhesives, textile finishes and other finishes where flexibility is important. |

## III. SUGGESTED SOLVENTS FOR AROCLOR AND CHLORINATED RUBBER COMPOSITIONS

Solvents and solvent mixtures suggested for use in preparing Aroclor and Parlon formulations are given in the following Table III:

TABLE III. SUGGESTED SOLVENTS FOR AROCLOR AND PARLON COMPOSITIONS

SOLVENTS

Amsco Solv, B and B
Amyl acetate
Butyl acetate
Carbon tetrachloride
Cellosolve
Diacetone alcohol
Diethyl carbonate
Ethyl acetate
Ethylene dichloride
Hi-Flash naphtha
Methyl acetate
Methyl ethyl ketone
Methyl isobutyl ketone
Methyl salicylate
Nutol
Octyl acetate
Sovasol Nos. 74, 75
Solvesso 100
Tollac
Toluene
Union Aromatic Solvent 3553-10
Union Solvent No. 30
Xylene



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## MIXED SOLVENTS

| | |
|---|---|
| 70 : 30 | Acetone : hexane |
| 97 : 3 | Acetone : mineral spirits |
| 83 : 17 | Benzene : isopentane |
| 41 : 7 : 35 : 17 | Cellosolve : ethanol (anhydrous) : ethyl acetate : xylene |
| 30 : 70 | Cellosolve : turpentine |
| 18 : 59 : 23 | Cellosolve : turpentine : mineral spirits |
| 64 : 36 | Ethyl acetate : isopentane |
| 30 : 30 : 40 | Ethyl acetate : isopropyl acetate : Troluoil |
| 40 : 60 | Methyl isobutyl ketone : Troluoil |
| 30 : 70 | Hi-Flash solvent naphtha : turpentine |
| 70 : 30 | Methyl acetate : isopentane |
| 85 : 15 | Shell TS-28 : xylene |

## IV. AROCLOR AND CHLORINATED RUBBER, PLASTICS FILMS

The resinous Aroclors 1262 and 5460 show good miscibility with chlorinated rubber films as laid down from toluene solution containing 20 per cent of the plastics, using 2 : 1 and 1 : 1, Parlon : resin, ratios. Similarly, the plasticizer type Aroclor 1242, 1254 and 1260 show good miscibility in chlorinated rubber.

The properties of films derived from the following formulations containing either Parlon and resinous Aroclors 1262 or 5460, or Parlon and the plasticizer type Aroclors 1242, 1254 or 1260 were studied.

### RESINOUS TYPE AROCLOR FOR PARLON PLASTICS

| Ingredients | Parts by weight | | | | | |
|---|---|---|---|---|---|---|
| Parlon, 20-cp. | 16 | 16 | 16 | 12 | 12 | 12 |
| Aroclor 5460 | 8 | 8 | 8 | 12 | 12 | 12 |
| Dibutyl phthalate | | 4 | | | 3 | |
| Tung oil, Thermolyzed, 976 | | | 5 | | | 3.75 |
| Xylene or butyl acetate | 76 | 72 | 71 | 76 | 73 | 72.25 |

### PLASTICIZER TYPE AROCLORS FOR PARLON PLASTICS

| Ingredients | Parts by weight | | |
|---|---|---|---|
| Parlon, 20-cp. | 20 | 20 | 20 |
| Aroclor 1254 or 1260 | 4 | 7 | 20 |
| Xylene | 76 | 73 | 70 |

Examination of the films cast from these lacquers revealed the following characteristics imparted by the Aroclors:

*Adhesion:*— Unplasticized chlorinated rubber films have very poor adhesive qualities. The lacquer film containing Aroclor 5460 gave good adhesion to aluminum, bare steel, primed steel, galvanized iron and Transite surfaces. Other commercially available resins, particularly oil modified alkyd resins, tested in similar films gave better adhesion than Aroclor 5460 to such surfaces as glass, tin, copper, sealed wood and cellophane.

The lacquer films plasticized with Aroclors 1254 or 1260 gave good adhesion to Transite, cellophane, galvanized iron and primed steel surfaces. Some of the other commercially available plasticizers tested in similar films gave better adhesion than the Aroclors to aluminum, tin, bare steel, copper and sealed wood surfaces.

Aroclors, alone, possess pronounced adhesive qualities. Doubtless, where the objective is to produce adhesives, by varying the Aroclor content or by using a mixture of Aroclors in the chlorinated rubber lacquers, much better adhesion to all of the surfaces would be accomplished than was the case with the type of plastics films studied.

