Lit. Berry, et al., v. Monsanto & Drakenfeld (Aroclor 4465) 1962

DSW 441719

STLCOPCB4056254

November 30, 1966

Morris E. Stokes, Esq.
Moser, Marsalek, Carpenter, Cleary
& Jaeckel
330 Pierce Building
St. Louis, Missouri 63102

Dear Morris:

Re: Dorothy Berry, et al.
vs. Monsanto Company

Enclosed are 16 signature pages for use in appending to Answers to Interrogatories put to Monsanto in the 16 pending lawsuits in the Court of Common Pleas, Washington County, Pennsylvania. To expedite their execution here, you will note that we retyped the execution page, in it making an indication that Mr. Mahoney, who is executing the Answers to Interrogatories, is a Vice President of Monsanto Company, and not Monsanto Chemical Company. This change may affect the earlier parts of our Answers in which a similar notation to the effect that Monsanto Company was formerly named Monsanto Chemical Company may be desirable.

The necessity for this change in our answer or the desirability of suggesting on the record in the various lawsuits that this change in our name has occurred we leave to your judgment and the thoughts of local counsel in Pennsylvania.

We have pencilled in the names of the various lawsuits in the upper right hand corner of these completed signature pages and have retained the set of Answers to Interrogatories in the Barrett case for our files. If you have any further questions or problems concerning our Answers please let me know.

Sincerely,

John F. Stapleton
Attorney

JFS:mjs
Encls.

DSW 441720

STLCOPCB4056255

cc: Mr. Charles W. Bovard, Claims Supervisor
Liberty Mutual Insurance Company
4650 Hampton Avenue
St. Louis, Missouri 63109

Mr. H. D. Dickens

Mr. R. B. Chapman

Mr. W. F. Waychoff

DSW 441721

TMK:er 2-10-66

IN THE COURT OF COMMON PLEAS OF WASHINGTON COUNTY, PENNSYLVANIA

| | | |
|---|---|---|
| **DOROTHY BERRY** | ) | |
| Plaintiff | ) | |
| | ) | No. 520 February Term, 1964, A.D. |
| vs. | ) | |
| | ) | No. 521 February Term, 1964, A.D. |
| B. F. DRAKENFELD & CO., INC., a corporation, and MONSANTO CHEMICAL COMPANY, a corporation | ) | |
| Defendants | ) | |

INTERROGATORIES

TO: ~~MONSANTO CHEMICAL COMPANY,~~
and H. GILMORE SCHMIDT, Esquire
438 Washington Trust Building
Washington, Pennsylvania

The following Interrogatories are addressed to you pursuant to Pennsylvania Rule of Civil Procedure No. 4005 (a) and are to be answered by you as required by Rule No. 4006:

1. Do you now manufacture and sell products known as Aroclor compounds?

2. If the answer to question No. 1 is yes, when were Aroclor compounds first manufactured and sold by you?

3. At the time the Aroclor compounds were first put on the market by you, state the chemical ingredients contained therein and the proportion of each ingredient.

4. Have any changes been made in the chemical ingredients contained in the Aroclor compounds or the proportion of such ingredients from the time they were put on the market until the present time?

(a) If so, state the date of such changes, describe such changes, and state the purpose or purposes of such changes.

5. Before the Aroclor compounds were first put on the market by you, was a study made by you or at your request of the available technical and medical literature to determine whether or not Aroclor compounds could cause injury or disease to workers in industry using such compounds?

(a) If so, state the time when such a study was made.

(b) If so, list the names, addresses and occupations of whoever made such a study.

(c) If the results of such a study are in writing, attach a copy hereto.

(d) If the results of such a study are not in writing, state the substance thereof.

6. At any time after the Aroclor compounds were first put on the market by you, was a study made by you or at your request of the available technical and medical literature to determine whether or not Aroclor compounds could cause injury or disease to workers in industry using such compounds?

(a) If so, state the time when such a study was made.

(b) If so, list the names, addresses and occupations of whoever made such a study.

(c) If the results of such a study are in writing, attach a copy hereto.



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(d) If the results of such a study are not in writing, state the substance thereof.

7. Before the Aroclor compounds were put on the market by you, were any tests made by you or at your request to determine whether or not Aroclor compounds could cause injury or disease to workers in industry using such compounds?

(a) If so, state the time when such tests were made.

(b) If so, state the names, addresses and occupations of whoever made such tests.

(c) If so, describe the testing procedures used.

(d) If so, describe the results of such tests.

8. At any time after the Aroclor compounds were put on the market by you, were any tests made by you or at your request to determine whether or not Aroclor compounds could cause injury or disease to workers in industry using such compounds?

(a) If so, state the time when such tests were made.

(b) If so, state the names, addresses and occupations of whoever made such tests.

(c) If so, describe the testing procedures used.

(d) If so, describe the results of such tests.

9. Before the Aroclor compounds were put on the market by you, did you request and receive the opinion of any medical doctor or doctors as to whether or not Aroclor compounds could cause injury or disease to workers in industry using Aroclor compounds?

(a) If so, state the time such opinion or opinions were received.



DSW 441724

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(b) If so, state the names and addresses of the doctors.

(c) If so, and the opinion or opinions were in writing, attach a copy or copies hereto.

(d) If so, and the opinion or opinions were oral, state the substance thereof.

10. At any time after the Aroclor compounds were put on the market by you, did you request and receive the opinion of any medical doctor or doctors as to whether or not Aroclor compounds could cause injury or disease to workers in industry using Aroclor compounds?

(a) If so, state the time such opinion or opinions were received.

(b) If so, state the names and addresses of the doctors.

(c) If so, and the opinion or opinions were in writing, attach a copy or copies hereto.

(d) If so, and the opinion or opinions were oral, state the substance thereof.

11. At any time either before or after the Aroclor compounds were first put on the market by you, was any work done by you or at your request, not covered by questions 5. through 10., inclusive, to determine whether or not Aroclor compounds could cause injury or disease to workers in industry using such compounds?

(a) If so, describe what, when and by whom such work was done.

12. Before the Aroclor compounds were put on the market by you, was any research done by you or at your request concerning methods of prevention of injury or disease to industrial workers from use of



DSW 441725

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Aroclor compounds?

(a) If so, state the time when such research was done.

(b) If so, state the names, addresses and occupations of whoever conducted such research.

(c) If so, and the results of such research are in writing, attach a copy hereto.

(d) If so, and the results of such research were oral, state the substance thereof.

13. At any time after the Aroclor compounds were put on the market by you, was any research done by you or at your request concerning methods of prevention of injury or disease to industrial workers from use of Aroclor compounds?

(a) If so, state the time when such research was done.

(b) If so, state the names, addresses and occupations of whoever conducted such research.

(c) If so, and the result of such research is in writing, attach a copy hereto.

(d) If so, and the result of such research was oral, state the substance thereof.

14. Have any claims been made against you prior to the date of the filing of this suit in which the claimant asserted that the use of Aroclor compounds caused him or her to suffer injury or disease?

(a) If so, state when and by whom such claims were made.

15. Did you publish any literature which contained any reference to the toxicity of Aroclor compounds?

(a) If so, attach copies hereto.



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16. Did the packages or containers in which Aroclor compounds were shipped to customers have labels?

(a) If so, attach copies of the type or types of labels.

17. Did the packages or containers in which Aroclor compounds were shipped to customers contain directions for use?

(a) If so, attach copies of the type or types of directions for use.

18. Did you sponsor any advertising of Aroclor compounds?

(a) If so, state the name of the publication in which such advertising appeared and the date of the issue of such publication.

19. Did you sell Aroclor compounds to B. F. Drakenfeld & Company?

(a) If so, state the type of Aroclor compound sold.

(b) If so, state the date of sale and amount sold.

20. Did any of the packages or containers in which the Aroclor compounds were shipped to B. F. Drakenfeld & Company contain directions for use of the Aroclor compounds by B. F. Drakenfeld & Company?

(a) If so, attach copies hereto.

21. Did any of the packages or containers in which the Aroclor compounds were shipped to B. F. Drakenfeld & Company contain labeling for use of the Aroclor compounds by B. F. Drakenfeld & Company?

(a) If so, attach copies hereto.

22. In connection with the sale of Aroclor compounds to B. F. Drakenfeld & Company, was any literature sent to B. F. Drakenfeld & Company by you which referred to the toxicity of Aroclor compounds?

(a) If so, attach copies hereto.



DSW 441727

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23. Did you know the use or uses of the Aroclor compounds by B. F. Drakenfeld & Company?

(a) If so, state when such knowledge came to you and the extent of such knowledge.

24. Did you ever furnish any instructions or suggestions to B. F. Drakenfeld & Company concerning the labeling to be used by them on their product?

(a) If so, and the instructions or suggestions were written, attach copies hereto.

(b) If so, and the instructions or suggestions were oral, state the substance thereof.

25. Did you ever furnish any instructions or suggestions to B. F. Drakenfeld & Company concerning the directions for use to be published by them in connection with their product?

(a) If so, and the instructions or suggestions were written, attach copies hereto.

(b) If so, and the instructions or suggestions were oral, state the substance thereof.

26. State the name of each person who was primarily responsible at any time during the period of years set forth in the Complaint in this case for the manufacture of Aroclor compounds by your company.

27. State the name of each person who was the principal assistant of each of the persons named in response to Question 26. above during the same period of time.

28. State the name of each person who was primarily responsible at any time during the period of years set forth in the Complaint in this case for the chemical composition of Aroclor compounds manufactured



DSW 441728

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by your company.

29. State the name of each person who was the principal assistant of each of the persons named in response to Question 28. above during the same period of time.

30. State the name of each person who was primarily responsible at any time during the period of years set forth in the Complaint in this case for the marketing of Aroclor compounds by your company.

31. State the name of each person who was the principal assistant of each of the persons named in response to Question 30. above during the same period of time.

32. State the name of each person in your company who was primarily responsible at any time during the period of years set forth in the Complaint in this case for the marketing of Aroclor compounds to B. F. Drakenfeld & Company.

33. State the name of each person who was the principal assistant to each of the persons named in response to Question 32. above during the same period of time.

34. State the name of each person who was primarily responsible at any time during the period of years set forth in the Complaint in this case for the labeling and preparation of descriptive literature concerning the Aroclor compounds manufactured by your company.

35. State the name of each person who was the principal assistant of each of the persons named in response to Question 34. above during the same period of time.

36. State the name of each person who was primarily responsible at any time during the period of years set forth in the Complaint in this



DSW 441729

STLCOPCB4056264

case for the advertising of Aroclor compounds manufactured by your company.

37. State the name of each person who was the principal assistant of each of the persons named in response to Question 36. above during the same period of time.

/s/ Thomas M. Kerr, Jr.

Patterson, Crawford, Arensberg & Dunn

Adolph L. Zeman
Zeman and Zeman



DSW 441730

STLCOPCB4056265

TMK:er 2-10-66

IN THE COURT OF COMMON PLEAS OF WASHINGTON COUNTY, PENNSYLVANIA

| | | |
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| MILDRED BARRETT<br><br>Plaintiff<br><br>vs.<br><br>B. F. DRAKENFELD & CO., INC., a corporation, and MONSANTO CHEMICAL COMPANY, a corporation<br><br>Defendants | ) | No. 518 February Term, 1964, A.D.<br><br>No. 519 February Term, 1964, A.D. |

INTERROGATORIES

TO: MONSANTO CHEMICAL COMPANY,
and H. GILMORE SCHMIDT, Esquire
438 Washington Trust Building
Washington, Pennsylvania

The following Interrogatories are addressed to you pursuant to Pennsylvania Rule of Civil Procedure No. 4005 (a) and are to be answered by you as required by Rule No. 4006:

1. Do you now manufacture and sell products known as Aroclor compounds?

2. If the answer to question No. 1 is yes, when were Aroclor compounds first manufactured and sold by you?

3. At the time the Aroclor compounds were first put on the market by you, state the chemical ingredients contained therein and the proportion of each ingredient.

4. Have any changes been made in the chemical ingredients contained in the Aroclor compounds or the proportion of such ingredients from the time they were put on the market until the present time?

(a) If so, state the date of such changes, describe such changes, and state the purpose or purposes of such changes.

5. Before the Aroclor compounds were first put on the market by you, was a study made by you or at your request of the available technical and medical literature to determine whether or not Aroclor compounds could cause injury or disease to workers in industry using such compounds?

(a) If so, state the time when such a study was made.

(b) If so, list the names, addresses and occupations of whoever made such a study.

(c) If the results of such a study are in writing, attach a copy hereto.

(d) If the results of such a study are not in writing, state the substance thereof.

6. At any time after the Aroclor compounds were first put on the market by you, was a study made by you or at your request of the available technical and medical literature to determine whether or not Aroclor compounds could cause injury or disease to workers in industry using such compounds?

(a) If so, state the time when such a study was made.

(b) If so, list the names, addresses and occupations of whoever made such a study.

(c) If the results of such a study are in writing, attach a copy hereto.



DSW 441732

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(d) If the results of such a study are not in writing, state the substance thereof.

7. Before the Aroclor compounds were put on the market by you, were any tests made by you or at your request to determine whether or not Aroclor compounds could cause injury or disease to workers in industry using such compounds?

(a) If so, state the time when such tests were made.

(b) If so, state the names, addresses and occupations of whoever made such tests.

(c) If so, describe the testing procedures used.

(d) If so, describe the results of such tests.

8. At any time after the Aroclor compounds were put on the market by you, were any tests made by you or at your request to determine whether or not Aroclor compounds could cause injury or disease to workers in industry using such compounds?

(a) If so, state the time when such tests were made.

(b) If so, state the names, addresses and occupations of whoever made such tests.

(c) If so, describe the testing procedures used.

(d) If so, describe the results of such tests.

9. Before the Aroclor compounds were put on the market by you, did you request and receive the opinion of any medical doctor or doctors as to whether or not Aroclor compounds could cause injury or disease to workers in industry using Aroclor compounds?

(a) If so, state the time such opinion or opinions were received.



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(b) If so, state the names and addresses of the doctors.

(c) If so, and the opinion or opinions were in writing, attach a copy or copies hereto.

(d) If so, and the opinion or opinions were oral, state the substance thereof.

10. At any time after the Aroclor compounds were put on the market by you, did you request and receive the opinion of any medical doctor or doctors as to whether or not Aroclor compounds could cause injury or disease to workers in industry using Aroclor compounds?

(a) If so, state the time such opinion or opinions were received.

(b) If so, state the names and addresses of the doctors.

(c) If so, and the opinion or opinions were in writing, attach a copy or copies hereto.

(d) If so, and the opinion or opinions were oral, state the substance thereof.

11. At any time either before or after the Aroclor compounds were first put on the market by you, was any work done by you or at your request, not covered by questions 5. through 10., inclusive, to determine whether or not Aroclor compounds could cause injury or disease to workers in industry using such compounds?

(a) If so, describe what, when and by whom such work was done.

12. Before the Aroclor compounds were put on the market by you, was any research done by you or at your request concerning methods of prevention of injury or disease to industrial workers from use of



DSW 441734

STLCOPCB4056269

Aroclor compounds?

(a) If so, state the time when such research was done.

(b) If so, state the names, addresses and occupations of whoever conducted such research.

(c) If so, and the results of such research are in writing, attach a copy hereto.

(d) If so, and the results of such research were oral, state the substance thereof.

13. At any time after the Aroclor compounds were put on the market by you, was any research done by you or at your request concerning methods of prevention of injury or disease to industrial workers from use of Aroclor compounds?

(a) If so, state the time when such research was done.

(b) If so, state the names, addresses and occupations of whoever conducted such research.

(c) If so, and the result of such research is in writing, attach a copy hereto.

(d) If so, and the result of such research was oral, state the substance thereof.

14. Have any claims been made against you prior to the date of the filing of this suit in which the claimant asserted that the use of Aroclor compounds caused him or her to suffer injury or disease?

(a) If so, state when and by whom such claims were made.

15. Did you publish any literature which contained any reference to the toxicity of Aroclor compounds?

(a) If so, attach copies hereto.



DSW 441735

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16. Did the packages or containers in which Aroclor compounds were shipped to customers have labels?

(a) If so, attach copies of the type or types of labels.

17. Did the packages or containers in which Aroclor compounds were shipped to customers contain directions for use?

(a) If so, attach copies of the type or types of directions for use.

18. Did you sponsor any advertising of Aroclor compounds?

(a) If so, state the name of the publication in which such advertising appeared and the date of the issue of such publication.

19. Did you sell Aroclor compounds to B. F. Drakenfeld & Company?

(a) If so, state the type of Aroclor compound sold.

(b) If so, state the date of sale and amount sold.

20. Did any of the packages or containers in which the Aroclor compounds were shipped to B. F. Drakenfeld & Company contain directions for use of the Aroclor compounds by B. F. Drakenfeld & Company?

(a) If so, attach copies hereto.

21. Did any of the packages or containers in which the Aroclor compounds were shipped to B. F. Drakenfeld & Company contain labeling for use of the Aroclor compounds by B. F. Drakenfeld & Company?

(a) If so, attach copies hereto.

22. In connection with the sale of Aroclor compounds to B. F. Drakenfeld & Company, was any literature sent to B. F. Drakenfeld & Company by you which referred to the toxicity of Aroclor compounds?

(a) If so, attach copies hereto.



DSW 441736

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23. Did you know the use or uses of the Aroclor compounds by B. F. Drakenfeld & Company?

(a) If so, state when such knowledge came to you and the extent of such knowledge.

24. Did you ever furnish any instructions or suggestions to B. F. Drakenfeld & Company concerning the labeling to be used by them on their product?

(a) If so, and the instructions or suggestions were written, attach copies hereto.

(b) If so, and the instructions or suggestions were oral, state the substance thereof.

25. Did you ever furnish any instructions or suggestions to B. F. Drakenfeld & Company concerning the directions for use to be published by them in connection with their product?

(a) If so, and the instructions or suggestions were written, attach copies hereto.

(b) If so, and the instructions or suggestions were oral, state the substance thereof.

26. State the name of each person who was primarily responsible at any time during the period of years set forth in the Complaint in this case for the manufacture of Aroclor compounds by your company.

27. State the name of each person who was the principal assistant of each of the persons named in response to Question 26. above during the same period of time.

28. State the name of each person who was primarily responsible at any time during the period of years set forth in the Complaint in this case for the chemical composition of Aroclor compounds manufactured



DSW 441737

STLCOPCB4056272

by your company.

29. State the name of each person who was the principal assistant of each of the persons named in response to Question 28. above during the same period of time.

30. State the name of each person who was primarily responsible at any time during the period of years set forth in the Complaint in this case for the marketing of Aroclor compounds by your company.

31. State the name of each person who was the principal assistant of each of the persons named in response to Question 30. above during the same period of time.

32. State the name of each person in your company who was primarily responsible at any time during the period of years set forth in the Complaint in this case for the marketing of Aroclor compounds to B. F. Drakenfeld & Company.

33. State the name of each person who was the principal assistant to each of the persons named in response to Question 32. above during the same period of time.

34. State the name of each person who was primarily responsible at any time during the period of years set forth in the Complaint in this case for the labeling and preparation of descriptive literature concerning the Aroclor compounds manufactured by your company.

35. State the name of each person who was the principal assistant of each of the persons named in response to Question 34. above during the same period of time.

36. State the name of each person who was primarily responsible at any time during the period of years set forth in the Complaint in this



DSW 441738

STLCOPCB4056273

case for the advertising of Aroclor compounds manufactured by your company.

37. State the name of each person who was the principal assistant of each of the persons named in response to Question 36. above during the same period of time.

/s/ Thomas M. Kerr, Jr.

Patterson, Crawford, Arensberg & Dunn

Adolph L. Zeman
Zeman and Zeman



DSW 441739

STLCOPCB4056274

TMK:er 2-11-66

IN THE COURT OF COMMON PLEAS OF WASHINGTON COUNTY, PENNSYLVANIA

| | | |
|---|---|---|
| **DOROTHY BERRY,** Plaintiff | ) No. **520** | February Term, 1964, A.D. |
| vs. | ) No. **521** | February Term, 1964, A.D. |
| B. F. DRAKENFELD & CO., INC., a corporation, and MONSANTO CHEMICAL COMPANY, a corporation, Defendants | ) | |

INTERROGATORIES

TO: B. F. DRAKENFELD & CO., INC. and
FRANCIS H. PATRONO, ESQ.
Tron Ward Building
80 East Chestnut Street
Washington, Pennsylvania

The following Interrogatories are addressed to you pursuant to Pennsylvania Rule of Civil Procedure No. 4005 (a) and are to be answered by you as required by Rule No. 4006:

1. Do you now manufacture and sell high-fire glass enamels containing ingredients known as Aroclor compounds?

2. If the answer to question No. 1 is yes, when were these glass enamels first manufactured and sold by you?

3. Have you ever manufactured and sold high-fire glass enamels containing ingredients known as Aroclor compounds?

4. If the answer to question No. 3 is yes, when were these glass enamels first manufactured and sold by you?

5. At the time these glass enamels were first put on the market by you, state the chemical ingredients contained therein and the proportion of each ingredient.

6. Have any changes been made in the chemical ingredients contained in high-fire glass enamels containing Aroclor compounds or the proportion of such ingredients from the time they were put on the market until the present time?

(a) If so, state the date of such changes, describe such changes, and state the purpose or purposes of such changes.

7. Before the high-fire glass enamels containing Aroclor compounds were first put on the market by you, was a study made by you or at your request of the available technical and medical literature to determine whether or not high-fire glass enamels containing Aroclor compounds could cause injury or disease to workers in industry using such enamels?

(a) If so, state the time when such a study was made.

(b) If so, list the names, addresses and occupations of whoever made such a study.

(c) If the results of such a study are in writing, attach a copy hereto.

(d) If the results of such a study are not in writing, state the substance thereof.

8. At any time after the high-fire glass enamels containing Aroclor compounds were first put on the market by you, was a study made by you or at your request of the available technical and medical literature to determine whether or not high-fire glass enamels containing Aroclor compounds could cause injury or disease to workers in industry using such enamels?



DSW 441741

STLCOPCB4056276

(a) If so, state the time when such a study was made.

(b) If so, list the names, addresses and occupations of whoever made such a study.

(c) If the results of such a study are in writing, attach a copy hereto.

(d) If the results of such a study are not in writing, state the substance thereof.

9. Before the high-fire glass enamels containing Aroclor compounds were put on the market by you, were any tests made by you or at your request to determine whether or not high-fire glass enamels containing Aroclor compounds could cause injury or disease to workers in industry using such enamels?

(a) If so, state the time when such tests were made.

(b) If so, state the names, addresses and occupations of whoever made such tests.

(c) If so, describe the testing procedures used.

(d) If so, describe the results of such tests.

10. At any time after the high-fire glass enamels containing Aroclor compounds were put on the market by you, were any tests made by you or at your request to determine whether or not high-fire glass enamels containing Aroclor compounds could cause injury or disease to workers in industry using such enamels?

(a) If so, state the time when such tests were made.

(b) If so, state the names, addresses and occupations of whoever made such tests.

(c) If so, describe the testing procedures used.



DSW 441742

STLCOPCB4056277

(d) If so, describe the results of such tests.

11. Before the high-fire glass enamels containing Aroclor compounds were put on the market by you, did you request and receive the opinion of any medical doctor or doctors as to whether or not high-fire glass enamels containing Aroclor compounds could cause injury or disease to workers in industry using such enamels?

(a) If so, state the time such opinion or opinions were received.

(b) If so, state the names and addresses of the doctors.

(c) If so, and the opinion or opinions were in writing, attach a copy or copies hereto.

(d) If so, and the opinion or opinions were oral, state the substance thereof.

12. At any time after the high-fire glass enamels containing Aroclor compounds were put on the market by you, did you request and receive the opinion of any medical doctor or doctors as to whether or not high-fire glass enamels containing Aroclor compounds could cause injury or disease to workers in industry using such enamels?

(a) If so, state the time such opinion or opinions were received.

(b) If so, state the names and addresses of the doctors.

(c) If so, and the opinion or opinions were in writing, attach a copy or copies hereto.

(d) If so, and the opinion or opinions were oral, state the substance thereof.

13. At any time either before or after the high-fire glass enamels



DSW 441743

STLCOPCB4056278

containing Aroclor compounds were first put on the market by you, was any work done by you or at your request, not covered by questions 5. through 10., inclusive, to determine whether or not high-fire glass enamels containing Aroclor compounds could cause injury or disease to workers in industry using such enamels?

(a) If so, describe what, when and by whom such work was done.

14. Before the high-fire glass enamels containing Aroclor compounds were put on the market by you, was any research done by you or at your request concerning methods of prevention of injury or disease to industrial workers from use of high-fire glass enamels containing Aroclor compounds?

(a) If so, state the time when such research was done.

(b) If so, state the names, addresses and occupations of whoever conducted such research.

(c) If so, and the results of such research are in writing, attach a copy hereto.

(d) If so, and the results of such research were oral, state the substance thereof.

15. At any time after the high-fire glass enamels containing Aroclor compounds were put on the market by you, was any research done by you or at your request concerning methods of prevention of injury or disease to industrial workers from use of high-fire glass enamels containing Aroclor compounds?

(a) If so, state the time when such research was done.

(b) If so, state the names, addresses and occupations of whoever conducted such research.



DSW 441744

STLCOPCB4056279

(c) If so, and the result of such research is in writing, attach a copy hereto.

(d) If so, and the result of such research was oral, state the substance thereof.

16. Have any claims been made against you prior to the date of the filing of this suit in which the claimant asserted that the use of high-fire glass enamels containing Aroclor compounds caused him or her to suffer injury or disease?

(a) If so, state when and by whom such claims were made.

17. Did you publish any literature which contained any reference to the toxicity of Aroclor compounds?

(a) If so, attach copies hereto.

18. Did you publish any literature which contained any reference to the toxicity of high-fire glass enamels containing Aroclor compounds?

(a) If so, attach copies hereto.

19. Did the packages or containers in which the high-fire glass enamels containing Aroclor compounds were shipped to customers have labels?

(a) If so, attach copies of the type or types of labels.

20. Did the packages or containers in which the high-fire glass enamels containing Aroclor compounds were shipped to customers contain directions for use?

(a) If so, attach copies of the type or types of directions for use.

21. Did you sponsor any advertising of Aroclor compounds?



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(a) If so, state the name of the publication in which such advertising appeared and the date of the issue of such publication.

22. Did you sponsor any advertising of high-fire glass enamels containing Aroclor compounds?

(a) If so, state the name of the publication in which such advertising appeared and the date of the issue of such publication.

23. Did you sell high-fire glass enamels containing Aroclor compounds to International Bent Glass Company?

(a) If so, state the type of enamels sold.

(b) If so, state the date of sale and amount sold.

24. Did any of the packages or containers in which the enamels were shipped to International Bent Glass Company contain directions for use of the high-fire glass enamels containing Aroclor compounds by International Bent Glass Company?

(a) If so, attach copies hereto.

25. Did any of the packages or containers in which the high-fire glass enamels containing Aroclor compounds were shipped to International Bent Glass Company contain labeling for use of such enamels by International Bent Glass Company?

(a) If so, attach copies hereto.

26. In connection with the sale of high-fire glass enamels containing Aroclor compounds to International Bent Glass Company, was any literature sent to International Bent Glass Company by you which referred to the toxicity of Aroclor compounds?

(a) If so, attach copies hereto.



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27. In connection with the sale of high-fire glass enamels containing Aroclor compounds to International Bent Glass Company, was any literature sent to International Bent Glass Company by you which referred to the toxicity of high-fire glass enamels containing Aroclor compounds?

(a) If so, attach copies hereto.

28. Did you know the use or uses of the high-fire glass enamels containing Aroclor compounds by International Bent Glass Company?

(a) If so, state when such knowledge came to you and the extent of such knowledge.

29. State the name of each person who was primarily responsible at any time during the period of years set forth in the Complaint in this case for the manufacture of high-fire glass enamels containing Aroclor compounds by your company.

30. State the name of each person who was the principal assistant of each of the persons named in response to Question 29. above during the same period of time.

31. State the name of each person who was primarily responsible at any time during the period of years set forth in the Complaint in this case for the chemical composition of the high-fire glass enamels containing Aroclor compounds manufactured by your company.

32. State the name of each person who was the principal assistant of each of the persons named in response to Question 31 above during the same period of time.

33. State the name of each person who was primarily responsible at any time during the period of years set forth in the Complaint in this case for the marketing of high-fire glass enamels containing Aroclor



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compounds by your company.

34. State the name of each person who was the principal assistant of each of the persons named in response to Question 33. above during the same period of time.

35. State the name of each person in your company who was primarily responsible at any time during the period of years set forth in the Complaint in this case for the marketing of high-fire glass enamels containing Aroclor compounds to International Bent Glass Company?

36. State the name of each person who was the principal assistant to each of the persons named in response to Question 35. above during the same period of time.

37. State the name of each person who was primarily responsible at any time during the period of years set forth in the Complaint in this case for the labeling and preparation of descriptive literature concerning the high-fire glass enamels containing Aroclor compounds manufactured by your company.

38. State the name of each person who was the principal assistant of each of the persons named in response to Question 37. above during the same period of time.

39. State the name of each person who was primarily responsible at any time during the period of years set forth in the Complaint in this case for the advertising of high-fire glass enamels containing Aroclor compounds manufactured by your company.

40. State the name of each person who was the principal assistant of each of the persons named in response to Question 39. above during the same period of time.

/s/ Thomas M. Kerr, Jr.
Patterson, Crawford, Arensberg & Dunn

Adolph L. Zeman
Zeman and Zeman

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STLCOPCB4056283

TMKjer 2-11-66

IN THE COURT OF COMMON PLEAS OF WASHINGTON COUNTY, PENNSYLVANIA

| | | |
|---|---|---|
| **MILDRED BARRETT** Plaintiff | ) No. **518** | February Term, 1964, A.D. |
| vs. | ) No. **519** | February Term, 1964, A.D. |
| B. F. DRAKENFELD & CO., INC., a corporation, and MONSANTO CHEMICAL COMPANY, a corporation, Defendants | ) | |

INTERROGATORIES

TO: B. F. DRAKENFELD & CO., INC. and
FRANCIS H. PATRONO, ESQ.
Tron Ward Building
80 East Chestnut Street
Washington, Pennsylvania

The following Interrogatories are addressed to you pursuant to Pennsylvania Rule of Civil Procedure No. 4005 (a) and are to be answered by you as required by Rule No. 4006:

1. Do you now manufacture and sell high-fire glass enamels containing ingredients known as Aroclor compounds?

2. If the answer to question No. 1 is yes, when were these glass enamels first manufactured and sold by you?

3. Have you ever manufactured and sold high-fire glass enamels containing ingredients known as Aroclor compounds?

4. If the answer to question No. 3 is yes, when were these glass enamels first manufactured and sold by you?



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5. At the time these glass enamels were first put on the market by you, state the chemical ingredients contained therein and the proportion of each ingredient.

6. Have any changes been made in the chemical ingredients contained in high-fire glass enamels containing Aroclor compounds or the proportion of such ingredients from the time they were put on the market until the present time?

(a) If so, state the date of such changes, describe such changes, and state the purpose or purposes of such changes.

7. Before the high-fire glass enamels containing Aroclor compounds were first put on the market by you, was a study made by you or at your request of the available technical and medical literature to determine whether or not high-fire glass enamels containing Aroclor compounds could cause injury or disease to workers in industry using such enamels?

(a) If so, state the time when such a study was made.

(b) If so, list the names, addresses and occupations of whoever made such a study.

(c) If the results of such a study are in writing, attach a copy hereto.

(d) If the results of such a study are not in writing, state the substance thereof.

8. At any time after the high-fire glass enamels containing Aroclor compounds were first put on the market by you, was a study made by you or at your request of the available technical and medical literature to determine whether or not high-fire glass enamels containing Aroclor compounds could cause injury or disease to workers in industry using such enamels?



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(a) If so, state the time when such a study was made.

(b) If so, list the names, addresses and occupations of whoever made such a study.

(c) If the results of such a study are in writing, attach a copy hereto.

(d) If the results of such a study are not in writing, state the substance thereof.

9. Before the high-fire glass enamels containing Aroclor compounds were put on the market by you, were any tests made by you or at your request to determine whether or not high-fire glass enamels containing Aroclor compounds could cause injury or disease to workers in industry using such enamels?

(a) If so, state the time when such tests were made.

(b) If so, state the names, addresses and occupations of whoever made such tests.

(c) If so, describe the testing procedures used.

(d) If so, describe the results of such tests.

10. At any time after the high-fire glass enamels containing Aroclor compounds were put on the market by you, were any tests made by you or at your request to determine whether or not high-fire glass enamels containing Aroclor compounds could cause injury or disease to workers in industry using such enamels?

(a) If so, state the time when such tests were made.

(b) If so, state the names, addresses and occupations of whoever made such tests.

(c) If so, describe the testing procedures used.



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(d) If so, describe the results of such tests.

11. Before the high-fire glass enamels containing Aroclor compounds were put on the market by you, did you request and receive the opinion of any medical doctor or doctors as to whether or not high-fire glass enamels containing Aroclor compounds could cause injury or disease to workers in industry using such enamels?

(a) If so, state the time such opinion or opinions were received.

(b) If so, state the names and addresses of the doctors.

(c) If so, and the opinion or opinions were in writing, attach a copy or copies hereto.

(d) If so, and the opinion or opinions were oral, state the substance thereof.

12. At any time after the high-fire glass enamels containing Aroclor compounds were put on the market by you, did you request and receive the opinion of any medical doctor or doctors as to whether or not high-fire glass enamels containing Aroclor compounds could cause injury or disease to workers in industry using such enamels?

(a) If so, state the time such opinion or opinions were received.

(b) If so, state the names and addresses of the doctors.

(c) If so, and the opinion or opinions were in writing, attach a copy or copies hereto.

(d) If so, and the opinion or opinions were oral, state the substance thereof.

13. At any time either before or after the high-fire glass enamels



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containing Aroclor compounds were first put on the market by you, was any work done by you or at your request, not covered by questions 5. through 10., inclusive, to determine whether or not high-fire glass enamels containing Aroclor compounds could cause injury or disease to workers in industry using such enamels?

(a) If so, describe what, when and by whom such work was done.

14. Before the high-fire glass enamels containing Aroclor compounds were put on the market by you, was any research done by you or at your request concerning methods of prevention of injury or disease to industrial workers from use of high-fire glass enamels containing Aroclor compounds?

(a) If so, state the time when such research was done.

(b) If so, state the names, addresses and occupations of whoever conducted such research.

(c) If so, and the results of such research are in writing, attach a copy hereto.

(d) If so, and the results of such research were oral, state the substance thereof.

15. At any time after the high-fire glass enamels containing Aroclor compounds were put on the market by you, was any research done by you or at your request concerning methods of prevention of injury or disease to industrial workers from use of high-fire glass enamels containing Aroclor compounds?

(a) If so, state the time when such research was done.

(b) If so, state the names, addresses and occupations of whoever conducted such research.



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(c) If so, and the result of such research is in writing, attach a copy hereto.

(d) If so, and the result of such research was oral, state the substance thereof.

16. Have any claims been made against you prior to the date of the filing of this suit in which the claimant asserted that the use of high-fire glass enamels containing Aroclor compounds caused him or her to suffer injury or disease?

(a) If so, state when and by whom such claims were made.

17. Did you publish any literature which contained any reference to the toxicity of Aroclor compounds?

(a) If so, attach copies hereto.

18. Did you publish any literature which contained any reference to the toxicity of high-fire glass enamels containing Aroclor compounds?

(a) If so, attach copies hereto.

19. Did the packages or containers in which the high-fire glass enamels containing Aroclor compounds were shipped to customers have labels?

(a) If so, attach copies of the type or types of labels.

20. Did the packages or containers in which the high-fire glass enamels containing Aroclor compounds were shipped to customers contain directions for use?

(a) If so, attach copies of the type or types of directions for use.

21. Did you sponsor any advertising of Aroclor compounds?



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(a) If so, state the name of the publication in which such advertising appeared and the date of the issue of such publication.

22. Did you sponsor any advertising of high-fire glass enamels containing Aroclor compounds?

(a) If so, state the name of the publication in which such advertising appeared and the date of the issue of such publication.

23. Did you sell high-fire glass enamels containing Aroclor compounds to International Bent Glass Company?

(a) If so, state the type of enamels sold.

(b) If so, state the date of sale and amount sold.

24. Did any of the packages or containers in which the enamels were shipped to International Bent Glass Company contain directions for use of the high-fire glass enamels containing Aroclor compounds by International Bent Glass Company?

(a) If so, attach copies hereto.

25. Did any of the packages or containers in which the high-fire glass enamels containing Aroclor compounds were shipped to International Bent Glass Company contain labeling for use of such enamels by International Bent Glass Company?

(a) If so, attach copies hereto.

26. In connection with the sale of high-fire glass enamels containing Aroclor compounds to International Bent Glass Company, was any literature sent to International Bent Glass Company by you which referred to the toxicity of Aroclor compounds?

(a) If so, attach copies hereto.



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27. In connection with the sale of high-fire glass enamels containing Aroclor compounds to International Bent Glass Company, was any literature sent to International Bent Glass Company by you which referred to the toxicity of high-fire glass enamels containing Aroclor compounds?

(a) If so, attach copies hereto.

28. Did you know the use or uses of the high-fire glass enamels containing Aroclor compounds by International Bent Glass Company?

(a) If so, state when such knowledge came to you and the extent of such knowledge.

29. State the name of each person who was primarily responsible at any time during the period of years set forth in the Complaint in this case for the manufacture of high-fire glass enamels containing Aroclor compounds by your company.

30. State the name of each person who was the principal assistant of each of the persons named in response to Question 29. above during the same period of time.

31. State the name of each person who was primarily responsible at any time during the period of years set forth in the Complaint in this case for the chemical composition of the high-fire glass enamels containing Aroclor compounds manufactured by your company.

32. State the name of each person who was the principal assistant of each of the persons named in response to Question 31 above during the same period of time.

33. State the name of each person who was primarily responsible at any time during the period of years set forth in the Complaint in this case for the marketing of high-fire glass enamels containing Aroclor



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compounds by your company.

34. State the name of each person who was the principal assistant of each of the persons named in response to Question 33. above during the same period of time.

35. State the name of each person in your company who was primarily responsible at any time during the period of years set forth in the Complaint in this case for the marketing of high-fire glass enamels containing Aroclor compounds to International Bent Glass Company?

36. State the name of each person who was the principal assistant to each of the persons named in response to Question 35. above during the same period of time.

37. State the name of each person who was primarily responsible at any time during the period of years set forth in the Complaint in this case for the labeling and preparation of descriptive literature concerning the high-fire glass enamels containing Aroclor compounds manufactured by your company.

38. State the name of each person who was the principal assistant of each of the persons named in response to Question 37. above during the same period of time.

39. State the name of each person who was primarily responsible at any time during the period of years set forth in the Complaint in this case for the advertising of high-fire glass enamels containing Aroclor compounds manufactured by your company.

40. State the name of each person who was the principal assistant of each of the persons named in response to Question 39. above during the same period of time.

/s/ Thomas M. Kerr, Jr.
Patterson, Crawford, Arensberg & Dunn

Adolph L. Zeman
Zeman and Zeman

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File

Berry, et al. vs. Mo.

Arocler

GARFIELD 1-5364

MORRIS E. STOKES

PIERCE BUILDING

MOSER, MARSALEK, CARPENTER,
CLEARY & JAECKEL
ATTORNEYS AT LAW

ST. LOUIS, MO.

DSW 441758

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# Precautions in the Use of Chlorinated Naphthalenes and Diphenyls

by LEONARD GREENBURG, Executive Director
Division of Industrial Hygiene, New York State Department of Labor

**BASED ON A GENERAL STUDY of the whole problem and especially on experience gained from two recent outbreaks of dermatitis and liver damage in cable plants using these materials, the New York State Department of Labor offers some specific recommendations for safe practice in working with chlorinated naphthalenes and diphenyls. The following is a digest of a report by Dr. Greenburg which appeared in full in the October 1943 issue of "The Industrial Bulletin," published by the Division of Industrial Hygiene at Albany.**

THE CHLORINATED naphthalenes comprise a group of chemical substances made by the addition of various amounts of chlorine to a naphthalene base. The amount of chlorine may vary from three to six or possibly more atoms, providing compounds from trichlornaphthalene to hexachlornaphthalene.

In the same manner, the varying amounts of chlorine are added to a diphenyl base providing a group of compounds of varying chlorine content.

As a rule, the final substances, as used in industry, are mixtures of differing chlorinated naphthalenes. Earlier, these were, as a rule, possessed of a lower degree of chlorination, and later on the compounds were usually of a higher degree of chlorination with varying amounts of chlorinated diphenyls added.

These substances are not new. Perchlornaphthalene was used in Germany during the last war. These groups of compounds are manufactured by approximately five companies in the United States and they are sold under varying trade names by the manufacturers.

The chlorinated naphthalenes and diphenyls are valuable industrial products. Briefly, their properties are as follows:

1. Resistance to water and alkali.
2. High insulating value and dielectric constant.
3. Thermo plasticity.
4. Quite stable chemically.
5. Flame resistant.

For these reasons, they are of value in the making of electric condensers and in the insulation of wire and cable.

### Experience in Industry

The chlorinated naphthalenes and diphenyls are applied in industry by two methods.

1. A cold method in which the material is dissolved in a solvent usually a mixture of petroleum naphtha and toluene and,
2. A hot method wherein the material is rendered plastic by heat.

During the past year the Division of Industrial Hygiene of the New York State Department of Labor has conducted an investigation in two cable plants using chlorinated naphthalenes and diphenyls. In this investigation, many cases of dermatitis were found, and several deaths due to liver damage among workers in the industry.

The examination of workers in the two factories showed relatively few cases of enlarged liver—five in all, on palpation.

Comparison in these two plants showed a very much higher incidence of acneform dermatitis in one of the plants as compared with the other; namely 21 per cent as compared with 60 per cent, the former being in the cold process establishment and the latter being in the establishment employing the hot process only. The dermatitis appeared to take place on the average in about seven and one-half months in the hot process plant as compared with 10 months in the cold process plant.

### Conclusions

As a result of our general re-study of this whole problem and our experience in two recent outbreaks, as well as several isolated experiences we are able to draw several basic conclusions:

1. Chlorinated naphthalenes and diphenyls are in general highly toxic compounds and must be used with extreme care. Industrial hygienists should make every effort to see that such exposures are controlled, insofar as humanly possible. In this effort, we do not believe it safe to rely on limiting atmospheric concentrations but rather to depend on a maximum of maintenance and engineering control.

2. Toxic exposures may be more readily controlled where the cold or solvent method of impregnating cable is employed than where the hot process is used.

3. Of the known cases of liver disease in our experience, the available history and experience generally points to exposure to vapors or fumes from the hot process. There is no clear evidence in our experience although it is possible that skin absorption may produce systemic poisoning. Physiologically we see no reason why this is not possible. However, most dermatitis cases do not develop liver damage.

And finally, I should like to call attention to a group of recommendations which were agreed upon by all of the groups involved in the last outbreaks of poisoning as being of utmost importance in the control of this hazard.

### Recommendations

1. Unless there is a very good reason for using the hot method of impregnation, all new installations should use the cold or solvent method of impregnation with chlorinated naphthalenes and diphenyls. Where the hot method is now being used it should be changed over to cold, if possible, or surrounded with every known protective measure.

2. General hygienic measures should be followed but in no case should these be allowed to supersede engineering control of the primary source of the exposure, the operations in the plant.

The following hygienic measures may be considered good practice where these compounds are handled.

a—Two lockers for each worker exposed to chlorinated waxes (one for working and one for street clothes).

b—All work clothes above the underwear should be provided and laundered at least twice a week by the management.

c—The workers should change to clean underwear at the end of each shift before getting into their street clothes.

d—Supervised cleaning.

1—At noon the workers should remove clothing and scrub hands and face under supervision.

2—At the end of the shift they should be required to take a supervised shower before changing back to street clothes.

e—Protective skin creams or protective clothing should be provided by the management at the discretion of the foreman, nurse, medical, or plant superintendent.

f—All departments handling chlorinated synthetic waxes should be thoroughly cleaned according to a prearranged schedule. This should include the removal of all deposits of waxy material from the machines, floors and surrounding objects. Workers doing the



Attachment to No. 6 (b) and (c)

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cleaning should be provided with protective clothing and supplied air or organic vapor masks where exhaust ventilation is inadequate or not possible.

3. The foremen of all departments where this material is handled should be apprised of the toxic nature of the material and instructed in safe handling procedures. These men should make it their duty to check up on the workers in their departments and instruct them in safe practice.

4. Preemployment and periodic physical examinations should be made of all exposed workers. These should include the taking of a full clinical history with special emphasis on gastro-intestinal disturbances and dermatitis. In addition, the skin should be carefully examined periodically and the more reliable liver function tests performed. Gastro-intestinal complaints developing in a worker at any time should be a signal for an immediate medical check-up. A history of liver disease, jaundice, or antisyphilitic treatment should automatically exclude a worker from jobs involving a possible toxic exposure. Pregnant women should not be employed where there is a possible exposure to the synthetic chlorinated waxes.

# New Castor Derivatives Make Multi-Purpose Insecticide

CHEMURGY is giving increased impetus to the development of insecticides of domestic vegetable origin to supplant imported materials such as rotenone and pyrethrum that are now scarce or unavailable.

One of the more recent of these is a product made from the castor plant. Using extractives from the castor leaves and other portions of the plant, Woburn Chemical Corp. is now in quantity production on its insecticide, Spra Kast, which it claims will control a large majority of the insects that eat up our food crops. The insecticide is made in two types, 2-C for use on citrus fruits and 2-A for vegetables.

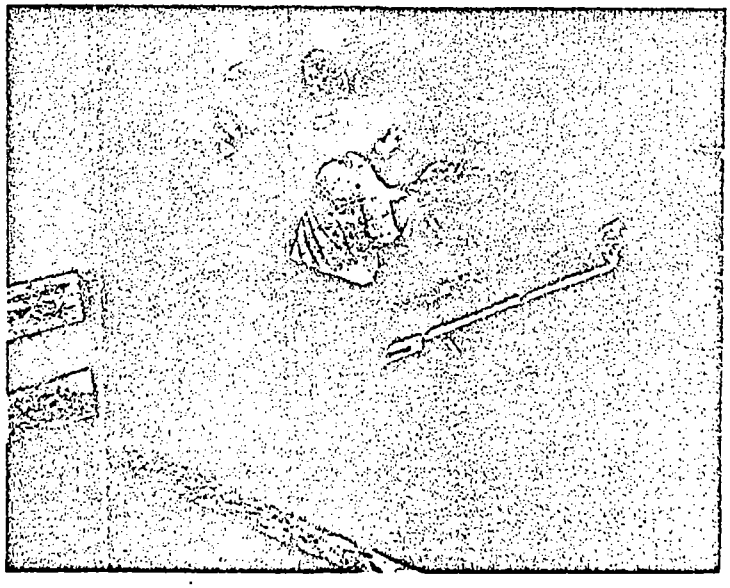
Type 2-A provides quick kill in addition to prolonged effectiveness, although on vegetables it is not necessary to provide the same degree of prolonged effectiveness because of the more frequent sprayings required to cover the continuous new growth. In combination with sulfur or copper, it has been used in commercial applications for the control of red spider, purple mite, six-spotted mite, rust mite, melanose and many soft-bodied worms infest vegetables. Particularly effective results have been obtained on net nacrosis on potatoes when in combination with neutral copper.

The castor extractives will not kill all insects. In some cases they act as a repellent, in other cases as a contact poison on sucking insects such as aphids, thrips, lice, mealy bugs, leafhoppers, and red bugs; they control chewing insects such as beetles, leaf rollers and caterpillars. The insects infesting beans, beets, cabbage, cucumbers, potatoes, spinach, tomatoes, melons, squash, lettuce, and peas have been reported controlled by the insecticide.

It has been somewhat difficult to determine chemically the exact nature of these castor extractives. Chemical literature does not provide laboratory techniques for such determinations. However, some interesting collateral benefits have been obtained from the use of these materials in insecticides. Which of the component parts produces this result is not known, but it was noticeable first in the orange groves of Florida, and later, on vegetables and fruit trees, that plants on which this spray has been used appear to be more vigorous and healthy than those on which some other insecticides have been used. Furthermore, it seems to accelerate the maturity of the crops. That may be due to enzymes from the plant, although it has not been proved. It is known, however, that the castor plants generate more enzymes than are needed for their own sustenance and growth and that this surplus of enzymes might be the explanation for the stimulation of growth, the healthy condition, and the acceleration of maturity in the crops on which castor insecticides are sprayed. Chlorophyl, which is another of the component parts of the spray, might add to these beneficial effects.

The Woburn Chemical Corp. has recently opened a new plant in Maryland for the production of castor insecticides. However, several factors prevent the development of this industry to meet all market requirements at the present time. The demands for castor oil in war production and the shipping difficulties encountered in bringing in the crops from Brazil and Mexico curtail the supply of available raw materials. The Commodity Credit Corporation has limited considerably the acreage of the castor bean crop in this country in its apportioning land area of crops to favor the edible grains which are of primary importance in the nation's wartime food problems. The curbing of supply results likewise from State Department adherence to provisions of the Reciprocal Trade Agreements, an important part of our good neighbor foreign policy, by which it attempts to keep the production of castor beans in the hands of South and Central American producers. However, the fact that the castor leaves cannot be shipped great distances in their natural state, since they begin to decompose very quickly after they are harvested, argues for a future crop production in this country sufficient to supply the leaves necessary for insecticide.

**Castor leaves being fed to chopper in first step in recovery of derivatives**





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# SAFETY MEASURES FOR USE OF CHLORINATED NAPHTHALENES AND DIPHENYLS IN INDUSTRY



*Article by Leonard Greenburg, M.D., Executive Director, Division of Industrial Hygiene*

The chlorinated naphthalenes comprise a group of chemical substances made by the addition of various amounts of chlorine to a naphthalene base. The amount of chlorine may vary from three to six or possibly more atoms providing compounds from trichlornaphthalene to hexachlornaphthalene.

In the same manner, the varying amounts of chlorine are added to a diphenyl base providing a group of compounds of varying chlorine content.

As a rule, the final substances, as used in industry, are mixtures of differing chlorinated naphthalenes. Earlier, these were, as a rule, possessed of a lower degree of chlorination and later on the compounds were usually of a higher degree of chlorination with varying amounts of chlorinated diphenyls added thereto.

These substances are not new. Perchlornaphthalene was used in Germany during the last war.

It is to be clearly understood that these groups of compounds are not manufactured by any one company but rather by approximately five in the United States and they are sold under varying trade names by the manufacturers.

The chlorinated naphthalenes and diphenyls are valuable industrial products. Because of certain properties which they possess, we may briefly state these valuable properties as follows:

1—Resistance to water and alkali.
2—High insulating value. They possess high dielectric constant.
3—Thermo plasticity.
4—Quite stable chemically.
5—Flame resistant.

For these reasons, these substances possess much value industrially in the making of electric condensers and in the insulation of wire and cable, etc.

## Method of Use in Industry

The chlorinated naphthalenes and diphenyls are used in industry by two methods.

1—A cold method in which the material is dissolved in a solvent usually a mixture of petroleum naphtha and toluene and,
2—A hot method wherein the material is rendered plastic by heat.

## Toxic Effects

The toxic effects of the chlorinated naphthalenes and diphenyls have been known for a long time. In the interval between 1899 and 1901, reports in both the French and German literature indicated an association between exposure to chlorine and acne and even though in some cases wax-like materials were a portion of the exposure, the general belief was that chlorine was more or less responsible for the acne. At the 1901 Congress of the German Dermatological Society, Herxheimer[1] pointed out that chlorinated hydrocarbons might be the etiological cause for the acne and in the same year Bettmann[2] stressed the possible effect of chlorinated hydrocarbons.

The first concise publication which definitely attributed the acne to chlorinated naphthalenes was a publication by Wauer[3] in 1918. This was followed on the continent by a number of confirmatory publications.

In the United States, Sulzberger[4] and his coworkers in 1934 reported three cases of acne from contact with "hot oils and waxes." Sulzberger did not specifically identify the chemical substances responsible for the production of the acne. In 1935, Schwartz[5] in a paper read before the American Public Health Association, described the typical acne form eruptions and attributed them to exposure to the chlorinated naphthalenes and diphenyls. This contribution was published in the American Journal of Public Health in 1936. Fulton and Matthews[6] of the Pennsylvania Department of Labor reported 101 cases of dermatitis due to chlorinated naphthalenes and diphenyls in a wire insulating plant. Jones and Alden[7] reported similar findings in the Archives of Dermatology and Syphilology in the same year.

In 1938, Mayers and Silverberg described acne-form skin eruptions in workers making electrical condensers.[8]

Space does not permit a discussion of the histology of these dermatological changes produced by this substance.

In general, it can be said with a fair measure of certainty that these changes are brought about in the skin, primarily by the contact of the skin with the vapors of these compounds or by actual contact with them in the form of solid or particulate matter. We have found, for example, that workers exposed to fumes have more acne than those exposed to dust alone and we have also found that workers exposed to the solid material or its particulate form have developed dermatitis. In this connection, the report of Fulton and Matthews is very interesting. They picture and describe a case of an infant, two and one-half years of age, who developed the dermatitis as a result of contact with the soiled working clothes of its father who was in the habit of playing with the child prior to changing his clothing.

More recently, Schwartz[9] has described cases of dermatitis among cable strippers employed at shipbuilding establishments and working with cables which had been impregnated with these compounds.

## Systemic Effects

In the United States, systemic effects in the form of acute yellow atrophy of the liver were reported by Flinn and Jarvik[10] in 1936 among men working with tetra and pentachlornaphthalene. These findings were verified by animal experimentation. In 1937, Drinker, Warren and Bennett[11] reported such liver changes among animals exposed to the material by inhalation and similar findings were obtained with the chlorinated diphenyl compounds. These latter authors also mention four non-fatal cases among humans and the three fatal cases previously cited by Flinn and Jarvik.

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I would like to cite two or three cases which we have encountered in our own experience[12] and which may be of interest from the point of view of duration of exposure prior to this type of poisoning. A girl 17 years of age was engaged in soldering electrical condensers which were impregnated with tri- and tetrachlornaphthalene for a period of approximately seven months. The autopsy for this case showed mild to severe degeneration of the liver and presented a clear picture of what is generally known as acute yellow atrophy. It was apparent in this case that the latter organ displayed areas of healing and new areas of pathology.

In the second case, a man 24 years of age developed jaundice after five months of exposure in the coating of wires with wax containing the higher chlorinated naphthalenes. He was away from work for a period of time and four months later the jaundice became quite intense with general malaise and loss of appetite. After two months more of work he was sent to the hospital where he rather rapidly passed away. The autopsy in this case showed extensive areas of necrosis and fibrosis of the liver with regeneration.

In a third case, published by Drs. Mayers and Smith[13] of the staff of the New York State Department of Labor, Division of Industrial Hygiene, an 13 year old girl became ill after five months of exposure in the soldering of electrical condensers. The waxes in this case were composed principally of trichlornaphthalene. She was hospitalized and recovered after a long and slow period of convalescence.

## Recent Industrial Experience

During the past year the Division of Industrial Hygiene of the New York State Department of Labor has conducted an investigation in two cable plants using chlorinated naphthalenes and diphenyls. In this investigation, many cases of dermatitis were found, and several deaths due to liver damage among workers in the industry.

The examination of workers in the two factories showed relatively few cases of enlarged liver—five in all, on palpation.

Comparison in these two plants showed a very much higher incidence of acneform dermatitis in one of the plants as compared with the other; namely 21 per cent as compared with 60 per cent, the former being in the cold process establishment and the latter being in the establishment employing the hot process only. The dermatitis appeared to take place on the average in about seven and one-half months in the hot process plant as compared with 10 months in the cold process plant.

## Conclusions

As a result of our general re-study of this whole problem and our experience in two recent outbreaks, as well as several isolated experiences we desire to draw several basic conclusions:

1—Chlorinated naphthalenes and diphenyls are in general highly toxic compounds and must be used with extreme care. Industrial hygienists should make every effort to see that such exposures are controlled, insofar as humanly possible. In this effort, we do not believe it safe to rely on limiting atmospheric concentrations but rather depend on a maximum of maintenance and engineering control.

2—Toxic exposures may be more readily controlled where the cold or solvent method of impregnating cable is employed than where the hot process is used.

3—Of the known cases of liver disease in our experience, the available history and experience generally points to exposure to vapors or fumes from the hot process. There is no clear evidence in our experience although it is possible that skin absorption may produce systemic poisoning. Physiologically we see no reason why this is not possible. However, most dermatitis cases do not develop liver damage.

And finally, I should like to call your attention to a group of recommendations which were finally agreed upon by all of the groups involved in the last outbreaks of poisoning as being of utmost importance in the control of this hazard.

## Recommendations

1—Unless there is a very good reason for using the hot method of impregnation, all new installations should use the cold or solvent method of impregnation with chlorinated naphthalenes and diphenyls. Where the hot method is now being used it should be changed over to cold, if possible, or surrounded with every known protective measure.

2—General hygienic measures should be followed but in no case should these be allowed to supercede engineering control of the primary source of the exposure, the operations in the plant.

The following hygienic measures may be considered good practice where these compounds are handled.

a—Two lockers for each worker exposed to chlorinated waxes (one for working and one for street clothes).

b—All work clothes above the underwear should be provided and laundered at least twice a week by the management.

c—The workers should change to clean underwear at the end of each shift before getting into his street clothes.

d—Supervised cleaning.

1—At noon the workers should remove outer clothing and scrub hands and face under supervision.

2—At the end of the shift they should be required to take a supervised shower before changing back to street clothes.

e—Protective skin creams or protective clothing should be provided by the management at the discretion of the foreman, nurse, medical, or plant superintendent.

f—All departments handling chlorinated synthetic waxes should be thoroughly cleaned according to a prearranged schedule. This should include the removal of all deposits of waxy material from the machines, floors and surrounding objects. Workers doing the cleaning should be provided with protective clothing and supplied air or organic vapor masks where exhaust ventilation is inadequate or not possible.

3—The foremen of all departments where this material is handled should be apprised of the toxic nature of the material and instructed in safe handling procedures. These men should make it their duty to check up on the workers in their departments and instruct them in safe practice.

4—Preemployment and periodic physical examina-



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tions should be made of all exposed workers. These should include the taking of a full clinical history with special emphasis on gastro-intestinal disturbances and dermatitis. In addition, the skin should be carefully examined periodically and the more reliable liver function tests performed. Gastro-intestinal complaints developing in a worker at any time should be a signal for an immediate medical check-up. A history of liver disease, jaundice, or antisyphilitic treatment should automatically exclude a worker from jobs involving a possible toxic exposure. Pregnant women should not be employed where there is a possible exposure to the synthetic chlorinated waxes.

5—Engineering control of plant operations cannot be over-emphasized but specific recommendations are not applicable to all cases. It would be wise for a plant using this class of materials to check their control measures with the State industrial hygiene agency, the insurance carrier and some competent consultant before occupational disease occurs.


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## DETERMINATION OF BENZENE IN THE PRESENCE OF TOLUENE, XYLENE AND OTHER SUBSTANCES*

By B. H. DOLIN, M.A.

Table II illustrates the results obtained with test solutions compared by the alternative visual method of standards comparison. A series of standards corresponding to the range of 1 to 10 per cent benzene with unit intervals was first used. The color was then reproduced simultaneously with several standards of concentrations with increments corresponding to 0.1 per cent of benzene varying from the standard most closely matching the test solution. Whenever the concentration of the test solution appeared to be greater than 10 per cent benzene, the test solution was diluted tenfold with alcohol, the color redeveloped, and the comparison repeated.

The determinations listed in Tables III and IV were made with the aid of the graph in Figure 3. The errors found when differences in readings between the five- and 15-minute intervals were considerable were greatly minimized by the use of empirically derived corrections. The correction applied in Table IV as well as the final results was multiplied by 10, since the test solutions were diluted tenfold. The formula used in computation for the series in Table III was benzene % = C − (B − A − 25) 0.005; the formula used for the series in Table IV was benzene % = 10(C − (B − A − 25) 0.005). C is benzene per cent corresponding to reading B on galvanometers. B and A are as given under "Procedure."

### Accuracy and Sensitivity

The presence of petroleum naphtha, ethyl acetate, butyl acetate, isobutyl alcohol, acetone, toluene, and xylene did not interfere with the determinations of benzene in the experiments tabulated. Reasonable accuracy, with a mean error of 1.6 per cent, was attained when the intensity of color produced was matched without the aid of a colorimeter. Greater accuracy was attained with the aid of a photoelectric colorimeter where a mean error 0.9 per cent for a similar range of concentrations was in evidence. Concentrations less than 0.2 per cent benzene could not be determined with the naked eye, whereas concentrations down to 0.01 per cent benzene could be determined by the use of a photoelectric colorimeter. The errors involved at concentrations less than 0.2 per cent benzene, however, were considerable and amounted to 10 per cent at 0.05 per cent benzene and more at lower concentrations.

The 10-ml. aliquot of solution used for color development represents 0.01 ml. of the sample of 0.50 ml. taken for analysis and diluted to 100 x 5. Since 0.01 per cent benzene can be detected, the method appears to be sensitive to $1 \times 10^{-6}$ ml. or $8.8 \times 10^{-7}$ g. of benzene. By visual comparison, in the absence of a photoelectric colorimeter or when an error above 1 per cent is not permissable, the sensitivity is reduced to $2 \times 10^{-5}$ ml. or $1.8 \times 10^{-6}$ g. of benzene.

The concentration of benzene vapor in air may be determined by the above method after the vapor has been transformed from the gaseous to the liquid phase. This may be accomplished by absorbing or dissolving the vapor in petroleum naphtha or alcohol. The concentration of benzene in the resulting solution may then be determined as prescribed. Without diluting the ether extract, but using the total nitrated material in alcoholic solution, $8.8 \times 10^{-7}$ g. or 0.27 p.p.m. may be detected on a sample of one liter of air. Concentrations of $1.8 \times 10^{-6}$ g. per liter of air or 5.6 p.p.m. may be determined with an error less than 1 per cent. By sampling 10 ml. portions of air, concentrations down to as low as $8.8 \times 10^{-6}$ g. of benzene per liter of air or 27 p.p.m. should be possible of detection. The significance of this may be realized when it is perceived that numerous samples of air may be taken in a comparitively short time and that many small portable containers may be used.

* Continued from page 376, September 1943 issue of *The Industrial Bulletin*.



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# Observations on the Toxic Effects Resulting from Exposure to Chlorinated Naphthalene and Chlorinated Phenyls with Suggestions for Prevention

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FOR over twenty years chlorinated naphthalenes have been extensively used for insulating wire and in the manufacture of certain electrical equipment. Chlorinated naphthalenes and chlorinated phenyls (sold under the trade names of Halowax and Arochlor) have marked electrical, heat and moisture resisting properties, and are practically non-inflammable. Their use in the manufacture and preparation of many types of electrical equipment has been tremendously increased, due to the enormous increase in the use of such equipment for the prosecution of this present world war.

In some mills hot concentrated Halowax is used to saturate wire insulation, while in other mills the compounds are dissolved in organic solvents, the solutions then being used cold to saturate the insulation. In both these processes the wet insulated wires are dried in drying tubes or ovens. During this drying process dangerous concentrations of chlorinated compounds are given off.

It has been known for many years that these compounds cause acne-like eruptions. In recent years serious systemic effects have been recognized. During the past year many cases of skin eruption and in addition six fatal cases of a peculiar type of subacute yellow atrophy of the liver have occurred among the workers in two wire and cable mills. At the request of the management of one of these mills and in cooperation with the Department of Health of Westchester County (N. Y.), one of the authors undertook an investigation of the mill in order to advise the management and the Department of Health as to means of prevention of the cutaneous lesions and systemic effects resulting from these toxic hydrocarbons. This mill used the cold process for saturating the wire insulation.

As the study progressed, it became apparent that the toxic lesions resulted from inhalation by men working in or near the drying ovens and also by some other method of absorption, presumably through the skin. This fact was clearly shown, because many of the acne-form eruptions occurred among the men operating the saturation baths and not exposed to the inhalation hazard. A few of the acne-form eruptions occurred among workmen handling the cold finished wire in a mill-room far removed from any possible inhalation

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hazard. Women working in the same mill rooms with the affected men showed no acne-form eruptions. None of these women handled the toxic substances.

An investigation was begun to determine what systemic effects would result from the administration of these substances to experimental animals by inhalation, ingestion and by surface application of the substances to the skin. This article describes pathological changes observed in man and experimental animals resulting from absorption of these toxic substances, and suggests means of preventing this absorption.

## Historical

Lehmann in 1919 *(1)* found that animals which were fed or which inhaled chlorinated naphthalenes lost appetite and at death showed peculiar lesions in the liver.

Flinn and Jarvik *(2)* in 1936 reported three cases of yellow atrophy of the liver occurring in three widely separated plants. Experimental studies on rabbits, using different compounds of chlorinated naphthalenes, indicated that the toxicity of these compounds increases with the increasing degrees of chlorination.

Flinn and Jarvik *(3)* later reported nine cases of yellow atrophy of the liver occurring in mills where chlorinated naphthalenes were being used to impregnate wire and other electrical equipment. They concluded that the cases of yellow atrophy of the liver occurring among the employees were probably due to exposure to chlorinated naphthalenes.

Drinker, Warren and Bennett *(4)* in 1938 described the morphological changes in the livers of rats exposed to chlorinated naphthalenes and chlorinated phenyls. These investigators administered the toxic substances by inhalation, feeding and subcutaneous injection. They found that the tri and tetra chlorinated naphthalenes produced only slight pathological changes in the liver, unless extremely high concentrations were used. However, animals exposed for six weeks to the higher chlorinated naphthalenes in low concentrations regularly showed marked liver damage, even though they gave no clinical evidence of such toxicity before death. The toxicity of each compound seemed directly related to its degree of chlorination.

Widespread liver degeneration can exist for several months without producing any evidence of ill-health in the animals, suggesting that the alterations take place slowly. Animals given a sublethal dose of chlorinated compounds, when given a very small dose of carbon tetrachloride immediately died, even though such a small dose of carbon tetrachloride given to a normal animal would not materially affect it. Exposure of rats to either higher chlorinated naphthalenes or chlorinated diphenyl results in a type of liver injury differing considerably from the liver lesions resulting from carbon tetrachloride *(5, 6)* and chloroform *(7)* poisoning.

The changes resulting from exposure to the compounds employed in their study involved all portions of the liver lobule, even though the initial morphological changes were more pronounced in the liver cells nearest the hepatic veins. The changes were degenerative in nature, first cloudy swelling then fatty infiltration and fatty degeneration. Complete disintegration of the cells with areas of necrosis finally resulted, regardless of the method of administration. This degeneration was characterized by accumulations of large amounts of acidophilic hyaline material. The characteristics of the liver changes produced can be markedly altered, quantitatively and qualitatively, by varying the degree of exposure. Blood examination during life revealed no significant abnormalities, and the injurious effects of these compounds were manifested solely in the liver.

The investigators concluded from their experiments that lower air concentrations must be obtained in the case of the more highly chlorinated naphthalenes and chlorinated diphenyls, than for trichlorinated naphthalenes, if a safe environment for workmen is to be assured.

Yarglou, Sands and Drinker *(8)* reporting on the ventilation of wire impregnating tanks using chlorinated hydrocarbons, showed that the requirements for the ventilation of such tanks varied greatly with the type as well as with the size of the tank. They suggest that an exhaust slot about 2 inches high extending along the full length of the tank with lateral ventilation was the most effective method of ventilating such tanks. For any given concentration of chlorinated naphthalene the degree of chlorination had no appreciable effect on ventilation requirements.

Greenburg, Mayers and Smith *(9)* in 1939 reported three cases showing the occurrence of similar pathological changes in the liver in three young adults known to have been working with chlorinated naphthalenes and diphenyls. They briefly summarized the systemic effects resulting from this exposure and made recommendations for prevention.

Drinker *(10)* in 1939 reported further observations on the possible systemic toxicity of certain of the chlorinated hydrocarbons. From this study he concluded that the permissible limit for air contamination with trichlor naphthalene was 10 mgm. per cu. m.; for tetra and penta chlor naphthalene, 1 mgm. per cu. m.; for penta and hexa chlor naphthalenes, 0.5 mgm. per cu. m.; and for the various chlorinated diphenyls 0.5 mgm. per cu. m.

Cleary, Maier and Hitchings *(11)* in 1938, reporting on the metabolism of chlorinated naphthalenes, stated that no significant storage of the material could be detected in lung, liver, skin or kidney, nor was any significant amount excreted in the urine. Both the rat and the dog apparently were able to remove and excrete the chloride promptly. A rise in the urinary ethereal sulphate fraction, but no significant change in the neutral sulphur excretion, was noted after chlorinated naphthalene feeding in the dog.

Riley *(12)* in 1943 stated that poisoning may result from inhalation of vapors, from prolonged skin contact with the vapor, liquid or solid phase, and from ingestion of the chlorinated material.

Cranch *(13)* in a recent personal communication to one of the authors, stated that the effect of these waxes on the skin resulting in the appearance of acne is not determined by the presence of chlorine alone, but is due rather to the compound effect of chlorine and a tar derivative. No such marked tendency to acne formation results from exposure to chlorinated petroleum derivatives, such as chlorinated paraffin. When chlorinated naphthalene is combined with chlorinated diphenyl, a more active acne is produced. Liver damage is not likely to occur following exposure to chlorinated naphthalene alone, but may occur from exposure to chlorinated diphenyl combined with chlorinated naphthalene or other tar derivatives. The severity of the acne is not correlated in any way with the degree of liver damage which might occur.

Cranch suggests that other factors are probably in-



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volved in the cases showing liver damage besides exposure to chlorinated waxes alone. The important point brought out in this communication was the fact that skin reactions with acne formation have been noted in men handling only the finished product, with no appreciable vapor exposure. As far as he knew, no liver cases had been attributed to skin absorption. He suggests that the absorption of these materials through the skin is very slow as compared with inhalation absorption.

Cranch also suggests that prevention depends first on the greatest possible reduction of vapor exposure and skin contact; second, on protection of the skin by means of cold creams and adequate bathing.

## Toxic Effects in Men Resulting from Exposure to Chlorinated Naphthalenes and Diphenyls

It has long been known that chlorinated naphthalenes and diphenyls are skin irritants. The lesions have been described by Schwartz *(11)* and others. The effects are first noted on exposed parts—either from fumes or from direct contact with the chemicals. Contamination of clothing results in more generalized distribution of the irritant effects. In workers with greasy skins and hypertrophied sebaceous glands, the effects are more frequent and prompt. After exposure of about six months, few workers fail to develop lesions.

The skin affection usually begins as a generalized folliculitis. Occasionally there is diffuse pigmentation of the skin of exposed areas. Later comedones, acne-like pustules and sebum cysts develop. These latter lesions tend to be chronic and on healing may leave permanent scars. Generalized papulo-pustular eruptions have been described. In the cases observed in this mill the skin lesions have been confined to the extensor surfaces of the arms, the back of the neck, the mandibular surfaces of the face, and along the hair margins. The lateral surfaces of the thighs have frequently been involved.

In addition to the skin lesions, symptoms of systemic poisoning have appeared in some workers. The first complaints are digestive disturbances, burning of the conjunctivae, and in some instances sexual impotence and haematuria.

It is not known just how frequently fatal poisoning results from absorption of these chemicals. It is worth noting, however, that six workers, formerly employed in these two mills, have been studied post mortem. One of the post mortems was performed by one of us and the other five by pathologists in this industrial area. We have had the privilege of examining the pathological material from some of these necropsies. In these six cases, death was in every instance due to subacute liver necrosis.

Since subacute liver necrosis is an uncommon disease and since all six workers had been exposed to absorption of the chemicals in Halowax and Arochlor, it is logical to suppose that these chemicals were the cause of the liver necrosis. In all these cases the livers were much reduced in size. Their weights ranged from 400 grams to 1100 grams. A review of the pathological changes in the autopsy material shows nothing of much significance, except in the livers. The hepatic lesions varied in character and intensity in the different cases, apparently depending upon the susceptibility of the different subjects, or possibly upon the length of time of exposure to the toxic agents.

All the livers were markedly distorted in shape, coarsely granular and mottled in yellow and red. For the most part they were very firm, although some showed large soft red areas. On section, their cut surfaces varied from mottled yellow and red with scattered necrotic areas to large yellow-gray areas showing small necrotic centers. In our case, there was a complicated melange of liver necrosis and cirrhosis. In all of the cases, however, there were large areas of degeneration and necrosis. The distinctive feature of this chemical intoxication is, clearly, liver necrosis. The cirrhosis and scarring are apparently attempts at repair.

In the autopsy material it is difficult to determine what portion of the liver lobule is primarily affected. In some the whole lobule is involved, while in others the lobules are so deformed that definite localization is impossible. In general, it appears that in the more acute cases, necrosis of the liver cells is the prime feature. In the more chronic cases the liver necrosis was complicated by scarring repair and regeneration of liver lobules.

## Experimental

*Materials employed:* In the animal experiments which we have conducted, the chemicals used were those regularly employed in and supplied to us by the mill for this purpose. They were Halowax and Arochlor in concentrated state and dissolved in naphtha and troluoil. The effects of the solvents alone (naphtha and troluoil) were also studied. In these experiments white mice, guinea pigs and rabbits were employed.

Three routes of introduction of the chemicals have been used—*viz:* by inhalation, by ingestion and by application to the skin. The first two avenues of absorption have been extensively investigated by other workers, but to the best of our knowledge there has been no systematic study of the systemic effects of skin absorption of these chemicals. Observation at the plant leads us to the conclusion that the skin is an important avenue of absorption of these chemicals. Therefore we have in our experiments directed particular attention to this mode of absorption. The inhalation and feeding experiments which we have carried out have conformed to the methods outlined by Bennett, Drinker and Warren *(4)*. They have proven useful, as controls, in gauging the importance of lesions produced by skin absorption.

The skin absorption experiments were performed for the most part with rabbits. Approximately 9 square inches of the hair on the backs of a series of rabbits was removed with clippers, the remaining hair shaved off and the resulting small skin abrasions allowed to heal for three days. These experimental animals were kept in cages alongside normal control rabbits. ½ ml., 1 ml., and 1½ ml. of diluted Halowax and Arochlor, containing 0.8 grm. dry Halowax per ml. and 0.6 grm. Arochlor per ml., respectively, was dropped on the shaved areas by means of a calibrated syringe. After allowing the chemicals to partially dry for about five minutes, the animals were returned to their cages. The substances were administered daily, in the above-described manner. Because of possible criticism that some of the chemicals might have been absorbed by ingestion or inhalation, this entire series of experiments was duplicated, following the same procedure cited above, but with the precaution of covering the application areas with molded celluloid guards.



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These celluloid guards were made by cutting and bending sheet celluloid into proper shapes and binding their sharp edges with adhesive tape. After each daily skin application the guards were replaced and firmly strapped in place with adhesive tape passing completely around the animals' bodies. This procedure, we believe, precluded any possibility of inhalation or ingestion of the toxic substances. In no instances were the guards removed or loosened by the animals' movements in their cages. To avoid skin irritation the inner surfaces of the guards which might come in contact with the skin were coated with vaseline.

A third series of skin absorption experiments was conducted in a similar manner, except that before the daily skin applications were made the shaved areas were covered with a thin layer of Protek. This substance is a cheap and apparently efficient type of cold cream used by mill workers.

After experiments with naphtha and troluoil alone, extending over four months, no animal showed any skin lesion resembling those caused by Halowax or Arochlor, either by inhalation, ingestion or skin absorption, and no animal died of whatever mild effects these substances might have caused. We therefore felt that the acne and the systemic effects observed in the remaining experimental animals could not have been caused by either naphtha or troluoil. The results of all three methods of absorption with both chemicals showed essentially the same type of skin lesion and liver necrosis. It was found that the rabbits were more uniform in their reactions, and the dosage could be more easily evaluated. Therefore, all the last experiments were made on rabbits. The extent of the skin lesions and liver necrosis depended on the size, frequency and number of inoculations.

Animals inoculated with large doses every day, whether by inhalation, feeding or skin absorption, died before definite liver necrosis developed. Animals inoculated with moderate and small daily doses lived for longer periods, and at necropsy showed skin lesions and subacute yellow atrophy of the liver, simulating the lesions observed in man. Animals sacrificed after a short series of small doses, showed slight to moderate degrees of liver degeneration, evidenced by fatty infiltration.

Four to five days after the first dose of chemical was dropped on the skin, all regrowth of hair was completely destroyed. The skin became markedly reddened, small papules and blisters formed, and finally the external epidermal layers desquamated. Some pustular lesions developed which were very similar to those seen in man. On necropsy, the livers of the animals were the only viscera showing any definite changes. The animal livers varied in appearance. Externally they were mottled in red, yellow and brown. They were finely to coarsely granular, and showed no marked abnormality in size. On section, the livers of the animals receiving the smallest dosage showed only a change in color, being more or less diffusely yellow with no gross evidence of necrosis. In animals receiving larger or more numerous doses of the toxic substances, there were opaque yellow areas of necrosis scattered throughout the liver substance.

The lesions were definitely degenerative in type, ranging from moderate degrees of fatty degeneration to marked hepatic degeneration and necrosis. Those resulting from skin absorption of Halowax and Arochlor were essentially identical to the lesions produced by inhalation of these substances. The rabbits treated with Protek before application of the chemicals to their skin, were partially protected and the chemical absorption retarded. There were similar but milder skin and liver lesions. Normal control animals kept in identical environment as the experimental animals developed no skin lesions and showed no fatty degeneration or liver necrosis at autopsy.

## Methods Recommended to Safeguard Workers Exposed to Chlorinated Naphthalenes and Diphenyls

The first step taken should be the formation of a working committee consisting of the superintendent, the chief engineer, the chief chemist and the consulting or plant physician of the mill. This committee should formulate practical changes, wherever found necessary to as far as possible protect the workers from the hazards of these toxic compounds. Because of the urgent need for these critical war materials, no changes should be advocated which will in any way slow down or prevent the greatest possible productivity of such important mills.

Protection must consist of prevention from inhalation, ingestion and skin absorption of these chemicals. Skin absorption, while long recognized as causing acne-form eruptions, has not in our opinion received proper consideration from the standpoint of systemic effects.

Toxic effects from inhalation are without question the most important because of the speed of absorption and the probable high dosage of toxic substances absorbed. Therefore, adequate ventilation is the primary consideration in any mill. The mill rooms and mixing house should be ventilated by intake and exhaust fans of sufficient volume and velocity to remove the majority of the fumes.

The drying tubes and drying ovens should be adequately ventilated and sealed as nearly air-tight as practicable. To accomplish this, large intake vents should be placed near the floor in the doors of the drying ovens. Large high-velocity exhaust fans and an adequate number of large exhaust stacks leading up above the roof of the mill should be installed. After the steam in the drying ovens has been turned off, fresh cool air from the mill room should be pumped through the ovens for a sufficient time, in sufficient volume and of a velocity of approximately 2000 cub. ft. per minute, to bring down the temperature of the drying ovens to that of room temperature, before opening their doors to unload.

Daily analysis should be made of the air in these ovens. They should not be opened for unloading until chemical analysis reveals less than 0.5 mgm. of chlorine, expressed as Halowax or Arochlor, per cubic meter of air. The drying tubes surrounding the wet impregnated cable should be ventilated by suction applied at the far end of the tubes. The air flow through the tubes should be sufficient to cool the saturated cable to a temperature at which no significant amount of vapor is given off from the cable after it leaves the drying tube.

The impregnating vats should have permanently hinged covers fitted with flanges that extend downward inside the tank, to avoid soiling the outside of the tank from dripping. These vats should be completely enclosed in a ventilation hood, with a hinged door in front. These hoods should be ventilated through a properly constructed lateral exhaust ventilation system. Yarglou, Sands and Drinker (8) recommend an ex-



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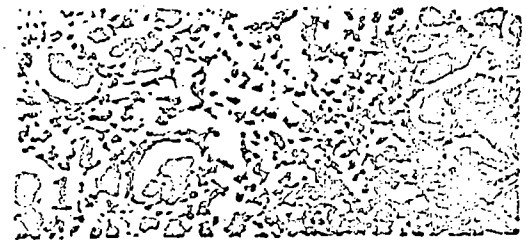
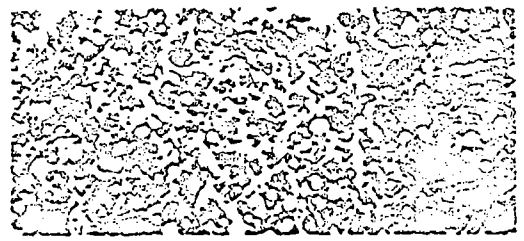
near slot approximately 2 inches high extending along the back, the full length of the tank, placed approximately 6 inches above the level of the liquid wax in the impregnation vat. Various speeds of exhaust should be tried until the proper speed is indicated by chemical analysis of the air in front of each hood.

In the cold process, Halowax and Arochlor are dissolved or diluted with solvents in mixing vats. The Halowax and Arochlor should be introduced into these vats with as little manual handling as possible. The vats should be kept covered at all times with a hinged cover, except when actually being filled. The workmen should not be allowed to place their hands inside these vats, even for taking the specific gravity of the mixtures. This can easily be accomplished by a long-handled glass thief introduced through a small opening in the cover of the tank. The specific gravity should be observed outside the tank, after removing the thief. The chemicals should be pumped outside of the mixing house to a loading platform through permanent pipes fitted with proper gate valves. Such pipes should be connected by proper couplings to tank trucks.

The tank trucks filled with the chemicals should then be driven to the felting mills, where they are emptied into conveniently located distribution tanks. The chemical compound should then be pumped or fed by gravity from the distribution tanks to the impregnation vats through appropriate sized pipes, not less than 2 inches in diameter. Separate lead pipes should extend downward to the vats from the main feed lines. Each pipe, just before it empties into the impregnation vats, should have a gate valve the full size of the pipe and of simple design so that it cannot become clogged by the mucilaginous fluid.

After the fluid chemical in the impregnation vats becomes contaminated by too much asbestos debris, the sludge remaining in the tank should be exhausted through exhaust pipes at least 4 inches in diameter, connected at or near the bottom of each impregnation vat. Such exhaust pipes should be attached at an angle leading out from the back of the vats and extend into receiving sludge vats with a simple gate valve the full size of the pipe placed near their lower ends. The remains of the asbestos sludge, which does not flow





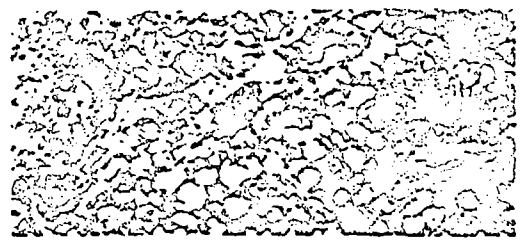


*FIG. 1—Human Liver: Late effects of liver necrosis. Bile ducts and capillaries, no liver cell regeneration.*

*FIG. 2—Human Liver: Right half of the field shows destroyed liver lobules without repair, the left half of the field shows regenerated and degenerating liver cells.*

*FIG. 3—Rabbit Liver: Effects of skin absorption of Arochlor—moderate dosage—half of the liver cells are opaque and granular, the other half contains large fat droplets. The darker areas are haemorrhage.*

*FIG. 4—Rabbit Liver: Effects of inhalation of Halowax—18 doses—showing complete liver necrosis.*

*FIG. 5—Rabbit Liver: Effects of skin absorption of Halowax, showing complete liver necrosis.*

*FIG. 6—Rabbit Liver: Effects of skin application of Halowax after application of Protek, showing partial liver necrosis.*



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through the pipes, should be scraped out of the vats and pushed into the sludge vats by means of a long-handled square-ended steel paddle. If the exhaust pipe should become clogged by the thick mucilaginous substance, a 4-foot long steel push rod with a 3-inch flat bell at its end should be used to push the obstructing sludge into the receiving vat. Both the paddle and the push rod should be stored in a vertical metal container.

The sludge vats should be of the correct capacity to receive the largest amount of sludge that may be exhausted into them, and of appropriate height and diameter, so as not to obstruct the passage ways. All such vats should be interchangeable. The tops of these vats should be constructed so that their entire top, with the exception of a 1-inch overhang rim, is open. A slide sleeve should be placed in this overhang rim. A strong metal sliding cover should be provided for each vat. An opening to receive the metal pipe should be placed in the slide cover, fitted with an angle extension to receive the solid 4-inch pipe from the saturation vat.

After the sludge vats have sedimented for an appropriate time, the good fluid Halowax should be pumped into receiving tanks through a pipe containing a glass observation window. After all the good chemical has been removed from the sludge vats, the remaining sedimented sludge should be dumped into burial ditches by placing the vats in an automatic dumping machine, so that no hand will have to touch the edges of the vats. The vats should not be cleaned out until their inside surfaces become covered with too much hardened chemical. The hardened sludge is then softened with an appropriate solvent and scraped off the sides of the vats with a long-handled square-ended steel paddle.

Elbow-length, thin, impermeable gloves should be used by the men when they adjust the nuts and screws of the mechanism in the vats. They should be taken off immediately, when the men have finished the job, to avoid excessive perspiration. The outsides of the impregnation vats should be frequently washed down with a proper solvent, to keep them free from the toxic chemicals.

After the above recommendations have been followed out, the personal factor has been almost completely eliminated. Clean working clothes, consisting of long-sleeved overalls fastened at the neck and wrists, should be provided. These clothes should be laundered frequently, daily if possible.

All eating of lunches, etc., should be forbidden in the workrooms. Candy, cigarettes, chewing gum and other ven[illegible] of such nature should be placed in rea[illegible] should be provided for the work-em[illegible]

[illegible] and shower baths should be in[illegible] workmen coming to work leave the[illegible] the outside locker room and pass through the shower room to the inside locker room, where they put on their clean work clothes and cover their hands, faces and necks with some type of cold cream or skin lotion. They should then be checked out by a checking system before they are allowed to go into the mill. When leaving work for lunch, they should be checked back through the inside locker room, where they should thoroughly wash their hands, faces and necks with soap and water before going to lunch. If they are going home they should also check through the inside locker room, where they leave their soiled clothes, take a complete hot soap shower bath (therefore sufficient shower baths should be provided) and are then checked out to the outer locker room. Here they put on their street clothes. This not only protects the workmen, but also their families, as it has been shown (*14*) that wives handling and washing such clothes and children playing with their father while he was wearing the soiled work clothes acquire the same type of skin lesion as the workmen themselves.

All new workers should be examined by the mill physician, and all men and women with a history of previous jaundice, liver diseases or skin diseases should be rejected or should be placed in departments where toxic substances are not handled. All workers in the mills where cables saturated with chlorinated naphthalenes and phenyls, whether wet or dry, are handled, should be periodically examined for skin lesions and systemic effects. No women who are pregnant should be allowed to work in these rooms, as they are notably very susceptible to liver toxemia. All workers in these mill rooms and all new employees should have frequent periodic laboratory tests made to determine whether or not any liver disfunction is present. Such laboratory examinations should include Hanger's Cephalin-cholesterol flocculation test, bilirubin content of the blood serum, and icteric index. If any one of the three show results exceeding the normal limits, the worker should be re-tested within one week and if such abnormality persists or increases such workman should be removed from this toxic hazard at once.

As it is a known fact that other conditions, such as gastro-intestinal upsets, etc., may cause one or more of these tests to show transient moderately abnormal findings, the first test should not be considered conclusive, nor should such workmen be barred from their work until such abnormal findings persist or increase.

At present the New York State laws relating to health in industrial plants are placed under the jurisdiction of the State Department of Labor and the local health department. Where a county health department has been established or where a properly functioning city department exists most of the health hazards in industry could be handled more readily by the local department than by the state. This is due to the fact that the state has but few employees to cover a large area, while the local health department is immediately available and often more familiar with local conditions and hence able to keep in closer contact with the industry and over a long period of time if necessary.

Laws should be passed making it necessary for medical directors of industrial plants to report at once all toxic disease conditions relating to industrial employment directly to the local health department, who would then make an investigation of existing conditions and, if possible, arrive at the solution of the difficulty, then make the necessary recommendations to the industrial plant, also furnishing the State Department of Labor a report of the investigation and the recommendations made. In cases where the investigation discloses that more extensive work is needed or the services of specialists required, the Department of Labor should then be called upon to complete the work. In this manner the state could be saved considerable time and trouble and be able to devote itself to more intensive work in other plants where its services were more urgently needed.

The responsibility for the enforcement of the laws relating to protective measures in industrial plants should be placed upon the local health departments



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In localities where no competent or responsible health department exists, the investigation and enforcement should be made by the Department of Labor.

At present in Westchester County there is a sanitary code established by the County Health Department which covers the regulations relating to food handling, food inspection, dish washing, management of cafeteria in general, together with sanitation and water supplies. These regulations are enforceable by the County health authorities and are in addition to those covered in the state sanitary code.

Only by compulsory reporting of all toxic industrial conditions and the cooperation of the state and local departments with the industry can these conditions be eliminated. The plant management must be assured that the aim of such procedures is to aid them and that production will not be interfered with.

## Discussion

For over twenty years reports have been published dealing with the toxic hazards of chlorinated naphthalenes. Every one agrees that definite systemic effects can occur from inhaling or ingesting these toxic substances. There is also general agreement regarding the acne-form eruptions that are caused by skin contact to them. To our knowledge no one has stressed the importance of the systemic effects caused by skin absorption.

Therefore this publication is primarily concerned with the systemic effects caused by skin absorption. It is very difficult in humans to prove that systemic effects occur from skin absorption, because the workmen quite naturally are subject not only to skin absorption but also to the hazards of ingestion and inhalation. Workmen in mills far removed from inhalation hazards and working only with the cold finished impregnated wires and cables, have in many instances acquired acne-form eruptions due to these chlorinated naphthalenes and chlorinated phenyls. None of these workmen, as far as we can ascertain, have shown recognizable systemic effects due to their absorption. This is understandable, as we know that liver function tests only show definite results when an appreciable liver degeneration has occurred. None of the six fatal cases showed any evidence of jaundice or other systemic effects until a few days to a week before hospital admission. They were in contact with these toxic substances for periods ranging from two months up to nine months. They all died within one to three weeks after hospital admission.

All of our experimental animals showed definite liver degeneration or necrosis in varying degrees, whether or not they were protected by Protek, when liquid chlorinated naphthalene or diphenyl was administered by dropping it on their shaved skins. Every precaution possible was taken to safeguard these animals against the toxic effects of inhalation and ingestion.

Parallel experiments were conducted by inhalation, by feeding and by skin absorption. All three series of animals showed the same type of liver degeneration. The difference in liver lesions found depended entirely on dosage and number of inoculations. During these experiments, none of the animals showed recognizable systemic effects until a few days before death. The animals killed during the course of the experiments showed no recognizable effects. Every animal killed showed some degree of liver degeneration. Normal control animals showed no liver lesions.

The experiments cited indicate that chlorinated naphthalenes and diphenyls cause systemic effects in animals whenever they absorb these toxic substances, whether by inhalation, ingestion or skin absorption. It would therefore seem probable that if experimental animals react in this way, man will also.

Because of the aforementioned facts, recommendations were made to the mill and were to a great extent followed out. For the past five months, not one single case of skin eruption or systemic disease, attributable to these toxic compounds, has occurred in this mill. Two deaths and between fifty and one hundred cases of acne-form eruptions occurred in this mill within the previous six months, before these changes were instituted. Therefore, the practical evidence would seem to indicate that if the above recommendations are carried out workmen will be almost completely protected. The cost of such changes will be quickly absorbed by the saving in man-hours, lowering of insurance rates and greater efficiency of the workers. The relations of the workers towards the management must of necessity be vastly improved.

## Summary


1. Studies concerning the toxic effects of chlorinated naphthalenes and diphenyls on experimental animals are reported.

2. These studies were undertaken because of the occurrence of acne-form eruptions and deaths among workmen in two wire and cable mills where these compounds were being used.

3. The compounds experimentally studied were administered to animals by inhalation, ingestion and skin absorption.

4. Liver degeneration in experimental animals is caused by skin absorption of either chlorinated naphthalenes or chlorinated diphenyls.

5. Histological examination of the viscera of these experimental animals showed that important toxic effects are manifested only in the skin and liver.

6. The liver degeneration has been described and illustrated.

7. The degenerative effects in the liver have been shown to be essentially identical regardless of whether the toxic substances were administered by inhalation, ingestion or skin absorption.

8. Methods are recommended to safeguard workers in mills using these toxic compounds.

9. Laws should be passed making it compulsory for all mills using toxic chemicals to adequately safeguard their workmen from such toxic hazards.

10. Inspection of the plants and authority to enforce protective measures should be placed under the Department of Health.


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## Reanite Bonding Process

A NEW method of bonding natural or synthetic rubber to metal, or plastics to metal, recently announced by the U. S. Stoneware Company, Akron, Ohio, manufacturers of Tygon synthetic materials and corrosion-resistant equipment, is reported to not only do away with costly brass plating processes, but to develop a bond from three to five times as strong. The new method, known as the Reanite Bonding Process, develops a bond between rubber and metal ranging from 900 lbs./sq. in. to as high as 1200 lbs./sq. in. on a pull test. This compares with bonds ranging from 250 to 400 lbs./sq. in. obtained by present methods.

While the bond develops its maximum strength at room temperatures, its strength over a range of —40°F. to as high as 300°F. is said to be substantially stronger than bonds obtained by conventional processes. A national independent research laboratory, using methods similar to those specified by ASTM, reported as follows: "Discs of rubber, half an inch thick, were vulcanized between two steel discs, two square inches in area, which had been cleaned and coated with Reanite cement. The direct pull necessary to tear the assembly apart was then determined (a) at room temperature, (b) immediately after immersion in boiling water for five minutes, and (c) after heating for 30 minutes in an oven at 300°F. The following figures are typical of tests made during the year, although in a considerable number of cases still higher figures were obtained."

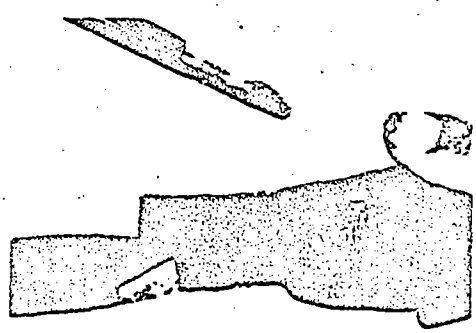
TEST OF BOND SEPARATION

| *Hardness of Rubber* | *Strength of Assembly (in pounds)* | | |
|---|---|---|---|
| *(Shore)* | *Room Temperature* | *212 F* | *300 F* |
| 50 | 1885 | 565 | 300 |
| 60 | 1912 | 502 | 367 |
| 50 | 1890 | 560 | 312 |

The Reanite Bonding Process is suitable for bonding natural or synthetic rubber, or plastics, to almost all metals, iron, steel, stainless steel, magnesium, aluminum, aluminum alloys, copper, bronze or brass. The accompanying illustration shows a test sample of aluminum, 5¾ in. long by 1¼ in. wide by 1/16 in. thick bonded to tire tread rubber ¼ in. thick. The rubber was cut away from a portion of the aluminum strip, and conventional line-pull tests were applied. Standard specifications call for such an assembly to withstand a direct pull of 19 pounds. On this test no separation of the bond occurred under pulls well above 300 pounds.

The process is simple in application. The surfaces to be joined are brushed, sprayed or dipped with Reanite. After being permitted to dry for an hour the surfaces are joined and the unit vulcanized by any of the conventional methods. It may also be used to bond metal to metal, or leather or wood to metal or to each other. The bond—metal to metal—ranges from 1,000 pounds to as high as 3,000 lbs. sq. in. on a combined shear-pull test. On bonds formed between synthetic rubber and metal, plastics and metal, or wood and metal, the materials themselves gave way before the bond.

The Reanite joint is unaffected by fresh or salt water, is non-corrosive to metals, possesses excellent corrosion-resistance in itself, and has high dielectric strength. While Reanite is formulated through cyclic modifications of materials high on the critical list, it is available for immediate shipment for essential end-uses. Present applications include fabrication of airplane assemblies, motor mounts, sound and vibration dampeners, instrument mounts, composite metallic and plastic units, and tank lining assemblies.



*Test sample of aluminum, 5¾ in. long by 1¼ in. wide by 1/16 in. thick, bonded to tire tread rubber ¼ in. thick, by the Reanite Process. In the test (see text) no separation of the bond occurred under pulls well above 300 pounds.*



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# HAZARDS IN INDUSTRIAL USE OF CHLORINATED NAPHTHALENE AND DIPHENYL



*Article by Edward C. Riley, M. D.,*
*Division of Industrial Hygiene*

Rapid industrial expansion for war has provided increasing opportunities for industrial poisonings from certain toxic chemicals. A recent increase in cases of occupational dermatitis, "chloracne," and acute or subacute yellow atrophy of the liver, has been attributed to compounds in the chlorinated naphthalene and diphenyl group, commonly sold under the trade name of "Halowax"* and "Aroclor." For this reason, a brief resume of the uses, potential health hazards, and control measures is presented at this time. Cases of injury to the health of workers from exposure to these substances, have been reported upon, from time to time, in the past by the Division of Industrial Hygiene.

## Properties and Industrial Uses

The increased use of these compounds in industry is dependent primarily on certain physical and chemical properties which make them suitable for diverse applications. The lower chlorinated compounds are viscous fluids whereas the higher chlorinated compounds are resinous or waxy solids at room temperature. The most highly chlorinated waxes are almost insoluble but the liquid and resinous products are soluble in most of the common organic solvents, thinners, and oils. As a group they are resistant to the actions of water and alkalies; do not oxidize and will not support combustion; are good electric insulators with high dielectric constants, and remain permanently thermoplastic.

At present most of the material produced in this country is used by the electrical industry to impregnate cable coverings and radio condensers. In certain lacquer and varnish finishes the material is used in small amounts as a plasticiser. Some of the compounds may also be used in mold lubricants, high pressure cutting oils, fire resistant fabric coatings, plastics, and in synthetic rubber substitutes. New uses for these materials are being sought continually and new applications may be introduced at any time.

Many compounds sold under a variety of trade names contain high percentages of these materials and the user may have no knowledge of the composition and potential health hazards. Experience has shown that wherever these compounds are handled without adequate control measures, industrial disease has resulted.

## Chemical Composition and Toxicity

Napthalene which has been widely used in moth balls has the formula $C_{10}H_8$. Diphenyl, $C_{12}H_{10}$ which is made by combining two molecules of benzol, is similar to naphthalene but has no common use. Chlorine can be made to replace any number of hydrogen atoms in either of these compounds. In general, the more chlorine atoms introduced into the compound the greater the toxicity. On the other hand the volatility and solubility decrease with an increase in combined chlorine.

*"Halowax" is an ambiguous designation because the Halowax Corporation manufactures substances other than the chlorinated naphthalenes and diphenyls.

## How Poisoning Occurs

Poisoning may result from inhalation of vapors or fumes; from prolonged skin contact with the vapor, fume, liquid or solid phase; or from ingestion of the chlorinated material. In industry these compounds are handled in several ways: In some plants the material is melted in a heated tank where it may be used to saturate electric products or mixed with other compounds to form plastics or protective coatings. The hot melt gives off vapors and fumes which are very toxic and must be removed from the atmosphere by efficient exhaust ventilation. In other cases the compound is dissolved in organic solvents at room temperature. The solution may be used to saturate electrical products or mixed into compounds used for waterproofing and flameproofing fabrics. It is usually necessary to drive off the solvent in a drying oven before the product is completed. During the drying process dangerous concentrations of chlorinated compounds may be driven off along with the solvent, and ovens should be adequately ventilated with fresh air. In the manufacture of electrical condensers, there is also exposure to the fumes released when leads are soldered on to impregnated condensers, as well as skin contact with the cold wax.

## Manifestations of Disease

Two distinct manifestations of industrial exposure may be seen. The fumes, as well as prolonged contact with the cold substances, may cause a diffuse eruption of small pimples and sometimes a dark pigmentation of the skin of the exposed areas. When the compounds penetrate or soil the clothing, they may cause similar lesions on the covered parts, the shoulders, arms, abdomen, back, thighs and legs. The lesions begin as small comedones or pimples and may develop into cysts under the skin; some of these may become secondarily infected and go on to suppuration. The pustules resemble acne vulgaris and heal slowly often leaving permanent scars.

A second, less frequent condition which may result from industrial exposure is toxic destruction of liver substance. This indicates systemic poisoning which may result from inhalation of vapors or fumes, from absorption through the skin, or from ingestion. Whenever chlorinated naphthalenes or diphenyls are absorbed into the system, the liver is the organ most affected; however, other vital organs may be damaged when the exposure has been great and poisoning severe. Frequently liver damage is detected only after months of exposure when the patient has developed jaundice and is seriously ill.

## Warning Signs

The appearance of a skin rash with pimples and pigmentation of the exposed areas in a formerly clear skinned person is often the first indication of an industrial exposure. The condition may develop soon or after months or even years of exposure to or contact with these materials and is difficult to clear up as long as the exposure remains. The exact



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relation of the rash to systemic poisoning is not known but it is known that they are both manifestations of exposure to these chlorinated compounds, and that most persons suffering from skin eruptions do not develop systemic poisoning.

The symptoms which should make one suspicious of systemic poisoning are: Lassitude, loss of appetite, loss of weight, restlessness, headache, nausea, vomiting, intestinal cramps and jaundice. Jaundice may be one of the first signs or it may not be observed until the patient has been driven by other smptoms to see a doctor. Whenever it occurs it is an indication that serious liver damage has taken place and competent medical advice should be sought at once.

### Preventive Measures

*Mechanical:*

1—Where possible impregnating machines and drying ovens should be completely enclosed and a negative pressure maintained to prevent leakage out.

2—Where this is not possible, sufficient exhaust ventilation should be provided to control vapors and fumes at the point of generation.

3—Provision should be made for cleaning all machinery and buildings periodically to prevent accumulation of deposits and secondary exposures. This should be done only by experienced crews with adequate personal protective equipment.

*Medical:*

1—Pre-employment and periodic medical examinations should be provided for all workers exposed to chlorinated naphthalenes and diphenyls. A history of liver disease, jaundice, or anti-syphilitic treatment should automatically exclude a worker from jobs involving a possible toxic exposure. Pregnant women should not be employed for this type of work.

2—Workers should be encouraged to report all skin conditions and other signs of injurious exposure to the plant management and their family physicians.

3—Skin cases should be seen daily at the plant dispensary and if the condition does not clear up promptly with the best available control measures, the worker should be removed entirely from work with these materials.

*Hygenic:*

1—Each worker should be provided with two lockers, one for his street clothes and one for his work clothes. These should be separated by a wash room provided with showers, where the worker is required to clean up under supervision at the end of each shift.

2—Protective clothing should be supplied and maintained by the management.

Where solvent is used, gloves, aprons, etc., of impermeable material should be provided.

3—Suitable skin creams may prove helpful and may be used at the discretion of the plant physician, or nurse.

4—At least twice a week, a complete set of clean work clothes should be provided for every exposed worker.

5—Either the employee or his foreman should be apprised of the toxic nature of the material and both should be instructed in safe handling procedures.


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## TOXICITY OF METALLIC SILVER

BY H. HEIMAN, M. D.

The present report is a review of the toxicity of the metal, silver. This is prompted by the appearance of metallic silver in many industrial plants in the country, which, heretofore, had used the metal in very small amounts or not at all. It is the purpose of this review to discuss the toxicity of silver with the object of preventing injury to the health of the worker handling it in industry.

For many years silver has been used in the arts for which use its physical characteristics have made it highly desirable. On the other hand, although these and other physical characteristics made it a metal of choice in industrial applications, the costliness of silver was such that the less expensive metals were used. The present world crisis has created the situation wherein the cost of a metal is no bar to its use since some of the less expensive metals are becoming increasingly scarce. This attitude has received sanction from the Federal governmental authorities who have released a large portion of their silver for industrial use. Of this metal which is released to industry a large part will be returned after the present war. Some of it, however, is to be utilized in such a manner that its reclamation will be difficult or uneconomical.

### Physical and Chemical Properties

Silver is a white metal with a specific gravity of 10.53, a melting point of 961° C., a boiling point of 1955° C., and an atomic weight of 107.88.[1] It is insoluble in water, alkali, and organic acids, resists oxidation, and is the metal best suited for conduction of heat and electricity.

### Industrial Uses

These properties of silver make it highly desirable for industrial use, and it is therefore found in the following:

1—*Process Industries*—For the lining of tanks, vats, and pipes in food manufacture, and as a catalyst to accelerate chemical action in the form of gauze, sponge, or mossy silver.