*Resistance to Aqueous Solutions:*— Aroclors 1254 or 1260 used as plasticizers and Aroclor 5460 used as a resin in chlorinated rubber produced plastics films possessing satisfactory resistance to 10 per cent hydrochloric acid, 5 per cent sodium hydroxide, 5 per cent sodium chloride solutions and to water spot tests.



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*Film Hardness:*— Using Aroclor 5460 in ratios of 5 : 10 and 10 : 10, Aroclor : Parlon, decidedly softer films were produced than when other commercial resins were similarly used. Likewise, Aroclors 1254 or 1260 used in ratios of 2 : 10 and 5 : 10, Aroclor : Parlon, gave softer films than obtained from other commercial plasticizers, used at these concentrations. This indicates the strong plasticizing action of these Aroclors on chlorinated rubber.

*Cold-Check Resistance:*— Regarding cold-check resistant qualities imparted to chlorinated rubber films, Aroclor 5460 is somewhat superior to Bakelite type resins, but not as good as long-oil modified alkyds. Aroclor 1260 used as a plasticizer rates, in terms of cold-check resistance, somewhat better than Aroclor 1254 and nearly as good as the best of the other plasticizers studied for this property.

*Miscellaneous Properties:*— Parlon plastics films containing Aroclors 5460, 1254 or 1260 have entirely satisfactory sanding and polishing characteristics.

*Weatherability:*— Pigmented chlorinated rubber finishes containing Aroclors have consistently shown good outdoor weatherability. However, similar unpigmented finishes, regardless of the plasticizer or resin used and also in the absence of these additives, have been found to give poor outdoor weathering. Relatively poor resistance to ultraviolet light is a weakness of chlorinated rubber.

Most pigments, with the exception of ultra-marine blue are usable with Parlon finishes and are recommended when the coating is to be subjected to outdoor weathering or exposed to ultraviolet light. However, there is considerable variation regarding the protection offered by different pigments. Inspection of Parlon-fortified alkyd enamels showed the weatherability varied from 63 months for the enamel pigmented with chrome green to 4 months for enamel pigmented with a titanium dioxide-iron blue combination.

## V. USES FOR AROCLORS IN CHLORINATED RUBBER COATINGS

### A. Finishes for Alkaline Surfaces:

Aroclors, as well as chlorinated rubber, are highly resistant against alkalies and moisture. Because of these properties paints based on Aroclor and chlorinated rubber combinations are used in large quantity for application to concrete floors, walls, swimming pools, etc. Examples of this type of paint are given in Table IV.

TABLE IV. AROCLOR PLASTICIZER IN CHLORINATED RUBBER PAINTS FOR ALKALINE SURFACES

(Examples of starting formulas)

| Materials | Formula 1 for basement floors | Formula 2 to meet Fed. Spec. TT-P-91 | Formula 3 for swimming pools |
|---|---|---|---|
| | | (Parts by weight) | |
| Parlon, 20-cp. type | 18 | 18 | 14.6 |
| Aroclor 1254 | 10 | 10 | 4.4 |
| Rezyl 869 | 8 | | |
| Aroclor 5460 or Cumar P10 | | 6 | |
| Beckosol 31 | | | 2.9 |
| Tung oil, Thermolyzed, 976 | | | 4.4 |
| Titanium dioxide | 16 | 16 | 19.7 |
| Zinc oxide | 2 | 2 | 6.5 |
| Silica flour | 3 | | |
| Carbon black | 0.2 | 0.5 | |
| Xylene | 42.8 | 47.5 | |
| Hi-Flash naphtha | | | 47.5 |
| Totals | 100 | 100 | 100 |

### B. Acids and Alkali-Resistant Finishes:

Particular care must be exercised in the choice of resins and plasticizers for use in chemical resistant paints. For this purpose, Aroclors are outstanding and are being used successfully in the acid and alkali-resistant chlorinated rubber formulations given in Table V.



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TABLE V. AROCLOR PLASTICIZERS AND RESINS FOR CHLORINATED RUBBER, ACID AND ALKALI-RESISTANT FINISHES