2—*Bearings and Electrical Contacts*—As a coating for steel in aviation bearings and as electrical contacts in telephone and telegraph instruments and for conduction of high amperage electric current (bus bars).



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subjected. To some extent its requirements seem to have been met by the institution of a regular interval between feeds, probably by affording relief when milk tension reaches a certain point. But the recommendation of a fixed interval has always placed the needs of the baby before those of the breast. Not long ago the regulation spacing in this country was 2 hours; some 25 years ago it gave place to 3 hours, and later still to 4. A reflex as delicate as this is unlikely to be suited by arbitrary measures of this nature. Further studies may well reveal that something fundamentally different is called for during the earliest days if the danger of overload is to be avoided; and management may need to be adapted far more closely to the individual woman.

The investigation reported here was undertaken in the hope of finding some clue to the frequent early failures of lactation. The draught reflex, which is so characteristic a feature once feeding is established, does not seem to come into effective operation when the breasts first begin active secretion, a time which seems particularly appropriate to its appearance. In multiparous women who have successfully nursed their babies, secretion and expulsion sometimes coincide, in which case the child obtains large quantities of milk from the outset and the continuance of lactation is seldom endangered. In primiparæ, on the other hand, the reflex if present must often be frustrated almost at once. In them the breast often seems incapable of achieving a balance between secretion and outflow, so that stasis and overloading result. These are liable to be followed within a short time by all the involutionary changes seen when nursing ends at the normal time and the child is weaned. We are, in fact, confronted by the curious phenomenon of a gland secreting against obstruction to outflow, and persisting up to a point when its activity is summarily brought to a close.

During the state of engorgement, when the breasts may contain enormous quantities of milk, even the strongest baby may be able to obtain virtually nothing. A frequent and unfortunate result of its efforts to feed is damage to the nipples, involving the woman in great suffering and exposing her to the risk of acute infective mastitis. The pain may have a further inhibitory influence on the reflex, for many refer to it as worse than the pangs of labour and confess it makes them dread the feed times. This type of injury is almost limited to the first weeks of suckling and I suspect is dependent on œdema of the epithelium covering the nipple which results from engorgement. It is surely a misreading of the pathology of this lesion to consider that the nipple must become accustomed to suction by the child before it is secure against trauma. The swollen watery surface seen at this stage is in striking contrast to the dry parched appearance it assumes soon after outflow from the breasts becomes free. Nine out of ten acute abscesses of the breast occur within the first month after delivery and a high proportion are in primiparous women.

We badly need to know what proportion of early failures arise from intrinsic defects in the structure of the breast and nipple, from faulty performance by the child, or from some artefact in the management of the lying-in period at variance with physiological requirements. I believe we shall see a satisfactory reduction in the number of these early failures, which are responsible for many babies having to be artificially fed at the most dangerous age, only when we learn to prevent, or at least curtail, the initial over-filling of the breasts, and can ensure that the draught reflex comes promptly and effectively into action.

The fat contents of milk set out here call for a reconsideration of the advice often given that a baby should be put to only one breast at each feed. The notion underlying this advice is that only so does it obtain milk containing the requisite amount of fat, but the figures hardly justify this assumption. Moreover, with the 4-hourly regime usually practised, this plan by exposing each breast to a delay of 8 hours before its milk is withdrawn favours overloading. Applied in the early weeks it is so often followed by a decline in the total yield and regressive changes that it cannot be justified.

### SUMMARY

Evidence is presented for the existence of a reflex mechanism governing the outflow of milk from the breast analogous to one already known to exist in animals.

This mechanism, here called the draught reflex, is susceptible to interference and conditioning.

The early suppression of milk secretion is commonly associated with overloading of the breasts in the first weeks of lactation. This state of engorgement may involve frustration of the draught reflex.

I am indebted to the maternity and child-welfare committee of the Cambridge borough council for leave to obtain samples of milk from women attending the council's infant-welfare centres; to the medical officer of health and his assistant for their co-operation; to Dr. John Hammond for advice and for permitting the fat estimations to be made by Mr. W. Oxley in the laboratory of the Cambridge School of Agriculture; and to Miss E. Raynham Smith for collecting milk samples.

## POISONING BY CHLORINATED NAPHTHALENE

EDWARD COLLIER, M.B. GLASG., D.P.H.
WORKS MEDICAL OFFICER

IN April, 1941, the Home Office issued an order extending the list of scheduled industrial diseases under the Workmen's Compensation Act to include poisoning by chlorinated naphthalene or its sequelæ. It is therefore important for medical practitioners in general, and for industrial medical officers, examining factory surgeons and medical referees appointed under the terms of the act in particular, to know the toxic effects which chlorinated naphthalene can produce. The following cases—12 of dermatitis and 1 of acute yellow atrophy of the liver—among workers in an engineering establishment exposed to the fumes and dust of chlorinated naphthalene, may be of interest.

Naphthalene, ($C_{10}H_8$) which is obtained from the distillation of coal tar has chemical properties akin to benzene and is extremely volatile. It is commonly used for impregnating wood in the manufacture of fire-lighters and is itself non-toxic. When naphthalene is chlorinated a wax-like substance is produced, used in industry as an insulating coat on wires of electrical apparatus, or on metal bars to circumscribe the action of plating processes—for example, in chromium plating. The wax is usually melted in a bath and the articles may be dipped in the bath directly, or the wax applied to them by means of a brush.

Poisoning by chlorinated naphthalene may take two forms: damage to the skin, producing an acne, particularly of the face; and toxic jaundice produced by either an acute or subacute necrosis of the liver, or by acute yellow atrophy of the liver.

AGE, DISTRIBUTION AND SEVERITY OF CHLORACNE IN A SERIES OF 12 CASES

| Case | Age (years) | Exposure before onset (months) | Site of first lesion | Sites of final lesions | Degree |
|---|---|---|---|---|---|
| 1 | 36 | 3½ | Angle jaw, rt. | Sides, face and neck | Sl. |
| 2 | 39 | 10 | Lt. ear, side, neck | " " " | Sl. |
| 3 | 21 | 9 | Both sides face | Face, neck, forearms | Sev. |
| 4 | 25 | 9½ | Angle jaw, rt. | Face, neck | Mod. |
| 5 | 35 | 8 | Rt. side, neck | Sides, neck | Sl. |
| 6 | 25 | 5 | Both sides, face | Sides, face and neck; shoulders | Sev. |
| 7 | 20 | 2 | Angle both jaws | Sides, face and neck; lt. shoulder, axilla | Sev. |
| 8 | 47 | 5½ | Angle, jaw, rt. | Sides, face and neck | Sl. |
| 9 | 33 | 9 | Rt. side neck | " " " " | Sl. |
| 10 | 30 | 8 | " " " | " " " " | Mod. |
| 11 | 28 | 3½ | Angle jaw, rt. | Sides, face | Mod. |
| 12 | 23 | 8½ | Rt. side, face | " " | Sl. |

### DAMAGE TO THE SKIN

Jones (1941) has already described 37 cases of chloracne among workers employed in a chemical industry which manufactures chlorinated naphthalene. The typical skin condition, caused by exposure to the dust or fumes of chlorinated naphthalene, starts on the face, around the angle of the jaws or over the malar prominences (see figure), and from there spreads on to the sides of the face and on to the sides and back of the neck. The skin lesions in a typical case are comedones, papules, pustules, and in severe cases small cysts. In some of my

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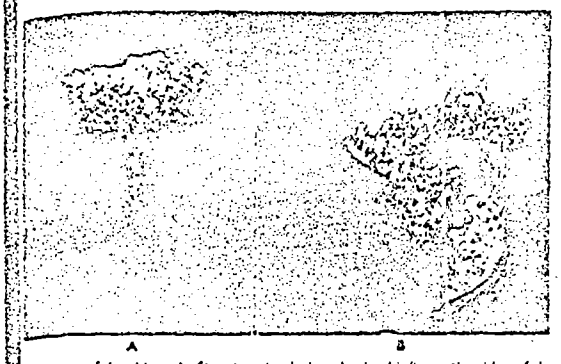
cases there was also a spread on to the shoulders and forearms, and in one case into the left axilla.

During September and October, 1941, there was an outbreak of chloracne of varying degrees of severity among 12 employees in the chromium plating department, who were exposed to the dust or fumes of chlorinated naphthalene; 2 were young women. The relevant facts in each case were as shown in the table.



A B

Chloracne of the skin. A. Showing that lesions begin chiefly on the sides of the face: note the relatively few lesions on the forehead and nose. B. Profuse lesions on left side of face.

No cases had a previous history of acne and no case had, at any time, been taking bromides or iodides. In classifying the severity of the cases, Bloch's method has been utilised:

Slight — 5–20 comedones.
Moderate — 20–50 comedones or papules and pustules.
Severe — 50 or more comedones or papules and pustules.

*Etiology.*—For 3–4 months before the onset of these cases there had been technical difficulties about getting efficient exhaust ventilation for the fumes rising from the bath in which the chlorinated naphthalene was being melted. The onset also coincided with a period of warm, humid weather which had lasted several weeks. During such weather the skin glands are active, and the chlorinated naphthalene dust is trapped in the secretion. Fraser White (1934) considers that the chlorinated naphthalene fumes or dust have a direct external, irritating effect on the skin and this view is supported by H.M. Chief Inspector of Factories (1936). The oil acne or dermatitis seen in workers in engineering factories is also regarded as being caused by a direct external irritation. Jones considers that where workers neglect personal cleanliness, the chlorinated naphthalene dust or fumes irritate the sebaceous glands of the skin, causing the cells to proliferate and produce an excess of secretion, so that the glands become plugged. Cleanliness is thus a factor of prime importance in prevention.

In all my cases the faces were affected. Only a few lesions were present on foreheads and none was seen on noses. No case was seen with an eruption on the chest. Employees handling the cold wax never develop chloracne.

Apart from the skin, chlorinated naphthalene, like tetrachlorethane, damages no organ but the liver. The following case was the first death in Scotland from acute yellow atrophy of the liver, caused by exposure to the dust and fumes of chlorinated naphthalene.

## CASE-HISTORY

The patient was a woman of 41 working in the chromium plating department in which the cases of chloracne occurred. She started work in the department on June 9, 1941, and was engaged in cutting cold chlorinated naphthalene wax off small parts after these had been dipped in the bath in which the chlorinated naphthalene was melted. She was never actually engaged in "dipping" and she never came in very close proximity with the fumes of the melted chlorinated naphthalene wax. In cutting off the wax, however, she was seated 6 feet from the bath, and worked there during the whole of the time of the technical difficulties in constructing efficient exhaust ventilation for the fumes coming from the bath. Thus she was exposed to whatever concentration of fumes could reach her from June to December, when the technical difficulties were overcome and the exhaust ventilation was pronounced to be satisfactory. Other four women engaged on the same task and seated at the same table have not been affected in any way. She ceased work on Dec. 26, when she came under the care of her own doctor, who treated her till Jan. 17, 1942, as a case of catarrhal jaundice. As she was making no improvement, she was then admitted to the Western Infirmary.

On admission she gave an 8 weeks history of feeling off colour, and of swelling of the feet, ankles and eyelids towards the end of the day. About 2 weeks later she noticed slight breathlessness on exertion; 4½ weeks before admission she was becoming slightly jaundiced and began to have troublesome nausea. She noted that her urine was dark and her stools greyish. Later the nausea was accompanied by vomiting. Her only other complaint was of increased thirst. There was no pain and no loss of weight during the illness. An attack of acute rheumatism 9 years before had left her with an endocarditis. In addition to icterus she had a purpuric rash of the legs and lower abdomen. There was no free fluid in the peritoneal cavity. The superficial area of liver dullness was 4½ in. On Jan. 20 she was sick and drowsy after breakfast. About noon she became unconscious. Muscular twitchings of all limbs were noted, but the only other abnormality of the central nervous system was a slight dilatation of the pupils. A patchy brownish discoloration of the skin developed; liver dullness 3½ in. Glucose saline was given intravenously and the muscular twitchings stopped, but otherwise the condition was much the same until death. All this time the liver dullness was decreasing, until no dullness could be detected on Jan. 22, when she died.

The following investigations were carried out:

Urine: deeply coloured; contained bile.

Fractional test-meal: high total acidity with no free hydrochloric acid; blood present in all specimens. Stools: yellowish; contained occult blood. Blood-count: slight leucocytosis, otherwise normal. Blood-urea: within normal limits. Van der Bergh: immediate positive direct reaction.

At autopsy there were 2 pints of straw-coloured fluid in the peritoneal cavity. The liver (650 g.) was very small and the capsule appeared wrinkled; consistence very soft with moderately hard lumps throughout, varying in size from ¼ to ½ in. in diameter. The cut surface showed large areas where the parenchyma had disappeared and the liver tissue was represented by dark red areas of sinusoids. The moderately firm lumps were areas of surviving liver tissue, yellowish and slightly lobular appearance. Histological examination showed the acute stages of acute yellow atrophy. Heart: moderate hypertrophy of the right ventricle, with chronic valvular disease. All other organs normal.

## DISCUSSION

I am of the opinion that the damage to the heart may have produced some damage also to the liver, which made that organ more susceptible to the toxic properties of chlorinated naphthalene than it would otherwise have been. Drinker and his colleagues (1937) state that chlorinated naphthalene attacks the liver alone of the internal organs. Greenburg (1939) has described three deaths caused by liver damage. In a Home Office memorandum (1941) on poisoning by chlorinated naphthalene 2 fatal cases of jaundice are mentioned, one in 1935 and the other in 1938. In each case the worker had been exposed to chlorinated naphthalene in a radio factory, though it was not definitely established in either case that the death was due to the employment. Later 2 more fatal cases of jaundice in different factories were traced, in both of which there was some history of exposure to chlorinated naphthalene; and localised exhaust ventilation and other precautions were enforced to prevent workers from coming into contact with it and inhaling the fumes or dust. Notwithstanding these measures, 2 further deaths have recently been reported (November, 1940, and January, 1941). American workers have reported 9 cases of subacute necrosis of the liver due to exposure to chlorinated naphthalene wax.

*Preventive measures.*—Overheating of the wax causes increased quantities of fumes to be evolved. The wax therefore should not be overheated; a temperature of 10–15° C. in excess of the melting-point will be found quite sufficient to produce a mobile fluid. As it is usually melted in open baths and the fumes or dust are therefore liberated into the atmosphere, it is important to provide an efficient exhaust ventilation at the point where the

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fumes or dust are evolved. The medical officer, with the co-operation of the head of the department, should scrutinise the plant at regular intervals to assure himself that it is working efficiently. All workers should be instructed on the protection afforded by personal cleanliness. Ample washing facilities, with hot and cold water, nail brushes, soap and towels should be provided. The general cleanliness of the industrial establishment should be of a high standard. General ventilation also should be good. Medical examination of new applicants who will be working with chlorinated naphthalene is also important. Those who have a previous history of acne or seborrhœa should be excluded because of their susceptibility, and so should all those with a history of liver trouble—cirrhosis or jaundice—and of heart disease. Regular medical examinations at weekly intervals should be undertaken in all workers who are exposed to the fumes or dust of chlorinated naphthalene. Any employee showing signs of an incipient acne should be immediately transferred to other employment. Liver function tests should be performed also on all employees who begin to complain of anorexia and vomiting, or who show signs of early jaundice.


SUMMARY

Poisoning by chlorinated naphthalene may result in chloracne of the face, particularly of the sides of the face; 12 such cases arising among workers who were exposed to the fumes or dust of chlorinated naphthalene are reported.

It may also produce acute yellow atrophy or necrosis of the liver. In a typical case with systemic effects, the liver is usually the only organ showing damage. One fatal case is described fully.

If cases of poisoning are to be prevented, the wax must not be overheated, and the fumes and dust must be properly carried away by exhaust ventilation. Workers must be instructed in the importance of personal cleanliness, and must be medically examined every week for signs of acne or jaundice.


I wish to thank Dr. W. R. Snodgrass of the Western Infirmary, Glasgow, for permission to publish clinical data relating to the fatal case.

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# SULPHAPYRIDINE ANURIA TREATED BY UNILATERAL NEPHROSTOMY


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IT is at present impossible entirely to eliminate the renal complications of sulphonamide therapy, especially in infants and young children, and it is therefore important that the treatment of sulphapyridine anuria should be established on a definite basis. In our view ureteric catheterisation should never be regarded as the last resort. On the contrary, we think it should be attempted early, and if it fails, as is likely in some cases, other operative procedures should be adopted without delay.

CASE-RECORD

A girl aged 2 years was admitted to hospital with cerebrospinal fever and was treated with full doses of sulphapyridine. Two days after admission a guaiacum test performed on the urine voided in the bed showed a positive reaction. The drug was immediately withdrawn and the usual administration of intravenous fluids, including magnesium sulphate, instituted, but in spite of this she proceeded to complete anuria. Catheterisation after 12 hours anuria produced only a few c.cm. of almost pure blood mixed with cellular debris. During the next 12 hours two specimens of clear urine, each of about 2 c.cm., were passed naturally, but after this suppression was complete and remained so until after operation, a period of three days, which we now consider to have been dangerously long. At the end of this time the child's general condition was alarming, with increasing drowsiness, vomiting and general œdema. Lumbar puncture showed that the meningitis had subsided, but the CSF urea was 90 mg. per 100 c.cm. It was now obvious that the child would die unless immediate relief could be given.

Ureteric catheterisation was considered first as the established method of treatment but was rejected for reasons which are discussed later. We next considered bilateral decapsulation of the kidneys with the passage of bougies down the ureters, an operation which has been carried out once in America, though we have been unable to discover its result. This, too, we rejected because we did not think the child would survive a long operation. Tsao's (1939) suggestion of (? bilateral) nephrostomy was also discussed (we could find no record of its ever having been performed), but it seemed possible that the simpler operation of unilateral nephrostomy might relieve the symptoms temporarily and allow any further necessary procedures to be carried out when the child's condition had improved. We hoped that the renal tubules were not irreparably damaged and that nephrostomy might drain the kidney above the level of complete obstruction.

Since there was no reason to expect that one kidney was more affected than the other, the left kidney was exposed. It was œdematous and friable and both it and the pelvis were at least five times the normal size. No concretions were actually felt in the pelvis. A nephrostomy tube was inserted into the pelvis and the wound closed, the whole operation being completed in less than ten minutes. No urine flowed through the tube at the time of operation. The child returned to the ward apparently moribund but within 4 hours the dressing was soaked with clear urine and within 12 hours clear urine was also passed in large amounts per urethram. A few hours later the child was sitting up and asking for food and the blood-urea was found to be 24 mg. per 100 c.cm.

She was discharged quite well a few weeks after operation. Before discharge her urine and blood-urea were both normal. An intravenous pyelogram showed a normal urinary tract on the right side, while the only abnormality seen on the left was that the renal pelvis was 1½ times the size of the normal right pelvis. Excretion of the dye was normal on both sides.

DISCUSSION

We suggest that a reasonable course of treatment to adopt in cases of sulphonamide anuria is as follows.

As soon as macroscopic hæmaturia appears the drug should of course be withdrawn, if this has not already been done, and now seems to be the time to consider the cautious administration of intravenous fluids, including magnesium sulphate. If suppression of urine nevertheless occurs operative procedures should be adopted before the patient's general condition has had time to deteriorate, and we suggest that if anuria has lasted 24 hours cystoscopy and ureteric catheterisation should be done. It should not be supposed, however, that ureteric catheterisation will always be successful.

Carroll and others (1940) have shown pyelograms in which the calyces as well as the pelvis and ureters are full of concretions and they say that at least half an hour's ureteric lavage must be carried out. Carson and Stewart Smith (1942) record a fatal case in which an operation was attempted. At autopsy they found the ureters and pelvis full of concretions and they think that ureteric catheterisation would not have been successful. Tsao gives details of an autopsy in which a probe could not be passed from the bladder into either ureteric orifice. Ureteric catheterisation, even when there is no such obstruction, often presents extreme technical difficulty. Dournashkin and Worton (1941) describe such a case in which the catheters had to be left in the ureters for 24 hours, and Williams (1941) reports one in which the catheter could not be passed up one ureter until the third attempt in 5 days. Benson and Perry (1942) report a case in which at cystoscopy both ureteric orifices were extremely œdematous and the right difficult to locate, while the catheter was passed up the left ureter only with difficulty. In the difficult case specialised experience and equipment are required which are only available in the larger hospitals. Moreover, there are circumstances in which ureteric catheterisation and prolonged lavage may be impossible—for instance in infants.

It seems, therefore, that some method of treatment is needed for those cases in which ureteric catheterisation

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rence of the psychosis but did not furnish any menstrual data. Kraines,[12] in discussing this condition, states that, "in those patients wherein the menstrual period is associated with emotional disturbances, testosterone propionate has been found useful." The action of this hormone would be the same as that of progesterone as regards their relationship to the estrogenic hormone. Physiologically, progesterone would be the indicated hormone for treatment.

In the 2 other cases familiar to me the psychosis persisted for eight months, during which time menstruation did not occur. It is quite likely that the reestablishment of the menstrual cycle in the case reported was responsible for the psychosis becoming periodic. It may be suggested that in the treatment of the continuous psychosis an attempt be made to reestablish the menstrual cycle by the use of the suitable endocrine therapy, large doses of progesterone being given during that particular phase. The rationale for this is quite apparent.

Time may prove the importance of the corpus luteum hormone in this as well as in other conditions. It no doubt plays the principal role in keeping the patient stable and probably accounts for the feeling of well-being experienced by some during pregnancy as compared to a nervous tension in the nonpregnant state. It is the probable cause for the absence of migraine during pregnancy. The use of the hormone is certainly indicated for the control of minor emotional disturbances frequently noted following delivery. The early use of it may prevent the development of a psychosis. Progesterone may be of definite value in the treatment of certain psychopathic conditions not associated with pregnancy.

In a review of the literature I was unable to find any case report in which the corpus luteum hormone was used as specific therapy for postpartum psychosis. Realizing that 1 case does not constitute definite proof, I submit this report with my impressions so that more complete work may be done by the men who care for these unfortunates, so badly treated by nature.


SUMMARY

The constant precipitating factor and the favorable prognosis for recovery indicate that postpartum psychosis is a clinical entity and is due to some disturbance of a physiologic nature resulting from the sudden termination of pregnancy.

The recurrence of the psychosis associated with the menstrual cycle in the case reported suggested that the condition had some relationship with the hormone balance. The most probable disturbance of the balance would likely be due to the sudden loss of a superabundance of progesterone furnished by the placenta. Excellent results were obtained by the administration of this hormone.

The loss of a large amount of progesterone at delivery and its accepted relationship to premenstrual tension indicate that the psychosis probably results from an excess of this estrogenic hormone in the circulation.

It is suggested that adequate dosage of progesterone be used in the treatment and that the menstrual cycle be reestablished if necessary.


12. Kraines, S. H.: Treatment of Psychiatric States Following Pregnancy, Illinois M. J. 80:200 (Sept.) 1941.

# Clinical Notes, Suggestions and New Instruments

## "CABLE RASH"—A NOTE ON A NEW CLEANSING MIXTURE

George E. Morris, M.D., and Irving R. Tabershaw, M.D., Boston

"Cable rash" or "Halowax dermatitis" has been known to the medical profession for more than twenty-five years. Yet in this period of war, as in 1918, cases are being seen of intractable "chloracne" occurring in navy yard workers along both seacoasts, despite the use of the most modern protective creams and ointments. This type of dermatitis is seen also in those engaged in the manufacture of the chlorinated naphthalenes and diphenyls, as well as in men in other occupations

Fig. 1.—Halowax spots before cleansing.

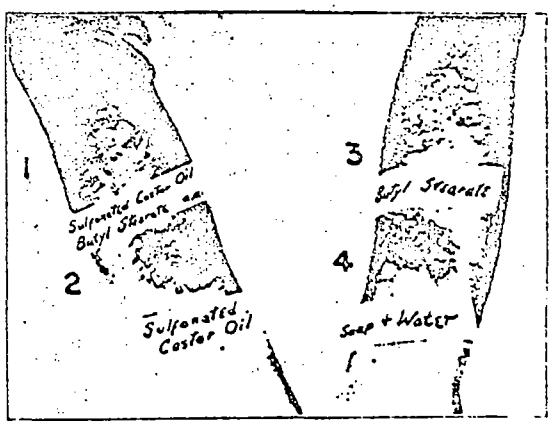


Fig. 2. 1, comparative results of cleansing with mixture described, 2, sulfonated castor oil—note Halowax still present on skin; 3, butyl stearate followed by soap and water, and 4, soap and water—note Halowax still on the skin.

in which these substances are employed. Such cable rashes are thought to be due at least in part to the blocking of the pores by the synthetic waxlike substances whose fumes solidify when they reach the skin. Acute yellow atrophy of the liver has been described as occurring from these chlorinated substances, but the present brief note is not concerned with this phase of their toxicity.

We feel that the removal of all the solid waxlike particles from the skin at the end of each work period would probably prevent the occurrence of this type of dermatitis; with this in mind we have experimented with the removal of these substances from the skin.

From the Division of Occupational Hygiene, Commonwealth of Massachusetts.

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A black chlorinated naphthalene (Halowax) was dissolved in chloroform and rubbed into the skin. Various mixtures of soaps, wetting agents and organic solvents were tried, and from the beginning it was obvious that soap and water would not completely remove the wax from the skin. It was finally found that butyl stearate would remove the wax from the pores; this could then be washed off with soap and water, leaving the skin clean. Since this involved two maneuvers, namely, first rubbing the oil well into the skin and then washing with soap and water, it was deemed more practical to evolve a one maneuver cleansing agent.

Such an agent consists of

| | Gm. or Cc |
|---|---|
| White corn meal | 50.0 |
| Butyl stearate | 22.5 |
| Sulfonated castor oil (75 per cent oil) | 22.5 |
| Oleic acid | 5.0 |

Mix the oils together and then add the corn meal.

This mixture is to be rubbed onto the skin and then removed with water. The procedure should be repeated. Butyl stearate has been found to be a bland, nonirritating substance, and no cases of dermatitis from its use have been reported. At room temperature it is a clear, colorless, odorless, stable oil with a chemical formula $C_{17}COOC_4H_9$. At a temperature below 68 F. it is a solid waxlike substance. It is important to use castor oil which contains 75 per cent of sulfonated oil and 25 per cent of inert material, for oils with greater percentages of inert materials have been found less effective. The accompanying illustrations show the efficacy of this method as compared with the use of soap and water alone or of sulfonated castor oil alone. We suggest that this mixture be tried as a cleansing agent both by workers before the acne develops and by those suffering from the disease.

23 Joy Street.

# Council on Pharmacy and Chemistry

## PRELIMINARY REPORT OF THE COUNCIL

The Council has authorized publication of the following preliminary report. Austin E. Smith, M.D., Secretary.

### STAPHYLOCOCCUS TOXOID (DIGEST-MODIFIED)-LEDERLE

Staphylococcus Toxoid (Digest-Modified)-Lederle was presented by Lederle Laboratories, Pearl River, N. Y., as "staphylococcus toxin treated with pepsin until it will no longer hemolyze rabbit erythrocytes or produce necrosis in the skin of a susceptible rabbit," for the prophylaxis or treatment of infections caused by the staphylococcus. The firm submitted labels, package insert and advertising circular and a galley proof of an article entitled "Staphylococcal Toxoid Prepared by Peptic Digestion" by I. A. Parfentjev, Frances L. Clapp and A. Waldschmidt, which, when presented by the firm, was to appear in the *Journal of Immunology*.

The firm claims that the use of peptic digestion of staphylococcus toxin decreases the possibility of allergic reactions and allows increased dosage of staphylococcus toxoid with less local or general reaction. However, the amount of evidence submitted at the time of presentation does not appear to warrant these claims, and further investigation seems advisable.

In view of this, the Council voted to issue a preliminary statement asserting that at the present time there is insufficient evidence to warrant acceptance of Staphylococcus Toxoid (Digest-Modified)-Lederle for inclusion in New and Nonofficial Remedies, as it appears to be an unessential modification of a toxoid for which the firm is already licensed, but that further consideration will be given to this particular preparation when additional evidence is available.

## NEW AND NONOFFICIAL REMEDIES

The following additional articles have been accepted as conforming to the rules of the Council on Pharmacy and Chemistry of the American Medical Association for admission to New and Nonofficial Remedies. A copy of the rules on which the Council bases its action will be sent on application.

Austin E. Smith, M.D., Secretary.

**DEXTROSE** (See New and Nonofficial Remedies, 1942, p. 418).

The following products have been accepted:

Pacific Coast Sterile Solutions Co., Los Angeles.

**Dextrose 5% W/V in Distilled Water:** 1,000 cc. bottles. Each hundred cubic centimeters contains 5 Gm. of dextrose.

**Dextrose 10% W/V in Distilled Water:** 1,000 cc. bottles. Each hundred cubic centimeters contains 10 Gm. of dextrose.

**Dextrose 5% W/V in Isotonic Sodium Chloride Solution:** 1,000 cc. bottles. Each hundred cubic centimeters contains 5 Gm. of dextrose and 0.9 Gm. of sodium chloride-U. S. P.

**Dextrose 10% W/V in Isotonic Sodium Chloride Solution:** 1,000 cc. bottles. Each hundred cubic centimeters contains 10 Gm. of dextrose and 0.9 Gm. of sodium chloride-U. S. P.

**THEOPHYLLINE WITH ETHYLENEDIAMINE** (See New and Nonofficial Remedies, 1942, p. 352).

The following additional dosage forms have been accepted:

H. E. Dubin Laboratories, Inc., New York.

**Ampules Solution Aminophyllin:** 0.48 Gm. in 20 cc.

**Tablets Aminophyllin:** 0.2 Gm. (3 grains).

**Tablets Aminophyllin:** 0.2 Gm. (3 grains) (Enteric Coated).

**VITAMIN A** (See New and Nonofficial Remedies, 1942, p. 539).

The following product has been accepted:

White Laboratories, Inc., Newark, N. J.

**White's Oleo-Blend Vitamin A Capsules:** Each capsule contains 25,000 U. S. P. units of vitamin A derived from fish liver oils.

**ASCORBIC ACID-U. S. P.** (See New and Nonofficial Remedies, 1942, p. 564).

The following dosage forms have been accepted:

Walker Vitamin Products, Inc., Mount Vernon, N. Y.

**Tablets Ascorbic Acid:** 25 mg., 50 mg. and 100 mg.

**ISOTONIC SOLUTION OF SODIUM CHLORIDE** (See New and Nonofficial Remedies, 1942, p. 425).

The following product has been accepted:

Pacific Coast Sterile Solutions Co., Los Angeles.

**Isotonic Solution of Sodium Chloride:** 1,000 cc. bottles. Each hundred cubic centimeters contains 0.9 Gm. of sodium chloride-U. S. P.

**NICOTINIC ACID-U. S. P.** (See New and Nonofficial Remedies, 1942, p. 561).

The following dosage forms have been accepted:

Walker Vitamin Products, Inc., Mount Vernon, N. Y.

**Tablets Nicotinic Acid:** 20 mg., 50 mg. and 100 mg.

**SODIUM ASCORBATE** (See The Journal, July 10, 1942, p. 883).

The following dosage form has been accepted:

George A. Breon & Co., Inc., Kansas City, Mo.

**Ampul Solution Sodium Ascorbate:** 500 mg. in 10 cc.

**SULFANILAMIDE** (See New and Nonofficial Remedies, 1942, p. 142).

The following dosage form has been accepted:

Horton & Converse, Los Angeles.

**Sulfanilamide Tablets:** 0.324 Gm. (5 grains).

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# INDUSTRIAL HYGIENE

DIVISION OF INDUSTRIAL HYGIENE, NEW YORK STATE DEPARTMENT OF LABOR

LEONARD GREENBURG, M. D., EXECUTIVE DIRECTOR

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## SYSTEMIC EFFECTS FROM EXPOSURE TO CERTAIN CHLORINATED HYDROCARBONS *


By Leonard Greenburg, M.D., May R. Mayers, M.D., and Adelaide Ross Smith, M.D.


These three cases show the occurrence of similar pathological changes in the liver in three young adults known to have been working with chlorinated naphthalenes and diphenyls—all were exposed directly or indirectly to the higher chlorinated hydrocarbons. In all three cases, a most careful investigation failed to reveal any other predisposing cause for the condition. In the first case in particular, that of a healthy young girl on her first job, the absence of any conditions predisposing to liver damage either preceding or following her exposure to the substances in question is especially clear.

It is of interest to note that two of the cases apparently had suffered from at least one previous attack of hepatitis followed by a certain degree of improvement before the onset of the fatal attack.

In view of the fact that Drinker, Warren and Bennett found no lesions in organs other than the liver in their experimental animals, it is noteworthy that such lesions were conspicuous in all three of the cases here reported. Such lesions, are, indeed, usual findings in cases of acute yellow atrophy of the liver in humans regardless of etiology. On the basis of present knowledge, it would be impossible to say whether they are the result of primary intoxication or are merely secondary to liver damage. In the light of the animal experiments, however, one would incline to the latter view and speculate as to the part played by length of exposure, in the final pathological picture.

It has been mentioned that, in Drinker's[4] experiments, rats with no evidence of clinical disease while being exposed to the chlorinated naphthalenes, promptly died from acute yellow atrophy of the liver when given doses of carbon tetrachloride so small as to be harmless to control animals. This prompts speculation as to whether death from acute yellow atrophy of the liver in workers similarly exposed occurs only in those having some pre-existing substratum of liver damage—such as might follow an attack of catarrhal jaundice, for example—and that this might account, in part at least, for the fact that only a very occasional worker out of a large group will suffer from systemic effects of exposure to these substances. In the three cases reported, however, no history was given suggesting that any hepatic disorder prior to exposure had occurred.

The presence of a papulo-pustular eruption in two cases is of interest. In one it antedated the systemic symptoms. This type of eruption is characteristic of the dermatitis caused by chlorinated naphthalenes, and until recently was the only disturbance attributed to them.

The presence of "aggregations of comedones" such as were found in Case 1 is also characteristic of the skin eruptions produced by these substances. The question as to whether or not the skin eruption in such a case is in any way connected with the onset of systemic effects cannot be answered, since thus far no correlation has been established between skin lesions and systemic disease[1].

It is interesting, therefore, that in Case I the skin eruption apparently antedated all evidences of systemic disease. Had the girl been promptly removed from further exposure when it was first observed it is possible that her life would have been saved; or had the physicians first called upon to treat the jaundice (of whatever origin) in her case, or in the second case here reported, recognized the danger of continuing exposure to the chlorinated naphthalenes, these deaths might possibly have been averted.

### Recommendations For Medical Control

1—The authors wish to stress the need for the conscientious reporting by physicians of all illnesses occurring among workers exposed to the chlorinated naphthalenes and diphenyls, particularly cases which have been carefully worked up, so that the clinical disease entities resulting from such exposure can become further clarified and thus more readily recognized in the future. Fewer errors in the diagnosis and management of these cases would occur, and workers' lives could undoubtedly be saved in this way.

2—Persons suffering from the typical acneform eruptions should be removed from further exposure.

3—Persons who have, at any time in the past, had any liver disease—even a mild catarrhal jaundice—should not work with these substances; nor should workers with a history of typhoid fever, malaria, gall-stones or other diseases known to affect the liver adversely.

4—Persons receiving arsphenamine treatment for syphilis; or those who are taking drugs believed to be injurious to the liver in susceptible persons, should not be further exposed in their work to potential liver poisons.

5—Persons working with the chlorinated naphthalenes and diphenyls, if requiring a general anesthetic for an operation, should not be given chloroform or avertin, and vice versa. individuals who have recently received such anesthetics should not immediately thereafter go back to their former work or to work with other substances believed to be potentially toxic to the liver.

6—Pregnant women should not be exposed because the liver, in pregnancy, appears to be peculiarly susceptible to injury.

7—Experience seems to indicate that by proper attention to ventilation and medical supervision of workers the chlorinated naphthalenes and diphenyls can be used in industry with safety.

### Summary


The systemic effects resulting from exposure to certain chlorinated naphthalenes are discussed, and the literature of the subject briefly summarized. Three liver deaths in workers handling these substances are presented in some detail, with autopsy findings. Recommendations for prevention are given.



* Continued from page 346 of the October 1939 issue of *The Industrial Bulletin.*


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## HEALTH CONSERVATION IN TUNNEL CONSTRUCTION

Dust is generated in tunnel construction by the rock drills, in blasting and during the shovelling and removal of broken rock (mucking). Smoke and toxic gases are formed during blasting and fog frequently forms at the heading when the drills are in operation. The contamination of the tunnel atmosphere by these several substances creates health and accident hazards which must be controlled in order to maintain good working conditions. This is the object of Industrial Code 33 on rock drilling and of the various regulations issued by the Industrial Commissioner.

The control of these contaminants involves new procedures in tunnel ventilation never before attempted in New York on the scale required by the Delaware Aqueduct. Indeed, in certain respect, the regulations are wholly new and without precedent.


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INDUSTRIAL HYGIENE
ION OF INDUSTRIAL HYGIENE, NEW YORK STATE
DEDEPARTMENT OF LABOR
LEONARD GREENBURG, M. D., EXECUTIVE DIRECTOR

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# SAFETY MEASURES FOR USE OF CHLORINATED NAPHTHALENES AND DIPHENYLS IN INDUSTRY

By LEONARD GREENBURG, M.D.

The chlorinated naphthalenes comprise a group of chemical substances made by the addition of various amounts of chlorine to a naphthalene base. The amount of chlorine may vary from three to six or possibly more atoms providing compounds from trichlornaphthalene to hexachlornaphthalene.

In the same manner, the varying amounts of chlorine are added to a diphenyl base providing a group of compounds of varying chlorine content.

As a rule, the final substances, as used in industry, are mixtures of differing chlorinated naphthalenes. Earlier, these were, as a rule, possessed of a lower degree of chlorination and later on the compounds were usually of a higher degree of chlorination with varying amounts of chlorinated diphenyls added thereto.

These substances are not new. Perchlornaphthalene was used in Germany during the last war.

It is to be clearly understood that these groups of compounds are not manufactured by any one company but rather by approximately five in the United States and they are sold under varying trade names by the manufacturers.

The chlorinated naphthalenes and diphenyls are valuable industrial products. Because of certain properties which they possess, we may briefly state these valuable properties as follows:

1—Resistance to water and alkali.
2—High insulating value. They possess high dielectric constant.
3—Thermo plasticity.
4—Quite stable chemically.
5—Flame resistant.

For these reasons, these substances possess much value industrially in the making of electric condensers and in the insulation of wire and cable, etc.

## Method of Use in Industry

The chlorinated naphthalenes and diphenyls are used in industry by two methods.

1—A cold method in which the material is dissolved in a solvent usually a mixture of petroleum naphtha and toluene and,
2—A hot method wherein the material is rendered plastic by heat.

## Toxic Effects

The toxic effects of the chlorinated naphthalenes and diphenyls have been known for a long time. In the interval between 1899 and 1901, reports in both the French and German literature indicated an association between exposure to chlorine and acne and even though in some cases wax-like materials were a portion of the exposure, the general belief was that chlorine was more or less responsible for the acne. At the 1901 Congress of the German Dermatological Society, Herxheimer[1] pointed out that chlorinated hydrocarbons might be the etiological cause for the acne and in the same year Bettmann[2] stressed the possible effect of chlorinated hydrocarbons.

The first concise publication which definitely attributed the acne to chlorinated naphthalenes was a publication by Wauer[3] in 1918. This was followed on the continent by a number of confirmatory publications.

In the United States, Sulzberger[4] and his coworkers in 1934 reported three cases of acne from contact with "hot oils and waxes." Sulzberger did not specifically identify the chemical substances responsible for the production of the acne. In 1935, Schwartz[5] in a paper read before the American Public Health Association, described the typical acne form eruptions and attributed them to exposure to the chlorinated naphthalenes and diphenyls. This contribution was published in the American Journal of Public Health in 1936. Fulton and Matthews[6] of the Pennsylvania Department of Labor reported 101 cases of dermatitis due to chlorinated naphthalenes and diphenyls in a wire insulating plant. Jones and Alden[7] reported similar findings in the Archives of Dermatology and Syphilology in the same year.

In 1938, Mayers and Silverberg described acneform skin eruptions in workers making electrical condensers.[8]

Space does not permit a discussion of the histology of these dermatological changes produced by this substance.

In general, it can be said with a fair measure of certainty that these changes are brought about in the skin, primarily by the contact of the skin with the vapors of these compounds or by actual contact with them in the form of solid or particulate matter. We have found, for example, that workers exposed to fumes have more acne than those exposed to dust alone and we have also found that workers exposed to the solid material or its particulate form have developed dermatitis. In this connection, the report of Fulton and Matthews is very interesting. They picture and describe a case of an infant, two and one-half years of age, who developed the dermatitis as a result of contact with the soiled working clothes of its father who was in the habit of playing with the child prior to changing his clothing.

More recently, Schwartz[9] has described cases of dermatitis among cable strippers employed at shipbuilding establishments and working with cables which had been impregnated with these compounds.

## Systemic Effects

In the United States, systemic effects in the form of acute yellow atrophy of the liver were reported by Flinn and Jarvik[10] in 1936 among men working with tetra and pentachlornaphthalene. These findings were verified by animal experimentation. In 1937, Drinker, Warren and Bennett[11] reported such



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conc changes among animals exposed to the material be inhalation and similar findings were obtained with the chlorinated diphenyl compounds. These latter authors also mention four non-fatal cases among humans and the three fatal cases previously cited by Flinn and Jarvik.

I should like to cite two or three cases which we have encountered in our own experience[12] and which may be of interest from the point of view of duration of exposure prior to this type of poisoning. A girl 17 years of age was engaged in soldering electrical condensers which were impregnated with tri- and tetrachlornaphthalene for a period of approximately seven months. The autopsy for this case showed mild to severe degeneration of the liver and presented a clear picture of what is generally known as acute yellow atrophy. It was apparent in this case that the latter organ displayed areas of healing and new areas of pathology.

In the second case, a man 24 years of age developed jaundice after five months of exposure in the coating of wires with wax containing the higher chlorinated naphthalenes. He was away from work for a period of time and four months later the jaundice became quite intense with general malaise and loss of appetite. After two months more of work he was sent to the hospital where he rather rapidly passed away. The autopsy in this case showed extensive areas of necrosis and fibrosis of the liver with regeneration.

In a third case, published by Drs. Mayers and Smith[13] of the staff of the New York State Department of Labor, Division of Industrial Hygiene, an 18 year old girl became ill after five months of exposure in the soldering of electrical condensers. The waxes in this case were composed principally of trichlornaphthalene. She was hospitalized and recovered after a long and slow period of convalescence.

## Recent Industrial Experience

During the past year the Division of Industrial Hygiene of the New York State Department of Labor has conducted an investigation in two cable plants using chlorinated naphthalenes and diphenyls. In this investigation, many cases of dermatitis were found, and several deaths due to liver damage among workers in the industry.

The examination of workers in the two factories showed relatively few cases of enlarged liver—five in all, on palpation.

Comparison in these two plants showed a very much higher incidence of acneform dermatitis in one of the plants as compared with the other; namely 21 per cent as compared with 60 per cent, the former being in the cold process establishment and the latter being in the establishment employing the hot process only. The dermatitis appeared to take place on the average in about seven and one-half months in the hot process plant as compared with 10 months in the cold process plant.

## Conclusions

As a result of our general re-study of this whole problem and our experience in two recent outbreaks, as well as several isolated experiences we desire to draw several basic conclusions:

1—Chlorinated naphtha[illegible] in general highly toxic com[illegible] with extreme care. Industri[illegible] every effort to see that such exposu[illegible] insofar as humanly possible. In th[illegible] not believe it safe to rely on limit[illegible] concentrations but rather to depend o[illegible] of maintenance and engineering control.

2—Toxic exposures may be more readily controlled where the cold or solvent method of impregnating cable is employed than where the hot process is used.

3—Of the known cases of liver disease in our experience, the available history and experience generally points to exposure to vapors or fumes from the hot process. There is no clear evidence in our experience although it is possible that skin absorption may produce systemic poisoning. Physiologically we see no reason why this is not possible. However, most dermatitis cases do not develop liver damage.

And finally, I should like to call your attention to a group of recommendations which were finally agreed upon by all of the groups involved in the last outbreaks of poisoning as being of utmost importance in the control of this hazard.

## Recommendations

1—Unless there is a very good reason for using the hot method of impregnation, all new installations should use the cold or solvent method of impregnation with chlorinated naphthalenes and diphenyls. Where the hot method is now being used it should be changed over to cold, if possible, or surrounded with every known protective measure.

2—General hygienic measures should be followed but in no case should these be allowed to supercede engineering control of the primary source of the exposure, the operations in the plant.

The following hygienic measures may be considered good practice where these compounds are handled.

a—Two lockers for each worker exposed to chlorinated waxes (one for working and one for street clothes).

b—All work clothes above the underwear should be provided and laundered at least twice a week by the management.

c—The workers should change to clean underwear at the end of each shift before getting into his street clothes.

d—Supervised cleaning.

1—At noon the workers should remove outer clothing and scrub hands and face under supervision.

2—At the end of the shift they should be required to take a supervised shower before changing back to street clothes.

e—Protective skin creams or protective clothing should be provided by the management at the discretion of the foreman, nurse, medical, or plant superintendent.

f—All departments handling chlorinated synthetic waxes should be thoroughly cleaned according to a prearranged schedule. This should include the removal of all deposits of waxy material from the machines, floors and surrounding objects. Workers doing the cleaning should be provided with protective clothing and supplied air or organic vapor masks where exhaust ventilation is inadequate or not possible.

3—The foremen of all departments where this



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d be apprised of the toxic- d instructed in safe hand- se men should make it their on the workers in their departments n in safe practice.

yment and periodic physical examina- be made of all exposed workers. These should include the taking of a full clinical history with special emphasis on gastro-intestinal disturbances and dermatitis. In addition, the skin should be carefully examined periodically and the more reliable liver function tests performed. Gastro-intestinal complaints developing in a worker at any time should be a signal for an immediate medical check-up. A history of liver disease, jaundice, or antisyphilitic treatment should automatically exclude a worker from jobs involving a possible toxic exposure. Pregnant women should not be employed where there is a possible exposure to the synthetic chlorinated waxes.

5—Engineering control of plant operations cannot be over-emphasized but specific recommendations are not applicable to all cases. It would be wise for a plant using this class of materials to check their control measures with the State industrial hygiene agency, the insurance carrier and some competent consultant before occupational disease occurs.


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## DETERMINATION OF BENZENE IN THE PRESENCE OF TOLUENE, XYLENE AND OTHER SUBSTANCES*

By B. H. DOLIN, M.A.

Table II illustrates the results obtained with test solutions compared by the alternative visual method of standards comparison. A series of standards corresponding to the range of 1 to 10 per cent benzene with unit intervals was first used. The color was then reproduced simultaneously with several standards of concentrations with increments corresponding to 0.1 per cent of benzene varying from the standard most closely matching the test solution. Whenever the concentration of the test solution appeared to be greater than 10 per cent benzene, the test solution was diluted tenfold with alcohol, the color redeveloped, and the comparison repeated.

The determinations listed in Tables III and IV were made with the aid of the graph in Figure 3. The errors found when differences in readings between the five- and 15-minute intervals were considerable were greatly minimized by the use of empirically derived corrections. The correction applied in Table IV as well as the final results was multiplied by 10, since the test solutions were diluted tenfold. The formula used in computation for the series in Table III was benzene % = C − (B − A − 25) 0.005; the formula used for the series in Table IV was benzene % = 10(C − (B − A − 25) 0.005). C is benzene per cent corresponding to reading B on galvanometers. B and A are as given under "Procedure."

### Accuracy and Sensitivity

The presence of petroleum naphtha, ethyl acetate, butyl acetate, isobutyl alcohol, acetone, toluene, and xylene did not interfere with the determinations of benzene in the experiments tabulated. Reasonable accuracy, with a mean error of 1.6 per cent, was attained when the intensity of color produced was matched without the aid of a colorimeter. Greater accuracy was attained with the aid of a photoelectric colorimeter where a mean error 0.9 per cent for a similar range of concentrations was in evidence. Concentrations less than 0.2 per cent benzene could not be determined with the naked eye, whereas concentrations down to 0.01 per cent benzene could be determined by the use of a photoelectric colorimeter. The errors involved at concentrations less than 0.2 per cent benzene, however, were considerable and amounted to 10 per cent at 0.05 per cent benzene and more at lower concentrations.

The 10-ml. aliquot of solution used for color development represents 0.01 ml. of the sample of 0.50 ml. taken for analysis and diluted to 100 x 5. Since 0.01 per cent benzene can be detected, the method appears to be sensitive to $1 \times 10^{-6}$ ml. or $8.8 \times 10^{-7}$ g. of benzene. By visual comparison, in the absence of a photoelectric colorimeter or when an error above 1 per cent is not permissable, the sensitivity is reduced to $2 \times 10^{-5}$ ml. or $1.8 \times 10^{-5}$ g. of benzene.

The concentration of benzene vapor in air may be determined by the above method after the vapor has been transformed from the gaseous to the liquid phase. This may be accomplished by absorbing or dissolving the vapor in petroleum naphtha or alcohol. The concentration of benzene in the resulting solution may then be determined as prescribed. Without diluting the ether extract, but using the total nitrated material in alcoholic solution, $8.8 \times 10^{-7}$ g. or 0.27 p.p.m. may be detected on a sample of one liter of air. Concentrations of $1.8 \times 10^{-6}$ g. per liter of air or 5.6 p.p.m. may be determined with an error less than 1 per cent. By sampling 10 ml. portions of air,

* Continued from page 376, September 1943 issue of *The Industrial Bulletin*.



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NAME: B F Drakenfield & Co Inc | CITY: Washington | STATE: Pa

| PRODUCT | [illegible] 1249 | | Aroclor 1262 | | Aroclor 4465 | | Aroclor 5460 | | TSP fumes | |
|---|---|---|---|---|---|---|---|---|---|---|
| YEAR | QUANTITY | AMOUNT | QUANTITY | AMOUNT | QUANTITY | AMOUNT | QUANTITY | AMOUNT | QUANTITY | AMOUNT |
| 1940 | 30 | 12.00 | 1630 | 462.00 | 25 | 34.00 | 5 | 2.00 | 100 | 3.17 |
| 1941 | — | — | 1000 | 270.00 | 2000 | 540.00 | 920 | 262.40 | 100 | 3.67 |
| 1942 | — | — | 1000 | 250.00 | 1500 | 385.00 | — | — | 100 | 3.65 |
| 1943 | — | — | — | — | — | — | — | — | — | — |
| 1944 | — | — | — | — | — | — | — | — | — | — |
| 1945 | — | — | — | — | 500 | 95.00 | — | — | — | — |
| 1946 | — | — | [illegible] | [illegible] | | | | | | |
| 1947 | | — | 6000 | 1112.00 | | | | | | |

| PRODUCT | MSP Anhy | | Phos Acid 85% Syrupy | | TSP. Med $600-150 | | TSPP Anhy. $400-100 | | | |
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| YEAR | QUANTITY | AMOUNT | QUANTITY | AMOUNT | QUANTITY | AMOUNT | QUANTITY | AMOUNT | QUANTITY | AMOUNT |
| 1940 | — | — | — | — | — | — | | | | |
| 1941 | 25 | 2.50 | 32 | 5.44 | — | — | | | | |
| 1942 | 25 | 2.50 | — | — | — | — | | | | |
| 1943 | — | — | — | — | 100 | 3.59 | | | | |
| 1944 | — | — | — | — | | — | | | | |
| 1945 | — | — | — | — | — | — | 300 | 17.25 | | |
| 1946 | — | — | | — | — | — | — | | | |
| 1947 | — | — | — | — | | | — | — | | |

ACME 30296-0

MONSANTO CHEMICAL CO.—ST. LOUIS
MASTER SALES CARD

NAME: B F Drakenfield & Co Inc | CITY: Washington | STATE: Pa

| PRODUCT | 1040-310 | | 1040-[illegible] | | [illegible] | | 3780-[illegible] | | 3780-500 | |
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| | Aroclor 1262 | | [illegible] | | [illegible] | | [illegible] | | [illegible] | |
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| 1949 | 2000 | [illegible] | 1900 | 332.00 | 10 | [illegible] | | | | |
| 1950 | 1000 | 187.50 | 1600 | [illegible] | — | — | | | | |
| 1951 | 2000 | 375.00 | 8000 | 1472.00 | — | — | | | | |
| 1952 | — | — | [illegible] | 1192.[illegible] | — | — | 50 | 10.00 | 50 | 25.00 |
| 1953 | — | — | [illegible] | 1192.[illegible] | — | — | — | | — | — |
| 1954 | | | 5000 | 925.00 | | | | | | |
| 1955 | | | | | | | | | | |

| PRODUCT | 2765-001 | | 1040-262 | | 1040-346 | | | | | |
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| | Santomerse [illegible] | | [illegible] | | [illegible] | | | | | |
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| 1950 | | | | | | | | | | |
| 1951 | | | | | | | | | | |
| 1952 | 8 | 9.60 | | | | | | | | |
| 1953 | 8 | 9.60 | 150 | 42.00 | 25 | 7.13 | | | | |
| 1954 | — | — | 100 | 28.50 | 50 | 14.25 | | | | |
| 1955 | | | | | | | | | | |

ACME 47011-8

MONSANTO CHEMICAL CO.—ST. LOUIS
MASTER SALES CARD

DSW 441783

Attachment to 19 (b)

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| 10.00 | | | | | 15. |
| | | | | 50.00 | |
| | | | | | 40. |
| 75.00 | | | | 25.00 | |
| | | | | | |

DSW 441784

STLCOPCB4056319

| sk | Dr. Clyde Milster | Johannes-Tate Pharmacy | Antles Madison St. Pharmacy | L. Weitman Prescription Pharmacy | Allen Laboratory | Beaumont Pharmacy |
|---|---|---|---|---|---|---|
| | | 143.85 | | | | |
| | | 1213.70 | | | | |
| | | 100.61 | | | | |
| | | 151.91 | | | | |
| | | 734.23 | 66.80 | | | |
| | | 157.92 | | | | |
| | | | | | | |
| | | | | | | |
| | | 138.48 | | | | |
| | | 1847.08 | | | 15.00 | |
| | 15.00 | 16.17 | | | | |
| | | 145.81 | | 6.12 | 25.00 | 156.47 |
| | 40.00 | | | | | |
| | | 121.47 | | | | |
| | | | | | | |

DSW 441785

STLCOPCB4056320

. Louis || Dr. Anthony | Dr. [illegible]

| Miscellaneous | Lost Wages | Totals Known to 12/5/66 |
|---|---|---|
| | | 485.85 |
| | | 3394.20 |
| | | 447.61 |
| | | 635.91 |
| | 192.00 | 3162.53 |
| | | 700.92 |
| 250.00 "Drugs" | 640.00 | 1811.00 |
| | | 55.00 |
| | | 432.48 |
| | 144.00 | 4335.08 |
| | 1344.00 | 1609.17 |
| | | 1281.40 |
| 100.00 Misc. Prescrpts | 96.00 | 301.00 |
| | 180.00 | 693.47 |
| 25.00 Medicine<br>75.00 Transpor-tation | | 100.00 |
| 400.00 Transpor- | | |

DSW 441786

STLCOPCB4056321

Garrett

STATE OF MISSOURI )
) SS:
COUNTY OF ST. LOUIS )

Before me, the undersigned authority, personally appeared _____ _____, who being duly sworn according to law, deposes and says that he is _____ of MONSANTO CHEMICAL COMPANY, and its duly authorized agent in this behalf; that the statements of fact set forth in the foregoing Answers to Interrogatories are true and correct to the best of his knowledge, information and belief.

_____

Sworn to and subscribed before me

this _____ day of _____, 1966.

_____
Notary Public

My Commission expires:

DSW 441787



STLCOPCB4056322

E. Curry

STATE OF MISSOURI )
) SS:
COUNTY OF ST. LOUIS )

Before me, the undersigned authority, personally appeared _____ _____, who being duly sworn according to law, deposes and says that he is _____ of MONSANTO CHEMICAL COMPANY, and its duly authorized agent in this behalf; that the statements of fact set forth in the foregoing Answers to Interrogatories are true and correct to the best of his knowledge, information and belief.

_____

Sworn to and subscribed before me

this _____ day of _____, 1966.

_____
Notary Public

My Commission expires:

DSW 441788



STLCOPCB4056323

Decter + Ritter

STATE OF MISSOURI )
) SS:
COUNTY OF ST. LOUIS )

Before me, the undersigned authority, personally appeared _____ _____, who being duly sworn according to law, deposes and says that he is _____ of MONSANTO CHEMICAL COMPANY, and its duly authorized agent in this behalf; that the statements of fact set forth in the foregoing Answers to Interrogatories are true and correct to the best of his knowledge, information and belief.

_____

Sworn to and subscribed before me

this _____ day of _____, 1966.

_____
Notary Public

My Commission expires:

DSW 441789



STLCOPCB4056324

Hard Schneider

STATE OF MISSOURI )
) SS:
COUNTY OF ST. LOUIS )

Before me, the undersigned authority, personally appeared _____ _____, who being duly sworn according to law, deposes and says that he is _____ of MONSANTO CHEMICAL COMPANY, and its duly authorized agent in this behalf; that the statements of fact set forth in the foregoing Answers to Interrogatories are true and correct to the best of his knowledge, information and belief.

_____

Sworn to and subscribed before me

this _____ day of _____, 1966.

_____
Notary Public

My Commission expires:

DSW 441790



STLCOPCB4056325

Charlotte Shoemaker

STATE OF MISSOURI )
) SS:
COUNTY OF ST. LOUIS )

Before me, the undersigned authority, personally appeared _____ _____, who being duly sworn according to law, deposes and says that he is _____ of MONSANTO CHEMICAL COMPANY, and its duly authorized agent in this behalf; that the statements of fact set forth in the foregoing Answers to Interrogatories are true and correct to the best of his knowledge, information and belief.

_____

Sworn to and subscribed before me

this _____ day of _____, 1966.

_____
Notary Public

My Commission expires:

DSW 441791



STLCOPCB4056326

Lowell Simpson

STATE OF MISSOURI )
) SS:
COUNTY OF ST. LOUIS )

Before me, the undersigned authority, personally appeared _____ _____, who being duly sworn according to law, deposes and says that he is _____ of MONSANTO CHEMICAL COMPANY, and its duly authorized agent in this behalf; that the statements of fact set forth in the foregoing Answers to Interrogatories are true and correct to the best of his knowledge, information and belief.

_____

Sworn to and subscribed before me

this _____ day of _____, 1966.

_____
Notary Public

My Commission expires:

DSW 441792



STLCOPCB4056327

Martha Sifer

STATE OF MISSOURI )
) SS:
COUNTY OF ST. LOUIS )

Before me, the undersigned authority, personally appeared _____ _____, who being duly sworn according to law, deposes and says that he is _____ of MONSANTO CHEMICAL COMPANY, and its duly authorized agent in this behalf; that the statements of fact set forth in the foregoing Answers to Interrogatories are true and correct to the best of his knowledge, information and belief.

_____

Sworn to and subscribed before me

this _____ day of _____, 1966.

_____
Notary Public

My Commission expires:

DSW 441793



STLCOPCB4056328

James A. White

STATE OF MISSOURI )
) SS:
COUNTY OF ST. LOUIS )

Before me, the undersigned authority, personally appeared _____ _____, who being duly sworn according to law, deposes and says that he is _____ of MONSANTO CHEMICAL COMPANY, and its duly authorized agent in this behalf; that the statements of fact set forth in the foregoing Answers to Interrogatories are true and correct to the best of his knowledge, information and belief.

_____

Sworn to and subscribed before me

this _____ day of _____, 1966.

_____
Notary Public

My Commission expires:

DSW 441794



STLCOPCB4056329

Thelma Hiemer

STATE OF MISSOURI )
) SS:
COUNTY OF ST. LOUIS )

Before me, the undersigned authority, personally appeared _____ _____, who being duly sworn according to law, deposes and says that he is _____ of MONSANTO CHEMICAL COMPANY, and its duly authorized agent in this behalf; that the statements of fact set forth in the foregoing Answers to Interrogatories are true and correct to the best of his knowledge, information and belief.

_____

Sworn to and subscribed before me

this _____ day of _____, 1966.

_____
Notary Public

My Commission expires:

DSW 441795



STLCOPCB4056330

Mary Ciccarelli

STATE OF MISSOURI )
) SS:
COUNTY OF ST. LOUIS )

Before me, the undersigned authority, personally appeared _____ _____, who being duly sworn according to law, deposes and says that he is _____ of MONSANTO CHEMICAL COMPANY, and its duly authorized agent in this behalf; that the statements of fact set forth in the foregoing Answers to Interrogatories are true and correct to the best of his knowledge, information and belief.

_____

Sworn to and subscribed before me

this _____ day of _____, 1966.

_____
Notary Public

My Commission expires:

DSW 441796



STLCOPCB4056331

Marie Clifford

STATE OF MISSOURI )
) SS:
COUNTY OF ST. LOUIS )

Before me, the undersigned authority, personally appeared _____ _____, who being duly sworn according to law, deposes and says that he is _____ of MONSANTO CHEMICAL COMPANY, and its duly authorized agent in this behalf; that the statements of fact set forth in the foregoing Answers to Interrogatories are true and correct to the best of his knowledge, information and belief.

_____

Sworn to and subscribed before me

this _____ day of _____, 1966.

_____
Notary Public

My Commission expires:

DSW 441797



STLCOPCB4056332

Theodore Carnevale

STATE OF MISSOURI )
) SS:
COUNTY OF ST. LOUIS )

Before me, the undersigned authority, personally appeared _____ _____, who being duly sworn according to law, deposes and says that he is _____ of MONSANTO CHEMICAL COMPANY, and its duly authorized agent in this behalf; that the statements of fact set forth in the foregoing Answers to Interrogatories are true and correct to the best of his knowledge, information and belief.

_____

Sworn to and subscribed before me

this _____ day of _____, 1966.

_____
Notary Public

My Commission expires:

DSW 441798



STLCOPCB4056333

Rita L. King

STATE OF MISSOURI )
) SS:
COUNTY OF ST. LOUIS )

Before me, the undersigned authority, personally appeared _____ _____, who being duly sworn according to law, deposes and says that he is _____ of MONSANTO CHEMICAL COMPANY, and its duly authorized agent in this behalf; that the statements of fact set forth in the foregoing Answers to Interrogatories are true and correct to the best of his knowledge, information and belief.

_____

Sworn to and subscribed before me

this _____ day of _____, 1966.

_____
Notary Public

My Commission expires:

DSW 441799



STLCOPCB4056334

Vergil A. Maness

STATE OF MISSOURI )
) SS:
COUNTY OF ST. LOUIS )

Before me, the undersigned authority, personally appeared _____ _____, who being duly sworn according to law, deposes and says that he is _____ of MONSANTO CHEMICAL COMPANY, and its duly authorized agent in this behalf; that the statements of fact set forth in the foregoing Answers to Interrogatories are true and correct to the best of his knowledge, information and belief.

_____

Sworn to and subscribed before me

this _____ day of _____, 1966.

_____
Notary Public

My Commission expires:

DSW 441800



STLCOPCB4056335

Bernie T Ford

STATE OF MISSOURI )
) SS:
COUNTY OF ST. LOUIS )

Before me, the undersigned authority, personally appeared _____ _____, who being duly sworn according to law, deposes and says that he is _____ of MONSANTO CHEMICAL COMPANY, and its duly authorized agent in this behalf; that the statements of fact set forth in the foregoing Answers to Interrogatories are true and correct to the best of his knowledge, information and belief.

_____

Sworn to and subscribed before me

this _____ day of _____, 1966.

_____
Notary Public

My Commission expires:

DSW 441801



STLCOPCB4056336

Ruth L. Ewing

STATE OF MISSOURI )
) SS:
COUNTY OF ST. LOUIS )

Before me, the undersigned authority, personally appeared _____ _____, who being duly sworn according to law, deposes and says that he is _____ of MONSANTO CHEMICAL COMPANY, and its duly authorized agent in this behalf; that the statements of fact set forth in the foregoing Answers to Interrogatories are true and correct to the best of his knowledge, information and belief.

_____

Sworn to and subscribed before me

this _____ day of _____, 1966.

_____
Notary Public

My Commission expires:

DSW 441802



STLCOPCB4056337

| Plaintiff and Case No. in Feb. Term, 1964 | Drs. Burkhart, Stryker and McKee | Dr. William Knight | Dr. James Allen | Dr. A. H. Conrad | Dr. Louis Keller |
|---|---|---|---|---|---|
| 518 Mildred<br>519 Barrett | 223.00 | 40.00 | 34.00 | 20.00 | 25.00 |
| 520 Dorothy<br>521 Berry | 2003.00 | 40.00 | | | 25.00 |
| 522 Walter F.<br>523 Miller | 257.00 | 40.00 | | | 25.0 |
| 524 Hazel<br>525 Schneider | 339.00 | 40.00 | | | 25.0 |
| 526 Charlotte<br>527 Shoemaker | 1925.00 | 102.00 | | 10.00 | |
| 528 Ronald<br>529 Simpson | 438.00 | 80.00 | | | 25.00 |
| 530 Martha<br>531 Syler | 921.00 | | | | |
| 532 James A.<br>533 White | | 40.00 | 15.00 | | |
| 534 Thelma<br>535 Wieners | 294.00 | | | | |
| 536 Mary<br>537 Chapman | 2129.00 | 40.00 | | | 25.00 |
| 538 Marie<br>539 Clifford | 161.00 | 40.00 | | 23.00 | |
| 540 Theodore<br>541 Czarnecki | 545.00 | 40.00 | | 263.00 | 50.00 |
| 542 Rita B.<br>543 King | | 40.00 | | | 25.00 |
| 544 Vergel A.<br>545 Maness | 277.00 | | 15.00 | | |
| 546 Bessie T.<br>547 Boyd | | | | | |
| 548 Ruth | | | | | |

DSW 441803

STLCOPCB4056338

STATE OF MISSOURI)
) SS
CITY OF ST. LOUIS)

IN THE CIRCUIT COURT OF THE CITY OF ST. LOUIS
STATE OF MISSOURI

| | | |
|---|---|---|
| THEODORE CZARNECKI, | ) | |
| | ) | |
| Plaintiff, | ) | |
| | ) | No. 47809 |
| vs. | ) | |
| | ) | Div. No. 1 |
| B. F. DRAKENFELD AND COMPANY, a corporation, and MONSANTO CHEMICAL COMPANY, a corporation, | ) | |
| | ) | |
| Defendants. | ) | |

ANSWER OF DEFENDANT MONSANTO CHEMICAL COMPANY TO INTERROGATORIES PROPOUNDED BY PLAINTIFF

Comes now defendant Monsanto Chemical Company and makes answers to the following interrogatories propounded by plaintiff:

1. Yes.

2. Approximately 1929.

3. Aroclors consist of the chemical elements hydrogen, carbon and chlorine. The hydrogen and carbon elements appear in two ring structures, called bi-phenyls and ter-phenyls, which can be chlorinated to varying degrees.

4. No changes in elements or structure. Degree of chlorination is varied depending on properties desired.

(a) No answer required.

5. No one can recall such a study being made prior to preparation of the first aroclors.

DSW 441804

6. Yes.

(a) Sometime prior to May, 1939.

(b) See study.

(c) See study.

(d) No answer required.

7. No one can recall such a study being made.

8. See answer to question 6. Tests have continued periodically and almost continuously in connection with newly suggested applications of the various Aroclors.

9. See answer to 7.

10. See answer to question 8.

11. Interrogatory deleted.

12. This defendant has no record of any specific research done concerning methods of prevention of injury or disease before Aroclor was first marketed. However, it was generally known that as an industrial practice, ventilation should be provided in any use of the products in which the product is volatilized. On Defendant's earliest available labels, in use from before 1947, it was recommended that prolonged skin contact be avoided, breathing of fumes and vapors be avoided, and adquate ventilation is recommended.

13. See answers to questions 8 and 10.

14. The Medical Department has searched its records and finds no record of claims against this defendant in which claimant asserted that the use of Aroclors caused the claimant

to suffer injury or disease, other than the suits described below. The Legal Department has one claim in suit (in addition to suits brought by employees of International Bent Glass.) The style of that suit is Charles Karner vs. Monsanto Chemical Company, pending in the Supreme Court of the State of New York, County of Bronx, summons issued April 12, 1962.

15. Yes. See attached copy of Monsanto Technical Bulletin No. PL-311, Revised April, 1962. Defendant published literature containing reference to the toxicity of Aroclor prior to 1940.

16. Yes.

(a) See attached photostat. Labels were generally red on white, earlier were probably black on white.

17. None other than precautions on label.

18. Yes. Advertised in "Chemical Week," "Chemical & Engineering News," a weekly trade journal, "Modern Plastics," a monthly magazine. This type of advertising has appeared periodically approximately during the past five to seven years.

19. Yes.

(a) 4465, a chlorinated ter-phenyl, and 1248, a chlorinated bi-phenyl, 1262, a chlorinated bi-phenyl.

(b) See records.

20. None, other than precautions on label.

21. Monsanto did not prepare labels for use by Drakenfeld on its finished product.

22. In making calls on B. F. Drakenfeld & Company, this defendant's salesmen undoubtedly left literature of the type referred to in this interrogatory, but there are no records available.

23. Presumably someone at Monsanto knew from the inception of sales to Drakenfeld, the general nature of Drakenfeld's use of Aroclors. A more detailed knowledge was eventually obtained through salesmen's visits to Drakenfeld. The extent of the knowledge was simply that Monsanto's representative was informed that Aroclor was used in some type of enamel or ink intended to be applied to glass for printing purposes.

24. Monsanto had no right to instruct Drakenfeld. The subjects of volatilization under heat, and the necessity for adequate ventilation, were discussed by and between Monsanto and Drakenfeld representatives. The specifics of labeling were not discussed, orally or in writing. Monsanto did not prepare, or advise in the preparation, of Drakenfeld's labels.

25. See answer to 24.

---

STATE OF MISSOURI)
) SS
CITY OF ST. LOUIS)

Elton L. French, of lawful age, being duly sworn, upon his oath, states that he is an attorney for defendant

Monsanto Chemical Company and as such is authorized to make the above and foregoing answers, and that they are true, to the best of his knowledge, information and belief.

(sgd) Elton L. French
Elton L. French

Subscribed and sworn to before me this 20 day of January, 1963.

Virginia Schroeder
Notary Public

My commission expires August 29, 1967.

Copy of the foregoing mailed this ___ day of _____, 196_, to Messrs. Guilfoil, Caruthers, Symington & Montrey, Attorneys for Plaintiff, 430 Paul Brown Building, St. Louis 1, Missouri, and to Messrs. Gray & Jeans, Attorneys for Codefendant, 721 Olive Street, St. Louis 1, Missouri.

_____
M. E. Stokes
MOSER, MARSALEK, CARPENTER, CLEARY & JAECKEL
Attorneys for Defendant Monsanto
Chemical Company
330 Pierce Building
St. Louis 2, Missouri
GArfield 1-5364

gt

DSW 441808

STLCOPCB4056343

The Corporation Trust Company
C T Corporation System
and Associated Companies

SERVICE OF PROCESS TRANSMITTAL FORM

St. Louis, Missouri
(City) (State)

June 17, 1963
(Date)

(xxx) VIA CERTIFIED MAIL
( ) VIA CERTIFIED AIR MAIL
( ) VIA MESSENGER

TO: Mr. E. J. Putzell, Jr.
c/o Monsanto Chemical Company
800 North Lindbergh Boulevard
St. Louis 66, Missouri

RE: **PROCESS SERVED IN THE STATE OF** MISSOURI

FOR MONSANTO CHEMICAL COMPANY (Name of Company) DELAWARE (Home State)

Enclosed are copies of legal process served upon the statutory agent of the above company as follows:

1. Title of Action: Vergel A. Maness vs. B. F. Drakenfeld and Company and Monsanto Chemical Company
2. Document(s) Served: Summons and Petition
3. Court: Circuit Court, City of St. Louis, Missouri No. 56079 E, Division 1
4. Nature of Action: Damages for alleged personal injuries - two Counts - amount each Count $45,000.00
5. On Whom Process was Served: C T Corporation System, St. Louis, Missouri
6. Date and Hour of Service: June 17, 1963 at 11:00 a.m.
7. Appearance or Answer Due: Within 30 days after service
8. Plaintiff's Attorney(s): Guilfoil, Caruthers, Symington & Montrey
430 Paul Brown Building
St. Louis 1, Missouri
9. Remarks:

FFB:jm

KINDLY ACKNOWLEDGE RECEIPT BY SIGNING AND RETURNING TO US THE ENCLOSED CARBON COPY OF THIS TRANSMITTAL FORM.

Signed C T CORPORATION SYSTEM

Per [signature]

Address 314 North Broadway
St. Louis, Missouri

NJ290-Y 1-62 50M Sets

DSW 441809

STLCOPCB4056344

STATE OF MISSOURI )
) ss.
CITY OF ST. LOUIS )

IN THE CIRCUIT COURT OF THE CITY OF ST. LOUIS,

STATE OF MISSOURI

| | | |
|---|---|---|
| VERGEL A. MANESS, Plaintiff, | ) | |
| vs. | ) | |
| B. F. DRAKENFELD AND COMPANY, a corporation, 45 Park Place, New York 7, N.Y., Serve: Secretary of State, Jefferson City, Missouri, | ) | Cause No. |
| and | ) | Division No. |
| MONSANTO CHEMICAL COMPANY, a corporation, Serve: C. T. Corporation Service, 314 No. Broadway, St. Louis 2, Missouri, Defendants. | ) | |

P E T I T I O N

COUNT I

Plaintiff, for cause of action in Count I of this petition, states:

(1) Defendant B. F. Drakenfeld and Company (hereinafter called "Drakenfeld") is and was a foreign corporation duly organized and existing under law at all times hereinafter mentioned; as hereinafter more particularly alleged, Drakenfeld has committed a tort against the person of plaintiff, in the

DSW 441810

STLCOPCB4056345

City of St. Louis, State of Missouri, and has thereby agreed that the Secretary of State of Missouri shall be its agent for the service of process, all as is provided in V.A.M.S., 1949, Section 351.630.

(2) Defendant Monsanto Chemical Company (hereinafter called "Monsanto") is and at all times hereinafter mentioned was a corporation organized and existing under the laws of the State of Delaware, having a registered agent and office in the City of St. Louis, State of Missouri, and having its principal place of business in the State of Missouri.

(3) Defendant Drakenfeld is engaged in the business of manufacturing, preparing and distributing into the channels of trade paints and enamels, and among the various products so distributed by said defendant is an enamel known as 24-018 enamel in 487 oil.

(4) Defendant Monsanto is engaged in the business of manufacturing and preparing chemicals, chemical products, oils and thinners and distributing said products into the channels of trade, and among the various products so manufactured and distributed by said defendant is the product known as Aroclor 4465.

(5) Defendant Drakenfeld prepares the aforesaid product 24-018 enamel in 487 oil by combining various other materials with Monsanto's product Aroclor 4465.

(6) Both defendants herein did know and intend that said products would be used by the consuming public and would be

handled, dealt with, touched and the fumes thereof would be inhaled by the public, and both defendants placed said products in the channels of trade with such knowledge and intention.

(7) Both defendants herein did impliedly warrant and represent that the products 24-018 enamel in 487 oil and Aroclor 4465 were fit and safe for such use by the public; but both defendants and each defendant knew that such products contained chlorinated biphenyls and chlorinated triphenyls, with a high amount of chlorination; said defendants, and each of them, knew that said products would from time to time be heated or baked in ovens, and that use by the public of said products was likely to cause liver damage, skin eruptions, rashes, acne, cysts and dermatitis of various kinds.

(8) Plaintiff, beginning in the year 1958 began to make use of said products in his employment with International Bent Glass Company, Inc. at St. Louis, Missouri, handling such products, touching the same, and inhaling the fumes thereof, all in reliance on the skill and judgment and aforesaid warranty of both defendants, being wholly unaware of the toxic and dangerous qualities of such products.

(9) After a period of such use of such products, the same, contrary to and in breach of the warranty of both defendants, directly and proximately caused plaintiff to become ill and diseased, in that plaintiff suffered eruptions of plaintiff's skin over and about plaintiff's neck, shoulders, chest, back, buttocks, face, ears and eyelids, said areas have become covered

with comedones, cysts, acne, infectious lesions, papules and a condition known as chloracne; plaintiff's eyelids and periorbital skin became erythematous, edematous and scaly; plaintiff's liver was injured, damaged and diseased; these conditions are painful, irritating and embarrassing; all of said conditions are permanent.

(10) Plaintiff has become obligated for large sums of money for medical attention for the aforesaid conditions and will become obligated for additional such sums in the future, in an amount not now ascertainable.

WHEREFORE, the premises considered, plaintiff prays judgment against the defendants and each of them, on this Count I of the petition for Forty-Five Thousand Dollars ($45,000.00), and for plaintiff's costs.

COUNT II

Plaintiff, for cause of action in Count II of this petition, states:

(1) Plaintiff restates and realleges each and every allegation in paragraphs (1), (2), (3), (4), (5) and (6) of Count I of this petition.

(2) Both defendants and each of them knew, or in the exercise of ordinary care should have known that said products, containing highly chlorinated biphenyls and triphenyls, are, and for many years have been, known to be of a toxic and dangerous nature in that they were reasonably likely to cause abnormal reactions, skin eruptions, rashes, liver damage, dermatitis and diseases, and defendants and each of them were under a duty to

give an adequate warning of such dangers and risks to the public who used such products, but both defendants and each of them negligently breached said duty by failing and omitting to give an adequate warning of such dangers and risks.

(3) Plaintiff began to make use of such products in 1958 in his employment at St. Louis, Missouri, with International Bent Glass Company, and as a direct and proximate result of the defendants' negligence, plaintiff was injured in thoseparticulars alleged hereinabove in Count I, paragraph (9).

(4) Plaintiff restates and realleges each and every allegation in Count I, paragraph (10).

WHEREFORE, the premises considered, plaintiff prays judgment on this Count II of this petition against the defendants, and each of them, in the sum of Forty-Five Thousand Dollars ($45,000.00) and for his costs.

GUILFOIL, CARUTHERS, SYMINGTON
AND MONTREY

By Rexford H. Caruthers

Rexford H. Caruthers
430 Paul Brown Building
St. Louis 1, Missouri
GArfield 1-2777
ATTORNEYS FOR PLAINTIFF

DSW 441814

STLCOPCB4056349

Form No. 75

# Circuit Court for the City of St. Louis

State of Missouri

Vergel A. Maness

Plaintiff

vs.

B. F. Drakenfeld and Co., et al

Defendant

No. 56079 E

Div. 1

## SUMMONS

The State of Missouri to Defendant Monsanto Chemical Company, a Corporation

You are hereby summoned to appear before the above-named court and to file your pleading to the petition, copy of which is attached hereto, and to serve a copy of your pleading upon

Guilfoil, Caruthers, Symington, et al attorneys for plaintiff,

whose address is 430 Paul Brown Bldg.

all within 30 days after service of this summons upon you, exclusive of the day of service. If you fail to do so, judgment by default will be taken against you for the relief demanded in the petition.

Dated June 12, 19 63

PHELIM O'TOOLE
Circuit Clerk.

By D. White
Deputy Clerk.

(Seal of Circuit Court)

DSW 441815

041000

STLCOPCB4056350

# RETURN ON SERVICE OF SUMMONS

I hereby certify that I have served the within summons:

(1) By delivering on the.....day of....., 19.....

a copy of the summons and a copy of the petition to each of the within-named defendants.....

.....

.....

.....

(2) By leaving on the.....day of....., 19.....

for each of the within-named defendants.....

.....

.....

a copy of the summons and a copy of the petition at the respective dwelling place or usual place of abode of said defendants with some person of his or her family over the age of 15 years;

(3) By.....

.....

.....

.....

.....

All done in.....County, Missouri.

Sheriff's fees:

Summons.....$

Non est.....$

Mileage.....$_____

Total.....$

.....

Sheriff of.....County, Missouri.

By.....

Deputy Sheriff.

**DIRECTIONS TO SHERIFF**

A copy of the summons and a copy of the petition must be served on each defendant. For methods of service in all classes of suits see Sec. 27 Civil Code.

No. 56079 E

Div. 1

**SUMMONS**

Civil Code, Form No. 1

In the Case of

.....

Plaintiff.....

vs.

[illegible]

[illegible]

Defendant.....

In the Circuit Court of the

City of St. Louis

STATE OF MISSOURI

DSW 441816

The Corporation Trust Company
C T Corporation System
and Associated Companies

SERVICE OF PROCESS TRANSMITTAL FORM

St. Louis, Missouri
(City) (State)

June 17, 1963
(Date)

(xxxx) VIA CERTIFIED MAIL
( ) VIA CERTIFIED AIR MAIL
( ) VIA MESSENGER

TO: Mr. E. J. Putzell, Jr.
c/o Monsanto Chemical Company
800 North Lindbergh Boulevard
St. Louis 66, Missouri

RE: **PROCESS SERVED IN THE STATE OF** MISSOURI

FOR MONSANTO CHEMICAL COMPANY (Name of Company) DELAWARE (Home State)

Enclosed are copies of legal process served upon the statutory agent of the above company as follows:

1. Title of Action: James A. White vs. B. F. Drakenfeld and Company and Monsanto Chemical Company
2. Document(s) Served: Summons and Petition
3. Court: Circuit Court, City of St. Louis, Missouri
   No. 56080 E, Division 1
4. Nature of Action: Damages for alleged personal injuries - two Counts-
   Amount each County $45,000.00
5. On Whom Process was Served: C T Corporation System, St. Louis, Missouri
6. Date and Hour of Service: June 17, 1963 at 11:00 a.m.
7. Appearance or Answer Due: Within 30 days after service
8. Plaintiff's Attorney(s): Guilfoil, Caruthers, Symington and Montrey
   430 Paul Brown Building
   St. Louis 1, Missouri
9. Remarks:

FFB:jm

KINDLY ACKNOWLEDGE RECEIPT BY SIGNING AND RETURNING TO US THE ENCLOSED CARBON COPY OF THIS TRANSMITTAL FORM.

Signed C T CORPORATION SYSTEM
Per [signature]
Address 314 North Broadway
St. Louis, Missouri

NJ290-Y 1-62 50M Se

DSW 441817

STLCOPCB4056352

STATE OF MISSOURI )
) ss.
CITY OF ST. LOUIS )

IN THE CIRCUIT COURT OF THE CITY OF ST. LOUIS,

STATE OF MISSOURI

| | | |
|---|---|---|
| JAMES A. WHITE, | ) | |
| Plaintiff, | ) | |
| vs. | ) | |
| B. F. DRAKENFELD AND COMPANY, a corporation, 45 Park Place, New York 7, N.Y., Serve: Secretary of State, Jefferson City, Missouri, | ) | Cause No. |
| | ) | Division No. |
| and | ) | |
| MONSANTO CHEMICAL COMPANY, a corporation, Serve: C. T. Corporation Service, 314 No. Broadway, St. Louis 2, Missouri, | ) | |
| Defendants. | ) | |

P E T I T I O N

COUNT I

Plaintiff, for cause of action in Count I of this petition, states:

(1) Defendant B. F. Drakenfeld and Company (hereinafter called "Drakenfeld") is and was a foreign corporation duly organized and existing under law at all times hereinafter mentioned; as hereinafter more particularly alleged, Drakenfeld has committed a tort against the person of plaintiff, in the

DSW 441818

STLCOPCB4056353

City of St. Louis, State of Missouri, and has thereby agreed that the Secretary of State of Missouri shall be its agent for the service of process, all as is provided in V.A.M.S., 1949, Section 351.630.

(2) Defendant Monsanto Chemical Company (hereinafter called "Monsanto") is and at all times hereinafter mentioned was a corporation organized and existing under the laws of the State of Delaware, having a registered agent and office in the City of St. Louis, State of Missouri, and having its principal place of business in the State of Missouri.

(3) Defendant Drakenfeld is engaged in the business of manufacturing, preparing and distributing into the channels of trade paints and enamels, and among the various products so distributed by said defendant is an enamel known as 24-018 enamel in 487 oil.

(4) Defendant Monsanto is engaged in the business of manufacturing and preparing chemicals, chemical products, oils and thinners and distributing said products into the channels of trade, and among the various products so manufactured and distributed by said defendant is the product known as Aroclor 4465.

(5) Defendant Drakenfeld prepares the aforesaid product 24-018 enamel in 487 oil by combining various other materials with Monsanto's product Aroclor 4465.

(6) Both defendants herein did know and intend that said products would be used by the consuming public and would be

handled, dealt with, touched and the fumes thereof would be inhaled by the public, and both defendants placed said products in the channels of trade with such knowledge and intention.

(7) Both defendants herein did impliedly warrant and represent that the products 24-018 enamel in 487 oil and Aroclor 4465 were fit and safe for such use by the public; but both defendants and each defendant knew that such products contained chlorinated biphenyls and chlorinated triphenyls, with a high amount of chlorination; said defendants, and each of them, knew that said products would from time to time be heated or baked in ovens, and that use by the public of said products was likely to cause liver damage, skin eruptions, rashes, acne, cysts and dermatitis of various kinds.

(8) Plaintiff, beginning in the year 1958 began to make use of said products in his employment with International Bent Glass Company, Inc. at St. Louis, Missouri, handling such products, touching the same, and inhaling the fumes thereof, all in reliance on the skill and judgment and aforesaid warranty of both defendants, being wholly unaware of the toxic and dangerous qualities of such products.

(9) After a period of such use of such products, the same, contrary to and in breach of the warranty of both defendants, directly and proximately caused plaintiff to become ill and diseased, in that plaintiff suffered eruptions of plaintiff's skin over and about plaintiff's neck, shoulders, chest, back, buttocks, face, ears and eyelids, said areas have become covered

with comedones, cysts, acne, infecticus lesions, papules and a condition known as chloracne; plaintiff's eyelids and periorbital skin became erythematous, edematous and scaly; plaintiff's liver was injured, damaged and diseased; these conditions are painful, irritating and embarrassing; all of said conditions are permanent.

(10) Plaintiff has become obligated for large sums of money for medical attention for the aforesaid conditions and will become obligated for additional such sums in the future, in an amount not now ascertainable.

WHEREFORE, the premises considered, plaintiff prays judgment against the defendants and each of them, on this Count I of the petition for Forty-Five Thousand Dollars ($45,000.00), and for plaintiff's costs.

COUNT II

Plaintiff, for cause of action in Count II of this petition, states:

(1) Plaintiff restates and realleges each and every allegation in paragraphs (1), (2), (3), (4), (5) and (6) of Count I of this petition.

(2) Both defendants and each of them knew, or in the exercise of ordinary care should have known that said products, containing highly chlorinated biphenyls and triphenyls, are, and for many years have been, known to be of a toxic and dangerous nature in that they were reasonably likely to cause abnormal reactions, skin eruptions, rashes, liver damage, dermatitis and diseases, and defendants and each of them were under a duty to give an adequate warning of such dangers and risks to the public

who used such products, but both defendants and each of them negligently breached said duty by failing and omitting to give an adequate warning of such dangers and risks.

(3) Plaintiff began to make use of such products in 1958 in his employment at St. Louis, Missouri, with International Bent Glass Company, and as a direct and proximate result of the defendants' negligence, plaintiff was injured in those particulars alleged hereinabove in Count I, paragraph (9).

(4) Plaintiff restates and realleges each and every allegation in Count I, paragraph (10).

WHEREFORE, the premises considered, plaintiff prays judgment on this Count II of this petition against the defendants, and each of them, in the sum of Forty-Five Thousand Dollars ($45,000.00) and for his costs.

GUILFOIL, CARUTHERS, SYMINGTON
AND MONTREY

By _____
Rexford H. Caruthers
430 Paul Brown Building
St. Louis 1, Missouri
GArfield 1-2777
ATTORNEYS FOR PLAINTIFF

DSW 441822

STLCOPCB4056357

Form No. 75

# Circuit Court for the City of St. Louis

State of Missouri

James A. White

Plaintiff

vs.

B. F. Drakenfeld & Co., et al

Defendant

No. 56080 E

Div. 1

## SUMMONS

The State of Missouri to Defendant Monsanto Chemical Company, a Corp.

You are hereby summoned to appear before the above-named court and to file your pleading to the petition, copy of which is attached hereto, and to serve a copy of your pleading upon

Guilfoil, Caruthers, Symington, et al attorneys for plaintiff,

whose address is 430 Paul Brown Bldg.

all within 30 days after service of this summons upon you, exclusive of the day of service. If you fail to do so, judgment by default will be taken against you for the relief demanded in the petition.

Dated June 12, 19 63

PHELIM O'TOOLE
Circuit Clerk.

By [signature]
Deputy Clerk.

(Seal of Circuit Court)

DSW 441823

STLCOPCB4056358

# RETURN ON SERVICE OF SUMMONS

I hereby certify that I have served the within summons:

(1) By delivering on the.....day of....., 19..

a copy of the summons and a copy of the petition to each of the within-named defendants.....

.....

.....

.....

(2) By leaving on the.....day of....., 19.....

for each of the within-named defendants.....

.....

.....

a copy of the summons and a copy of the petition at the respective dwelling place or usual place of abode of said defendants with some person of his or her family over the age of 15 years;

(3) By.....

.....

.....

.....

.....

All done in.....County, Missouri.

Sheriff's fees:

Summons.....$

Non est.....$

Mileage.....$

Total.....$

Sheriff of.....County, Missouri.

By.....
Deputy Sheriff.

DIRECTIONS TO SHERIFF

A copy of the summons and a copy of the petition must be served on each defendant. For methods of service in all classes of suits see Sec. 27 Civil Code.

DSW 441824

No. 56080 E

Div. 1

SUMMONS

Civil Code, Form No. 1

In the Case of

.....

.....Plaintiff.....

vs.

Dramatic Chemical Co

.....Defendant.....

In the Circuit Court of the

City of St. Louis

STATE OF MISSOURI

STLCOPCB4056359

JOHN F. EVANS
JOHN R. DIXON
WM. W. EVANS
JAMES V. GALLEN
JOHN C. SHEPHERD
EDWARD W. WARNER
RALPH C. KLEINSCHMIDT
EUGENE K. BUCKLEY

ROBERT M. EVANS
HENRY D. MENGHINI
PAUL V. GILBERT
ALBERT J. SEIER
ROBERT J. ROBINSON

EVANS & DIXON
ATTORNEYS AT LAW
COTTON BELT BUILDING
III NORTH FOURTH STREET
SAINT LOUIS

October 25, 1962

Monsanto Chemical Company
800 North Lindbergh Boulevard
Saint Louis 41, Missouri

D. F. Drakenfeld and Company
45 Park Place
New York 7, New York

Re: Virgil Maness vs International Bent Glass Company
(Virgil Maness, International Bent Glass Company and United States Casualty Company vs Monsanto Chemical Company and D.F. Drakenfeld and Company)

Gentlemen:

This is to advise that this firm represents the employer and insurer in the above styled action, wherein Virgil Maness, an employee of International Bent Glass Company, asserts he sustained injury and damages as a result of an exposure or contact with certain chemical products, all by reason of the negligence of the Monsanto Chemical Company and D. F.Drakenfeld and Company.

Under Missouri statutes, the employer and insurer are subrogated to the extent of any compensation or the expense of any medical aid paid to or on behalf of the employee under our Workmen's Compensation statutes. This subrogation right extends to the recovery on the part of the employee against any third party, by reason of suit or settlement.

Kindly consider this letter a lien against any possible recovery on the part of Mr. Maness as noted, and acknowledge receipt of same.

Thank you for your cooperation.

Yours very truly,

Edward W. Warner

EWW:mm
CC: Moser,Marsalek,et al,Attorneys at Law,330 Pierce Bldg.,St. Louis 2,Mo.
~~CC: Carothers and Monfrey,Attorneys at Law,818 Olive St.,St. Louis 1, Mo.~~
CC: U.S.Casualty Company,Western Dept.,175 West Jackson Blvd.,Chicago 4,Il

DSW 441825

JOHN F. EVANS
JOHN R. DIXON
WM. W. EVANS
JAMES V. GALLEN
JOHN C. SHEPHERD
EDWARD W. WARNER
RALPH C. KLEINSCHMIDT
EUGENE K. BUCKLEY

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PAUL V. GILBERT

EVANS & DIXON
ATTORNEYS AT LAW
COTTON BELT BUILDING
111 NORTH FOURTH STREET
SAINT LOUIS

MAIN 1-7755

October 25, 1962

Monsanto Chemical Company
800 North Lindbergh Boulevard
St. Louis 41, Missouri

D. F. Drakenfeld and Company
45 Park Place
New York 7, New York

RE: Mary Chapman vs. International Bent Glass Company (Mary Chapman, International Bent Glass Company and United States Casualty Company vs. Monsanto Chemical Company and D. F. Drakenfeld and Company)

Gentlemen:

This is to advise that this firm represents the employer and insurer in the above styled action, wherein Mary Chapman, an employee of International Bent Glass Company, asserts she sustained injury and damages as a result of an exposure or contact with certain chemical products, all by reason of the negligence of the Monsanto Chemical Company and D. F. Drakenfeld and Company.

Under Missouri statutes, the employer and insurer are subrogated to the extent of any compensation or the expense of any medical aid paid to or on behalf of the employee under our Workmen's Compensation statutes. This subrogation right extends to the recovery on the part of the employee against any third party, by reason of suit or settlement.

Kindly consider this letter a lien against any possible recovery on the part of Mrs. Chapman as noted, and acknowledge receipt of same.

Thank you for your cooperation.

Yours very truly,

Edward W. Warner

EWW-vbp

CC- Moser, Marsalek, et al, Attys. at Law, 330 Pierce Bldg.St. Louis 2,Mo.
CC- Caruthers and Montrey, Attys. at Law, 818 Olive St.,St. Louis 1, Mo.
CC- U. S. Casualty Company, Western Dept., 175 West Jackson Blvd., Chicago 4, Illinois.

JOHN F. EVANS
JOHN R. DIXON
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EVANS & DIXON
ATTORNEYS AT LAW
COTTON BELT BUILDING
III NORTH FOURTH STREET
SAINT LOUIS

MAIN 1-7755

October 25, 1962

Monsanto Chemical Company
800 North Lindbergh Boulevard
St. Louis 41, Missouri

D. F. Drakenfeld and Company
45 Park Place
New York 7, New York

RE: Martha Syler vs. International Bent Glass Company (Martha Syler, International Bent Glass Company and United States Casualty Company vs. Monsanto Chemical Company and D. F. Drakenfeld and Company)

Gentlemen:

This is to advise that this firm represents the employer and insurer in the above styled action, wherein Martha Syler, an employee of International Bent Glass Company, asserts she sustained injury and damages as a result of an exposure or contact with certain chemical products, all by reason of the negligence of the Monsanto Chemical Company and D. F. Drakenfeld and Company.

Under Missouri statutes, the employer and insurer are subrogated to the extent of any compensation or the expense of any medical aid paid to or on behalf of the employee under our Workmen's Compensation statutes. This subrogation right extends to the recovery on the part of the employee against any third party, by reason of suit or settlement.

Kindly consider this letter a lien against any possible recovery on the part of Mrs. Syler as noted, and acknowledge receipt of same.

Thank you for your cooperation.

Yours very truly,

Edward W. Warner

EWW-vbp

CC-Moser, Marsalek, et al, Attys. at Law, 330 Pierce Bldg. St. Louis 2, Mo
CC-Caruthers and Montrey, Attys. at Law, 818 Olive St., St. Louis 1, Mo.
CC-U. S. Casualty Company, Western Dept., 175 West Jackson Blvd., Chicago 4, Illinois.

JOHN F. EVANS
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ROBERT J. ROBINSON

EVANS & DIXON
ATTORNEYS AT LAW
COTTON BELT BUILDING
III NORTH FOURTH STREET
SAINT LOUIS

MAIN 1-7755

October 25, 1962

Mnnsanto Chemical Company
800 North Lindbergh Boulevard
Saint Louis 41, Missouri

D.F.Drakenfeld and Company
45 Park Place
New York 7, New York

Re: Charlotte Shoemaker vs International Bent Glass Company
(Charlotte Shoemaker, International Bent Glass Company and United States Casualty Company vs Monsanto Chemical Company and D. F.Drakenfeld and Company)

Gentlemen:

This is to advise that this firm represents the employer and insurer in the above styled action, wherein Charlotte Shoemaker, an employee of International Bent Glass Company, asserts she sustained injury and damages as a result of an exposure or contact with certain chemical products, all by reason of the negligence of the Monsanto Chemical Company, and D. F. Drakenfeld and Company.

Under Missouri statutes, the employer and insurer are subrogated to the extent of any compensation or the expense of any medical aid paid to or on behalf of the employee under our Workmen's Compensation statutes. This subrogation right extends to the recovery on the part of the employee against any third party, by reason of suit or settlement.

Kindly consider this letter a lien against any possible recovery on the part of Mrs. Shoemaker as noted, and acknowledge receipt of same.

Thank you for your cooperation.

Yours very truly,

Edward W.Warner

EWW:mm
cc: Moser,Marsalek,et al,Attorneys at Law,330 Pierce Bldg.,St. Louis 2, Mo.
cc: Caruthers and Montrey, Attorneys at Law,818 Olive St., St. Louis 1, Mo.
cc: U.S. Casualty Company,Western Dept.,175 West Jackson Blvd.,Chicago 4,Il.

JOHN F. EVANS
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ATTORNEYS AT LAW
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111 NORTH FOURTH STREET
SAINT LOUIS

MAIN 1-7755

October 25, 1962

Monsanto Chemical Company
800 North Lindbergh Boulevard
St. Louis 41, Missouri

D. F. Drakenfeld and Company
45 Park Place
New York 7, New York

RE: Ronald Simpson vs. International Bent Glass Company (Ronald Simpson, International Bent Glass Company and United States Casualty Company vs. Monsanto Chemical Company and D. F. Drakenfeld and Company)

Gentlemen:

This is to advise that this firm represents the employer and insurer in the above styled action, wherein Ronald Simpson, an employee of International Bent Glass Company, asserts he sustained injury and damages as a result of an exposure or contact with certain chemical products, all by reason of the negligence of the Monsanto Chemical Company and D. F. Drakenfeld and Company.

Under Missouri statutes, the employer and insurer are subrogated to the extent of any compensation or the expense of any medical aid paid to or on behalf of the employee under our Workmen's Compensation statutes. This subrogation right extends to the recovery on the part of the employee against any third party, by reason of suit or settlement.

Kindly consider this letter a lien against any possible recovery on the part of Mr. Simpson as noted, and acknowledge receipt of same.

Thank you for your cooperation.

Yours very truly,

Edward W. Warner

EWW-vbp

CC- Moser, Marsalek, et al, Attys. at Law, 330 Pierce Bldg. St.Louis 2,Mo.
CC- Caruthers and Montrey, Attys. at Law, 818 Olive St., St. Louis 1, Mo.
CC- U. S. Casualty Company, Western Dept., 175 West Jackson Blvd., Chicago 4, Illinois

DSW 441829

JOHN F. EVANS
JOHN R. DIXON
WM. W. EVANS
JAMES V. GALLEN
JOHN C. SHEPHERD
EDWARD W. WARNER
RALPH C. KLEINSCHMIDT
EUGENE K. BUCKLEY

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ROBERT J. ROBINSON

EVANS & DIXON
ATTORNEYS AT LAW
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111 NORTH FOURTH STREET
SAINT LOUIS

MAIN 1-7755

October 25, 1962

Monsanto Chemical Company
800 North Lindbergh Boulevard
Saint Louis 41, Missouri

D. F. Drakenfeld and Company
45 Park Place
New York 7, New York

Re: Mildred Barrett vs. International Bent Glass Company (Mildred Barrett, International Bent Glass Company and United States Casualty Company vs. Monsanto Chemical Company and D. F. Drakenfeld and Company)

Gentlemen:

This is to advise that this firm represents the employer and insurer in the above-styled action, wherein Mildred Barrett, an employee of International Bent Glass Company, asserts she sustained injury and damages as a result of an exposure or contact with certain chemical products, all by reason of the negligence of the Monsanto Chemical Company and D. F. Drakenfeld and Company.

Under Missouri statutes, the employer and insurer are subrogated to the extent of any compensation or the expense of any medical aid paid to or on behalf of the employee under our Workmen's Compensation statutes. This subrogation right extends to the recovery on the part of the employee against any third party, by reason of suit or settlement.

Kindly consider this letter a lien against any possible recovery on the part of Mrs. Barrett as noted, and acknowledge receipt of same. Thank you for your cooperation.

Yours very truly,

Edward W. Warner

EWW:dl
cc: Moser, Marsalek, et al., Attorneys at Law, 330 Pierce Bldg. (2)
cc: Caruthers and Montrey, Attorneys at Law, 818 Olive Street (1)
cc: U. S. Casualty Company, Western Department, 175 West Jackson Blvd., Chicago 4, Ill.

JOHN F. EVANS
JOHN R. DIXON
WM. W. EVANS
JAMES V. GALLEN
JOHN C. SHEPHERD
EDWARD W. WARNER
RALPH C. KLEINSCHMIDT
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ROBERT J. ROBINSON

EVANS & DIXON
ATTORNEYS AT LAW
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111 NORTH FOURTH STREET
SAINT LOUIS

MAIN 1-7755

October 25, 1962

Monsanto Chemical Company
800 North Lindbergh Boulevard
St. Louis 41, Missouri

D. F. Drakenfeld and Company
45 Park Place
New York 7, New York

Gentlemen:

Re: Anna Marie Clifford vs. International Bent Glass Company (Anna Marie Clifford, International Bent Glass Company and United States Casualty Company vs. Monsanto Chemical Company and D. F. Drakenfeld and Company)

This is to advise that this firm represents the employer and insurer in the above-styled action, wherein Anna Marie Clifford, an employee of International Bent Glass Company, asserts she sustained injury and damages as a result of an exposure or contact with certain chemical products, all by reason of the negligence of the Monsanto Chemical Company and D. F. Drakenfeld and Company.

Under Missouri statutes, the employer and insurer are subrogated to the extent of any compensation or the expense of any medical aid paid to or on behalf of the employee under our Workmen's Compensation statutes. This subrogation right extends to the recovery on the part of the employee against any third party, by reason of suit or settlement.

Kindly consider this letter a lien against any possible recovery on the part of Mrs. Clifford as noted, and acknowledge receipt of same.

Thank you for your cooperation.

DSW 441831

Yours very truly,

Edward W. Warner

EWW:nl
cc: Moser, Marsalek, et al., Attys. at Law, 330 Pierce Bldg.,St.L.(2)
cc: Caruthers & Montrey, Attys. at Law, 818 Olive St.,St. Louis 1, Mo.
cc: U. S. Casualty Co., Western Dept., 175 W. Jackson Blvd., Chicago 4, Illinois

JOHN F. EVANS
JOHN R. DIXON
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SAINT LOUIS

MAIN 1-7755

October 25, 1962

Monsanto Chemical Company
800 North Lindbergh Boulevard
St. Louis 41, Missouri

D. F. Drakenfeld and Company
45 Park Place
New York 7 New York

Gentlemen:

Re: Ted Czarnecki vs. International Bent Glass Company (Ted Czarnecki, International Bent Glass Company and United States Casualty Company vs. Monsanto Chemical Company and D. F. Drakenfeld and Company

This is to advise that this firm represents the employer and insurer in the above-styled action, wherein Ted Czarnecki, an employee of International Bent Glass Company, asserts he sustained injury and damages as a result of an exposure or contact with certain chemical products, all by reason of the negligence of the Monsanto Chemical Company and D. F. Drakenfeld and Company.

Under Missouri statutes, the employer and insurer are subrogated to the extent of any compensation or the expense of any medical aid paid to or on behalf of the employee under our Workmen's Compensation statutes. This subrogation right extends to the recovery on the part of the employee against any third party, by reason of suit or settlement.

Kindly consider this letter a lien against any possible recovery on the part of Mr. Czarnecki as noted, and acknowledge receipt of same.

Thank you for your cooperation.