(Examples for starting formulations)

| Materials | 1 For interior use against acids and alkalies | 2 For exterior use against acids | 3 For exterior use against alkalies | 4 For maximum resistance to acids and alkalies | 5 For use against soap solutions |
|---|---|---|---|---|---|
| | | | (Parts by weight) | | |
| Parlon, 20-cp. type | 16 | 16 | 16 | 18 | 12 |
| Aroclor 5460 | 6.4 | | | | 6 |
| Bakelite XJ-12895 | | | 6.4 | | |
| Rezyl 807 (solids) | | 6.4 | | | |
| Aroclor 1254 | 8 | 4.8 | 4.8 | 8 | |
| Aroclor 1260 | | | | 6 | |
| Tung oil, Thermolyzed, 976 | | 4.8 | 4.8 | | 7.7 |
| Iron oxide | 16 | 16 | 16 | 18 | |
| Titanium dioxide | | | | | 18 |
| Zinc oxide | | | | | 6 |
| Zylene | 53.6 | 52 | 52 | 39 | 28 |
| Hi-Flash naphtha | | | | 11 | 10.3 |
| Toluene | | | | | 12 |
| Totals | 100 | 100 | 100 | 100 | 100 |

The paints given in Table V were applied to metal bars or panels and tested. Formula 1, an interior paint, showed good resistance to a 10 per cent hydrochloric acid solution and to a 5 per cent sodium hydroxide solution. The acid resistant paint described under the heading of Formula 2 has shown excellent outdoor protection to metal surfaces on acid manufacturing plants. Similarly, paints based on Formula 3 have given good outdoor performance on alkali producing plants. Paint based on Formula 4 was found to have excellent resistance to acids, alkalies and other corrosive materials such as salt solutions. Moreover, this paint showed good adhesion to various surfaces including glass. Paint based on Formula 5 is indicated to have good resistance against warm aqueous solutions containing soap.

It should be pointed out that Aroclor and chlorinated rubber finishes are not recommended for continuous exposure at temperatures above 140°F.

### C. Marine Finishes:

Aroclor plasticized chlorinated rubber coatings possess good resistance to salt water and their hard finish deters algae and marine growths from adhering to them. These qualities and good chemical resistance indicates the usefulness of these paints to protect wood and metal used in making boats, barges and other marine equipment. A suggested formula for a marine paint is given in Table VI.

TABLE VI. AROCLOR PLASTICIZER FOR A CHLORINATED RUBBER MARINE WHITE PAINT

(Starting formulation)

| Materials | Parts by weight |
|---|---|
| Parlon, 20-cp. type | 20 |
| Aroclor 1254 | 6 |
| Rezyl 869 | 6 |
| Titanium dioxide | 25 |
| Xylene | 23 |
| Hi-Flash naphtha | 20 |
| Total | 100 |



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### D. Emulsion Paints:

Aroclor 1254 is used in chlorinated rubber emulsion paints recommended when chemical resistance is required on porous surfaces. Hercules Powder Company report that the preferred water phases for such paints are either a 1 per cent solution of Aerosol OT in distilled water or a 4 per cent solution of sodium oleate in distilled water. For the complete emulsion, a ratio by weight of lacquer phase to water phase of 2.5 to 1 is suggested. Parlon of any desired viscosity may be used. A typical paint phase for the Aroclor-Parlon emulsion paint contains the following ingredients:

PAINT PHASE FOR THE EMULSION

| Ingredients | Parts by weight |
|---|---|
| Parlon | 28 |
| Aroclor 1254 | 14 |
| Cumar P10 | 10 |
| Xylene | 24 |
| Hi-Flash naphtha | 24 |
| Total | 100 |

### E. Adhesives:

Aroclor and chlorinated rubber adhesives are resistant to chemicals and were developed originally for adhering labels to acid bottles. These adhesives are also of unusual interest because of their good fire resistant qualities. A typical formulation contains the following ingredients:

AROCLOR PLASTICIZERS FOR CHLORINATED RUBBER ADHESIVES

| Ingredients | Parts by weight |
|---|---|
| Parlon, 125-cp. type | 20 |
| Aroclor 1254 | 6 |
| Aroclor 1260 | 6 |
| Toluene | 68 |
| Total | 100 |

### F. Paper and Textile Coatings:

Aroclor and chlorinated rubber coatings are worthy of consideration for specific end uses in the paper and textile coatings fields. In general, however, the use of this type of coating in these fields may be restricted especially where freedom from odor and taste are required. Unpigmented Aroclor and chlorinated rubber finishes would seem suitable for certain fabrics used indoors, but not where they are exposed to high temperatures and direct sunlight.

### G. Coatings for Electrical Apparatus:

Because of their desirable electrical properties, compositions containing Aroclors and chlorinated rubber are very useful to insulate and protect electrical wire and apparatus from moisture. When fortified with selected fungistats and waxes, coatings of this type are used to "tropicalize" or protect electronic equipment against both moisture and fungi. Moreover, the fire resistant qualities of these plastics are highly desirable for use in the electrical field.