DSW 441832

Yours very truly,

Edward W. Warner

EWW:nl
cc: Moser, Marsalek, et al., Attys. at Law, 330 Pierce Bldg.,St.L.(2)
cc: Caruthers & Montrey, Attys. at Law, 818 Olive St.,St. Louis 1, Mo.
cc: U. S. Casualty Co., Western Dept., 175 W. Jackson Blvd.,Chicago 4, Illinois

JOHN F. EVANS
JOHN R. DIXON
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EVANS & DIXON
ATTORNEYS AT LAW
COTTON BELT BUILDING
111 NORTH FOURTH STREET
SAINT LOUIS

MAIN 1-7755

October 25, 1962

Monsanto Chemical Company
800 North Lindbergh Boulevard
St. Louis 41, Missouri

D. F. Drakenfeld and Company
45 Park Place
New York 7, New York

Gentlemen:

Re: Dorotha Berry vs. International Bent Glass Company (Dorotha Berry, International Bent Glass Company and United States Casualty Company vs. Monsanto Chemical Company and D. F. Drakenfeld and Company)

This is to advise that this firm represents the employer and insurer in the above-styled action, wherein Dorotha Berry, an employee of International Bent Glass Company, asserts she sustained injury and damages as a result of an exposure or contact with certain chemical products, all by reason of the negligence of the Monsanto Chemical Company and D. F. Drakenfeld and Company.

Under Missouri statutes, the employer and insurer are subrogated to the extent of any compensation or the expense of any medical aid paid to or on behalf of the employee under our Workmen's Compensation statutes. This subrogation right extends to the recovery on the part of the employee against any third party, by reason of suit or settlement.

Kindly consider this letter a lien against any possible recovery on the part of Mrs. Berry as noted, and acknowledge receipt of same. Thank you for your cooperation.

Yours very truly,

Edward W. Warner

EWW:nl
cc: Moser, Marsalek, et al., Attys. at Law, 330 Pierce Bldg., St. L. 2,Mo.
cc: Caruthers and Montrey, Attys. at Law, 818 Olive Street, St. L. 1, Mo.
cc: U. S. Casualty Co., Western Department, 175 West Jackson Blvd., Chicago 4, Illinois

JOHN F. EVANS
JOHN R. DIXON
WM. W. EVANS
JAMES V. GALLEN
JOHN C. SHEPHERD
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RALPH C. KLEINSCHMIDT
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ROBERT J. ROBINSON

EVANS & DIXON
ATTORNEYS AT LAW
COTTON BELT BUILDING
III NORTH FOURTH STREET
SAINT LOUIS

MAIN 1-7755

October 25, 1962

Monsanto Chemical Company
800 North Lindbergh Boulevard
Saint Louis 41, Missouri

D. F. Drakenfeld and Company
45 Park Place
New York 7, New York

Re: Rita King vs International Bent Glass Company
(Rita King, International Bent Glass Company and United States Casualty Company vs Monsanto Chemical Company and D. F. Drakenfeld and Company)

Gentlemen:

This is to advise that this firm represents the employer and insurer in the above-styled action, wherein Rita King, an employee of International Bent Glass Company, asserts she sustained injury and damages as a result of an exposure or contact with certain chemical products, all by reason of the negligence of the Monsanto Chemical Company and D. F. Drakenfeld and Company.

Under Missouri statutes, the employer and insurer are subrogated to the extent of any compensation or the expense of any medical aid paid to or on behalf of the employee under our Workmen's Compensation statutes. This subrogation right extends to the recovery on the part of the employee against any third party, by reason of suit or settlement.

Kindly consider this letter a lien against any possible recovery on the part of Mrs. King as noted, and acknowledge receipt of same.

Thank you for your cooperation.

Yours very truly,

Edward W. Warner

EWW:mm
cc: Moser, Marsalek, et al.,Attorneys at Law,330 Pierce Bldg.,St.L.2, Mo.
cc: Caruthers and Montrey,Attorneys at Law,818 Olive St.,St. Louis 1,Mo.
cc: U.S.Casualty Co.,Western Dept.,175 West Jackson Blvd.,Chicago 4,Ill.

JOHN F. EVANS
JOHN R. DIXON
WM. W. EVANS
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EDWARD W. WARNER
RALPH C. KLEINSCHMIDT
EUGENE K. BUCKLEY

ROBERT M. EVANS
HENRY D. MENGHINI
PAUL V. GILBERT
ALBERT J. SEIER
ROBERT J. ROBINSON

EVANS & DIXON
ATTORNEYS AT LAW
COTTON BELT BUILDING
111 NORTH FOURTH STREET
SAINT LOUIS

MAIN 1-7755

October 25, 1962

Monsanto Chemical Company
800 North Lindbergh Boulevard
Saint Louis 41, Missouri

D.F. Drakenfeld and Company
45 Park Place
New York 7, New York

Re: Walter Miller vs International Bent Glass Company
(Walter Miller, International Bent Glass Company and United States Casualty Company vs Monsanto Chemical Company and D. F.Drakenfeld and Company)

---

Gentlemen:

This is to advise that this firm represents the employer and insurer in the above styled action, wherein Walter Miller, an employee of International Bent Glass Company, asserts he sustained injury and damages as a result of an exposure or contact with certain chemical products, all by reason of the negligence of the Monsanto Chemical Company and D. F. Drakenfeld and Company.

Under Missouri statutes, the employer and insurer are subrogated to the extent of any compensation or the expense of any medical aid paid to or on behalf of the employee under our Workmen's Compensation statutes. This subrogation right extends to the recovery on the part of the employee against any third party, by reason of suit or settlement.

Kindly consider this letter a lien against any possible recovery on the part of Mr. Miller as noted, and acknowledge receipt of same.

Thank you for your cooperation.

Yours very truly,

Edward W. Warner

EWW:mm
cc: Moser,Marsalek,etal,Attorneys at Law,330 Pierce Bldg.,St. Louis 2, Mo.
cc: Caruthers and Montrey,Attorneys at Law,818 Olive St.,St. Louis 1, Mo.
cc: U.S.Casualty Co.,Western Dept.,175 West Jackson Blvd.,Chicago 4,Ill.

JOHN F. EVANS
JOHN R. DIXON
WM. W. EVANS
JAMES V. GALLEN
JOHN C. SHEPHERD
EDWARD W. WARNER
RALPH C. KLEINSCHMIDT
EUGENE K. BUCKLEY

ROBERT M. EVANS
HENRY D. MENGHINI
PAUL V. GILBERT

EVANS & DIXON
ATTORNEYS AT LAW
COTTON BELT BUILDING
111 NORTH FOURTH STREET
SAINT LOUIS

MAIN 1-7755

October 25, 1962

Monsanto Chemical Company
800 North Lindbergh Boulevard
St. Louis 41, Missouri

D. F. Drakenfeld and Company
45 Park Place
New York 7, New York

RE: Thelma Wieners vs. International Bent Glass Company (Thelma Wieners, International Bent Glass Company and United States Casualty Company vs. Monsanto Chemical Company and D. F. Drakenfeld and Company)

Gentlemen:

This is to advise that this firm represents the employer and insurer in the above styled action, wherein Thelma Wieners, an employee of International Bent Glass Company, asserts she sustained injury and damages as a result of an exposure or contact with certain chemical products, all by reason of the negligence of the Monsanto Chemical Company and D. F. Drakenfeld and Company.

Under Missouri statutes, the employer and insurer are subrogated to the extent of any compensation or the expense of any medical aid paid to or on behalf of the employee under our Workmen's Compensation statutes. This subrogation right extends to the recovery on the part of the employee against any third party, by reason of suit or settlement.

Kindly consider this letter a lien against any possible recovery on the part of Mrs. Wieners as noted, and acknowledge receipt of same.

Thank you for your cooperation.

Yours very truly,

Edward W. Warner

EWW-vbp

CC- Moser, Marsalek, et al, Attys. at Law, 330 Pierce Bldg. St. Louis 2,Mo
CC- Caruthers and Montrey, Attys. at Law, 818 Olive St.,St. Louis 1, Mo.
CC- U. S. Casualty Company, Western Dept., 175 West Jackson Blvd., Chicago 4, Illinois.

DSW 441836

JOHN F. EVANS
JOHN R. DIXON
WM. W. EVANS
JAMES V. GALLEN
JOHN C. SHEPHERD
EDWARD W. WARNER
RALPH C. KLEINSCHMIDT
EUGENE K. BUCKLEY

ROBERT M. EVANS
HENRY D. MENGHINI
PAUL V. GILBERT
ALBERT J. SEIER
ROBERT J. ROBINSON

EVANS & DIXON
ATTORNEYS AT LAW
COTTON BELT BUILDING
111 NORTH FOURTH STREET
SAINT LOUIS

MAIN 1-7755

October 25, 1962

Monsanto Chemical Company
800 North Lindbergh Boulevard
Saint Louis 41, Missouri

D. F. Drakenfeld and Company
45 Park Place
New York 7, New York

Re: Hazel Schneider vs International Bent Glass Company
(Hazel Schneider, International Bent Glass Company and United States Casualty Company vs Monsanto Chemical Company and D. F. Drakenfeld and Company)

Gentlemen:

This is to advise that this firm represents the employer and insurer in the above styled action, wherein Hazel Schneider, an employee of International Bent Glass Company, asserts she sustained injury and damages as a result of an exposure or contact with certain chemical products, all by reason of the negligence of the Monsanto Chemical Company and D. F. Drakenfeld and Company.

Under Missouri statutes, the employer and insurer are subrogated to the extent of any compensation or the expense of any medical aid paid to or on behalf of the employee under our Workmen's Compensation statutes. This subrogation right extends to the recovery on the part of the employee against any third party, by reason of suit or settlement.

Kindly consider this letter a lien against any possible recovery on the part of Mrs. Schneider as noted, and acknowledge receipt of same. Thank you for your cooperation.

Yours very truly,

Edward W. Warner

EWW:mm
CC: Moser,Marsalek,et al,Attorneys at Law,330 Pierce Bldg.,St. Louis 2, Mo.
CC: Caruthers and Montrey,Attorneys at Law,818 Olive St.,St. Louis 1, Mo.
CC: U.S.Casualty Company,Western Dept.,175 West Jackson Blvd.,Chicago 4,Ill.

9H-5 (32908)

# PRIORITY SERVICE...

## URGENT!

file

**This report is in answer to your inquiry on which you requested Priority Handling.**

DSW 441838

# Dun & Bradstreet ANALYTICAL Report

| IC | NAME & ADDRESS | | STARTED | RATING UNCHANGED |
|---|---|---|---|---|
| 28 15<br>50x29 | DRAKENFELD, B. F. & CO.<br><br>45-47 PARK PLACE<br>NEW YORK 7 N Y | A- AD 1 JUNE 25 1962 N<br>INC. MNFR COLORS &<br>CHEMICALS WHOL INDUSTRIAL<br>DECAL PAPERS, CARBONIZING<br>TISSUES & BRONZE POWDERS | 1869<br><br><br><br>TRADE<br>WORTH<br>EMPLS | 1<br>Also Washington, Pa<br><br><br><br>DISC-PPT<br>$4,500,000 +<br>200 |

**SUMMARY**

LONG ESTABLISHED BUSINESS CONTINUES UNDER EXPERIENCED MANAGEMENT. 1961 SALES WERE STEADY COMPARED TO THE PRIOR YEAR AND OPERATIONS PROFITABLE. A LIQUID FINANCIAL CONDITION MAINTAINED WITH CASH COVERING TOTAL LIABILITIES. 1962 SALES REPORTED UPWARD THUS FAR.

**TRADE**

| HC | OWE | P DUE | TERMS | Jan 22 1962 | SOLD |
|---|---|---|---|---|---|
| 13495 | | | 1-10-30 | Disc | Over 3 yrs to 11-61 |
| 12000 | | | ½-10-30 | Disc | Over 3 yrs |
| 10000 | 2000 | | 30-10-1 | Disc | Over 3 yrs to 12-61 |
| 4000 | | | 2-10 EOM | Disc | Over 3 yrs to 12-61 |
| 3000 | 1000 | | 2-10-30 | Disc | Over 3 yrs |
| 1000 | | | ½-10th & 25th 30 | Disc | Over 3 yrs |
| 1000 | | | 1-10-30 | Disc | Over 3 yrs to 10-61 |
| 200 | | | 2-10-30 | Disc | 1st Sale |
| 50 | | | 2-20th Prox 60 | Disc | Over 3 yrs to current |
| 78500 | 16500 | | | Ppt | Over 3 yrs to 12-61 |
| 7000 | | | 30 | Ppt | 2 yrs to 10-61 |
| 4000 | 1000 | | 30 | Ppt | Over 3 yrs to 11-61 |
| 3000 | 3000 | | Cash on Arriv | Ppt | Over 3 yrs to 11-61 |
| 2000 | 300 | | Cash 19th of mo | Ppt | Over 3 yrs |
| 257 | 36 | | 30 | Ppt | 1 yr |

**BANKING**

Accounts are maintained at three local and one out-of-town banks for a number of years with substantial aggregate balances carried. Accounts are all non-borrowing and well regarded.

**CURRENT**

J. T. Moriarty, Treasurer, interviewed on June 22, 1962 stated that sales thus far in 1962 have increased compared to a similar period of the previous year and operations remain profitable. A liquid financial condition is maintained at this date with cash balances alone covering total liabilities. Tangible net worth is in excess of $4,500,000.
6-25-62 (543 3) L01 9B3 3A14 6B46

DSW 441839

PLEASE NOTE WHETHER NAME, BUSINESS AND STREET ADDRESS CORRESPOND WITH YOUR INQUIRY.
The foregoing report is furnished, at your request, under your Subscription Contract, in STRICT CONFIDENCE, by DUN & BRADSTREET, Inc. as your agents and employees, for your exclusive use as an aid in determining the advisability of granting credit or insurance, and for no other purpose. DUN & BRADSTREET, Inc. does not guarantee the correctness of the information contained herein and shall not be liable for any loss or injury caused by the neglect or other act or failure to act on the part of said company, its officers, agents or employees, in procuring, collecting or communicating said information. 9R4-1 (30489)

MANAGEMENT Scott J. Courtney, Pres
Irwin F. Zellier, V Pres
James T. Moriarty, Treas
John B. Kennaugh, Asst Treas
Victor H. Remington, V Pres
Harold D. Miller, Sec
Daniel E. Mc Laughlin, Asst Sec
DIRECTORS: Tristan Antell, Scott J. Courtney, C. B. Major (Chairman), Harold D. Miller, James T. Moriarty, Victor H. Remington and Irwin F. Zellier

HISTORY Started: 1869 by John Marshing & Co., partnership, including the late B. F. Drakenfeld Sr., succeeded January 1, 1905 by F. B. Drakenfeld & Co., partnership of B. F. Drakenfeld Sr. and B. F. Drakenfeld Jr. The senior partner died March 25, 1913 and the business continued by the surviving partner until succeeded by this corporation.

Incorporated: New York June 7, 1913.
Outstanding Capital Stock: 29,336 shares of preferred stock, par value $50 each and 29,348 shares of common stock, par value $50 per share as of December 31, 1961.

S. J. Courtney, born 1883, widower, entered the employ of the predecessor company in 1896 and became Secretary of this corporation at its inception. In 1926 elected Treasurer and in 1931 elected President. Is in charge of management.

I. F. Zeiller, born 1900, married. Employed by this company in 1918, subsequently elected Assistant Secretary. In 1931 elected Secretary and in 1940 Vice President. Is in charge of sales.

V. H. Remington, born 1902, married. Employed by this company since 1928. Elected a Vice President in 1954 and a director in 1956. Is in charge of Washington, Pa. operations.

H. D. Miller, born 1904, married. Employed by this company since 1925. Elected Assistant Secretary in 1937 and Secretary in 1940. In 1942 elected a director. Is in charge of paper sales.

J. T. Moriarty, born 1916 and married. Employed by this company since June 1939. Served with the U.S. Army in the Intelligence Corps receiving his discharge in October 1945. Was elected Treasurer in 1946 and director in December 1949. Is in charge of finances.

D. E. Mc Laughlin, born 1916, married. Employed by this company in 1933 and served U.S. Army and in 1946. Then elected Assistant Secretary and assists Zeiller in sales.

J. B. Kennaugh, born 1915, married. Employed by the company since 1933, elected Assistant Treasurer in 1960.

C. B. Major is the widow of the late C. A. Major, former Chairman of the Board, who died April 29, 1961. She was shortly thereafter elected Chairman of the Board and a director. No change reported in the capital stock outstanding. T. Antell elected a director 1959. Maintains his individual business at 40 Wall St., New York City.

OPERATION Products: Manufacturer of colors and chemicals for the ceramic industries. Wholesales industrial chemicals, decalcomania papers, carbonizing tissues, bronze powders. A portion of merchandise, decalcomania paper, carbonizing tissues, metal leaf and bronze powders is imported.

Distribution: To glass, clayware, porcelain enameling, decalcomania, carbon paper, plastic industries.
Number of Accounts: About 3500 active accounts.
Territory: U.S.
6-25-62

(CONTINUED)

DSW 441841

DRAKENFELD, B F & CO. INC.
NEW YORK 7 N Y



FINANCE This long established business is reported to have operated on a profitable and progressive basis over a period of years. Through a partial retention of annual earnings a sizable tangible net worth has been accumulated, a large part of which has been invested in plant and equipment. While management has not submitted financial statements, periodic interviews have indicated a sound financial condition, operating entirely on invested capital. Bank and trade relations have been excellent.

J. T. Moriarty, Treasurer, interviewed June 22, 1962 exhibited the December 31, 1961 financial statement which indicated tangible net worth in excess of $4,500,000. A liquid financial condition was maintained with strong cash balances alone covering total debt, the latter being of moderate proportions in relation to the tangible net worth. Favorable secondary support was provided by accounts receivable described as fully collectable within terms with bad debt losses nil. No long term or contingent liabilities were outstanding. Fixed assets were free and clear of mortgage or lien encumbrance.

Moriarty stated that sales in 1961 were steady compared to the prior year and operations were conducted at a favorable rate of profit.

Outside quarters consulted expressed the opinion that a sizable investment is indicated and regards this company as under the capable management of those long experienced in the line and maintaining financial affairs in order.
6-25-62

(CONTINUED)

STLCOPCB4056376

OPERATION
(Cont'd) Terms: Net 30 day terms.
Seasons: Fairly steady throughout the year.
Employees: About 200.

Facilities: At the caption address owns and occupies an entire five-story old type building maintained in normal repair and situated in the downtown business district. Premises orderly.

Manufacturing plant at Washington, Pa. consists of an umber of one and two story buildings with total floor area of about170,000 square feet, including office and laboratory maintained in excellent repair.
6-25-62 (543 3)

CT SYSTEM

The Corporation Trust Company
C T Corporation System
and Associated Companies

SERVICE OF PROCESS TRANSMITTAL FORM

St. Louis, Missouri
(City) (State)

July 2, 1962
(Date)

( ) VIA CERTIFIED MAIL
( ) VIA CERTIFIED AIR MAIL
(xxx) VIA MESSENGER

TO: Mr. E. J. Putzell, Jr.
c/o Monsanto Chemical Company
800 North Lindbergh
St. Louis 66, Missouri

For the Attention of Mr. E. L. French

RE: **PROCESS SERVED IN THE STATE OF** MISSOURI

FOR MONSANTO CHEMICAL COMPANY (Name of Company) DELAWARE (Home State)

Enclosed are copies of legal process served upon the statutory agent of the above company as follows:

1. Title of Action: (Name of Plaintiff) attached vs. B. F. Drakenfeld and Company and Monsanto Chemical Company

2. Document(s) Served: Summons and Petitinn

3. Court: Circuit Court City of St. Louis, Missouri

4. Nature of Action: Defendant Drakenfeld manufactures and distributes into channel of trade paints etc. among products enamel 24-018 enamel in 489 oil. Defendant Monsanto manufactures chemical products, etc. among same is product Aroclor 4465. Alleges both defendants did know products would be used by***

5. On Whom Process was Served: C T Corporation System, St. Louis, Missouri

6. Date and Hour of Service: July 2, 1962 at 11:00 A.M.

7. Appearance or Answer Due: 30 days after date of service

8. Plaintiff's Attorney(s): Caruthers and Montrey
430 Paul Brown Building
St. Louis 1, Missouri

9. Remarks: ***public and heated or baked in ovens & likely to cause liver damag skin eruptions etc. Each plaintiff employed by International Bent Glass Company, Inc., St. Louis, Mo. & Alleges came in contact with products aforesa causing skin eruptions, etc. including injury to liver, all of which are permanent.
Name of each Plaintiff, amount claimed & Case No. on attached sheet.

ALM:jm

KINDLY ACKNOWLEDGE RECEIPT BY SIGNING AND RETURNING TO US THE ENCLOSED CARBON COPY OF THIS TRANSMITTAL FORM.

Signed C T CORPORATION SYSTEM

Per [signature]

Address 314 North Broadway
St. Louis 2, Missouri

DSW 441843

NJ290-Y 1-62 50M Sets

STLCOPCB4056378

| PLAINTIFF | AMOUNT | CASE NO. |
|---|---|---|
| Dorothy Berry | $25,000.00 | 47803E |
| Rita B. King | 45,000.00 | 47804E |
| Thelma Wieners | 50,000.00 | 47805E |
| Martha Syler | 45,000.00 | 47806E |
| Ronnie Simpson | 30,000.00 | 47807E |
| Mildred Barrett | 27,500.00 | 47808E |
| Theodore Czarnecki | 45,000.00 | 47809E |
| Marie Clifford | 27,500.00 | 47810E |
| Mary Chapman | 17,500.00 | 47811E |
| Hazel Schneider | 17,500.00 | 47813E |
| Walter Frank Miller | 17,500.00 | 47814E |
| Charlotte Shoemaker | 47,500.00 | 47812E |
| | 395,000.— | |

DSW 441844

STATE OF MISSOURI )
) SS
CITY OF ST. LOUIS )

IN THE CIRCUIT COURT OF THE CITY OF ST. LOUIS

STATE OF MISSOURI

| | | |
|---|---|---|
| CHARLOTTE SHOEMAKER,<br><br>Plaintiff,<br><br>-vs-<br><br>B.F. DRAKENFELD AND COMPANY,<br>a corporation,<br>45 Park Place<br>New York 7, New York<br>Serve: Secretary of State<br>Jefferson City, Missouri<br><br>and<br><br>MONSANTO CHEMICAL COMPANY,<br>a corporation,<br>Serve: C.T. Corporation Servic<br>314 N. Broadway<br>St. Louis 2, Missouri,<br><br>Defendants. | ) | No.<br><br>Div. No. 1 |

P E T I T I

COUNT

Plaintiff, for cause of action in Count [illegible] of this Petition, states:

1. Defendant, B. F. DRAKENFELD [illegible] COMPANY, (hereinafter called "Drakenfeld") is and was a foreign corporation duly organized and existing under law at all times hereinafter mentioned; as hereinafter more particularly alleged, DRAKENFELD has committed a tort against the person of Plaintiff, in the City of St. Louis, State of Missouri, and has thereby agreed that the Secretary of State of Missouri shall be its agent



DSW 441845

STLCOPCB4056380

for the service of process, all as is provided in V.A.M.S., 1949, Section 351.630.

2. Defendant, MONSANTO CHEMICAL COMPANY (hereinafter called "Monsanto") is and at all times hereinafter mentioned was a corporation organized and existing under the laws of the State of Delaware, having a registered agent and office in the City of St. Louis, State of Missouri, and having its principal place of business in the State of Missouri.

3. Defendant DRAKENFELD is engaged in the business of manufacturing, preparing and distributing into the channels of trade paints and enamels, and among the various products so distributed by said Defendant is an enamel known as 24-018 enamel in 487 oil.

4. Defendant MONSANTO is engaged in the business of manufacturing and preparing chemicals, chemical products, oils and thinners and distributing said products into the channels of trade, and among the various products so manufactured and distributed by said Defendant is the product known as Aroclor 4465.

5. Defendant DRAKENFELD prepares the aforesaid product 24-018 enamel in 487 oil, by combining various other materials with Monsanto's product Aroclor 4465.

6. Both Defendants herein did know and intend that said products would be used by the consuming public and would be handled, dealt with, touched and the fumes thereof would be inhaled by the public, and both Defendants placed said



DSW 441846

STLCOPCB4056381

products in the channels of trade with such knowledge and intention.

7. Both Defendants herein did impliedly warrant and represent that the products 24-018 enamel in 487 oil, and Aroclor 4465 were fit and safe for such use by the public; but both Defendants and each Defendant knew that such products contained chlorinated biphenyls and chlorinated triphenyls, with a high amount of chlorination; said Defendants, and each of them, knew that said products would from time to time be heated or baked in ovens, and that use by the public of said products was likely to cause liver damage, skin eruptions, rashes, acne, cysts and dermatitis of various kinds.

8. Plaintiff, ~~[illegible]~~ in the year 1958 began to make use of said products in his employment with International Bent Glass Company, Inc. at St. Louis, Missouri, handling such products, touching the same, and inhaling the fumes thereof, all in reliance on the skill and judgment and aforesaid warranty of both Defendants, being wholly unaware of the toxic and dangerous qualities of such products.

9. After a period of such use of such products, the same, contrary to and in breach of the warranty of both Defendants, directly and proximately caused Plaintiff to become ill and diseased, in that Plaintiff suffered eruptions of Plaintiff's skin over and about Plaintiff's neck, shoulders, chest, back, buttocks, face, ears and eyelids, said areas have become covered with comedones, cysts, acne, infectious lesions,



DSW 441847

STLCOPCB4056382

papules and a condition known as chloracne; Plaintiff's eyelids and periorbital skin became erythematous,, edematous and scaly; Plaintiff's liver was injured, damaged and diseased; these conditions are painful, irritating and embarrassing; all of said conditions are permanent.

10. Plaintiff has become obligated for large sums of money for medical attention for the aforesaid conditions and will become obligated for additional such sums in the future, in an amount not now ascertainable.

WHEREFORE, the premises considered, Plaintiff prays judgment against the Defendants and each of them, on this Count I of the petition for **FORTY SEVEN THOUSAND FIVE HUNDRED DOLLARS ($47,500.00)**, and for Plaintiff's costs.

COUNT II

Plaintiff for cause of action in Count II of this Petition states:

1. Plaintiff restates and realleges each and every allegation in paragraphs 1, 2, 3, 4, 5, and 6 of Count I of this petition.

2. Both Defendants and each of them knew, or in the exercise of ordinary care should have known that said products, containing highly chlorinated biphenyls and triphenyls, are, and for many years have been, known to be of a toxic and dangerous nature in that they were reasonably likely to cause abnormal reactions, skin eruptions, rashes, liver damage, dermatitis and diseases, and Defendants and each of them were



DSW 441848

STLCOPCB4056383

under a duty to give an adequate warning of such dangers and risks to the public who used such products, but both Defendants and each of them negligently breached said duty by failing and omitting to give an adequate warning of such dangers and risks.

3. Plaintiff began to make use of such products in 1958 in her employment at St. Louis, Missouri with International Bent Glass Company, and as a direct and proximate result of the Defendants' negligence, Plaintiff was injured in those particulars alleged hereinabove in Count I, Paragraph 9.

4. Plaintiff restates and realleges each and every allegation in Count I, Paragraph 10.

WHEREFORE, the premises considered, Plaintiff prays judgment on this Count II of this Petition against the Defendants, and each of them, in the sum of FORTY SEVEN THOUSAND FIVE HUNDRED DOLLARS ($47,500.00), and for her costs.

CARUTHERS AND MONTREY

BY John P. Montrey

JOHN P. MONTREY
430 Paul Brown Bldg.
St. Louis 1, Missouri
GArfield 1-2777
ATTORNEYS FOR PLAINTIFF

DSW 441849

STLCOPCB4056384

Form No. 75

# Circuit Court for the City of St. Louis

State of Missouri

Charlotte Shoemaker

Plaintiff

vs.

B. F. Drakenfeld & Co., a Corp.

Defendant

No. 47812 2

Div. 1

## SUMMONS

The State of Missouri to Defendant Monsanto Chemical Co., a Corp.

You are hereby summoned to appear before the above-named court and to file your pleading to the petition, copy of which is attached hereto, and to serve a copy of your pleading upon

Caruthers & Montrey attorneys for plaintiff,

whose address is 430 Paul Brown Bldg.

all within 30 days after service of this summons upon you, exclusive of the day of service. If you fail to do so, judgment by default will be taken against you for the relief demanded in the petition.

Dated June 29, 19 6

PHELIM O'TOOLE
Circuit Clerk.

By M. White
Deputy Clerk.

2

(Seal of Circuit Court)

DSW 441850

STLCOPCB4056385

# RETURN ON SERVICE OF SUMMONS

I hereby certify that I have served the within summons:

(1) By delivering on the.....day of....., 19.....

a copy of the summons and a copy of the petition to each of the within-named defendants.....

.....

.....

.....

(2) By leaving on the.....day of....., 19.....

for each of the within-named defendants.....

.....

.....

a copy of the summons and a copy of the petition at the respective dwelling place or usual place of abode of said defendants with some person of his or her family over the age of 15 years;

(3) By.....

.....

.....

.....

.....

All done in.....County, Missouri.

Sheriff's fees:

Summons.....$

Non est.....$

Mileage.....$

Total.....$

Sheriff of.....County, Missouri.

By.....

Deputy Sheriff.

**DIRECTIONS TO SHERIFF**

A copy of the summons and a copy of the petition must be served on each defendant. For methods of service in all classes of suits see Sec. 27 Civil Code.

No. 47812

Div. 1

**SUMMONS**

Civil Code, Form No. 1

In the Case of

.....

Plaintiff

vs.

.....

Defendant

In the Circuit Court of the

City of St. Louis

STATE OF MISSOURI

DSW 441851

STLCOPCB4056386

STATE OF MISSOURI )
) SS
CITY OF ST. LOUIS )

IN THE CIRCUIT COURT OF THE CITY OF ST. LOUIS

STATE OF MISSOURI

| | | |
|---|---|---|
| **WALTER FRANK MILLER,** | ) | |
| Plaintiff, | ) | |
| -vs- | ) | |
| B.F. DRAKENFELD AND COMPANY, a corporation, 45 Park Place New York 7, New York Serve: Secretary of State Jefferson City, Missouri | ) | No. |
| | ) | Div. No. 1 |
| and | ) | |
| MONSANTO CHEMICAL COMPANY, a corporation, Serve: C.T. Corporation Service 314 N. Broadway St. Louis 2, Missouri, | ) | |
| Defendants. | ) | |

P E T I T I O N

COUNT I

Plaintiff, for cause of action in Count I of this Petition, states:

1. Defendant, B. F. DRAKENFELD AND COMPANY, (hereinafter called "Drakenfeld") is and was a foreign corporation duly organized and existing under law at all times hereinafter mentioned; as hereinafter more particularly alleged, DRAKENFELD has committed a tort against the person of Plaintiff, in the City of St. Louis, State of Missouri, and has thereby agreed that the Secretary of State of Missouri shall be its agent



DSW 441852

STLCOPCB4056387

for the service of process, all as is provided in V.A.M.S., 1949, Section 351.630.

2. Defendant, MONSANTO CHEMICAL COMPANY (hereinafter called "Monsanto") is and at all times hereinafter mentioned was a corporation organized and existing under the laws of the State of Delaware, having a registered agent and office in the City of St. Louis, State of Missouri, and having its principal place of business in the State of Missouri.

3. Defendant DRAKENFELD is engaged in the business of manufacturing, preparing and distributing into the channels of trade paints and enamels, and among the various products so distributed by said Defendant is an enamel known as 24-018 enamel in 487 oil.

4. Defendant MONSANTO is engaged in the business of manufacturing and preparing chemicals, chemical products, oils and thinners and distributing said products into the channels of trade, and among the various products so manufactured and distributed by said Defendant is the product known as Aroclor 4465.

5. Defendant DRAKENFELD prepares the aforesaid product 24-018 enamel in 487 oil, by combining various other materials with Monsanto's product Aroclor 4465.

6. Both Defendants herein did know and intend that said products would be used by the consuming public and would be handled, dealt with, touched and the fumes thereof would be inhaled by the public, and both Defendants placed said



DSW 441853

STLCOPCB4056388

products in the channels of trade with such knowledge and intention.

7. Both Defendants herein did impliedly warrant and represent that the products 24-018 enamel in 407 oil, and Aroclor 4465 were fit and safe for such use by the public; but both Defendants and each Defendant knew that such products contained chlorinated biphenyls and chlorinated triphenyls, with a high amount of chlorination; said Defendants, and each of them, knew that said products would from time to time be heated or baked in ovens, and that use by the public of said products was likely to cause liver damage, skin eruptions, rashes, acne, cysts and dermatitis of various kinds.

8. Plaintiff, ~~xxxxxxxx~~ in the year 1958 began to make use of said products in his employment with International Bent Glass Company, Inc. at St. Louis, Missouri, handling such products, touching the same, and inhaling the fumes thereof, all in reliance on the skill and judgment and aforesaid warranty of both Defendants, being wholly unaware of the toxic and dangerous qualities of such products.

9. After a period of such use of such products, the same, contrary to and in breach of the warranty of both Defendants, directly and proximately caused Plaintiff to become ill and diseased, in that Plaintiff suffered eruptions of Plaintiff's skin over and about Plaintiff's neck, shoulders, chest, back, buttocks, face, ears and eyelids, said areas have become covered with comedones, cysts, acne, infectious lesions,



DSW 441854

STLCOPCB4056389

papules and a condition known as chloracne; Plaintiff's eyelids and periorbital skin became erythematous,, edematous and scaly; Plaintiff's liver was injured, damaged and diseased; these conditions are painful, irritating and embarrassing; all of said conditions are permanent.

10. Plaintiff has become obligated for large sums of money for medical attention for the aforesaid conditions and will become obligated for additional such sums in the future, in an amount not now ascertainable.

WHEREFORE, the premises considered, Plaintiff prays judgment against the Defendants and each of them, on this Count I of the petition for SEVENTEEN THOUSAND FIVE HUNDRED DOLLARS ($17,500.00), and for Plaintiff's costs.

COUNT II

Plaintiff for cause of action in Count II of this Petition states:

1. Plaintiff restates and realleges each and every allegation in paragraphs 1, 2, 3, 4, 5, and 6 of Count I of this petition.

2. Both Defendants and each of them knew, or in the exercise of ordinary care should have known that said products, containing highly chlorinated biphenyls and triphenyls, are, and for many years have been, known to be of a toxic and dangerous nature in that they were reasonably likely to cause abnormal reactions, skin eruptions, rashes, liver damage, dermatitis and diseases, and Defendants and each of them were



DSW 441855

STLCOPCB4056390

under a duty to give an adequate warning of such dangers and risks to the public who used such products, but both Defendants and each of them negligently breached said duty by failing and omitting to give an adequate warning of such dangers and risks.

3. Plaintiff began to make use of such products in 1958 in his employment at St. Louis, Missouri with International Bent Glass Company, and as a direct and proximate result of the Defendants' negligence, Plaintiff was injured in those particulars alleged hereinabove in Count I, Paragraph 9.

4. Plaintiff restates and realleges each and every allegation in Count I, Paragraph 10.

WHEREFORE, the premises considered, Plaintiff prays judgment on this Count II of this Petition against the Defendants, and each of them, in the sum of SEVENTEEN THOUSAND FIVE HUNDRED DOLLARS ($17,500.00), and for his costs.

CARUTHERS AND MONTREY

BY _____

JOHN P. MONTREY
430 Paul Brown Bldg.
St. Louis 1, Missouri
GArfield 1-2777
ATTORNEYS FOR PLAINTIFF

DSW 441856

STLCOPCB4056391

Form No. 75

# Circuit Court for the City of St. Louis

State of Missouri

Walter Frank Miller

Plaintiff

vs.

B. F. Drakenfeld & Co., et al

Defendant

No. 47814 E

Div. 1

## SUMMONS

The State of Missouri to Defendant Monsanto Chemical Co., a Corp.

You are hereby summoned to appear before the above-named court and to file your pleading to the petition, copy of which is attached hereto, and to serve a copy of your pleading upon

Caruthers & Montrey attorney S for plaintiff,

whose address is 430 Paul Brown Bldg.

all within 30 days after service of this summons upon you, exclusive of the day of service. If you fail to do so, judgment by default will be taken against you for the relief demanded in the petition.

Dated June 29, 19 62

PHELIM O'TOOLE
Circuit Clerk.

By [illegible]
Deputy Clerk.

(Seal of Circuit Court)

DSW 441857

STLCOPCB4056392

# RETURN ON SERVICE OF SUMMONS

I hereby certify that I have served the within summons:

(1) By delivering on the.....day of....., 19.....

a copy of the summons and a copy of the petition to each of the within-named defendants.....

.....

.....

.....

(2) By leaving on the.....day of....., 19.....

for each of the within-named defendants.....

.....

.....

a copy of the summons and a copy of the petition at the respective dwelling place or usual place of abode of said defendants with some person of his or her family over the age of 15 years;

(3) By.....

.....

.....

.....

.....

All done in.....County, Missouri.

Sheriff's fees:

Summons.....$

Non est.....$

Mileage.....$

Total.....$

Sheriff of.....County, Missouri.

By.....

Deputy Sheriff.

**DIRECTIONS TO SHERIFF**

A copy of the summons and a copy of the petition must be served on each defendant. For methods of service in all classes of suits see Sec. 27 Civil Code.

No. 47814-E

Div. 1

**SUMMONS**

Civil Code, Form No. 1

In the Case of

Plaintiff

vs.

Defendant

In the Circuit Court of the

City of St. Louis

STATE OF MISSOURI

DSW 441858

STLCOPCB4056393

STATE OF MISSOURI )
) SS
CITY OF ST. LOUIS )

IN THE CIRCUIT COURT OF THE CITY OF ST. LOUIS

STATE OF MISSOURI

| | | |
|---|---|---|
| HAZEL SCHNEIDER, | ) | |
| | ) | |
| Plaintiff, | ) | |
| | ) | |
| -vs- | ) | |
| | ) | |
| B.F. DRAKENFELD AND COMPANY, | ) | |
| a corporation, | ) | |
| 45 Park Place | ) | |
| New York 7, New York | ) | |
| Serve: Secretary of State | ) | No. |
| Jefferson City, Missouri | ) | |
| | ) | Div. No. 1 |
| and | ) | |
| | ) | |
| MONSANTO CHEMICAL COMPANY, | ) | |
| a corporation, | ) | |
| Serve: C.T. Corporation Service | ) | |
| 314 N. Broadway | ) | |
| St. Louis 2, Missouri, | ) | |
| | ) | |
| Defendants. | ) | |

P E T I T I O N

COUNT I

Plaintiff, for cause of action in Count I of this Petition, states:

1. Defendant, B. F. DRAKENFELD AND COMPANY, (hereinafter called "Drakenfeld") is and was a foreign corporation duly organized and existing under law at all times hereinafter mentioned; as hereinafter more particularly alleged, DRAKENFELD has committed a tort against the person of Plaintiff, in the City of St. Louis, State of Missouri, and has thereby agreed that the Secretary of State of Missouri shall be its agent



DSW 441859

STLCOPCB4056394

for the service of process, all as is provided in V.A.M.S., 1949, Section 351.630.

2. Defendant, MONSANTO CHEMICAL COMPANY (hereinafter called "Monsanto") is and at all times hereinafter mentioned was a corporation organized and existing under the laws of the State of Delaware, having a registered agent and office in the City of St. Louis, State of Missouri, and having its principal place of business in the State of Missouri.

3. Defendant DRAKENFELD is engaged in the business of manufacturing, preparing and distributing into the channels of trade paints and enamels, and among the various products so distributed by said Defendant is an enamel known as 24-018 enamel in 487 oil.

4. Defendant MONSANTO is engaged in the business of manufacturing and preparing chemicals, chemical products, oils and thinners and distributing said products into the channels of trade, and among the various products so manufactured and distributed by said Defendant is the product known as Aroclor 4465.

5. Defendant DRAKENFELD prepares the aforesaid product 24-018 enamel in 487 oil, by combining various other materials with Monsanto's product Aroclor 4465.

6. Both Defendants herein did know and intend that said products would be used by the consuming public and would be handled, dealt with, touched and the fumes thereof would be inhaled by the public, and both Defendants placed said



DSW 441860

STLCOPCB4056395

products in the channels of trade with such knowledge and intention.

7. Both Defendants herein did impliedly warrant and represent that the products 24-018 enamel in 487 oil, and Aroclor 4465 were fit and safe for such use by the public; but both Defendants and each Defendant knew that such products contained chlorinated biphenyls and chlorinated triphenyls, with a high amount of chlorination; said Defendants, and each of them, knew that said products would from time to time be heated or baked in ovens, and that use by the public of said products was likely to cause liver damage, skin eruptions, rashes, acne, cysts and dermatitis of various kinds.

8. Plaintiff, [illegible] in the year 1958 began to make use of said products in his employment with International Bent Glass Company, Inc. at St. Louis, Missouri, handling such products, touching the same, and inhaling the fumes thereof, all in reliance on the skill and judgment and aforesaid warranty of both Defendants, being wholly unaware of the toxic and dangerous qualities of such products.

9. After a period of such use of such products, the same, contrary to and in breach of the warranty of both Defendants, directly and proximately caused Plaintiff to become ill and diseased, in that Plaintiff suffered eruptions of Plaintiff's skin over and about Plaintiff's neck, shoulders, chest, back, buttocks, face, ears and eyelids, said areas have become covered with comedones, cysts, acne, infectious lesions,



DSW 441861

STLCOPCB4056396

papules and a condition known as chloracne; Plaintiff's eyelids and periorbital skin became erythematous,, edematous and scaly; Plaintiff's liver was injured, damaged and diseased; these conditions are painful, irritating and embarrassing; all of said conditions are permanent.

10. Plaintiff has become obligated for large sums of money for medical attention for the aforesaid conditions and will become obligated for additional such sums in the future, in an amount not now ascertainable.

WHEREFORE, the premises considered, Plaintiff prays judgment against the Defendants and each of them, on this Count I of the petition for SEVENTEEN THOUSAND FIVE HUNDRED DOLLARS ($17,500.00), and for Plaintiff's costs.

COUNT II

Plaintiff for cause of action in Count II of this Petition states:

1. Plaintiff restates and realleges each and every allegation in paragraphs 1, 2, 3, 4, 5, and 6 of Count I of this petition.

2. Both Defendants and each of them knew, or in the exercise of ordinary care should have known that said products, containing highly chlorinated biphenyls and triphenyls, are, and for many years have been, known to be of a toxic and dangerous nature in that they were reasonably likely to cause abnormal reactions, skin eruptions, rashes, liver damage, dermatitis and diseases, and Defendants and each of them were



DSW 441862

STLCOPCB4056397

under a duty to give an adequate warning of such dangers and risks to the public who used such products, but both Defendants and each of them negligently breached said duty by failing and omitting to give an adequate warning of such dangers and risks.

3. Plaintiff began to make use of such products in 1953 in her employment at St. Louis, Missouri with International Bent Glass Company, and as a direct and proximate result of the Defendants' negligence, Plaintiff was injured in those particulars alleged hereinabove in Count I, Paragraph 9.

4. Plaintiff restates and realleges each and every allegation in Count I, Paragraph 10.

WHEREFORE, the premises considered, Plaintiff prays judgment on this Count II of this Petition against the Defendants, and each of them, in the sum of SEVENTEEN THOUSAND FIVE HUNDRED DOLLARS ($17,500.00) and for her costs.

CARUTHERS AND MONTREY

BY John P. Montrey

JOHN P. MONTREY
430 Paul Brown Bldg.
St. Louis 1, Missouri
GArfield 1-2777
ATTORNEYS FOR PLAINTIFF

DSW 441863

STLCOPCB4056398

Form No. 75

# Circuit Court for the City of St. Louis

State of Missouri

Hazel Schneider

Plaintiff

vs.

A. F. Drakenfeld & Co., et al

Defendant

No. 47813 E

Div. 1

## SUMMONS

The State of Missouri to Defendant Monsanto Chemical Co., a Corp.

You are hereby summoned to appear before the above-named court and to file your pleading to the petition, copy of which is attached hereto, and to serve a copy of your pleading upon

Caruthers & Montrey attorneys for plaintiff,

whose address is 430 Paul Brown Bldg.

all within 30 days after service of this summons upon you, exclusive of the day of service. If you fail to do so, judgment by default will be taken against you for the relief demanded in the petition.

Dated June 29, 19 62

PHELIM O'TOOLE
Circuit Clerk.

By M. White
Deputy Clerk.

(Seal of Circuit Court)

DSW 441864

STLCOPCB4056399

# RETURN ON SERVICE OF SUMMONS

I hereby certify that I have served the within summons:

(1) By delivering on the.....day of....., 19.....

a copy of the summons and a copy of the petition to each of the within-named defendants.....

.....

.....

.....

(2) By leaving on the.....day of....., 19.....

for each of the within-named defendants.....

.....

.....

a copy of the summons and a copy of the petition at the respective dwelling place or usual place of abode of said defendants with some person of his or her family over the age of 15 years;

(3) By.....

.....

.....

.....

.....

All done in.....County, Missouri.

Sheriff's fees:

Summons.....$

Non est.....$

Mileage.....$

Total.....$

Sheriff of.....County, Missouri.

By.....

Deputy Sheriff.

**DIRECTIONS TO SHERIFF**

A copy of the summons and a copy of the petition must be served on each defendant. For methods of service in all classes of suits see Sec. 27 Civil Code.

No.....47813.....

Div.....1

**SUMMONS**

Civil Code, Form No. 1

In the Case of

.....

Plaintiff

vs.

.....

Defendant

In the Circuit Court of the

City of St. Louis

STATE OF MISSOURI

DSW 441865

STLCOPCB4056400

STATE OF MISSOURI )
) SS
CITY OF ST. LOUIS )

IN THE CIRCUIT COURT OF THE CITY OF ST. LOUIS

STATE OF MISSOURI

| | | |
|---|---|---|
| MARY CHAPMAN, | ) | |
| Plaintiff, | ) | |
| -vs- | ) | |
| B.F. DRAKENFELD AND COMPANY, a corporation, 45 Park Place New York 7, New York Serve: Secretary of State Jefferson City, Missouri | ) | No. |
| and | ) | Div. No. 1 |
| MONSANTO CHEMICAL COMPANY, a corporation, Serve: C.T. Corporation Service 314 N. Broadway St. Louis 2, Missouri, | ) | |
| Defendants. | ) | |

P E T I T I O N

COUNT I

Plaintiff, for cause of action in Count I of this Petition, states:

1. Defendant, B. F. DRAKENFELD AND COMPANY, (hereinafter called "Drakenfeld") is and was a foreign corporation duly organized and existing under law at all times hereinafter mentioned; as hereinafter more particularly alleged, DRAKENFELD has committed a tort against the person of Plaintiff, in the City of St. Louis, State of Missouri, and has thereby agreed that the Secretary of State of Missouri shall be its agent



DSW 441866

STLCOPCB4056401

for the service of process, all as is provided in V.A.M.S., 1949, Section 351.630.

2. Defendant, MONSANTO CHEMICAL COMPANY (hereinafter called "Monsanto") is and at all times hereinafter mentioned was a corporation organized and existing under the laws of the State of Delaware, having a registered agent and office in the City of St. Louis, State of Missouri, and having its principal place of business in the State of Missouri.

3. Defendant DRAKENFELD is engaged in the business of manufacturing, preparing and distributing into the channels of trade paints and enamels, and among the various products so distributed by said Defendant is an enamel known as 24-018 enamel in 487 oil.

4. Defendant MONSANTO is engaged in the business of manufacturing and preparing chemicals, chemical products, oils and thinners and distributing said products into the channels of trade, and among the various products so manufactured and distributed by said Defendant is the product known as Aroclor 4465.

5. Defendant DRAKENFELD prepares the aforesaid product 24-018 enamel in 487 oil, by combining various other materials with Monsanto's product Aroclor 4465.

6. Both Defendants herein did know and intend that said products would be used by the consuming public and would be handled, dealt with, touched and the fumes thereof would be inhaled by the public, and both Defendants placed said



DSW 441867

STLCOPCB4056402

products in the channels of trade with such knowledge and intention.

7. Both Defendants herein did impliedly warrant and represent that the products 24-018 enamel in 487 oil, and Aroclor 4465 were fit and safe for such use by the public; but both Defendants and each Defendant knew that such products contained chlorinated biphenyls and chlorinated triphenyls, with a high amount of chlorination; said Defendants, and each of them, knew that said products would from time to time be heated or baked in ovens, and that use by the public of said products was likely to cause liver damage, skin eruptions, rashes, acne, cysts and dermatitis of various kinds.

8. Plaintiff, [redacted] in the year 1958 began to make use of said products in his employment with International Bent Glass Company, Inc. at St. Louis, Missouri, handling such products, touching the same, and inhaling the fumes thereof, all in reliance on the skill and judgment and aforesaid warranty of both Defendants, being wholly unaware of the toxic and dangerous qualities of such products.

9. After a period of such use of such products, the same, contrary to and in breach of the warranty of both Defendants, directly and proximately caused Plaintiff to become ill and diseased, in that Plaintiff suffered eruptions of Plaintiff's skin over and about Plaintiff's neck, shoulders, chest, back, buttocks, face, ears and eyelids, said areas have become covered with comedones, cysts, acne, infectious lesions,



DSW 441868

STLCOPCB4056403

papules and a condition known as chloracne; Plaintiff's eyelids and periorbital skin became erythematous,, edematous and scaly; Plaintiff's liver was injured, damaged and diseased; these conditions are painful, irritating and embarrassing; all of said conditions are permanent.

10. Plaintiff has become obligated for large sums of money for medical attention for the aforesaid conditions and will become obligated for additional such sums in the future, in an amount not now ascertainable.

WHEREFORE, the premises considered, Plaintiff prays judgment against the Defendants and each of them, on this Count I of the petition for SEVENTEEN THOUSAND FIVE HUNDRED DOLLARS ($17,500.00), and for Plaintiff's costs.

COUNT II

Plaintiff for cause of action in Count II of this Petition states:

1. Plaintiff restates and realleges each and every allegation in paragraphs 1, 2, 3, 4, 5, and 6 of Count I of this petition.

2. Both Defendants and each of them knew, or in the exercise of ordinary care should have known that said products, containing highly chlorinated biphenyls and triphenyls, are, and for many years have been, known to be of a toxic and dangerous nature in that they were reasonably likely to cause abnormal reactions, skin eruptions, rashes, liver damage, dermatitis and diseases, and Defendants and each of them w



DSW 441869

STLCOPCB4056404

under a duty to give an adequate warning of such dangers and risks to the public who used such products, but both Defendants and each of them negligently breached said duty by failing and omitting to give an adequate warning of such dangers and risks.

3. Plaintiff began to make use of such products in 1963 in her employment at St. Louis, Missouri with International Bent Glass Company, and as a direct and proximate result of the Defendants' negligence, Plaintiff was injured in those particulars alleged hereinabove in Count I, Paragraph 9.

4. Plaintiff restates and realleges each and every allegation in Count I, Paragraph 10.

WHEREFORE, the premises considered, Plaintiff prays judgment on this Count II of this Petition against the Defendants, and each of them, in the sum of SEVENTEEN THOUSAND FIVE HUNDRED DOLLARS ($17,500.00) and her costs.

CARUTHERS AND MONTREY

BY John P. Montrey

JOHN P. MONTREY
430 Paul Brown Bldg.
St. Louis 1, Missouri
GArfield 1-2777
ATTORNEYS FOR PLAINTIFF

DSW 441870

STLCOPCB4056405

Form No. 75

# Circuit Court for the City of St. Louis

State of Missouri

Mary Chapman

Plaintiff

vs.

B. F. Drakenfeld & Co., et al

Defendant

No. 47811 E

Div. 1

## SUMMONS

The State of Missouri to Defendant Monsanto Chemical Co., a Corp.

You are hereby summoned to appear before the above-named court and to file your pleading to the petition, copy of which is attached hereto, and to serve a copy of your pleading upon

Caruthers & Montrey attorneys for plaintiff,

whose address is 430 Paul Brown Bldg.

all within 30 days after service of this summons upon you, exclusive of the day of service. If you fail to do so, judgment by default will be taken against you for the relief demanded in the petition.

Dated June 29, 1962

PHELIM O'TOOLE
Circuit Clerk.

By [illegible]
Deputy Clerk.

(Seal of Circuit Court)

DSW 441871

STLCOPCB4056406

# RETURN ON SERVICE OF SUMMONS

I hereby certify that I have served the within summons:

(1) By delivering on the.....day of....., 19.....

a copy of the summons and a copy of the petition to each of the within-named defendants.....

.....

.....

.....

(2) By leaving on the.....day of....., 19.....

for each of the within-named defendants.....

.....

.....

a copy of the summons and a copy of the petition at the respective dwelling place or usual place of abode of said defendants with some person of his or her family over the age of 15 years;

(3) By.....

.....

.....

.....

.....

All done in.....County, Missouri.

Sheriff's fees:

Summons.....$

Non est.....$

Mileage.....$_____

Total.....$

.....

Sheriff of.....County, Missouri.

By.....

Deputy Sheriff.

**DIRECTIONS TO SHERIFF**

A copy of the summons and a copy of the petition must be served on each defendant. For methods of service in all classes of suits see Sec. 27 Civil Code.

No. 47811-3

Div. 1

SUMMONS

Civil Code, Form No. 1

In the Case of

.....

Plaintiff

vs.

.....

Defendant

In the Circuit Court of the

City of St. Louis

STATE OF MISSOURI

DSW 441872

STLCOPCB4056407

STATE OF MISSOURI )
) SS
CITY OF ST. LOUIS )

IN THE CIRCUIT COURT OF THE CITY OF ST. LOUIS

STATE OF MISSOURI

| | | |
|---|---|---|
| MARIE CLIFFORD, | ) | |
| Plaintiff, | ) | |
| -vs- | ) | |
| B.F. DRAKENFELD AND COMPANY, a corporation. 45 Park Place New York 7, New York Serve: Secretary of State Jefferson City, Missouri | ) | No. |
| and | ) | Div. No. 1 |
| MONSANTO CHEMICAL COMPANY, a corporation, Serve: C.T. Corporation Service 314 N. Broadway St. Louis 2, Missouri, | ) | |
| Defendants. | ) | |

PETITION

COUNT I

Plaintiff, for cause of action in Count I of this Petition, states:

1. Defendant, B. F. DRAKENFELD AND COMPANY, (hereinafter called "Drakenfeld") is and was a foreign corporation duly organized and existing under law at all times hereinafter mentioned; as hereinafter more particularly alleged, DRAKENFELD has committed a tort against the person of Plaintiff, in the City of St. Louis, State of Missouri, and has thereby agreed that the Secretary of State of Missouri sh[illegible] be its agent



DSW 441873

STLCOPCB4056408

for the service of process, all as is provided in V.A.M.S., 1949, Section 351.630.

2. Defendant, MONSANTO CHEMICAL COMPANY (hereinafter called "Monsanto") is and at all times hereinafter mentioned was a corporation organized and existing under the laws of the State of Delaware, having a registered agent and office in the City of St. Louis, State of Missouri, and having its principal place of business in the State of Missouri.

3. Defendant DRAKENFELD is engaged in the business of manufacturing, preparing and distributing into the channels of trade paints and enamels, and among the various products so distributed by said Defendant is an enamel known as 24-018 enamel in, 487 oil.

4. Defendant MONSANTO is engaged in the business of manufacturing and preparing chemicals, chemical products, oils and thinners and distributing said products into the channels of trade, and among the various products so manufactured and distributed by said Defendant is the product known as Aroclor 4465.

5. Defendant DRAKENFELD prepares the aforesaid product 24-018 enamel in 487 oil, by combining various other materials with Monsanto's product Aroclor 4465.

6. Both Defendants herein did know and intend that said products would be used by the consuming public and would be handled, dealt with, touched and the fumes thereof would be inhaled by the public, and both Defendants placed said



DSW 441874

STLCOPCB4056409

products in the channels of trade with such knowledge and intention.

7. Both Defendants herein did impliedly warrant and represent that the products 24-018 enamel in 487 oil, and Aroclor 4465 were fit and safe for such use by the public; but both Defendants and each Defendant knew that such products contained chlorinated biphenyls and chlorinated triphenyls, with a high amount of chlorination; said Defendants, and each of them, knew that said products would from time to time be heated or baked in ovens, and that use by the public of said products was likely to cause liver damage, skin eruptions, rashes, acne, cysts and dermatitis of various kinds.

8. Plaintiff, beginning in the year 1958 began to make use of said products in his employment with International Bent Glass Company, Inc. at St. Louis, Missouri, handling such products, touching the same, and inhaling the fumes thereof, all in reliance on the skill and judgment and aforesaid warranty of both Defendants, being wholly unaware of the toxic and dangerous qualities of such products.

9. After a period of such use of such products, the same, contrary to and in breach of the warranty of both Defendants, directly and proximately caused Plaintiff to become ill and diseased, in that Plaintiff suffered eruptions of Plaintiff's skin over and about Plaintiff's neck, shoulders, chest, back, buttocks, face, ears and eyelids, said areas have become covered with comedones, cysts, acne, infectious lesions.



DSW 441875

STLCOPCB4056410

papules and a condition known as chloracne; Plaintiff's eyelids and periorbital skin became erythematous,, edematous and scaly; Plaintiff's liver was injured, damaged and diseased; these conditions are painful, irritating and embarrassing; all of said conditions are permanent.

10. Plaintiff has become obligated for large sums of money for medical attention for the aforesaid conditions and will become obligated for additional such sums in the future, in an amount not now ascertainable.

WHEREFORE, the premises considered, Plaintiff prays judgment against the Defendants and each of them, on this Count I of the petition for TWENTY SEVEN THOUSAND FIVE HUNDRED DOLLARS ($27,500.00), and for Plaintiff's costs.

COUNT II

Plaintiff for cause of action in Count II of this Petition states:

1. Plaintiff restates and realleges each and every allegation in paragraphs 1, 2, 3, 4, 5, and 6 of Count I of this petition.

2. Both Defendants and each of them knew, or in the exercise of ordinary care should have known that said products, containing highly chlorinated biphenyls and triphenyls, are, and for many years have been, known to be of a toxic and dangerous nature in that they were reasonably likely to cause abnormal reactions, skin eruptions, rashes, liver damage, dermatitis and diseases, and Defendants and each of them were



DSW 441876

STLCOPCB4056411

under a duty to give an adequate warning of such dangers and risks to the public who used such products, but both Defendants and each of them negligently breached said duty by failing and omitting to give an adequate warning of such dangers and risks.

3. Plaintiff began to make use of such products in 1958 inher employment at St. Louis, Missouri with International Bent Glass Company, and as a direct and proximate result of the Defendants' negligence, Plaintiff was injured in those particulars alleged hereinabove in Count I, Paragraph 9.

4. Plaintiff restates and realleges each and every allegation in Count I, Paragraph 10.

WHEREFORE, the premises considered, Plaintiff prays judgment on this Count II of this Petition against the Defendants, and each of them, in the sum of TWENTY SEVEN THOUSAND FIVE HUNDRED DOLLARS ($27,500.00) and her costs.

CARUTHERS AND MONTREY

BY John P. Montrey

JOHN P. MONTREY
430 Paul Brown Bldg.
St. Louis 1, Missouri
GArfield 1-2777
ATTORNEYS FOR PLAINTIFF

DSW 441877

STLCOPCB4056412

Form No. 75

# Circuit Court for the City of St. Louis

State of Missouri

Marie Clifford

Plaintiff

vs.

B. F. Drakenfeld & Co., et al

Defendant

No. 47810 E

Div. 1

## SUMMONS

The State of Missouri to Defendant Monsanto Chemical Co., a Corp.

You are hereby summoned to appear before the above-named court and to file your pleading to the petition, copy of which is attached hereto, and to serve a copy of your pleading upon

Caruthers & Montrey attorneys for plaintiff,

whose address is 430 Paul Brown Bldg.

all within 30 days after service of this summons upon you, exclusive of the day of service. If you fail to do so, judgment by default will be taken against you for the relief demanded in the petition.

Dated June 29, 19 62

PHELIM O'TOOLE
Circuit Clerk.

By M. White
Deputy Clerk.

(Seal of Circuit Court)

DSW 441878

STLCOPCB4056413

# RETURN ON SERVICE OF SUMMONS

I hereby certify that I have served the within summons:

(1) By delivering on the.....day of....., 19.....

a copy of the summons and a copy of the petition to each of the within-named defendants.....

.....

.....

.....

(2) By leaving on the.....day of....., 19.....

for each of the within-named defendants.....

.....

.....

a copy of the summons and a copy of the petition at the respective dwelling place or usual place of abode of said defendants with some person of his or her family over the age of 15 years;

(3) By.....

.....

.....

.....

.....

All done in.....County, Missouri.

Sheriff's fees:

Summons.....$

Non est.....$

Mileage.....$

Total.....$

Sheriff of.....County, Missouri.

By.....
Deputy Sheriff.

**DIRECTIONS TO SHERIFF**

A copy of the summons and a copy of the petition must be served on each defendant. For methods of service in all classes of suits see Sec. 27 Civil Code.

No. 47810 E

Div. 1

**SUMMONS**

Civil Code, Form No. 1

In the Case of

.....

.....Plaintiff

vs.

.....

.....Defendant.

In the Circuit Court of the

City of St. Louis

STATE OF MISSOURI

DSW 441879

STLCOPCB4056414

STATE OF MISSOURI )
) SS
CITY OF ST. LOUIS )

IN THE CIRCUIT COURT OF THE CITY OF ST. LOUIS

STATE OF MISSOURI

| | | |
|---|---|---|
| THEODORE CZARNECKI, | ) | |
| | ) | |
| Plaintiff, | ) | |
| | ) | |
| -vs- | ) | |
| | ) | |
| B.F. DRAKENFELD AND COMPANY, | ) | |
| a corporation, | ) | |
| 45 Park Place | ) | |
| New York 7, New York | ) | |
| Serve: Secretary of State | ) | No. |
| Jefferson City, Missouri | ) | |
| | ) | Div. No. 1 |
| and | ) | |
| | ) | |
| MONSANTO CHEMICAL COMPANY, | ) | |
| a corporation, | ) | |
| Serve: C.T. Corporation Service | ) | |
| 314 N. Broadway | ) | |
| St. Louis 2, Missouri, | ) | |
| | ) | |
| Defendants. | ) | |

P E T I T I O N

COUNT I

Plaintiff, for cause of action in Count I of this Petition, states:

1. Defendant, B. F. DRAKENFELD AND COMPANY, (hereinafter called "Drakenfeld") is and was a foreign corporation duly organized and existing under law at all times hereinafter mentioned; as hereinafter more particularly alleged, DRAKENFELD has committed a tort against the person of Plaintiff, in the City of St. Louis, State of Missouri, and has thereby agreed that the Secretary of State of Missouri shall be its agent



DSW 441880

STLCOPCB4056415

for the service of process, all as is provided in V.A.M.S., 1949, Section 351.630.

2. Defendant, MONSANTO CHEMICAL COMPANY (hereinafter called "Monsanto") is and at all times hereinafter mentioned was a corporation organized and existing under the laws of the State of Delaware, having a registered agent and office in the City of St. Louis, State of Missouri, and having its principal place of business in the State of Missouri.

3. Defendant DRAKENFELD is engaged in the business of manufacturing, preparing and distributing into the channels of trade paints and enamels, and among the various products so distributed by said Defendant is an enamel known as 24-018 enamel in 487 oil.

4. Defendant MONSANTO is engaged in the business of manufacturing and preparing chemicals, chemical products, oils and thinners and distributing said products into the channels of trade, and among the various products so manufactured and distributed by said Defendant is the product known as Aroclor 4465.

5. Defendant DRAKENFELD prepares the aforesaid product 24-018 enamel in 487 oil, by combining various other materials with Monsanto's product Aroclor 4465.

6. Both Defendants herein did know and intend that said products would be used by the consuming public and would be handled, dealt with, touched and the fumes thereof would be inhaled by the public, and both Defendants placed said



DSW 441881

STLCOPCB4056416

products in the channels of trade with such knowledge and intention.

7. Both Defendants herein did impliedly warrant and represent that the products 24-018 enamel in 487 oil, and Aroclor 4465 were fit and safe for such use by the public; but both Defendants and each Defendant knew that such products contained chlorinated biphenyls and chlorinated triphenyls, with a high amount of chlorination; said Defendants, and each of them, knew that said products would from time to time be heated or baked in ovens, and that use by the public of said products was likely to cause liver damage, skin eruptions, rashes, acne, cysts and dermatitis of various kinds.

8. Plaintiff, beginning in the year 1958 began to make use of said products in his employment with International Bent Glass Company, Inc. at St. Louis, Missouri, handling such products, touching the same, and inhaling the fumes thereof, all in reliance on the skill and judgment and aforesaid warranty of both Defendants, being wholly unaware of the toxic and dangerous qualities of such products.

9. After a period of such use of such products, the same, contrary to and in breach of the warranty of both Defendants, directly and proximately caused Plaintiff to become ill and diseased, in that Plaintiff suffered eruptions of Plaintiff's skin over and about Plaintiff's neck, shoulders, chest, back, buttocks, face, ears and eyelids, said areas have become covered with comedones, cysts, acne, infectious lesions,



DSW 441882

STLCOPCB4056417

papules and a condition known as chloracne; Plaintiff's eyelids and periorbital skin became erythematous,, edematous and scaly; Plaintiff's liver was injured, damaged and diseased; these conditions are painful, irritating and embarrassing; all of said conditions are permanent.

10. Plaintiff has become obligated for large sums of money for medical attention for the aforesaid conditions and will become obligated for additional such sums in the future, in an amount not now ascertainable.

WHEREFORE, the premises considered, Plaintiff prays judgment against the Defendants and each of them, on this Count I of the petition for **FORTY FIVE THOUSAND DOLLARS ($45,000.00)** and for Plaintiff's costs.

COUNT II

Plaintiff for cause of action in Count II of this Petition states:

1. Plaintiff restates and realleges each and every allegation in paragraphs 1, 2, 3, 4, 5, and 6 of Count I of this petition.

2. Both Defendants and each of them knew, or in the exercise of ordinary care should have known that said products, containing highly chlorinated biphenyls and triphenyls, are, and for many years have been, known to be of a toxic and dangerous nature in that they were reasonably likely to cause abnormal reactions, skin eruptions, rashes, liver damage, dermatitis and diseases, and Defendants and each of them were



DSW 441883

STLCOPCB4056418

under a duty to give an adequate warning of such dangers and risks to the public who used such products, but both Defendants and each of them negligently breached said duty by failing and omitting to give an adequate warning of such dangers and risks.

3. Plaintiff began to make use of such products in 1958 in his employment at St. Louis, Missouri with International Bent Glass Company, and as a direct and proximate result of the Defendants' negligence, Plaintiff was injured in those particulars alleged hereinabove in Count I, Paragraph 9.

4. Plaintiff restates and realleges each and every allegation in Count I, Paragraph 10.

WHEREFORE, the premises considered, Plaintiff prays judgment on this Count II of this Petition against the Defendants, and each of them, in the sum of **FORTY FIVE THOUSAND DOLLARS ($45,000.00), and for his costs.**

CAKUTHERS AND MONTREY

BY John P. Montrey

JOHN P. MONTREY
430 Paul Brown Bldg.
St. Louis 1, Missouri
GArfield 1-2777
ATTORNEYS FOR PLAINTIFF

Form No. 75

# Circuit Court for the City of St. Louis

State of Missouri

Theodore Czarnecki

Plaintiff

vs.

B. F. Drakenfeld Y Co. & Corp.

Defendant

No. 47809-E

Div. 1

## SUMMONS

The State of Missouri to Defendant Monsanto Chemical Co., a Corp.

You are hereby summoned to appear before the above-named court and to file your pleading to the petition, copy of which is attached hereto, and to serve a copy of your pleading upon

Caruthers & Montrey attorney s for plaintiff,

whose address is 430 Paul Brown Bldg.

all within 30 days after service of this summons upon you, exclusive of the day of service. If you fail to do so, judgment by default will be taken against you for the relief demanded in the petition.

Dated June 29, 19 62

PHELIM O'TOOLE
Circuit Clerk.

By M. White
Deputy Clerk.

(Seal of Circuit Court)

DSW 441885

STLCOPCB4056420

# RETURN ON SERVICE OF SUMMONS

I hereby certify that I have served the within summons:

(1) By delivering on the.....day of....., 19.....

a copy of the summons and a copy of the petition to each of the within-named defendants.....

.....

.....

.....

(2) By leaving on the.....day of....., 19.....

for each of the within-named defendants.....

.....

.....

a copy of the summons and a copy of the petition at the respective dwelling place or usual place of abode of said defendants with some person of his or her family over the age of 15 years;

(3) By.....

.....

.....

.....

.....

All done in.....County, Missouri.

Sheriff's fees:

Summons.....$

Non est.....$

Mileage.....$

Total.....$

Sheriff of.....County, Missouri.

By.....
Deputy Sheriff.

**DIRECTIONS TO SHERIFF**

A copy of the summons and a copy of the petition must be served on each defendant. For methods of service in all classes of suits see Sec. 27 Civil Code.

DSW 441886

No. 47809 E

Div. 1

**SUMMONS**

Civil Code, Form No. 1

In the Case of

.....

Plaintiff

vs.

.....

Defendant

In the Circuit Court of the
City of St. Louis
STATE OF MISSOURI

STLCOPCB4056421

STATE OF MISSOURI )
) SS
CITY OF ST. LOUIS )

IN THE CIRCUIT COURT OF THE CITY OF ST. LOUIS

STATE OF MISSOURI

| | | |
|---|---|---|
| MILDRED BARRETT, | ) | |
| Plaintiff, | ) | |
| -vs- | ) | |
| B.F. DRAKENFELD AND COMPANY, a corporation, 45 Park Place New York 7, New York Serve: Secretary of State Jefferson City, Missouri | ) | No. |
| | ) | Div. No. 1 |
| and | ) | |
| MONSANTO CHEMICAL COMPANY, a corporation, Serve: C.T. Corporation Service 314 N. Broadway St. Louis 2, Missouri, | ) | |
| Defendants. | ) | |

P E T I T I O N

COUNT I

Plaintiff, for cause of action in Count I of this Petition, states:

1. Defendant, B. F. DRAKENFELD AND COMPANY, (hereinafter called "Drakenfeld") is and was a foreign corporation duly organized and existing under law at all times hereinafter mentioned; as hereinafter more particularly alleged, DRAKENFELD has committed a tort against the person of Plaintiff, in the City of St. Louis, State of Missouri, and has thereby agreed that the Secretary of State of Missouri shall be its agent



DSW 441887

STLCOPCB4056422

for the service of process, all as is provided in V.A.M.S., 1949, Section 351.630.

2. Defendant, MONSANTO CHEMICAL COMPANY (hereinafter called "Monsanto") is and at all times hereinafter mentioned was a corporation organized and existing under the laws of the State of Delaware, having a registered agent and office in the City of St. Louis, State of Missouri, and having its principal place of business in the State of Missouri.

3. Defendant DRAKENFELD is engaged in the business of manufacturing, preparing and distributing into the channels of trade paints and enamels, and among the various products so distributed by said Defendant is an enamel known as 24-018 enamel in 487 oil.

4. Defendant MONSANTO is engaged in the business of manufacturing and preparing chemicals, chemical products, oils and thinners and distributing said products into the channels of trade, and among the various products so manufactured and distributed by said Defendant is the product known as Aroclor 4465.

5. Defendant DRAKENFELD prepares the aforesaid product 24-018 enamel in 487 oil, by combining various other materials with Monsanto's product Aroclor 4465.

6. Both Defendants herein did know and intend that said products would be used by the consuming public and would be handled, dealt with, touched and the fumes thereof would be inhaled by the public, and both Defendants placed said



DSW 441888

STLCOPCB4056423

products in the channels of trade with such knowledge and intention.

7. Both Defendants herein did impliedly warrant and represent that the products 24-018 enamel in 487 oil, and Aroclor 4465 were fit and safe for such use by the public; but both Defendants and each Defendant knew that such products contained chlorinated biphenyls and chlorinated triphenyls, with a high amount of chlorination; said Defendants, and each of them, knew that said products would from time to time be heated or baked in ovens, and that use by the public of said products was likely to cause liver damage, skin eruptions, rashes, acne, cysts and dermatitis of various kinds.

8. Plaintiff, beginning in the year 1957 began to make use of said products in his employment with International Bent Glass Company, Inc. at St. Louis, Missouri, handling such products, touching the same, and inhaling the fumes thereof, all in reliance on the skill and judgment and aforesaid warranty of both Defendants, being wholly unaware of the toxic and dangerous qualities of such products.

9. After a period of such use of such products, the same, contrary to and in breach of the warranty of both Defendants, directly and proximately caused Plaintiff to become ill and diseased, in that Plaintiff suffered eruptions of Plaintiff's skin over and about Plaintiff's neck, shoulders, chest, back, buttocks, face, ears and eyelids, said areas have become covered with comedones, cysts, acne, infectious lesions,



DSW 441889

STLCOPCB4056424

papules and a condition known as chloracne; Plaintiff's eyelids and periorbital skin became erythematous,, edematous and scaly; Plaintiff's liver was injured, damaged and diseased; these conditions are painful, irritating and embarrassing; all of said conditions are permanent.

10. Plaintiff has become obligated for large sums of money for medical attention for the aforesaid conditions and will become obligated for additional such sums in the future, in an amount not now ascertainable.

WHEREFORE, the premises considered, Plaintiff prays judgment against the Defendants and each of them, on this Count I of the petition for TWENTY SEVEN THOUSAND FIVE HUNDRED DOLLARS ($27,500) and for Plaintiff's costs.

COUNT II

Plaintiff for cause of action in Count II of this Petition states:

1. Plaintiff restates and realleges each and every allegation in paragraphs 1, 2, 3, 4, 5, and 6 of Count I of this petition.

2. Both Defendants and each of them knew, or in the exercise of ordinary care should have known that said products, containing highly chlorinated biphenyls and triphenyls, are, and for many years have been, known to be of a toxic and dangerous nature in that they were reasonably likely to cause abnormal reactions, skin eruptions, rashes, liver damage, dermatitis and diseases, and Defendants and each of them were



DSW 441890

STLCOPCB4056425

under a duty to give an adequate warning of such dangers and risks to the public who used such products, but both Defendants and each of them negligently breached said duty by failing and omitting to give an adequate warning of such dangers and risks.

3. Plaintiff began to make use of such products in 1957 in her employment at St. Louis, Missouri with International Bent Glass Company, and as a direct and proximate result of the Defendants' negligence, Plaintiff was injured in those particulars alleged hereinabove in Count I, Paragraph 9.

4. Plaintiff restates and realleges each and every allegation in Count I, Paragraph 10.

WHEREFORE, the premises considered, Plaintiff prays judgment on this Count II of this Petition against the Defendants, and each of them, in the sum of TWENTY SEVEN THOUSAND FIVE HUNDRED DOLLARS ($27,500.00) and for her costs.

CARUTHERS AND MONTREY

BY John P. Montrey

JOHN P. MONTREY
430 Paul Brown Bldg.
St. Louis 1, Missouri
GArfield 1-2777
ATTORNEYS FOR PLAINTIFF

DSW 441891

STLCOPCB4056426

Form No. 75

# Circuit Court for the City of St. Louis

State of Missouri

Mildred Barrett

Plaintiff

vs.

B. F. Drakenfeld & Co., a Corp., et al

Defendant

No. 47808 E

Div. 1

## SUMMONS

The State of Missouri to Defendant Monsanto Chemical Co., a Corp.

You are hereby summoned to appear before the above-named court and to file your pleading to the petition, copy of which is attached hereto, and to serve a copy of your pleading upon

Caruthers & Montrey attorney s for plaintiff ,

whose address is 430 Paul Brown Bldg.

all within 30 days after service of this summons upon you, exclusive of the day of service. If you fail to do so, judgment by default will be taken against you for the relief demanded in the petition.

Dated June 29, 19 62

PHELIM O'TOOLE
Circuit Clerk.

By D. White
Deputy Clerk.

(Seal of Circuit Court)

DSW 441892

STLCOPCB4056427

# RETURN ON SERVICE OF SUMMONS

I hereby certify that I have served the within summons:

(1) By delivering on the.....day of....., 19.....

a copy of the summons and a copy of the petition to each of the within-named defendants.....

.....

.....

.....

(2) By leaving on the.....day of....., 19.....

for each of the within-named defendants.....

.....

.....

a copy of the summons and a copy of the petition at the respective dwelling place or usual place of abode of said defendants with some person of his or her family over the age of 15 years;

(3) By.....

.....

.....

.....

.....

All done in.....County, Missouri.

Sheriff's fees:

Summons.....$

Non est.....$

Mileage.....$

Total.....$

Sheriff of.....County, Missouri.

By.....

Deputy Sheriff.

**DIRECTIONS TO SHERIFF**

A copy of the summons and a copy of the petition must be served on each defendant. For methods of service in all classes of suits see Sec. 27 Civil Code.

DSW 441893

No. 47808 Div. 1

**SUMMONS**

Civil Code, Form No. 1

In the Case of

.....

Plaintiff

vs.

.....

Defendant

In the Circuit Court of the City of St. Louis STATE OF MISSOURI

STLCOPCB4056428

STATE OF MISSOURI )
) SS
CITY OF ST. LOUIS )

IN THE CIRCUIT COURT OF THE CITY OF ST. LOUIS

STATE OF MISSOURI

| | | |
|---|---|---|
| **RONNIE SIMPSON,** | ) | |
| | ) | |
| Plaintiff, | ) | |
| | ) | |
| -vs- | ) | |
| | ) | |
| B.F. DRAKENFELD AND COMPANY, | ) | |
| a corporation, | ) | |
| 45 Park Place | ) | |
| New York 7, New York | ) | |
| Serve: Secretary of State | ) | No. |
| Jefferson City, Missouri | ) | |
| | ) | Div. No. 1 |
| and | ) | |
| | ) | |
| MONSANTO CHEMICAL COMPANY, | ) | |
| a corporation, | ) | |
| Serve: C.T. Corporation Service | ) | |
| 314 N. Broadway | ) | |
| St. Louis 2, Missouri, | ) | |
| | ) | |
| Defendants. | ) | |

P E T I T I O N

COUNT I

Plaintiff, for cause of action in Count I of this Petition, states:

1. Defendant, B. F. DRAKENFELD AND COMPANY, (hereinafter called "Drakenfeld") is and was a foreign corporation duly organized and existing under law at all times hereinafter mentioned; as hereinafter more particularly alleged, DRAKENFELD has committed a tort against the person of Plaintiff, in the City of St. Louis, State of Missouri, and has thereby agreed that the Secretary of State of Missouri shall be and again



DSW 441894

STLCOPCB4056429

for the service of process, all as is provided in V.A.M.S., 1949, Section 351.630.

2. Defendant, MONSANTO CHEMICAL COMPANY (hereinafter called "Monsanto") is and at all times hereinafter mentioned was a corporation organized and existing under the laws of the State of Delaware, having a registered agent and office in the City of St. Louis, State of Missouri, and having its principal place of business in the State of Missouri.

3. Defendant DRAKENFELD is engaged in the business of manufacturing, preparing and distributing into the channels of trade paints and enamels, and among the various products so distributed by said Defendant is an enamel known as 24-018 enamel in 487 oil.

4. Defendant MONSANTO is engaged in the business of manufacturing and preparing chemicals, chemical products, oils and thinners and distributing said products into the channels of trade, and among the various products so manufactured and distributed by said Defendant is the product known as Aroclor 4465.

5. Defendant DRAKENFELD prepares the aforesaid product 24-018 enamel in 487 oil, by combining various other materials with Monsanto's product Aroclor 4465.

6. Both Defendants herein did know and intend that said products would be used by the consuming public and would be handled, dealt with, touched and the fumes thereof would be inhaled by the public, and both Defendants placed said



DSW 441895

STLCOPCB4056430

products in the channels of trade with such knowledge and intention.

7. Both Defendants herein did impliedly warrant and represent that the products 24-018 enamel in 487 oil, and Aroclor 4465 were fit and safe for such use by the public; but both Defendants and each Defendant knew that such products contained chlorinated biphenyls and chlorinated triphenyls, with a high amount of chlorination; said Defendants, and each of them, knew that said products would from time to time be heated or baked in ovens, and that use by the public of said products was likely to cause liver damage, skin eruptions, rashes, acne, cysts and dermatitis of various kinds.

8. Plaintiff, beginning in the year 1958 began to make use of said products in his employment with International Bent Glass Company, Inc. at St. Louis, Missouri, handling such products, touching the same, and inhaling the fumes thereof, all in reliance on the skill and judgment and aforesaid warranty of both Defendants, being wholly unaware of the toxic and dangerous qualities of such products.

9. After a period of such use of such products, the same, contrary to and in breach of the warranty of both Defendants, directly and proximately caused Plaintiff to become ill and diseased, in that Plaintiff suffered eruptions of Plaintiff's skin over and about Plaintiff's neck, shoulders, chest, back, buttocks, face, ears and eyelids, said areas have become covered with comedones, cysts, acne, infectious lesions



DSW 441896

STLCOPCB4056431

papules and a condition known as chloracne; Plaintiff's eyelids and periorbital skin became erythematous,, edematous and scaly; Plaintiff's liver was injured, damaged and diseased; these conditions are painful, irritating and embarrassing; all of said conditions are permanent.

10. Plaintiff has become obligated for large sums of money for medical attention for the aforesaid conditions and will become obligated for additional such sums in the future, in an amount not now ascertainable.

WHEREFORE, the premises considered, Plaintiff prays judgment against the Defendants and each of them, on this Count I of the petition for THIRTY THOUSAND DOLLARS ($30,000.00), and for Plaintiff's costs.

COUNT II

Plaintiff for cause of action in Count II of this Petition states:

1. Plaintiff restates and realleges each and every allegation in paragraphs 1, 2, 3, 4, 5, and 6 of Count I of this petition.

2. Both Defendants and each of them knew, or in the exercise of ordinary care should have known that said products, containing highly chlorinated biphenyls and triphenyls, are, and for many years have been, known to be of a toxic and dangerous nature in that they were reasonably likely to cause abnormal reactions, skin eruptions, rashes, liver damage, dermatitis and diseases, and Defendants and each of them were



DSW 441897

STLCOPCB4056432

under a duty to give an adequate warning of such dangers and risks to the public who used such products, but both Defendants and each of them negligently breached said duty by failing and omitting to give an adequate warning of such dangers and risks.

3. Plaintiff began to make use of such products in 1958 in his employment at St. Louis, Missouri with International Bent Glass Company, and as a direct and proximate result of the Defendants' negligence, Plaintiff was injured in those particulars alleged hereinabove in Count I, Paragraph 9.

4. Plaintiff restates and realleges each and every allegation in Count I, Paragraph 10.

WHEREFORE, the premises considered, Plaintiff prays judgment on this Count II of this Petition against the Defendants, and each of them, in the sum of **THIRTY THOUSAND DOLLARS ($30,000.00)** and for his costs.

CARUTHERS AND MONTREY

John P. Montrey

JOHN P. MONTREY
430 Paul Brown Bldg.
St. Louis 1, Missouri
GArfield 1-2777
ATTORNEYS FOR PLAINTIFF

DSW 441898

STLCOPCB4056433

Form No. 75

# Circuit Court for the City of St. Louis

State of Missouri

Ronnie Simpson

Plaintiff

vs.

B. F. Drakenfeld & Co., et al

Defendant

No. 47807 2

Div. 1

## SUMMONS

The State of Missouri to Defendant Monsanto Chemical Co., a Corp.

You are hereby summoned to appear before the above-named court and to file your pleading to the petition, copy of which is attached hereto, and to serve a copy of your pleading upon

Caruthers & Montrey attorneys for plaintiff,

whose address is 430 Paul Brown Bldg.

all within 30 days after service of this summons upon you, exclusive of the day of service. If you fail to do so, judgment by default will be taken against you for the relief demanded in the petition.

Dated June 29, 19 62.

PHELIM O'TOOLE
Circuit Clerk.

By D. White
Deputy Clerk.

(Seal of Circuit Court)

DSW 441899

STLCOPCB4056434

# RETURN ON SERVICE OF SUMMONS

I hereby certify that I have served the within summons:

(1) By delivering on the.....day of....., 19.....

a copy of the summons and a copy of the petition to each of the within-named defendants.....

.....

.....

.....

(2) By leaving on the.....day of....., 19.....

for each of the within-named defendants.....

.....

.....

a copy of the summons and a copy of the petition at the respective dwelling place or usual place of abode of said defendants with some person of his or her family over the age of 15 years;

(3). By.....

.....

.....

.....

.....

All done in.....County, Missouri.

Sheriff's fees:

Summons .....$

Non est.....$

Mileage.....$_____

Total.....$

Sheriff of.....County, Missouri.

By.....

Deputy Sheriff.

**DIRECTIONS TO SHERIFF**

A copy of the summons and a copy of the petition must be served on each defendant. For methods of service in all classes of suits see Sec. 27 Civil Code.

DSW 441900

No. 47807 E

Div. 1

**SUMMONS**

Civil Code, Form No. 1

In the Case of

.....

Plaintiff

vs.

.....

Defendant

In the Circuit Court of the

City of St. Louis

STATE OF MISSOURI

STLCOPCB4056435

STATE OF MISSOURI )
) SS
CITY OF ST. LOUIS )

IN THE CIRCUIT COURT OF THE CITY OF ST. LOUIS

STATE OF MISSOURI

| | | |
|---|---|---|
| **MARTHA SYLER,** | ) | |
| | ) | |
| Plaintiff, | ) | |
| | ) | |
| -vs- | ) | |
| | ) | |
| B.F. DRAKENFELD AND COMPANY, | ) | |
| a corporation, | ) | |
| 45 Park Place | ) | |
| New York 7, New York | ) | |
| Serve: Secretary of State | ) | No. |
| Jefferson City, Missouri | ) | |
| | ) | Div. No. 1 |
| and | ) | |
| | ) | |
| MONSANTO CHEMICAL COMPANY, | ) | |
| a corporation, | ) | |
| Serve: C.T. Corporation Service | ) | |
| 314 N. Broadway | ) | |
| St. Louis 2, Missouri, | ) | |
| Defendants. | | |

P E T I T I O N

COUNT I

Plaintiff, for cause of action in Count I of this Petition, states:

1. Defendant, B. F. DRAKENFELD AND COMPANY, (hereinafter called "Drakenfeld") is and was a foreign corporation duly organized and existing under law at all times hereinafter mentioned; as hereinafter more particularly alleged, DRAKENFELD has committed a tort against the person of Plaintiff, in the City of St. Louis, State of Missouri, and has thereby agreed that the Secretary of State of Missouri shall be its agent



DSW 441901

STLCOPCB4056436

for the service of process, all as is provided in V.A.M.S., 1949, Section 351.630.

2. Defendant, MONSANTO CHEMICAL COMPANY (hereinafter called "Monsanto") is and at all times hereinafter mentioned was a corporation organized and existing under the laws of the State of Delaware, having a registered agent and office in the City of St. Louis, State of Missouri, and having its principal place of business in the State of Missouri.

3. Defendant DRAKENFELD is engaged in the business of manufacturing, preparing and distributing into the channels of trade paints and enamels, and among the various products so distributed by said Defendant is an enamel known as 24-018 enamel in 487 oil.

4. Defendant MONSANTO is engaged in the business of manufacturing and preparing chemicals, chemical products, oils and thinners and distributing said products into the channels of trade, and among the various products so manufactured and distributed by said Defendant is the product known as Aroclor 4465.

5. Defendant DRAKENFELD prepares the aforesaid product 24-018 enamel in 487 oil, by combining various other materials with Monsanto's product Aroclor 4465.

6. Both Defendants herein did know and intend that said products would be used by the consuming public and would be handled, dealt with, touched and the fumes thereof would be inhaled by the public, and both Defendants placed said



DSW 441902

STLCOPCB4056437

products in the channels of trade with such knowledge and intention.

7. Both Defendants herein did impliedly warrant and represent that the products 24-018 enamel in 487 oil, and Aroclor 4465 were fit and safe for such use by the public; but both Defendants and each Defendant knew that such products contained chlorinated biphenyls and chlorinated triphenyls, with a high amount of chlorination; said Defendants, and each of them, knew that said products would from time to time be heated or baked in ovens, and that use by the public of said products was likely to cause liver damage, skin eruptions, rashes, acne, cysts and dermatitis of various kinds.

8. Plaintiff, xxxxxxxxx in the year 1958 began to make use of said products in his employment with International Bent Glass Company, Inc. at St. Louis, Missouri, handling such products, touching the same, and inhaling the fumes thereof, all in reliance on the skill and judgment and aforesaid warranty of both Defendants, being wholly unaware of the toxic and dangerous qualities of such products.

9. After a period of such use of such products, the same, contrary to and in breach of the warranty of both Defendants, directly and proximately caused Plaintiff to become ill and diseased, in that Plaintiff suffered eruptions of Plaintiff's skin over and about Plaintiff's neck, shoulders, chest, back, buttocks, face, ears and eyelids, said areas have become covered with comedones, cysts, acne, infectious lesions;



DSW 441903

STLCOPCB4056438

papules and a condition known as chloracne; Plaintiff's eyelids and periorbital skin became erythematous,, edematous and scaly; Plaintiff's liver was injured, damaged and diseased; these conditions are painful, irritating and embarrassing; all of said conditions are permanent.

10. Plaintiff has become obligated for large sums of money for medical attention for the aforesaid conditions and will become obligated for additional such sums in the future, in an amount not now ascertainable.

WHEREFORE, the premises considered, Plaintiff prays judgment against the Defendants and each of them, on this Count I of the petition for **FORTY FIVE THOUSAND DOLLARS, ($45,000.00)**, and for Plaintiff's costs.

COUNT II

Plaintiff for cause of action in Count II of this Petition states:

1. Plaintiff restates and realleges each and every allegation in paragraphs 1, 2, 3, 4, 5, and 6 of Count I of this petition.

2. Both Defendants and each of them knew, or in the exercise of ordinary care should have known that said products, containing highly chlorinated biphenyls and triphenyls, are, and for many years have been, known to be of a toxic and dangerous nature in that they were reasonably likely to cause abnormal reactions, skin eruptions, rashes, liver damage, dermatitis and diseases, and Defendants and each of them were



DSW 441904

STLCOPCB4056439

under a duty to give an adequate warning of such dangers and risks to the public who used such products, but both Defendants and each of them negligently breached said duty by failing and omitting to give an adequate warning of such dangers and risks.

3. Plaintiff began to make use of such products in 1958 in her employment at St. Louis, Missouri with International Bent Glass Company, and as a direct and proximate result of the Defendants' negligence, Plaintiff was injured in those particulars alleged hereinabove in Count I, Paragraph 9.

4. Plaintiff restates and realleges each and every allegation in Count I, Paragraph 10.

WHEREFORE, the premises considered, Plaintiff prays judgment on this Count II of this Petition against the Defendants, and each of them, in the sum of **FORTY FIVE THOUSAND DOLLARS ($45,000.00)** and for her costs.

CARUTHERS AND MONTREY

BY John P. Montrey

JOHN P. MONTREY
430 Paul Brown Bldg.
St. Louis 1, Missouri
GArfield 1-2777
ATTORNEYS FOR PLAINTIFF

Form No. 75

# Circuit Court for the City of St. Louis

State of Missouri

Martha Syler

Plaintiff

vs.

B. F. Drakenfeld & Co., a Corp.

Defendant

No. 47806 E

Div. 1

## SUMMONS

The State of Missouri to Defendant ~~XXXXXXXXXXXXXXXX~~ Monsanto Chemical Co., a Corp.

You are hereby summoned to appear before the above-named court and to file your pleading to the petition, copy of which is attached hereto, and to serve a copy of your pleading upon

Caruthers & Montrey attorney s. for plaintiff,

whose address is 430 Paul Brown Bldg.

all within 30 days after service of this summons upon you, exclusive of the day of service. If you fail to do so, judgment by default will be taken against you for the relief demanded in the petition.

Dated June 29, 19 62

PHELIM O'TOOLE
Circuit Clerk.

By D. White
Deputy Clerk.

(Seal of Circuit Court)

DSW 441906

STLCOPCB4056441

# RETURN ON SERVICE OF SUMMONS

I hereby certify that I have served the within summons:

(1) By delivering on the.....day of....., 19.....

a copy of the summons and a copy of the petition to each of the within-named defendants.....

.....

.....

.....

(2) By leaving on the.....day of....., 19.....

for each of the within-named defendants.....

.....

.....

a copy of the summons and a copy of the petition at the respective dwelling place or usual place of abode of said defendants with some person of his or her family over the age of 15 years;

(3) By.....

.....

.....

.....

.....

All done in.....County, Missouri.

Sheriff's fees:

Summons.....$

Non est.....$

Mileage.....$_____

Total.....$

Sheriff of.....County, Missouri.

By.....

Deputy Sheriff.

**DIRECTIONS TO SHERIFF**

A copy of the summons and a copy of the petition must be served on each defendant. For methods of service in all classes of suits see Sec. 27 Civil Code.

DSW 441907

No. 47806 E

Div. 1

**SUMMONS**

Civil Code, Form No. 1

In the Case of

.....

Plaintiff

vs.

.....

Defendant

In the Circuit Court of the

City of St. Louis

STATE OF MISSOURI

STLCOPCB4056442

STATE OF MISSOURI )
) SS
CITY OF ST. LOUIS )

IN THE CIRCUIT COURT OF THE CITY OF ST. LOUIS

STATE OF MISSOURI

| | | |
|---|---|---|
| THELMA WIENERS, | ) | |
| | ) | |
| Plaintiff, | ) | |
| | ) | |
| -vs- | ) | |
| | ) | |
| B.F. DRAKENFELD AND COMPANY, | ) | |
| a corporation, | ) | |
| 45 Park Place | ) | |
| New York 7, New York | ) | |
| Serve: Secretary of State | ) | No. |
| Jefferson City, Missouri | ) | |
| | ) | Div. No. 1 |
| and | ) | |
| | ) | |
| MONSANTO CHEMICAL COMPANY, | ) | |
| a corporation, | ) | |
| Serve: C.T. Corporation Service | ) | |
| 314 N. Broadway | ) | |
| St. Louis 2, Missouri, | ) | |
| | ) | |
| Defendants. | ) | |

PETITION

COUNT I

Plaintiff, for cause of action in Count I of this Petition, states:

1. Defendant, B. F. DRAKENFELD AND COMPANY, (hereinafter called "Drakenfeld") is and was a foreign corporation duly organized and existing under law at all times hereinafter mentioned; as hereinafter more particularly alleged, DRAKENFELD has committed a tort against the person of Plaintiff, in the City of St. Louis, State of Missouri, and has thereby agreed that the Secretary of State of Missouri shall be its agent



DSW 441908

STLCOPCB4056443

for the service of process, all as is provided in V.A.M.S., 1949, Section 351.630.

2. Defendant, MONSANTO CHEMICAL COMPANY (hereinafter called "Monsanto") is and at all times hereinafter mentioned was a corporation organized and existing under the laws of the State of Delaware, having a registered agent and office in the City of St. Louis, State of Missouri, and having its principal place of business in the State of Missouri.

3. Defendant DRAKENFELD is engaged in the business of manufacturing, preparing and distributing into the channels of trade paints and enamels, and among the various products so distributed by said Defendant is an enamel known as 24-018 enamel in 487 oil.

4. Defendant MONSANTO is engaged in the business of manufacturing and preparing chemicals, chemical products, oils and thinners and distributing said products into the channels of trade, and among the various products so manufactured and distributed by said Defendant is the product known as Aroclor 4465.

5. Defendant DRAKENFELD prepares the aforesaid product 24-018 enamel in 487 oil, by combining various other materials with Monsanto's product Aroclor 4465.

6. Both Defendants herein did know and intend that said products would be used by the consuming public and would be handled, dealt with, touched and the fumes thereof would be inhaled by the public, and both Defendants placed said



DSW 441909

STLCOPCB4056444

products in the channels of trade with such knowledge and intention.

7. Both Defendants herein did impliedly warrant and represent that the products 24-018 enamel in 487 oil, and Aroclor 4465 were fit and safe for such use by the public; but both Defendants and each Defendant knew that such products contained chlorinated biphenyls and chlorinated triphenyls, with a high amount of chlorination; said Defendants, and each of them, knew that said products would from time to time be heated or baked in ovens, and that use by the public of said products was likely to cause liver damage, skin eruptions, rashes, acne, cysts and dermatitis of various kinds.

8. Plaintiff, beginning in the year 1958 began to make use of said products in his employment with International Bent Glass Company, Inc. at St. Louis, Missouri, handling such products, touching the same, and inhaling the fumes thereof, all in reliance on the skill and judgment and aforesaid warranty of both Defendants, being wholly unaware of the toxic and dangerous qualities of such products.

9. After a period of such use of such products, the same, contrary to and in breach of the warranty of both Defendants, directly and proximately caused Plaintiff to become ill and diseased, in that Plaintiff suffered eruptions of Plaintiff's skin over and about Plaintiff's neck, shoulders, chest, back, buttocks, face, ears and eyelids, said areas have become covered with comedones, cysts, acne, infectious lesions,



DSW 441910

STLCOPCB4056445

papules and a condition known as chloracne; Plaintiff's eyelids and periorbital skin became erythematous,, edematous and scaly; Plaintiff's liver was injured, damaged and diseased; these conditions are painful, irritating and embarrassing; all of said conditions are permanent.

10. Plaintiff has become obligated for large sums of money for medical attention for the aforesaid conditions and will become obligated for additional such sums in the future, in an amount not now ascertainable.

WHEREFORE, the premises considered, Plaintiff prays judgment against the Defendants and each of them, on this Count I of the petition for FIFTY THOUSAND DOLLARS ($50,000.00), and for Plaintiff's costs.

COUNT II

Plaintiff for cause of action in Count II of this Petition states:

1. Plaintiff restates and realleges each and every allegation in paragraphs 1, 2, 3, 4, 5, and 6 of Count I of this petition.

2. Both Defendants and each of them knew, or in the exercise of ordinary care should have known that said products, containing highly chlorinated biphenyls and triphenyls, are, and for many years have been, known to be of a toxic and dangerous nature in that they were reasonably likely to cause abnormal reactions, skin eruptions, rashes, liver damage, dermatitis and diseases, and Defendants and each of them were



DSW 441911

STLCOPCB4056446

under a duty to give an adequate warning of such dangers and risks to the public who used such products, but both Defendants and each of them negligently breached said duty by failing and omitting to give an adequate warning of such dangers and risks.

3. Plaintiff began to make use of such products in 1958 in her employment at St. Louis, Missouri with International Bent Glass Company, and as a direct and proximate result of the Defendants' negligence, Plaintiff was injured in those particulars alleged hereinabove in Count I, Paragraph 9.

4. Plaintiff restates and realleges each and every allegation in Count I, Paragraph 10.

WHEREFORE, the premises considered, Plaintiff prays judgment on this Count II of this Petition against the Defendants, and each of them, in the sum of **FIFTY THOUSAND DOLLARS ($50,000.00)**, and for her costs.

CARUTHERS AND MONTREY

BY John P. Montrey

JOHN P. MONTREY
430 Paul Brown Bldg.
St. Louis 1, Missouri
GArfield 1-2777
ATTORNEYS FOR PLAINTIFF

Form No. 75

# Circuit Court for the City of St. Louis

State of Missouri

Thelma Wieners

Plaintiff

vs.

B. F. Drakenfeld & Co., et al

Defendant

No. 47805 E

Div. 1

## SUMMONS

The State of Missouri to Defendant Monsanto Chemical Co., a Corp.

You are hereby summoned to appear before the above-named court and to file your pleading to the petition, copy of which is attached hereto, and to serve a copy of your pleading upon

Caruthers & Montrey attorney S for plaintiff ,

whose address is 430 Paul Brown Bldg.

all within 30 days after service of this summons upon you, exclusive of the day of service. If you fail to do so, judgment by default will be taken against you for the relief demanded in the petition.

Dated June 29, 19 62

PHELIM O'TOOLE
Circuit Clerk.

By M. White
Deputy Clerk.

(Seal of Circuit Court)

DSW 441913

STLCOPCB4056448

# RETURN ON SERVICE OF SUMMONS

I hereby certify that I have served the within summons:

(1) By delivering on the.....day of....., 19.....

a copy of the summons and a copy of the petition to each of the within-named defendants.....

.....

.....

.....

(2) By leaving on the.....day of....., 19.....

for each of the within-named defendants.....

.....

.....

a copy of the summons and a copy of the petition at the respective dwelling place or usual place of abode of said defendants with some person of his or her family over the age of 15 years;

(3) By.....

.....

.....

.....

.....

All done in.....County, Missouri.

Sheriff's fees:

Summons.....$

Non est.....$

Mileage.....$

Total.....$

.....

Sheriff of.....County, Missouri.

By.....

Deputy Sheriff.

**DIRECTIONS TO SHERIFF**

A copy of the summons and a copy of the petition must be served on each defendant. For methods of service in all classes of suits see Sec. 27 Civil Code.

No. 47305-E

Div. 1

**SUMMONS**

Civil Code, Form No. 1

In the Case of

.....

Plaintiff

vs.

Millersville Chemical Co. Inc.

Defendant

In the Circuit Court of the

City of St. Louis

STATE OF MISSOURI

c/o C. T. Corp.

314 N. Broadway

DSW 441914

STLCOPCB4056449

STATE OF MISSOURI )
) SS
CITY OF ST. LOUIS )

IN THE CIRCUIT COURT OF THE CITY OF ST. LOUIS

STATE OF MISSOURI

| | | |
|---|---|---|
| RITA B. KING, | ) | |
| | ) | |
| Plaintiff, | ) | |
| | ) | |
| -vs- | ) | |
| | ) | |
| B.F. DRAKENFELD AND COMPANY, | ) | |
| a corporation, | ) | |
| 45 Park Place | ) | |
| New York 7, New York | ) | |
| Serve: Secretary of State | ) | No. |
| Jefferson City, Missouri | ) | |
| | ) | Div. No. 1 |
| and | ) | |
| | ) | |
| MONSANTO CHEMICAL COMPANY, | ) | |
| a corporation, | ) | |
| Serve: C.T. Corporation Service | ) | |
| 314 N. Broadway | ) | |
| St. Louis 2, Missouri, | ) | |
| | ) | |
| Defendants. | ) | |

P E T I T I O N

COUNT I

Plaintiff, for cause of action in Count I of this Petition, states:

1. Defendant, B. F. DRAKENFELD AND COMPANY, (hereinafter called "Drakenfeld") is and was a foreign corporation duly organized and existing under law at all times hereinafter mentioned; as hereinafter more particularly alleged, DRAKENFELD has committed a tort against the person of Plaintiff, in the City of St. Louis, State of Missouri, and has thereby agreed that the Secretary of State of Missouri shall be its agent



DSW 441915

STLCOPCB4056450

for the service of process, all as is provided in V.A.M.S., 1949, Section 351.630.

2. Defendant, MONSANTO CHEMICAL COMPANY (hereinafter called "Monsanto") is and at all times hereinafter mentioned was a corporation organized and existing under the laws of the State of Delaware, having a registered agent and office in the City of St. Louis, State of Missouri, and having its principal place of business in the State of Missouri.

3. Defendant DRAKENFELD is engaged in the business of manufacturing, preparing and distributing into the channels of trade paints and enamels, and among the various products so distributed by said Defendant is an enamel known as 24-018 enamel in 487 oil.

4. Defendant MONSANTO is engaged in the business of manufacturing and preparing chemicals, chemical products, oils and thinners and distributing said products into the channels of trade, and among the various products so manufactured and distributed by said Defendant is the product known as Aroclor 4465.

5. Defendant DRAKENFELD prepares the aforesaid product 24-018 enamel in 487 oil, by combining various other materials with Monsanto's product Aroclor 4465.

6. Both Defendants herein did know and intend that said products would be used by the consuming public and would be handled, dealt with, touched and the fumes thereof would be inhaled by the public, and both Defendants placed said



DSW 441916

STLCOPCB4056451

products in the channels of trade with such knowledge and intention.

7. Both Defendants herein did impliedly warrant and represent that the products 24-018 enamel in 487 oil, and Aroclor 4465 were fit and safe for such use by the public; but both Defendants and each Defendant knew that such products contained chlorinated biphenyls and chlorinated triphenyls, with a high amount of chlorination; said Defendants, and each of them, knew that said products would from time to time be heated or baked in ovens, and that use by the public of said products was likely to cause liver damage, skin eruptions, rashes, acne, cysts and dermatitis of various kinds.

8. Plaintiff, beginning in the year 1959 began to make use of said products in his employment with International Bent Glass Company, Inc. at St. Louis, Missouri, handling such products, touching the same, and inhaling the fumes thereof, all in reliance on the skill and judgment and aforesaid warranty of both Defendants, being wholly unaware of the toxic and dangerous qualities of such products.

9. After a period of such use of such products, the same, contrary to and in breach of the warranty of both Defendants, directly and proximately caused Plaintiff to become ill and diseased, in that Plaintiff suffered eruptions of Plaintiff's skin over and about Plaintiff's neck, shoulders, chest, back, buttocks, face, ears and eyelids, said areas have become covered with comedones, cysts, acne, infectious lesions,



DSW 441917

STLCOPCB4056452

papules and a condition known as chloracne; Plaintiff's eyelids and periorbital skin became erythematous,, edematous and scaly; Plaintiff's liver was injured, damaged and diseased; these conditions are painful, irritating and embarrassing; all of said conditions are permanent.