### H. Inks:

Aroclor plasticized chlorinated rubber compositions are very useful for printing inks where faster drying time and increased chemical resistance are desired. The alkali-resistant properties of such plastics suggest their use in the printing of soap wrappers and soap boxes, bottle labels and other commodities where the ink must be resistant to alkalies.

## VI. RESINS AND PLASTICIZERS, OTHER THAN AROCLOR, MISCIBLE IN CHLORINATED RUBBER

The resins and plasticizers given in the following Table VII are miscible in chlorinated rubber. This was determined by the examination of films laid down from 2 : 1, and 1 : 1, Parlon : resin or plasticizer ratios at 20 per cent concentration in toluene.



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## TABLE VII. RESINS AND PLASTICIZERS MISCIBLE IN PARLON

### RESINS

Amberol 801, 806P, ST-137, F7
Aroclor 1262, 5460
Aroplaz 920, 930, 935, 940
Bakelite XR-3180, XR-4503, XR-4006, BR-2963, XJ-9868, BR-1329, BR-3360
Beckacite 1112
Beckamine P-138, P-254
Super-Beckamine 3501
Beckopol 1400
Beckosol 1 (solid), 18, 31, 34, 40, 1329
Beetle Resin 227-8
Clorafin 70
Copal
Cumar P10
Dammar
Duraplex C-45-LV, C-48, C-49, C-50-LV, C-51, C-62, D-61, D-62, E-71, E-71-A, E-73
East India gum
Ester gum
Ethyl Methacrylate
Esterol 750
Formvar
Geiva 2.5
Glyptal 1247, 2450, 2454, 2458, 2464, 2466, 2500
Lewisol 2L, 28, 33
Methyl Methacrylate Polymers
Neville R-3, R-10
Pentalyn A, G, M, X
Petrex 1, 130H
Phenac 633-M
Rezyl 116, X315, 412, 775, 803, 807, 829, 869, 880, 1103
Rosin
Santolite MHP
Staybelite Ester 1, 2, 10
Staybelite resin
Super-Beckacite 1001
Syntex H1, H3, H12, 17, 213, 22, 28, 29, 32, 36
Teglac 15, Z-152
Velsicol AD6-3
Vinsol

### PLASTICIZERS

Amylchloro naphthalene
Amyl oleate
Amyl stearate
Aroclor 1242
Aroclor 1254
Aroclor 1260
Butyl myristate
Butyl stearate
Camphor
Castor oil, raw
Castor oil, dehydrated
Castor oil fatty acid esters
Cellosolve phthalate
Coconut fatty acid esters
Diamyl naphthalene
Diamyl phthalate
Dibutyl phthalate
Dibutyl sebacate
Diethyl phthalate
Dimethyl phthalate
Fish oil
Hercolyn
Linseed oil
Methyl cellosolve oleate
Monoamyl naphthalene
Naftolen
Neville heavy oil No. 2
Nevillite oil
Oiticica oil
Palm fatty acid esters
Perilla oil
Polyamyl naphthalene
Resinous Products C-24
Santicizer B-16
Santicizer M-17
Sextol phthalate
Sextol stearate
Soya bean fatty acid esters
Soya bean oil
Thermoil A
Tributyl phosphate
Tricresyl phosphate
Triethyl citrate
Triphenyl phosphate
Tung oil, Thermolyzed, 976

The strong points and limitations of the resins and plasticizers given in Table VII relative to the properties they impart to chlorinated rubber are known. None give the important over-all desired qualities attained by the use of Aroclors. If occasion arises to consider the use of these materials in specific applications for chlorinated rubber, then more detailed information about them will be given.





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## VII. GENERAL

Prior to Word War II Aroclors, used in substantial amount with chlorinated rubber, made rapid growth in the applications given in this report. During the war, scarcity of natural rubber curtailed these developments but since the war industry has been quick to resume the use of Aroclor plasticized chlorinated rubber compositions.

Their principal field of application is as lacquers, varnishes and paints where flame resistance, corrosion resistance, chemical resistance, i.e., resistance to acids, alkalies and water, and good electrical insulating properties are required.

When properly pigmented these paints or coatings have good weatherability. Although the adhesion of unplasticized chlorinated rubber films to common structural materials is poor, when plasticized with Aroclors strong adhesive bonds are obtained. Aroclors improve the flexibility and life of chlorinated rubber plastics coatings.

The formulations of Aroclors and chlorinated rubber along with their suggested uses, as given in this report, are in line with good commercial practice. Much of the date given was obtained from other firms, particularly Hercules Powder Company, Wilmington, Delaware. The information given is to serve as a guide or starting point in the development of formulations to expand taking advantage of the outstanding qualities of Aroclors as resins and plasticizers for chlorinated rubber.

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