10. Plaintiff has become obligated for large sums of money for medical attention for the aforesaid conditions and will become obligated for additional such sums in the future, in an amount not now ascertainable.

WHEREFORE, the premises considered, Plaintiff prays judgment against the Defendants and each of them, on this Count I of the petition for **FORTY FIVE THOUSAND DOLLARS ($45,000.00)**, and for Plaintiff's costs.

COUNT II

Plaintiff for cause of action in Count II of this Petition states:

1. Plaintiff restates and realleges each and every allegation in paragraphs 1, 2, 3, 4, 5, and 6 of Count I of this petition.

2. Both Defendants and each of them knew, or in the exercise of ordinary care should have known that said products, containing highly chlorinated biphenyls and triphenyls, are, and for many years have been, known to be of a toxic and dangerous nature in that they were reasonably likely to cause abnormal reactions, skin eruptions, rashes, liver damage, dermatitis and diseases, and Defendants and each of them were



DSW 441918

STLCOPCB4056453

under a duty to give an adequate warning of such dangers and risks to the public who used such products, but both Defendants and each of them negligently breached said duty by failing and omitting to give an adequate warning of such dangers and risks.

3. Plaintiff began to make use of such products in 1959 in her employment at St. Louis, Missouri with International Bent Glass Company, and as a direct and proximate result of the Defendants' negligence, Plaintiff was injured in those particulars alleged hereinabove in Count I, Paragraph 9.

4. Plaintiff restates and realleges each and every allegation in Count I, Paragraph 10.

WHEREFORE, the premises considered, Plaintiff prays judgment on this Count II of this Petition against the Defendants, and each of them, in the sum of **FORTY FIVE THOUSAND DOLLARS ($45,000.00) and for her costs.**

CARUTHERS AND MONTREY

BY John P. Montrey

JOHN P. MONTREY
430 Paul Brown Bldg.
St. Louis 1, Missouri
GArfield 1-2777
ATTORNEYS FOR PLAINTIFF

Form No. 75

# Circuit Court for the City of St. Louis

State of Missouri

Rita B. King

Plaintiff

vs.

B. F. Drakenfeld & Co., et al

Defendant

No. 47804 E

Div. 1

## SUMMONS

The State of Missouri to Defendant Monsanto Chemical Co., a Corp.

You are hereby summoned to appear before the above-named court and to file your pleading to the petition, copy of which is attached hereto, and to serve a copy of your pleading upon

Caruthers & Montrey attorneys for plaintiff,

whose address is 430 Paul Brown Bldg.

all within 30 days after service of this summons upon you, exclusive of the day of service. If you fail to do so, judgment by default will be taken against you for the relief demanded in the petition.

Dated June 29, 19 62

PHELIM O'TOOLE
Circuit Clerk.

By D. White
Deputy Clerk.

(Seal of Circuit Court)

DSW 441920

STLCOPCB4056455

# RETURN ON SERVICE OF SUMMONS

I hereby certify that I have served the within summons:

(1) By delivering on the.....day of....., 19.....

a copy of the summons and a copy of the petition to each of the within-named defendants.....

.....

.....

.....

(2) By leaving on the.....day of....., 19.....

for each of the within-named defendants.....

.....

.....

a copy of the summons and a copy of the petition at the respective dwelling place or usual place of abode of said defendants with some person of his or her family over the age of 15 years;

(3) By.....

.....

.....

.....

.....

All done in.....County, Missouri.

Sheriff's fees:

Summons.....$

Non est.....$

Mileage.....$_____

Total.....$

Sheriff of.....County, Missouri.

By.....

Deputy Sheriff.

**DIRECTIONS TO SHERIFF**

A copy of the summons and a copy of the petition must be served on each defendant. For methods of service in all classes of suits see Sec. 27 Civil Code.

DSW 441921

No. 47804 E

Div. 1

**SUMMONS**

Civil Code, Form No. 1

In the Case of

.....

Plaintiff

vs.

.....

Defendant

In the Circuit Court of the

City of St. Louis

STATE OF MISSOURI

STLCOPCB4056456

STATE OF MISSOURI )
) SS
CITY OF ST. LOUIS )

IN THE CIRCUIT COURT OF THE CITY OF ST. LOUIS

STATE OF MISSOURI

| | | |
|---|---|---|
| DOROTHY BERRY, | ) | |
| Plaintiff, | ) | |
| -vs- | ) | |
| B.F. DRAKENFELD AND COMPANY,<br>a corporation,<br>45 Park Place<br>New York 7, New York<br>Serve: Secretary of State<br>Jefferson City, Missouri | ) | No. |
| and | ) | Div. No. 1 |
| MONSANTO CHEMICAL COMPANY,<br>a corporation,<br>Serve: C.T. Corporation Service<br>314 N. Broadway<br>St. Louis 2, Missouri, | ) | |
| Defendants. | ) | |

PETITION

COUNT I

Plaintiff, for his cause of action in Count I of this Petition, states:

1. Defendant, B. F. DRAKENFELD AND COMPANY, (hereinafter called "Drakenfeld") is and at all times hereinafter mentioned was a foreign corporation duly organized and existing under law, ~~at all times hereinafter mentioned, as hereinafter more particularly alleged, DRAKENFELD has committed a tort against the person of Plaintiff, in the~~ City of St. Louis, State of Missouri, and has thereby agreed ~~that the Secretary of State of Missouri shall be its agent~~



DSW 441922

STLCOPCB4056457

~~for the service of process, all as is provided in V.A.M.S., 1949, Section 351.630.~~

2. Defendant, MONSANTO CHEMICAL COMPANY, (hereinafter called "Monsanto") is and at all times hereinafter mentioned, was a corporation organized and existing under the laws of the State of Delaware, having a registered agent and office in the City of St. Louis, State of Missouri, and having its principal place of business in the State of Missouri.

3. Defendant DRAKENFELD is engaged in the business of manufacturing, preparing and distributing into the channels of trade paints and enamels, and among the various products so distributed by said Defendant is an enamel known as 24-018 enamel in 487 oil.

4. Defendant MONSANTO is engaged in the business of manufacturing and preparing chemicals, chemical products, oils and thinners and distributing said products into the channels of trade, and among the various products so manufactured and distributed by said Defendant is the product known as Aroclor 4465.

5. Defendant DRAKENFELD prepares the aforesaid product 24-018 enamel in 487 oil, by combining various other materials with Monsanto's product Aroclor 4465.

6. At all times hereinafter mentioned, Both Defendants herein did know and intend that said products would be used by the consuming public and would be handled, dealt with, touched and the fumes thereof would be inhaled by the public, and both Defendants placed said



DSW 441923

STLCOPCB4056458

B Plaintiff, beginning in the year 1955 and continuouing until the month of May, 1962, made use of 24-018 enamel in 487 oil, as supplied by defendants

A During the years 1955, 1956, 1957, 1958, 1959, 1960 & 1961, and until the month of May, 1962, defendant Drakenfeld continuously supplied 24-018 enamel in 487 oil containing defendant Monsanto's Arclor 4465 to the International Bent Glass Company, Inc., in St. Louis, Missouri, and said product was used daily by said latter company in the process of making its products. At all times during which 24-018 enamel in 487 oil was so used in the manufacturing processes of International Bent Glass Company, Inc.,

products in the channels of trade with such knowledge and intention.

7. A Both Defendants herein did impliedly warrant and represent that the products 24-018 enamel in 487 oil, and Aroclor 4465 were fit and safe for such use by the public, but both Defendants and each Defendant knew that such products contained chlorinated biphenyls and chlorinated triphenyls, with a high amount of chlorination; said Defendants, and each of them, knew that said products would from time to time be heated or baked in ovens, and that use by the public of said products was likely to cause liver damage, skin eruptions, rashes, acne, cysts and dermatitis of various kinds.

8. B ~~Plaintiff, [illegible] in the year 1950, began to make use of said products~~ in his employment with International Bent Glass Company, Inc., at St. Louis, Missouri, and, in connection therewith, handl~~ing~~ed ~~such~~ said product~~s~~, touch~~ing~~ed ~~the~~ same, and inhal~~ing~~ed the fumes thereof, all in reliance on the skill and judgment and aforesaid warranty of both Defendants, being wholly unaware of the toxic and dangerous qualities of such products.

9. During the year 1955, ~~After a period of~~ ~~such~~ use of ~~such~~ said product~~s~~, ~~the same, contrary to and in breach of the warranty of both Defendants, directly and proximately caused Plaintiff to become ill and diseased, in that~~ Plaintiff began to suffer~~ed~~ eruptions of Plaintiff's skin over and about Plaintiff's neck, shoulders, chest, back, buttocks, face, ears and eyelids, said areas ~~have~~ become covered with comedones, cysts, acne, infectious lesions,



DSW 441926

STLCOPCB4056461

C Plaintiff continued to suffer these aforesaid conditions through the period of time during which he used 24-018 enamel in 487 oil, still suffers the residual effects of the same, and will suffer said residual effects permanently.

DSW 441927

E 2. During the years 1955, 1956, 1957, 1958, 1959, 1960 & 1961, and until the month of May, 1962, defendant Drakenfeld continuously supplied 24-018 enamel in 487 oil containing defendant Monsanto's Aroclor 4465 to the International Bent Glass Company, Inc., in St. Louis, Missouri, and said product was used daily by said latter company in the process of making its products.

D 10. At various times throughout the period of time heretofore mentioned, diligent attempts were made by plaintiff, his employer, International Bent Glass Company, Inc., its representatives, and other employees similarly injured, and their representatives, to determine, discover and ascertain the nature, extent and cause of his disease and injury through the use of various skilled medical experts and specialists, but said medical experts and specialists were unable to determine, discover or ascertain the same. During the month of May, 1962, The Occupational Health Research and Training Facility, Division of Occupational Health, Public Health Service, United States Department of Health, Education and Welfare, as a result of an investigation conducted by its representatives in March, 1962, determined, discovered and ascertained for the first time that the direct and proximate cause of plaintiff's condition, as heretofore alleged, was the use of defendant Drakenfeld's 24-018 enamel in 487 oil, containing defendant Monsanto's Aroclor 4465, and communicated its finding to plaintiff in the month of May, 1962, thus constituting plaintiff's first knowledge of the direct and proximate cause of his condition, as heretofore alleged.

11. As a result of the aforesaid actions of defendant Drakenfeld, said defendant has engaged in a continuous course of tortious conduct commencing in and not terminating until May, 1962, and thus defendant Drakenfeld has committed a tort in whole or in part against the person of the plaintiff in the City of St. Louis, State of Missouri, after the effective date of V.A.M.S. 1949, Section 351.630, to-wit, October 13, 1961, and has thereby agreed that the Secretary of State of Missouri shall be its agent for the service of process, all as is provided in said V.A.M.S. 1949, Section 351.630.

papules and a condition known as chloracne; Plaintiff's eyelids and periorbital skin became erythematous,, edematous and scaly; Plaintiff's liver ~~was~~ became injured, damaged and diseased/. ~~these conditions are~~ painful, irritating and ~~embarrassing; all of said conditions are permanent.~~

C

D 10+11

~~10~~ 12. Plaintiff has become obligated for large sums of money for medical attention for the aforesaid conditions and will become obligated for additional such sums in the future, in an amount not now ascertainable.

WHEREFORE, the premises considered, Plaintiff prays judgment against the Defendants and each of them, on this Count I of the petition for **TWENTY FIVE THOUSAND DOLLARS, ($25,000.00)**, and for ~~Plaintiff's~~ his costs.

COUNT II

Plaintiff for ~~this~~ cause of action in Count II of ~~this~~ the Petition, states:

1. Plaintiff restates and realleges each and every allegation in paragraphs 1, 2, 3, 4, 5, and 6 of Count I of this petition.

E 2

3~~2~~. Both Defendants and each of them knew, or in the exercise of ordinary care should have known that said products, containing highly chlorinated biphenyls and triphenyls, are, and for many years have been, known to be of a toxic and dangerous nature in that they were reasonably likely to cause abnormal reactions, skin eruptions, rashes, liver damage, dermatitis and diseases, and Defendants and each of them were



DSW 441930

STLCOPCB4056465

F 4. Plaintiff restates and realleges each and every allegation of Paragraphs 8, 9 and 10 of Count I of this Petition.

5. Plaintiff was injured in the particulars alleged hereinabove in Count I, Paragraph 9, and as herein realleged in Paragraph 4 of this Count, as a direct and proximate result of defendant's negligence as heretofore alleged.

DSW 441931

STLCOPCB4056466

G

Guilfoil, Caruthers, Symington, Montrey & Daniel
By (sgd) Rexford H. Caruthers
Rexford H. Caruthers
By (sgd) J. Paul Allred, Jr.
J. Paul Allred, Jr.
434 Paul Brown Building
Saint Louis 1, Missouri
CHestnut 1-6890
ATTORNEYS FOR PLAINTIFF

DSW 441932

under a duty to give an adequate warning of such dangers and risks to the public who used such products, but both Defendants and each of them negligently breached said duty by failing and omitting to give an adequate warning of such dangers and risks.

F 445

3. Plaintiff began to make use of such products in 1958 in her employment at St. Louis, Missouri with International Bent Glass Company, and as a direct and proximate result of the Defendants' negligence, Plaintiff was injured in those particulars alleged hereinabove in Count I, Paragraph 9.

6 ~~4~~. Plaintiff restates and realleges each and every allegation ~~in~~ of Paragraphs 11 and 12, of this Petition Count I, ~~Paragraph 10.~~

WHEREFORE, the premises considered, Plaintiff prays judgment on this Count II of this Petition against the Defendants, and each of them, in the sum of TWENTY FIVE THOUSAND DOLLARS ($25,000.00) and for her costs.

G

CARUTHERS AND MONTREY

John P. Montrey

JOHN P. MONTREY
430 Paul Brown Bldg.
St. Louis 1, Missouri
GArfield 1-2777
ATTORNEYS FOR PLAINTIFF

DSW 441933

STLCOPCB4056468

Form No. 75

# Circuit Court for the City of St. Louis

State of Missouri

Dorothy Berry

Plaintiff

vs.

B. F. Drakenfeld & Co., et al

Defendant

No. 47803 E

Div. 1

## SUMMONS

The State of Missouri to Defendant Monsanto Chemical Co., a Corp.

You are hereby summoned to appear before the above-named court and to file your pleading to the petition, copy of which is attached hereto, and to serve a copy of your pleading upon

Caruthers & Montrey attorneys for plaintiff,

whose address is 430 Paul Brown Bldg.

all within 30 days after service of this summons upon you, exclusive of the day of service. If you fail to do so, judgment by default will be taken against you for the relief demanded in the petition.

Dated June 29th, 19 62

PHELIM O'TOOLE
Circuit Clerk.

By [illegible]
Deputy Clerk.

(Seal of Circuit Court)

DSW 441934

STLCOPCB4056469

# RETURN ON SERVICE OF SUMMONS

I hereby certify that I have served the within summons:

(1) By delivering on the.....day of....., 19.....

a copy of the summons and a copy of the petition to each of the within-named defendants.....

.....

.....

.....

(2) By leaving on the.....day of....., 19.....

for each of the within-named defendants.....

.....

.....

a copy of the summons and a copy of the petition at the respective dwelling place or usual place of abode of said defendants with some person of his or her family over the age of 15 years;

(3) By.....

.....

.....

.....

.....

All done in.....County, Missouri.

Sheriff's fees:

Summons.....$

Non est.....$

Mileage.....$_____

Total.....$

Sheriff of.....County, Missouri.

By.....

Deputy Sheriff.

**DIRECTIONS TO SHERIFF**

A copy of the summons and a copy of the petition must be served on each defendant. For methods of service in all classes of suits see Sec. 27 Civil Code.

DSW 441935

No. 47803 E

Div. 1

**SUMMONS**

Civil Code, Form No. 1

In the Case of

.....

Plaintiff.....

vs.

[illegible]

[illegible]

Defendant.....

In the Circuit Court of the

City of St. Louis

STATE OF MISSOURI

[illegible]

STLCOPCB4056470

Dr. W. J. Foley – New York
Dr. Paul Lorne – St. Louis
Dr. R.L. Jenkins – Anniston
Messrs. Edgar H. Hardy
J.F. Reeves (2)
A.M. Ellenburg
R.P. Loewen

December 30, 1947

Celanese Corporation of America
Central Research Laboratory
Summit, New Jersey

Dr. L. S. Birnbaum

Gentlemen:

As suggested by Dr. R. L. Jenkins in his letter to you on December 23, we are pleased to write about Aroclor toxicity considerations.

The best published information about the toxicity of Aroclor vapors with reference to possible damage to the liver is in a series of three articles written for the Journal of Industrial Hygiene and Toxicology. The first article appearing in the September 1937 issue, Vol. 19, No. 7 and the second article published in the February 1938 issue, Vol. 20, No. 2 were written by C. K. Drinker, M. F. Warren, and C. A. Bennet and cover only Aroclor 4465. The third article written by Dr. Drinker alone is more complete as it gives information about Aroclors 4465, 1254, 1268 and 5460. We particularly wish to refer you to this article entitled, "Further Observations on the Possible Systemic Toxicity of Certain of the Chlorinated Hydrocarbons with suggestions for Permissible Concentrations in the Air of Workrooms", by Cecil K. Drinker, The Journal of Industrial Hygiene and Toxicology, Vol. 21, No. 5, May, 1939.

In this article Dr. Drinker tabulates the permissible limits of the compounds in mg. per cubic meter of air in workrooms. The following data is an excerpt pertaining to permissible limits of various Aroclors:

| Material | | Permissible Limit Mg. per Cu. M. |
|---|---|---|
| No. 6 | Aroclor 4465 | 0.5 |
| No. 9 | Aroclor 1254 | 0.5 |
| No. 13 | Aroclor 1268 | 10.0 |
| No. 14 | Aroclor 5460 | 0.5 |

From this, it is noted that there is a marked variation in the toxicity of the vapors of different Aroclors. To quote Dr. Drinker, "Aroclors 1268 is almost non-toxic". The vapors of the other Aroclors studied are toxic and should be avoided. In general, the more highly chlorinated biphenyls are less toxic than the lower chlorinated derivatives, proba-

Attachment to 15

DSW 441936

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bly due to decreased solubility. The chlorinated terphenyls appear to be more toxic than corresponding chlorinated biphenyls.

Where the cold or solvent method is used for the impregnation of Aroclors usually only normal precautions or ordinary cleanliness of commercial plant practice are followed. When the Aroclors are applied by hot methods, 300° F. or higher, the workrooms should be ventilated by intake and exhaust fans of sufficient volume and velocity to remove the majority of the fumes. Where ever drying ovens are used, the vapors must be removed. Suggestions about this are given in the article entitled, "Observations on the Toxic Effects Resulting from Exposure to Chlorinated Naphthalene and Chlorinated Phenyls with Suggestions for Prevention", by Dr. H. Von Wedel, Dr. Wm. A. Holla and Dr. James Denton, published in The Rubber Age, Vol. 53, No. 5, August 1943.

In general, it is believed that the maximum permissible amount of Aroclor vapor in the workroom is evident to the workmen because of an irritating influence on the eye membranes. It therefore becomes a self-revealing signal when the vapors levels are reached.

If you desire, we will be glad to send you an instrument which we have with full instructions for its operation to measure Aroclor vapors in your workroom atmospheres. This would be the most certain method to determine that your working conditions are safe.

In your letter of December 19 to Mr. Jenkins, you asked whether studies have been made of the possible toxicity or dermatitis due to finished manufactured items containing Aroclors as an ingredient.

It was determined by the skin patch test procedure given by Dr. Louis Schwartz and Dr. Samuel M. Peck in reprint No. 2552 from the Public Health Reports, Vol. 59, No. 17 (April 28, 1944) that canvas painted with Aroclor 5460 and an oil modified alkyd resin in such a manner that each square inch of fabric contained 10.5 mg. of Aroclor 5460, was neither a skin irritant nor a sensitizer.

The following commercial applications are some typical large current outlets for Aroclors and to our knowledge, there is no instance of difficulty about toxicity even though in a number of these applications elevated temperatures are used and consumers come in rather close contact with the finished commodity containing Aroclor.

1. Actuating fluid for thermostats.
2. Heat transfer medium.
3. Non-flammable hydraulic fluid, especially for die casting machines.
4. Adhesives for many purposes.
5. Wood preservative and sealer treatments.
6. Air compressor lubricant.
7. Plasticizer for nitrocellulose, ethyl cellulose and polyvinylchloride coatings. (In a number of applications of this type the consumer comes in

DSW 441937

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intimate contact with the coating compositions.
A good example is [illegible] of ladies' shoes).

8. Plasticizer for Marlon and Pliolite paints and coatings.
9. Plasticizer for wire insulating compounds.
10. In transformers and condensators.
11. As an impregnant for [illegible] products.
12. Pressure sensitive [illegible].
13. In fire retardant paints and coatings.
14. Impregnant for textiles.
15. Industrial printing inks.
16. Stop-off lacquers for electroplating.
17. Ceramic, glaze printing.
18. Plasticizer for asphalt compositions.
19. In the manufacture of dentures.

Based on our practical experience in the manufacture and sale of millions of pounds of Aroclors annually, the point that we would emphasize is that workers should not be exposed to Aroclor vapors and that the men working with Aroclors should observe "good housekeeping" rules about keeping their clothing and skins free of the material and avoid ingestion of it.

Adequate ventilation has proved successful in keeping the atmosphere free from harmful amounts of Aroclors around machinery and in plants.

When you have had opportunity to give consideration to our above comments, please let us have your thoughts and let us know if we can be of further assistance to you.

Yours very truly,

P. G. Benignus
Development Department

rh

Copied by rs
1/5/48

DSW 441938

## TOXICITY AND SAFE HANDLING

### Inhalation

At ordinary temperatures the AROCLOR chlorinated polyphenyls have not presented industrial toxicological problems. The hazard of potential toxic exposure varies with their volatility: the lower-chlorinated, more-volatile ones present more of a potential problem from the standpoint of both inhalation and skin contact. When AROCLOR compounds are used at elevated temperatures, engineering controls must be applied, either by the use of closed systems or by effective local-exhaust ventilation together with general workroom exhaust.

Vapor of the liquid AROCLOR compounds at room temperature should not be breathed in a confined space, and no vapor of any AROCLOR compound evolved at elevated temperatures should be allowed to be dispersed into the general workroom.

Inhalation tests on animals indicate that the maximum safe concentration of vapor is in the range of from 0.5 to 1.0 milligram of the lower-chlorinated AROCLOR compounds per cubic meter of air. The threshold limits (maximum allowable concentration for an 8-hour working day) set by the American Conference of Government Hygienists are 1.0 milligram of the lower-chlorinated AROCLOR compounds per cubic meter of air and 0.5 milligram of the more-highly-chlorinated compounds, such as AROCLOR 1254, per cubic meter of air.

### Skin Contact

Schwartz patch tests on 200 volunteers showed that AROCLOR 1254 was neither a primary skin irritant or a sensitizer.

Continuous or repeated skin contact with the AROCLOR compounds must be avoided by the use of gloves and protective garments, because of the possible occurance of a condition called chloracne. Although reports of this condition caused by AROCLOR compounds are rare, it can be produced by excessive skin contact. If any AROCLOR compound is spilled on the skin, the skin should be washed in the usual manner with a soap solution.

A burn caused by contact with a hot AROCLOR compound should be treated like any ordinary burn. AROCLOR compound adhering to the burned area need not be removed immediately, unless treatment of the burn demands it, in which case either soap and water or repeated washings with a vegetable oil are recommended.



DSW 441939

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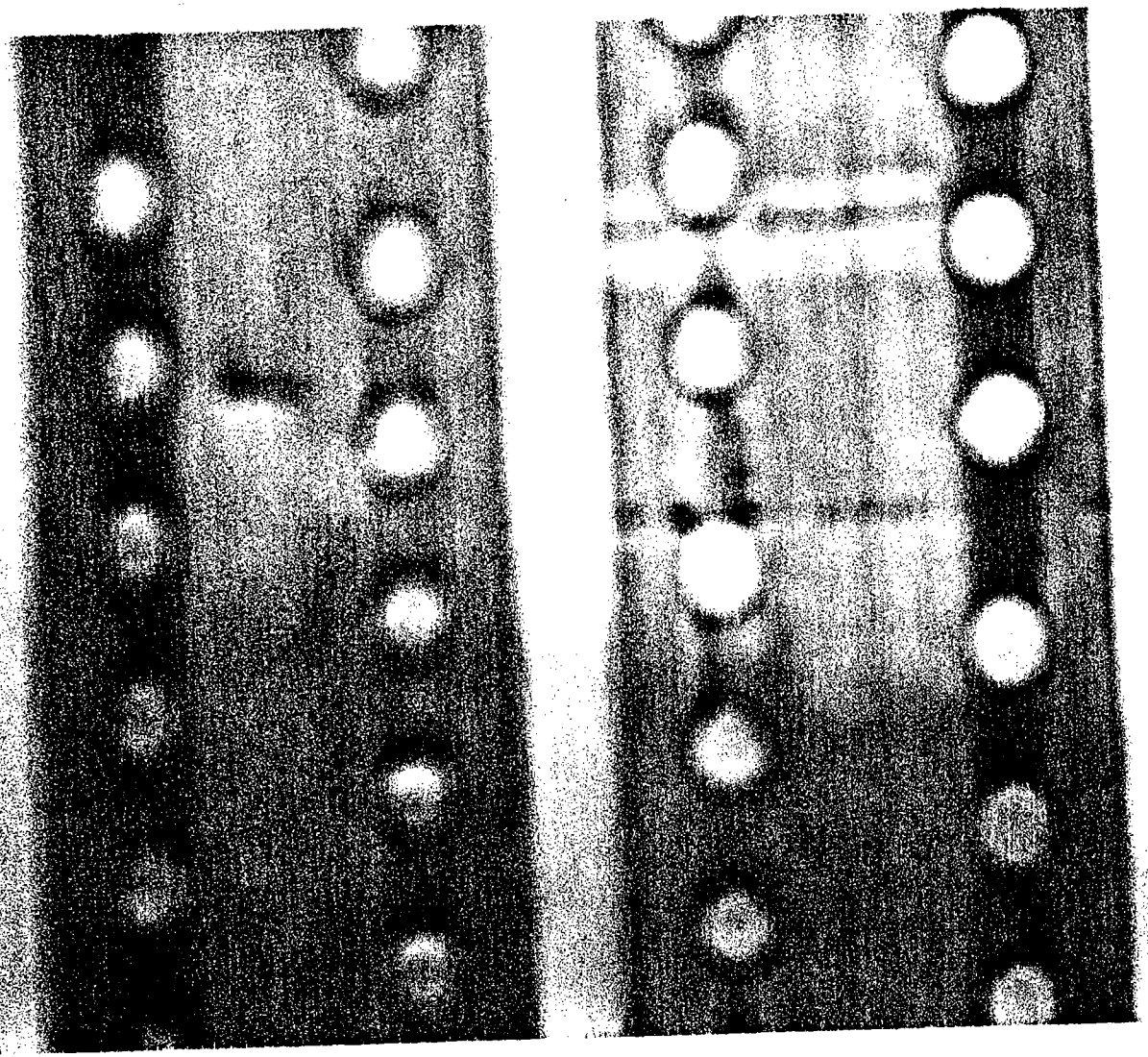

11/6/62

LAWSUITS HAVE NOT BEEN INSTITUTED AGAINST MCC AND DRAKENFELD

DSW 441940

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JOHN F. EVANS
JOHN R. DIXON
WM. W. EVANS
JAMES V. GALLEN
JOHN C. SHEPHERD
EDWARD W. WARNER
RALPH C. KLEINSCHMIDT
EUGENE K. BUCKLEY

ROBERT M. EVANS
HENRY D. MENGHINI
PAUL V. GILBERT
ALBERT J. SEIER
ROBERT J. ROBINSON

EVANS & DIXON
ATTORNEYS AT LAW
COTTON BELT BUILDING
III NORTH FOURTH STREET
SAINT LOUIS

MAIN 1-7755

October 25, 1962

Monsanto Chemical Company
800 North Lindbergh Boulevard
Saint Louis 41, Missouri

D. F. Drakenfeld and Company
45 Park Place
New York 7, New York

Re: Dale McIntyre vs International Bent Glass Company
(Dale McIntyre, International Bent Glass Company and United States Casualty Company vs Monsanto Chemical Company and D. F. Drakenfeld and Company)

---

Gentlemen:

This is to advise that this firm represents the employer and insurer in the above styled action, wherein Dale McIntyre, an employee of International Bent Glass Company, asserts he sustained injury and damages as a result of an exposure or contact with certain chemical products, all by reason of the negligence of the Monsanto Chemical Company, and D. F. Drakenfeld and Company.

Under Missouri statutes, the employer and insurer are subrogated to the extent of any compensation or the expense of any medical aid paid to or on behalf of the employee under our Workmen's Compensation statutes. This subrogation right extends to the recovery on the part of the employee against any third party, by reason of suit or settlement.

Kindly consider this letter a lien against any possible recovery on the part of Mr. McIntyre as noted, and acknowledge receipt of same.

Thank you for your cooperation.

Yours very truly,

Edward W. Warner

EWW:mm

cc: Moser, Marsalek, et al, Attorneys at Law, 330 Pierce Bldg., St. Louis 2, Mo
~~cc: Caruthers and Montrey, Attorneys at Law, 818 Olive St., St. Louis 1, Mo.~~
CC: U.S.Casualty Company, Western Dept., 175 West Jackson Blvd., Chicago 4, Il

DSW 441941

JOHN F. EVANS
JOHN R. DIXON
WM. W. EVANS
JAMES V. GALLEN
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EVANS & DIXON
ATTORNEYS AT LAW
COTTON BELT BUILDING
111 NORTH FOURTH STREET
SAINT LOUIS

MAIN 1-7755

October 25, 1962

Monsanto Chemical Company
800 North Lindbergh Boulevard
St. Louis 41, Missouri

D. F. Drakenfeld and Company
45 Park Place
New York 7, New York

Gentlemen:

Re: Ruth Bruning vs. International Bent Glass Company (Ruth Bruning, International Bent Glass Company and United States Casualty Company vs. Monsanto Chemical Company and D. F. Drakenfeld and Company)

---

This is to advise that this firm represents the employer and insurer in the above-styled action, wherein Ruth Bruning, an employee of International Bent Glass Company, asserts she sustained injury and damages as a result of an exposure or contact with certain chemical products, all by reason of the negligence of the Monsanto Chemical Company and D. F. Drakenfeld and Company.

Under Missouri statutes, the employer and insurer are subrogated to the extent of any compensation or the expense of any medical aid paid to or on behalf of the employee under our Workmen's Compensation statutes. This subrogation right extends to the recovery on the part of the employee against any third party, by reason of suit or settlement.

Kindly consider this letter a lien against any possible recovery on the part of Mrs. Bruning as noted, and acknowledge receipt of same.

Thank you for your cooperation.

Yours very truly,

Edward W. Warner

EWW:nl
cc: Moser, Marsalek, et al., Attys. at Law, 330 Pierce Bldg., St. L. (2)
~~cc: Carruthers & Montrey, Attys. at Law, 818 Olive St., St. Louis 1, Mo.~~
cc: U. S. Casualty Co., Western Dept., 175 W. Jackson Blvd., Chicago 4, Illinois

DSW 441942

JOHN F. EVANS
JOHN R. DIXON
WM. W. EVANS
JAMES V. GALLEN
JOHN C. SHEPHERD
EDWARD W. WARNER
RALPH C. KLEINSCHMIDT
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EVANS & DIXON
ATTORNEYS AT LAW
COTTON BELT BUILDING
111 NORTH FOURTH STREET
SAINT LOUIS

MAIN 1-7755

October 25, 1962

Monsanto Chemical Company
800 North Lindbergh Boulevard
St. Louis 41, Missouri

D. F. Drakenfeld and Company
45 Park Place
New York 7, New York

Gentlemen:

Re: Thelma Boyd vs. International Bent Glass Company (Thelma Boyd, International Bent Glass Company and United States Casualty Company vs. Monsanto Chemical Company and D. F. Drakenfeld and Company)

This is to advise that this firm represents the employer and insurer in the above-styled action, wherein Thelma Boyd, an employee of International Bent Glass Company, asserts she sustained injury and damages as a result of an exposure or contact with certain chemical products, all by reason of the negligence of the Monsanto Chemical Company and D. F. Drakenfeld and Company.

Under Missouri statutes, the employer and insurer are subrogated to the extent of any compensation or the expense of any medical aid paid to or on behalf of the employee under our Workmen's Compensation statutes. This subrogation right extends to the recovery on the part of the employee against any third party, by reason of suit or settlement.

Kindly consider this letter a lien against any possible recovery on the part of Mrs. Boyd as noted, and acknowledge receipt of same. Thank you for your cooperation.

Yours very truly,

Edward W. Warner

EWW:nl
cc: Moser, Marsalek, et al., Attys. at Law, 330 Pierce Bldg., St.Louis(2)
cc: Carithers & Montrey, Attys. at Law, 818 Olive St., St. Louis 1, Mo.
cc: U. S. Casualty Co., Western Dept., 175 West Jackson Blvd., Chicago 4, Illinois

DSW 441943

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St. Louis Post-Dispatch 2/27/64

# House Committee Approves Creating Ozark Rivers Preserve

WASHINGTON, Feb. 26 (UPI) —The House Interior Committee today approved a bill creating a system of national scenic riverways in the Missouri Ozarks.

The bill, fought through the Congress for more than three years, establishes a new concept for federal recreational preserves.

The Senate has already passed a bill creating a federal preserve along the Current and Jacks Fork rivers. That measure, however, contains important differences from the bill approved by the House committee.

One of the differences is the name of the preserve. The House measure calls for a new designation—Ozark National Scenic Riverways. This new category of national park permits hunting and fishing—an activity prohibited in most national recreational areas.

The House bill now authorizes the Secretary of the Interior to acquire 65,000 privately owned acres and to negotiate with the state of Missouri for donation of Big Spring, Alley Spring and Round Spring State Parks into the federal preserve. The bill limits acquisition costs for the land to $7,000,000.

# ELECTRICAL SHOCKS KILL TWO; CHILD HURT

Two persons were electrocuted yesterday in separate accidents in St. Louis county and a child was burned when she placed an extension cord in her mouth.

Thomas F. Taveggia, an employe of Wood Tech Corp., Barrett Station and Dougherty Ferry roads, Kirkwood, was killed when a crane lift he was operating came in contact with 7200 volt high wires.

Taveggia, 25 years old, was unloading rafters for a building project in Arnold, Mo., the Highway Patrol said. He lived at 6207A Eichelberger street.

George Warner, 904 Yeatman avenue, Webster Groves, died today in St. Louis County Hospital, after he was found yesterday unconscious in the basement of the home of Mr. and Mrs. William McDonough, 222 West Glendale road, Webster Groves.

Warner, 64, a washing machine repairman, was found lying on the floor near the machine he had been called to repair. A screwdriver with an apparently burned end was in his hand. His heart had stopped. Webster Groves firemen restored his heart beat through artificial respiration.

Tina Stidman, 2½-year-old daughter of Mr. and Mrs. Preston Stidman of 2511 Leslie drive, Overland, is in critical condition in St. Louis County Hospital with injuries suffered when she put an extension cord in her mouth.

Stidman told Overland police he was working in the basement and his daughter was playing on the floor nearby. He had turned his back when the accident occurred, he said.

# SUITS FOR $485,000 OVER PAINT PRODUCT

Suits for damages totaling $485,000 were filed in circuit court today by 14 persons against Monsanto Chemical Co. and a New York paint firm.

The petitioners alleged that their health was impaired through exposure to products of Monsanto and the B. F. Drakenfeld Co. of New York City between 1955 and 1962, when they worked as employes of International Bent Glass, Inc., 1825 North Nineteenth street.

International Bent Glass is a light fixture manufacturing firm.

Names of the plaintiffs and the amounts they are seeking are: Ronald Simpson, $30,000; Marie Clifford, $27,500; Mary Chapman, $17,500; Dorothy Berry, $25,000; Mildred Barrett, $27,500; Rita B. King, $45,000; James A. White, $45,000; Walter F. Miller, $17,500; Thelma Wieners, $50,000; Martha Syler, $45,000; Theodore Czarnecki, $45,000; Charlotte Shoemaker, $47,500; Hazel Schneider, $17,500, and Vergel A. Maness, $45,000.

The plaintiffs allege that they suffered liver ailments, skin eruptions, cysts and other skin ailments as the result of handling an enamel distributed by the Drakenfeld firm.

The enamel contained a Monsanto ingredient which Drakenfeld knew or should have known was toxic and dangerous, the petition alleges. Both firms were negligent in failing to warn of the risk, it is alleged.

The suit states that the United States Public Health Service found in a 1962 inquiry that the plaintiffs' ailments were caused by use of the enamel.

## HERBERT HOOVER'S CONDITION BETTER

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It is agreed that the liability of The Pulitzer Publishing Company in the event of failure to publish an advertisement for any reason or in the event that errors occur in the publishing of an advertisement, shall be limited to the amount paid by the advertiser. Claims concerning omission or incorrect insertions will not be considered unless made within 30 days from date of publication.

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[illegible]EISTER Colonial Mortuary
6[illegible]4 Chippewa PR 2-1938

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FRATERNAL NOTICES 13
MASONIC [illegible]


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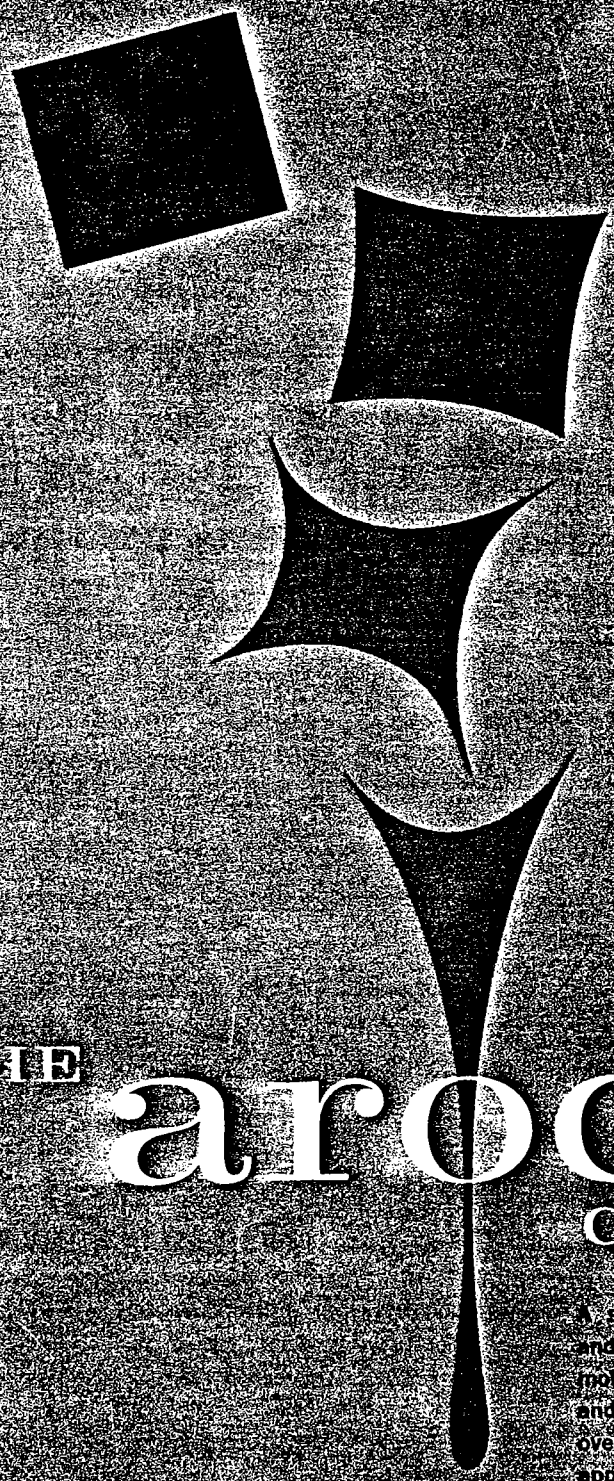

# THE aroclor® COMPOUNDS

A series of heat-resistant, chemically inert and fire-retarding compounds ranging from mobile "oily" liquids through viscous resins and solids that perform unique functions in over a hundred different industrial and product applications.

Monsanto

DSW 441945

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STLCOPCB4056481

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.

*Aroclor is a trademark of Monsanto Chemical Company for its chlorinated aromatic hydrocarbons and their derivatives, including chlorinated diphenyl. Reg. U. S. Pat. Ofc. 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.

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DSW 441948

STLCOPCB4056483

# 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.

DSW 441949



STLCOPCB4056484

# general physical properties of

| | Aroclor 1221 | Aroclor 1232 | Aroclor 1242 | Aroclor 1248 | Aroclor 1254 |
|---|---|---|---|---|---|
| Form | Colorless mobile oil | Practically colorless mobile oil | Practically colorless mobile oil | Colorless to light yellow-green, clear, mobile oil | 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 Sec. (ASTM—D-88) 210°F (98.9°C) | 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"

DSW 441950



STLCOPCB4056485

# some of the aroclor compounds

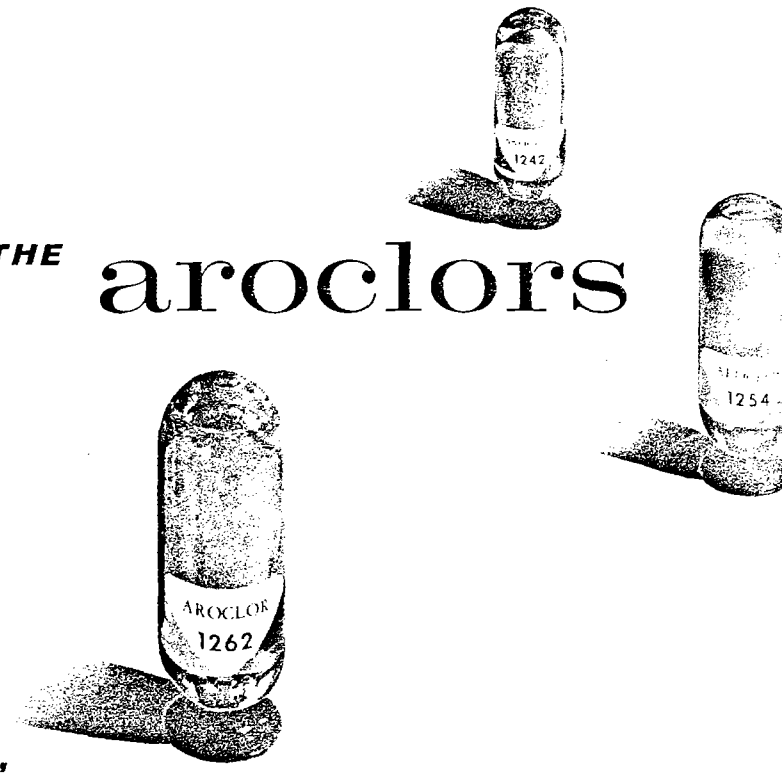
| Aroclor 1260 Light yellow soft sticky resin | Aroclor 1262 Light yellow sticky clear resin | Aroclor 1268 White to off-white powder | Aroclor 4465 Light-yellow, clear, brittle resin | Aroclor 5442 Yellow trans-parent sticky resin | Aroclor 5460 Clear, yellow-to-amber, brittle resin | Aroclor 2565 Black, 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) 13.50 | 1.572-1.583 (90°/15.5°C) 13.72 | 1.804-1.811 (25°/25°C) 15.09 | 1.670 (25°/25°C) 13.91 | 1.470 (25°/25°C) 12.24 | 1.670 (25°/25°C) 13.91 | 1.734 (25°/25°C) 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<br>0.0 to 0.1 | 0.5 to 0.6<br>0.0 to 0.1 | 0.1 to 0.2<br>0.0 to 0.06 | 0.2 to 0.3<br>0.0 to 0.02 | 0.2<br>0.01 | 0.03<br>1.5 to 1.7 (at 260°—5 hrs.) | 0.2 to 0.3<br>— |
| None | None | None | None | 247°<br>477° | None | None |
| None | None | None | None | >350°<br>>662° | None | None |
| 31°<br>88° | 35°-38°<br>99° | —<br>— | —<br>— | 46°<br>115° | —<br>— | —<br>— |
| —<br>— | —<br>— | 150° to 170° (hold pt.)<br>302° to 338° (hold pt.) | 60° to 66°<br>140° to 151° | 46° to 52°<br>115° to 126° | 98° to 105.5°<br>208° to 222° | 66° to 72°<br>149° to 162° |
| 1.647-1.649 | 1.6501-1.6517 | — | 1.664-1.667 | — | 1.660-1.665 | — |
| 72-78<br>3200-4500<br>— | 86-100<br>600-850 (160°F or 71°C)<br>— | —<br>—<br>— | 90-150 (266°F or 130°C)<br>—<br>— | 300-400<br>—<br>— | —<br>—<br>— | —<br>—<br>— |

DSW 441951



STLCOPCB4056486

## 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.

DSW 441952



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## 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.

DSW 441953



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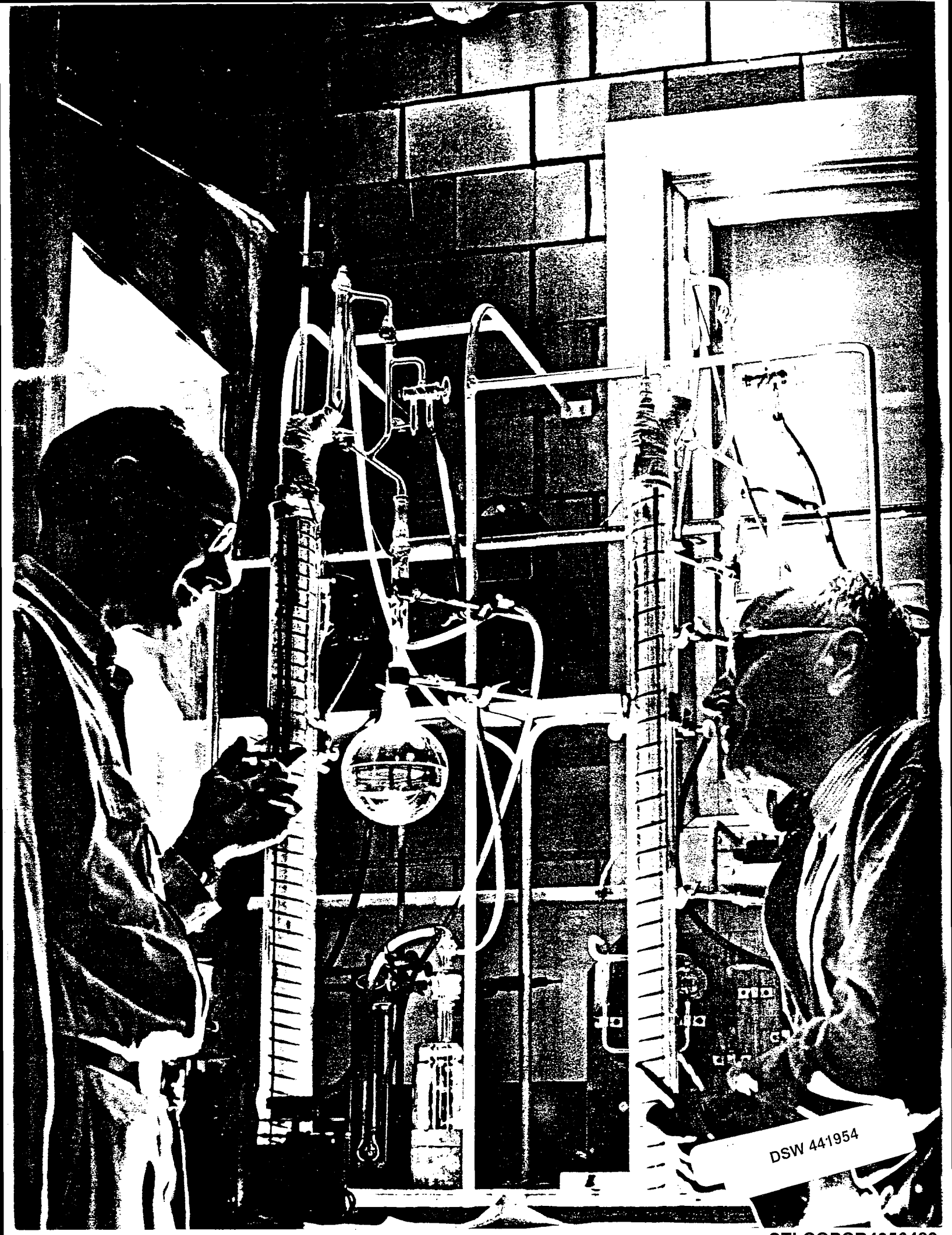


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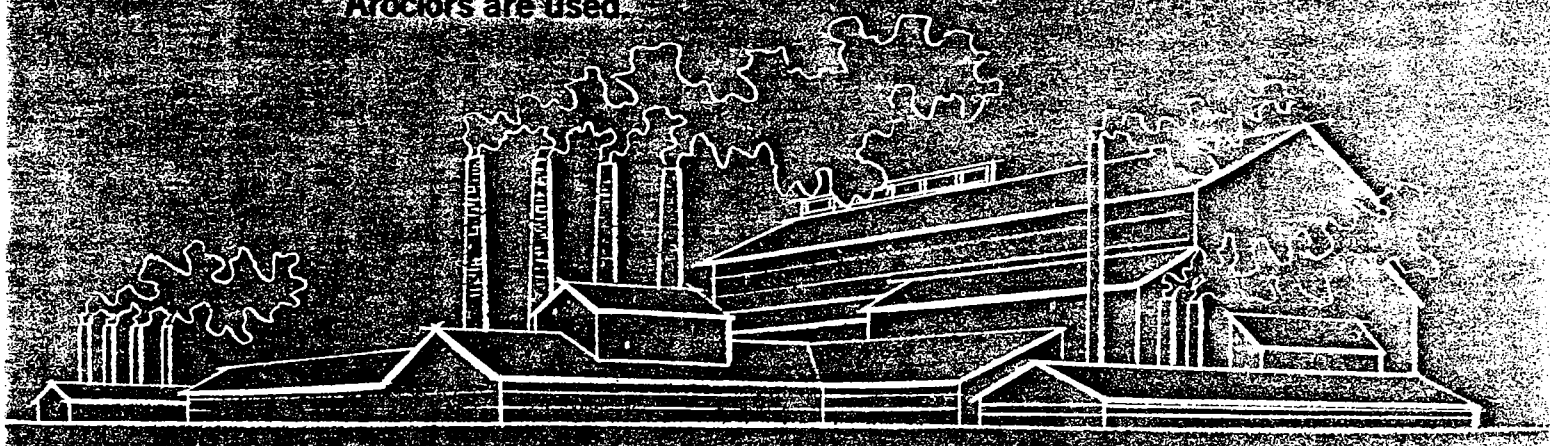
# industrial applications of the aroclors

Because of the unique properties of the Aroclors, these inert, durable oily liquids and resins have found a variety of special jobs in systems operation, manufacturing uses and product formulating. Wherever an inert liquid is required in engineering — wherever an extender, a "tack-imparting" ingredient, or a low cost additive is needed to impart flame retardance, chemical resistance, or to slow evaporation — Aroclors may serve the need.

The following applications will indicate the many ways Aroclors are used.



DSW 441955



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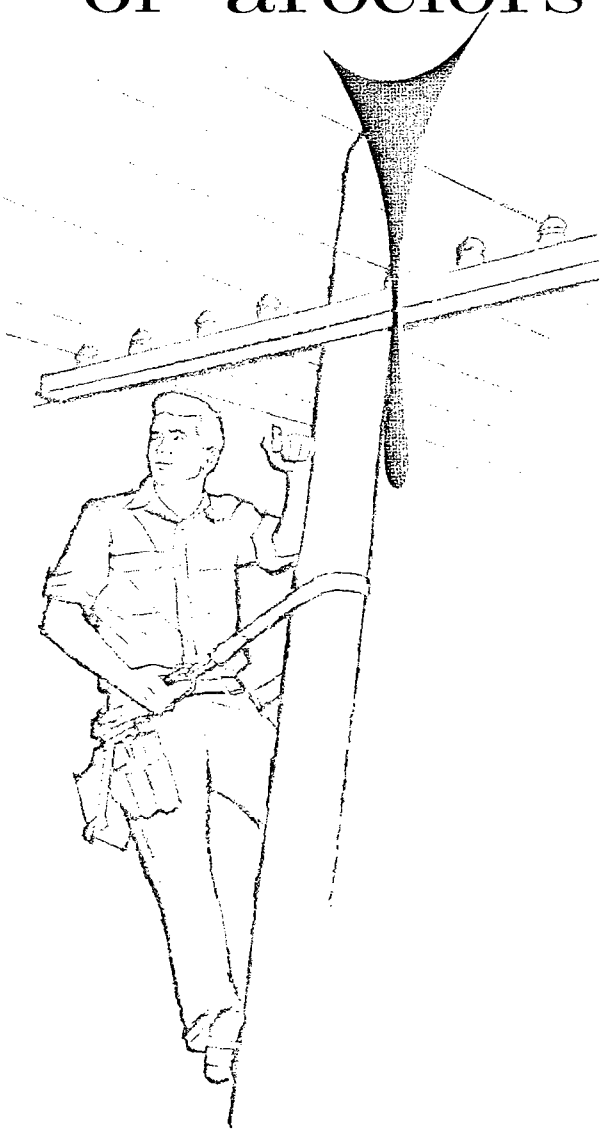
*Aroclors are among the purest commercial chemical compounds, virtually free of even traces of conducting impurities. For this reason, the Aroclors' dielectric properties closely approximate the theoretical maximum for the particular organic compound. With their stability, heat resistance and flame resistance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

DSW 441956



STLCOPCB4056491

rescent 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*

| Aroclor | Dielectric Constant at 1,000 Cycles (1) 25°C | 100°C | Volume Resistivity (2) Ohm-cm at 100°C, 500 Volts D.C. | Dielectric Strength (3) | Power Factor (4) 100°C, 1,000 Cycles |
|---|---|---|---|---|---|
| 1232 | 5.7 | 4.6 | | | |
| 1242 | 5.8 | 4.9 | Above $500 \times 10^9$ | Greater than 35KV | <0.1% |
| 1248 | 5.6 | 4.6 | Above $500 \times 10^9$ | Greater than 35KV | <0.1% |
| 1254 | 5.0 | 4.3 | Above $500 \times 10^9$ | Greater than 35KV | <0.1% |
| 1260 | 4.3 | 3.7 | Above $500 \times 10^9$ | Greater than 35KV | <0.1% |
| 1268 | 2.5 | — | | | |
| 5442 | 3.0 | 4.9 | Above $500 \times 10^9$ | | |
| 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

DSW 441957



STLCOPCB4056492

## *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. |
| 95% | 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 | $100 \times 10^9$ 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 | 50 max. |
| Condition | Clear |
| Acidity, mg. KOH/g. | 0.01 max. |

*Determined by special request.

DSW 441958



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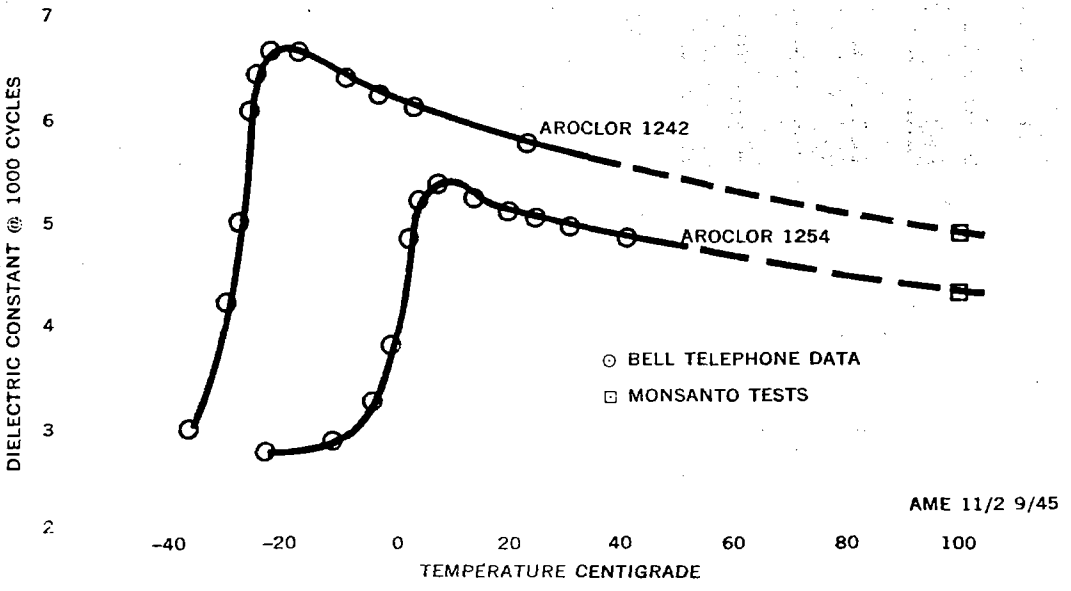
## *Typical Capacitor Aroclor* *(continued)*

| *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.<br>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.:<br>Color, APHA — 60 max.<br>Acidity, mg. KOH/g. — 0.01 max.<br>Inorg. Chlorides, ppm — 0.10 max.<br>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 recuest.

### *DIELECTRIC CONSTANT VS. TEMPERATURE*
AROCLOR 1242 & AROCLOR 1254

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STLCOPCB4056494

*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.*

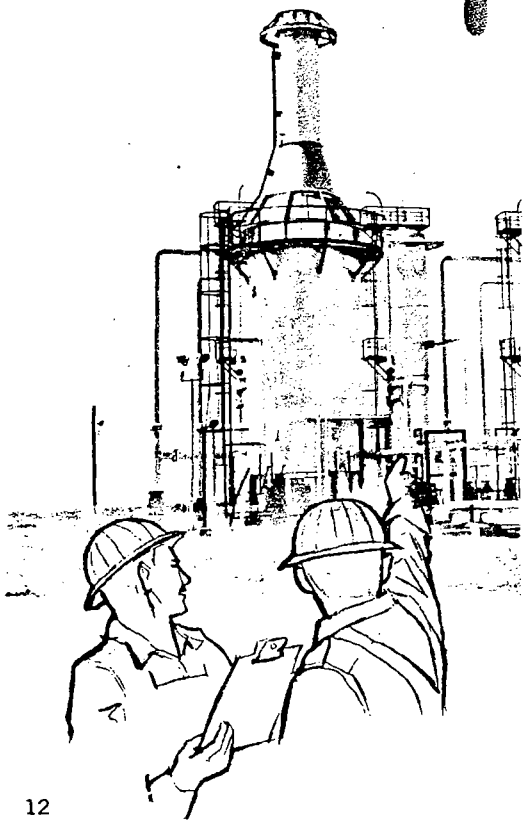
# mechanical applications of aroclors

## 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.

oto courtesy of
tro-Chem Development Division
ba Consolidated Industries, Inc.



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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.

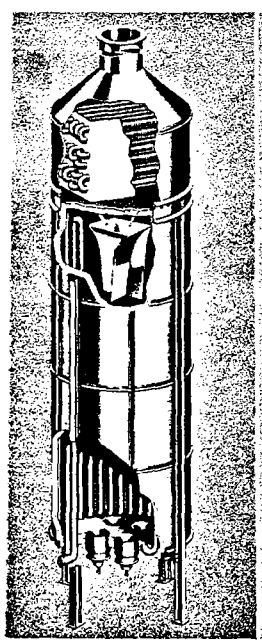

Photo courtesy of
Western Precipitation Corp.

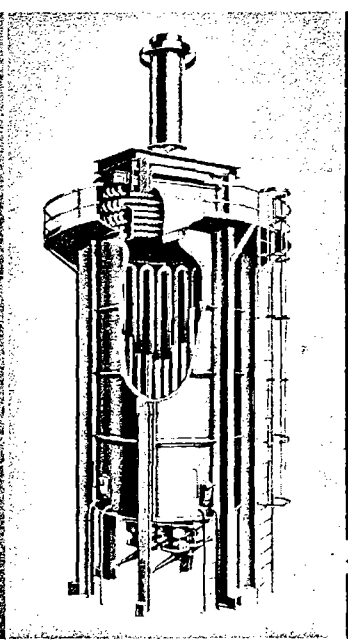

Photo courtesy of
Struthers Wells Corp.

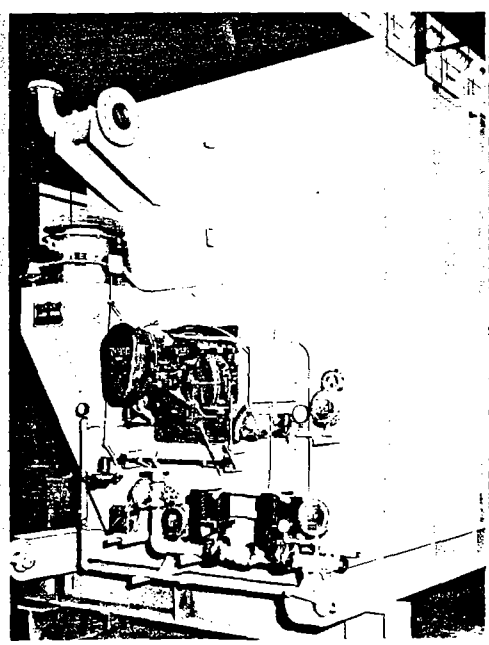

Photo courtesy of
Union Iron Works

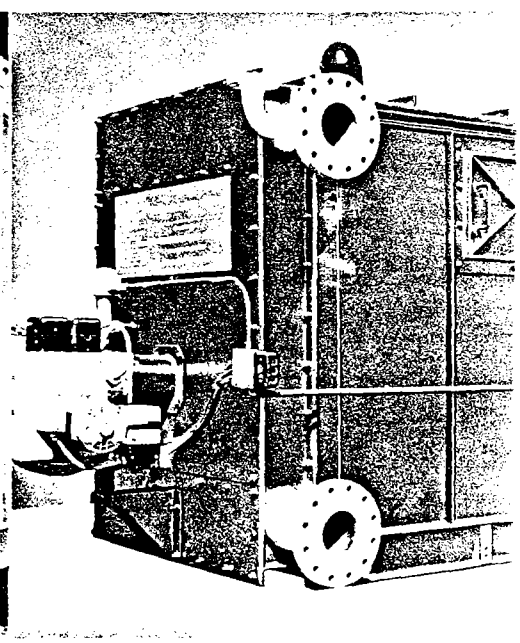

Photo courtesy of
The International Boiler Works Co.

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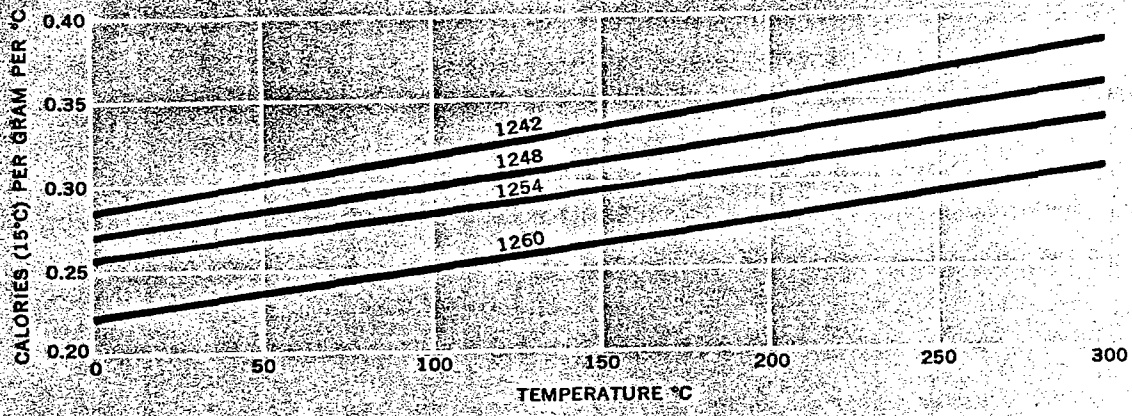
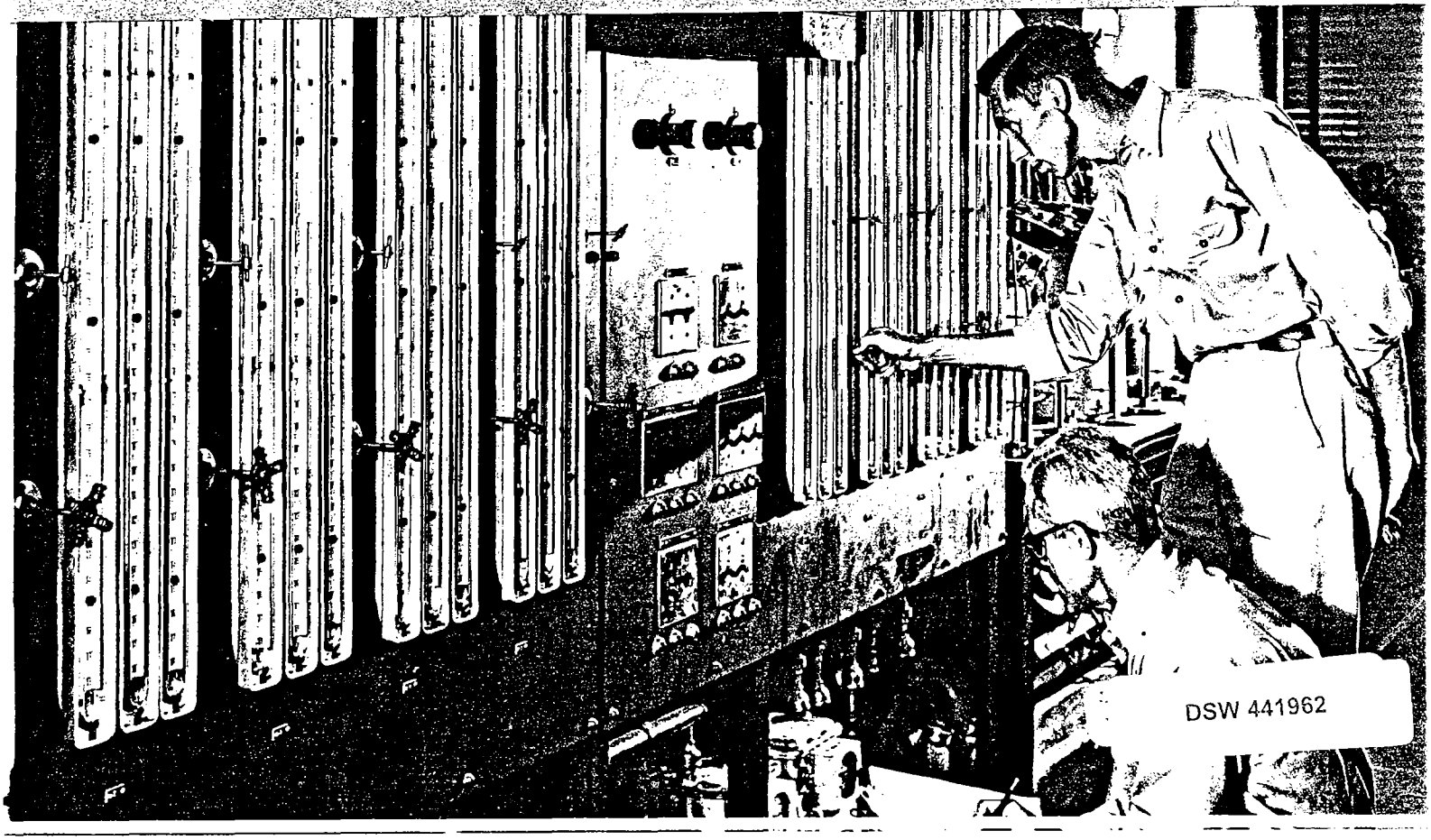
## HEAT CAPACITY OF AROCLORS
AT VARIOUS TEMPERATURES




## THERMAL CONDUCTIVITY OF AROCLOR 1248

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



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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.



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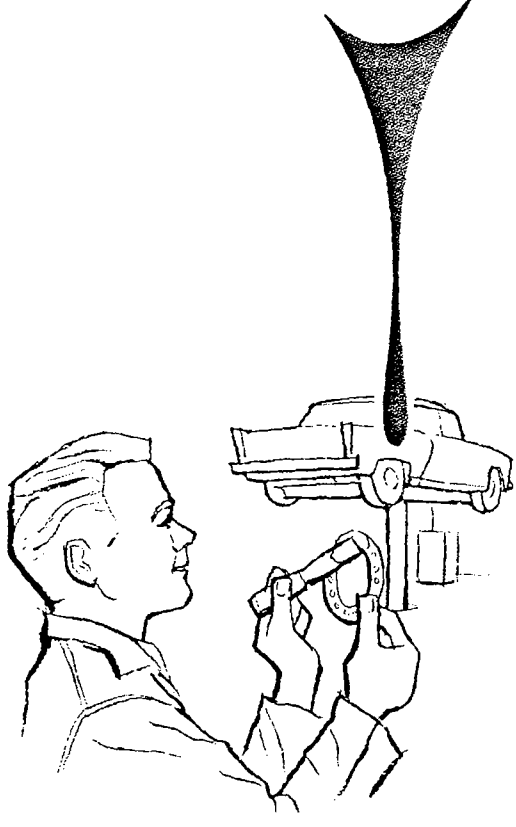
*With their wide range of physical properties, their inertness, lubricity, and vapor-suppressing characteristics — Aroclors can be valuable ingredients in an extraordinary variety of formulated products. They are compatible with a variety of solvents, oils, resins. They are virtually non-volatile and 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.

DSW 441964



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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

DSW 441965



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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:

| Mix No. | % by weight Oil* | Aroclor 1248 | Pour Pt. | Gravity at 15.5°C. | Approx. 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.

*Bright Stock: Gravity API 22-23

DSW 441966



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### 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 |

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

DSW 441967



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## 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.

*Mobay Chemical Co. trademark. Registered U. S. Pat. Ofc.

DSW 441968

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### 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.



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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 application requires no solvent. This coating on paper or fabric has extremely good flexibility.

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

DSW 441970



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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.

DSW 441971



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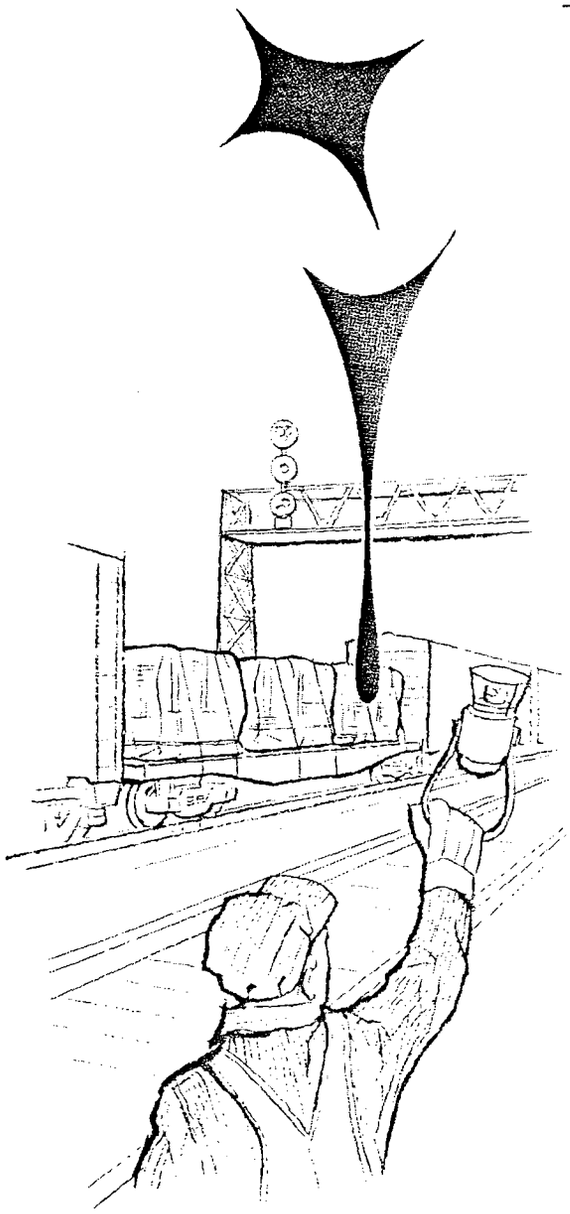
*Aroclors are valuable as low cost plasticizers for a variety of applications. Aroclors improve chemical resistance, flame retardance, oxidation resistance, and reduce the cost of plasticized elastomers. Depending upon the use, the various Aroclor compounds offer a number of benefits to the user.*

# 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

DSW 441972

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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

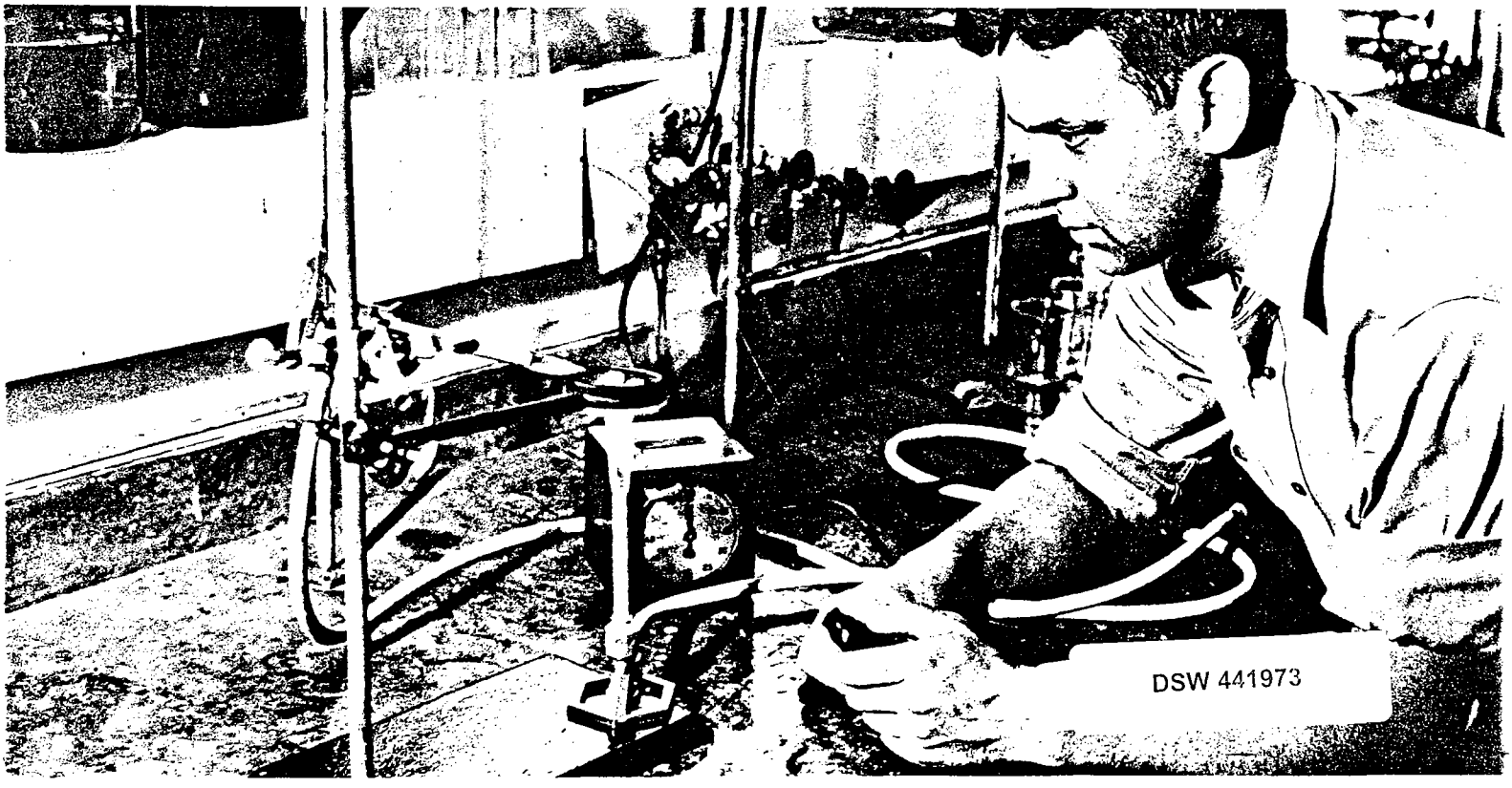
The Aroclors are valuable as secondary plasticizers, or plasticizer-extenders for polyvinyl chloride formulations. The Aroclors impart greatly improved chemical resistance over conventionally ester-plasticized compositions. For example, a formulation plasticized with 3 parts of DOP and 1 part of Aroclor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

Aroclor 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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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.

## EPOXY RESINS

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.

## POLYETHYLENE

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.

## ASPHALT

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.

## POLYESTER RESINS

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.

## PHENOLICS

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.

DSW 441974

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*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

DSW 441975



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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 | 80–70 |
| 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.

DSW 441976

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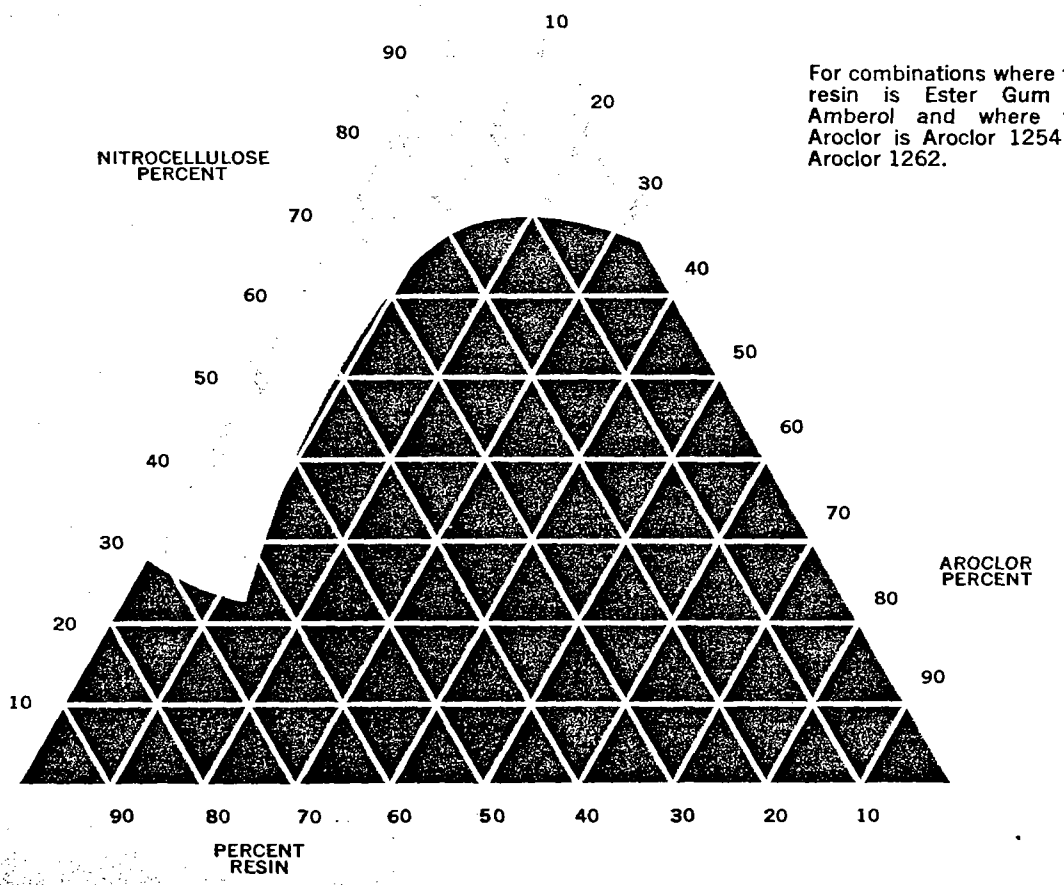
In the trilinear diagrams, the compositions, represented by any point in the unshaded areas, are those which produce homogeneous lacquer films. On the other hand compositions represented by points in the shaded areas produce impractical, segregated, brittle or soft films. For detailed information as 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.

DSW 441977



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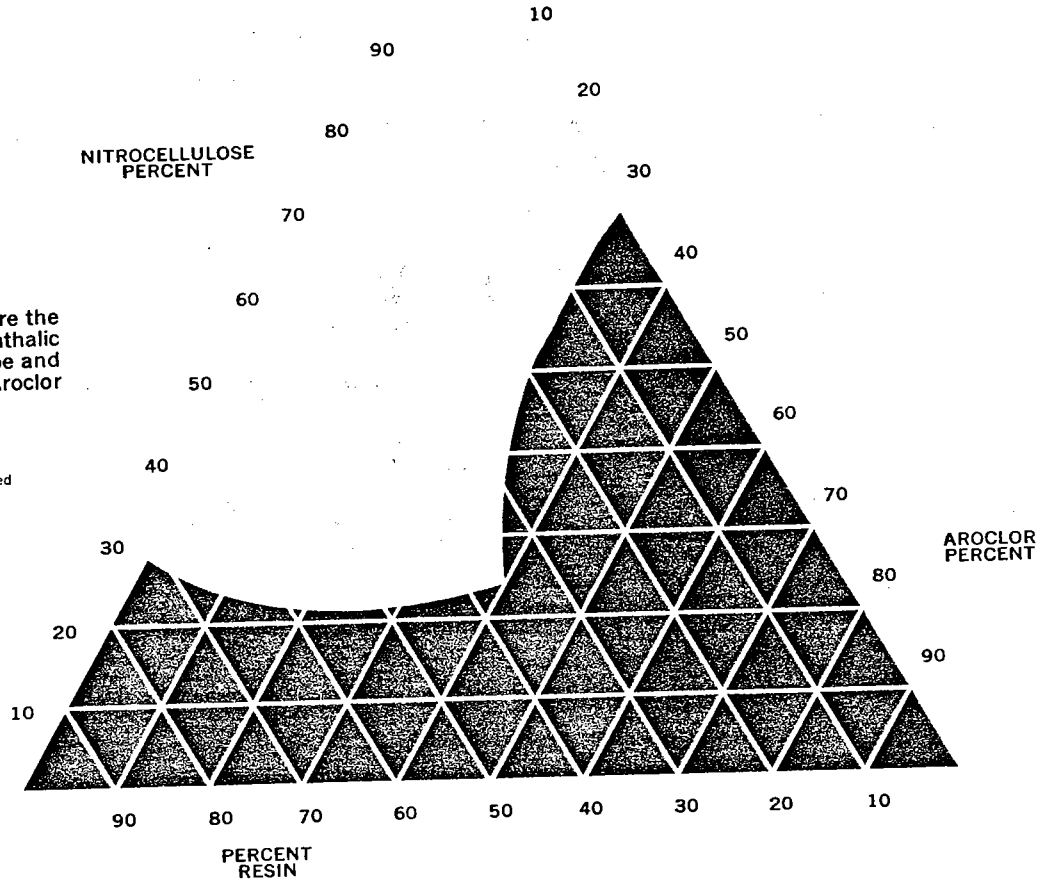
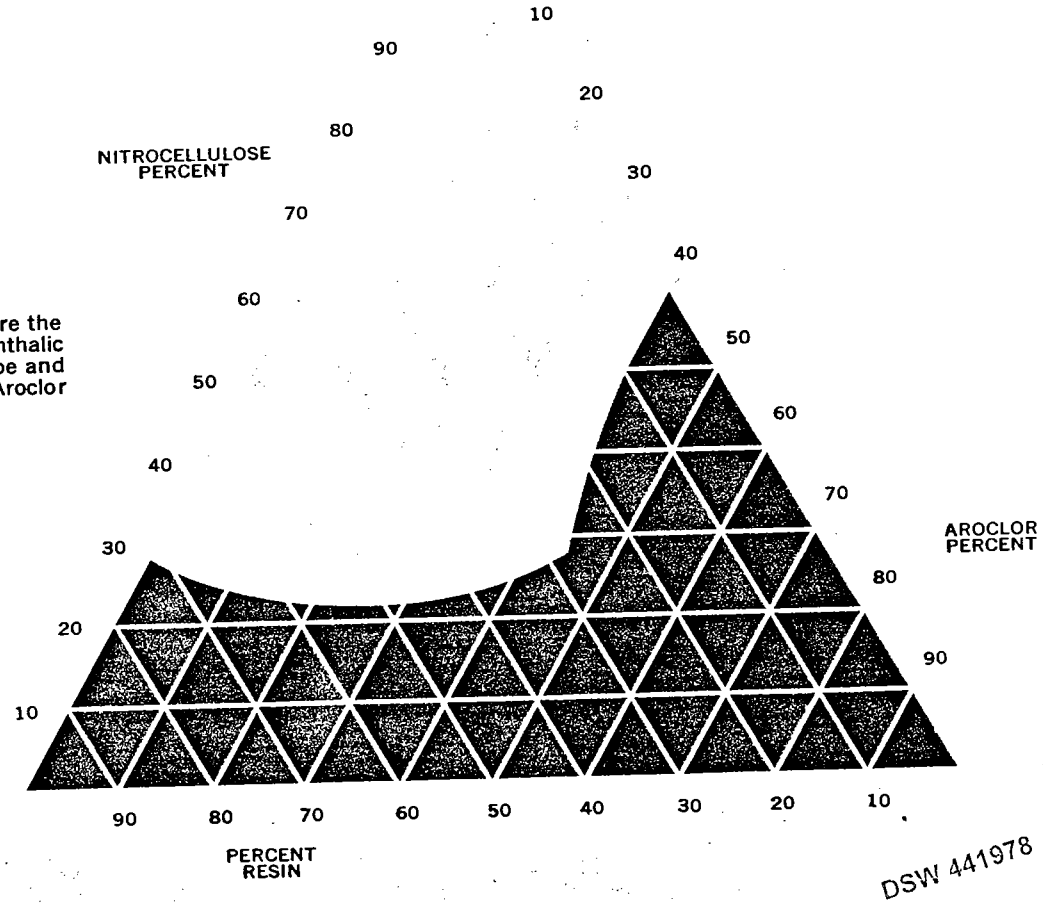
For combinations where the resin is of the phthalic anhydride-glucerol type and where the Aroclor is Aroclor 1262.*

*Aroclor 1260 may be substituted without material change.



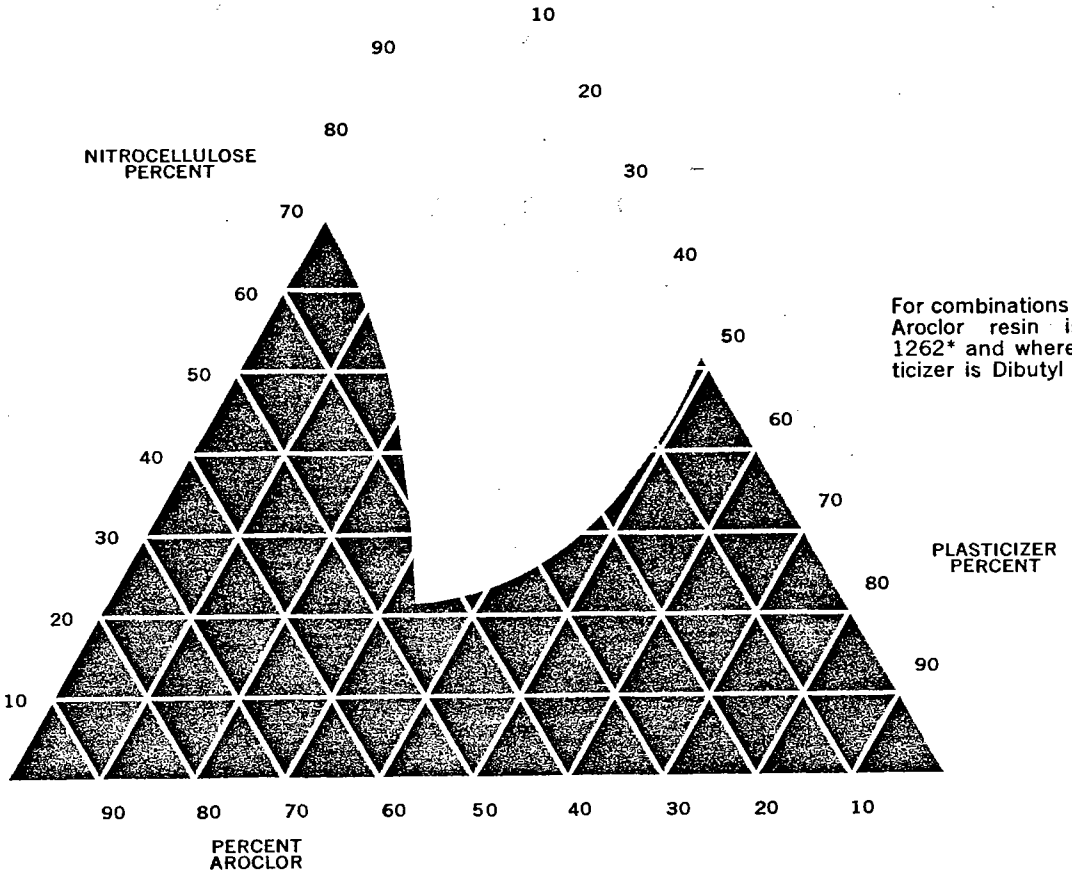

For combinations where the resin is of the phthalic anhydride-glycerol type and where the Aroclor is Aroclor 1254.



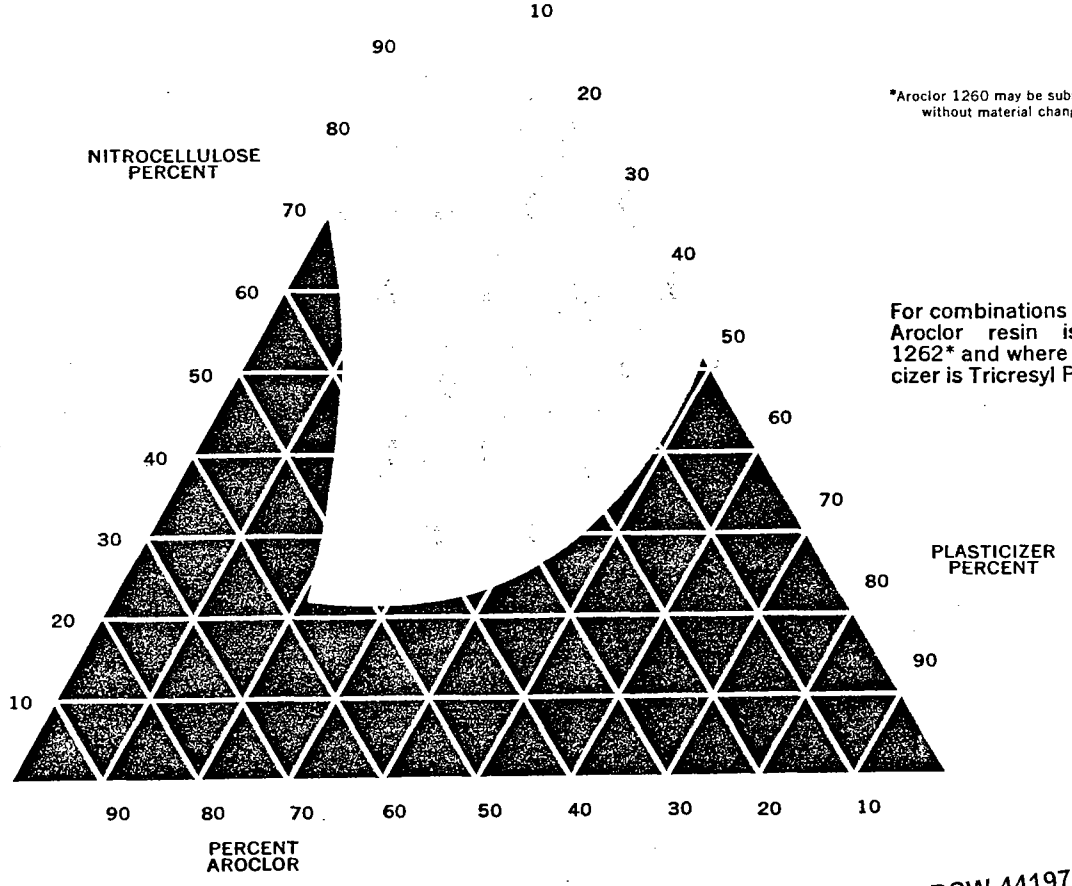

DSW 441978



STLCOPCB4056513




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




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

*Aroclor 1260 may be substituted without material change.

DSW 441979



STLCOPCB4056514

## *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.

DSW 441980

STLCOPCB4056515

## 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

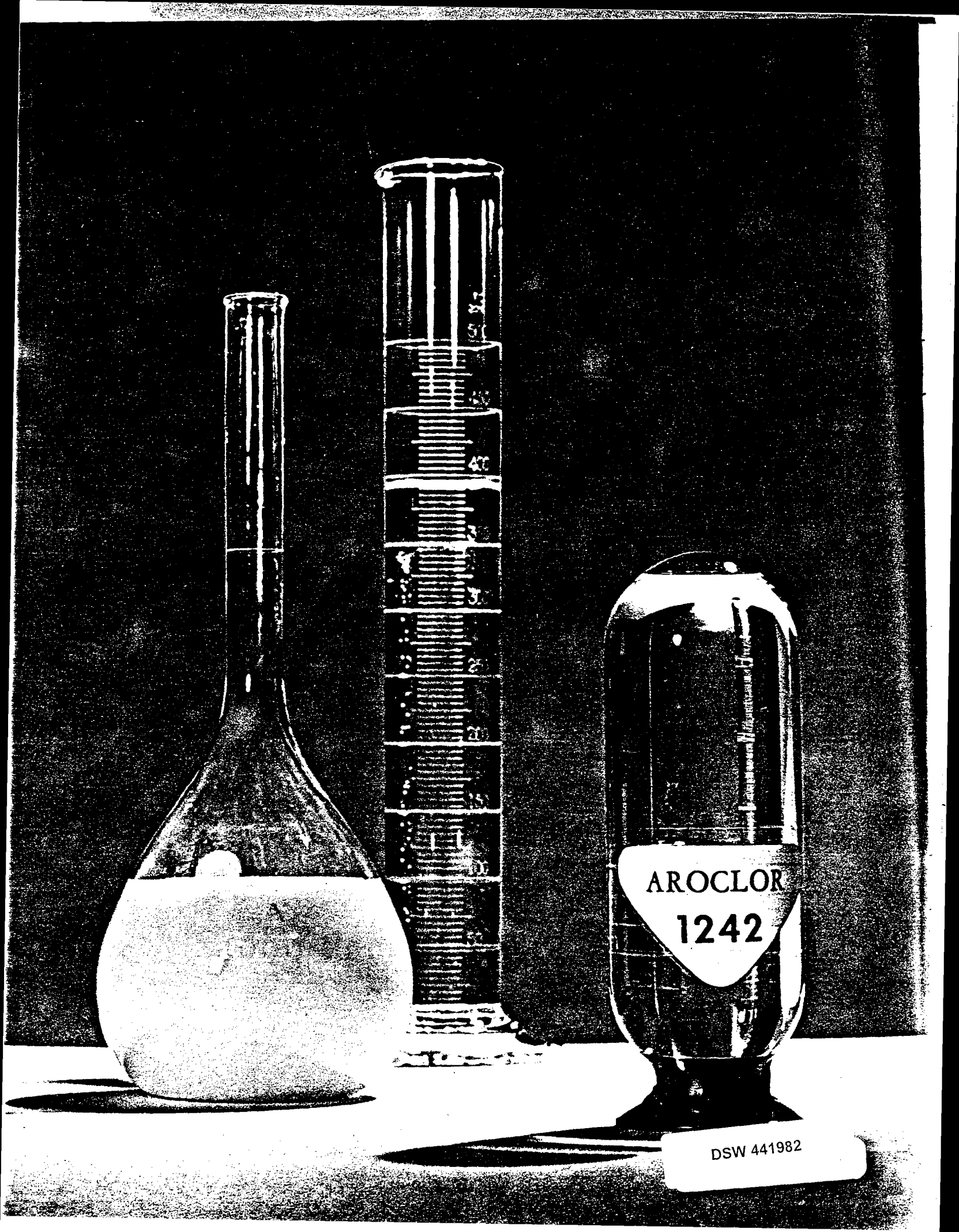
Aroclor 1262 is used as a low cost plasticizer for crepe rubber in paint compositions. Used in concentrations of 5 to 50% based on the weight of the rubber polymer, it increases the gloss and alkali resistance of the film and strengthens the adhesion of the film to steel.

*W. M. Gearheart and F. M. Ball, OFFICIAL DIGEST, Vol. 343, 1953.

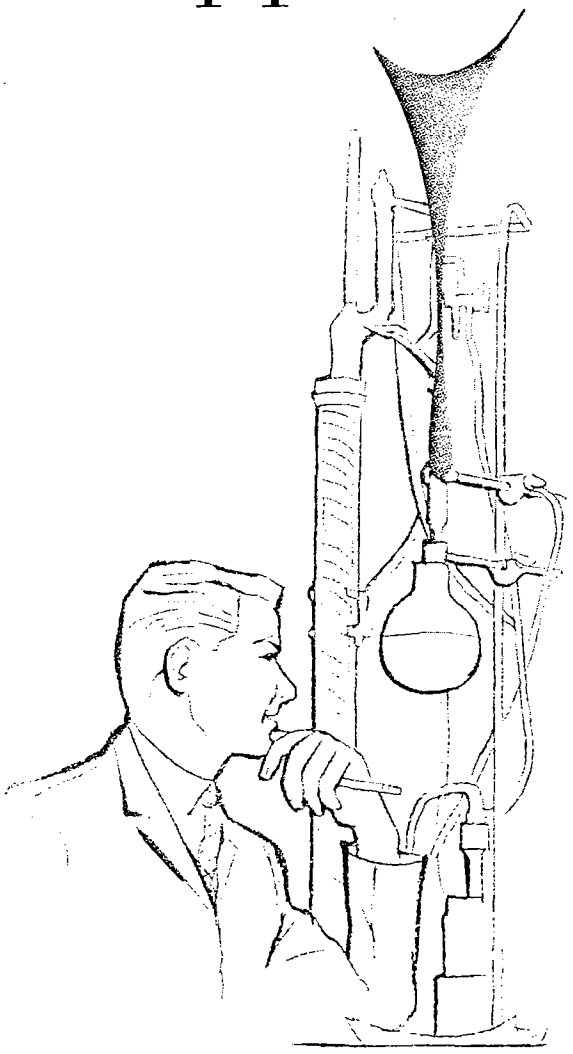
DSW 441981



STLCOPCB4056516


AROCLOR
1242
DSW 441982

# 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<br>1 lb. of Stearic Acid |
| (Portion 2) | 8 lbs. of water<br>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<br>4 parts Oleic Acid |
| (Portion 2) | 92 parts water<br>2 parts Ammonium Hydroxide (28%)<br>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. Ofc.

DSW 441983



STLCOPCB4056518

## 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°C | — | 10.0 32°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°C | 440 99°C | — | — | 114 31°C | 425 100°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°C | 307 99°C | VS | VS | 173 26°C | 259 98°C | SS | — | — |
| Cellosolve | S | S | S | S | S | S | S | — | — |
| Diethylene Glycol | — | — | — | — | — | — | S | — | — |
| p-p′ Dihydroxy Ethyl Ether | 16.9 23°C | 19 99°C | SS | SS | 8 30°C | 10 100°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°C | S | 2.0 28°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°C | 80.0 70°C | — | — | 10 27°C | 28 75°C | SS | — | — |
| Glycerine | I | I | I | I | I | I | I | I | — |
| Methyl Alcohol | 42.5 29°C | 88.5 60°C | — | — | 15 26°C | 22.2 65°C | SS | — | — |
| Phenol—90% | 194 30°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.

DSW 441984



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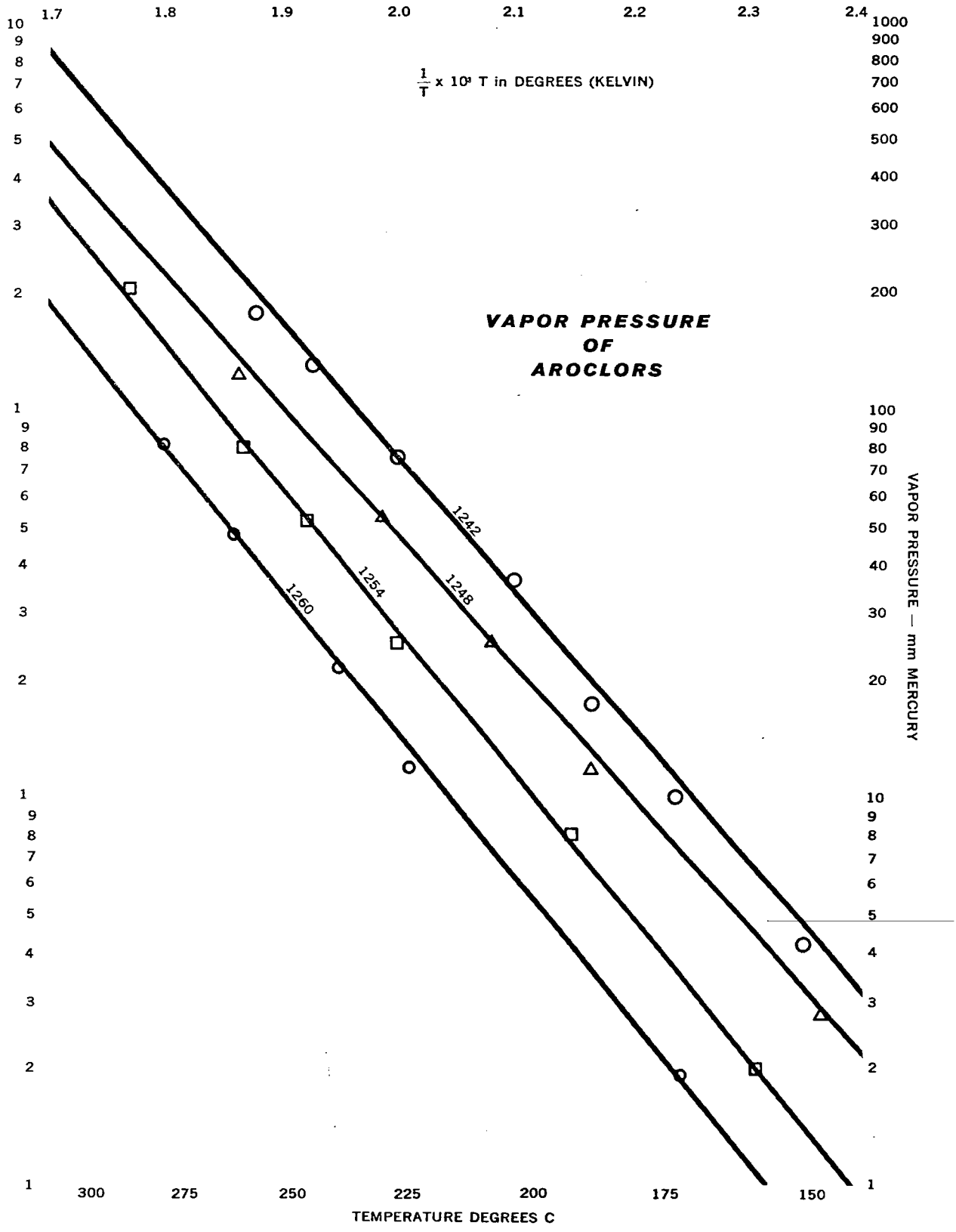



DSW 441985



STLCOPCB4056520

## *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. |

DSW 441986



STLCOPCB4056521

## *RESISTANCE OF STRUCTURAL MATERIALS TO AROCLORS*

| Metals | Aroclor Number 1248 25°C | 1248 125°C | 1254 25°C | 1254 125°C | 4465 125°C | 5460 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 $1.0 \times 10^{-6}$ cm/day penetration or .00014 in/yr.

R—Good resistance—has penetration between $1.0 \times 10^{-6}$ and $10 \times 10^{-6}$ cm/day or between 0.00014 and 0.0014 in/yr.

D—Doubtful resistance, penetration between $10 \times 10^{-6}$ cm/day and $100 \times 10^{-6}$ cm/day or between 0.0014 and 0.014 in/yr.

P—Poor resistance—penetration greater than $100 \times 10^{-6}$ 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.

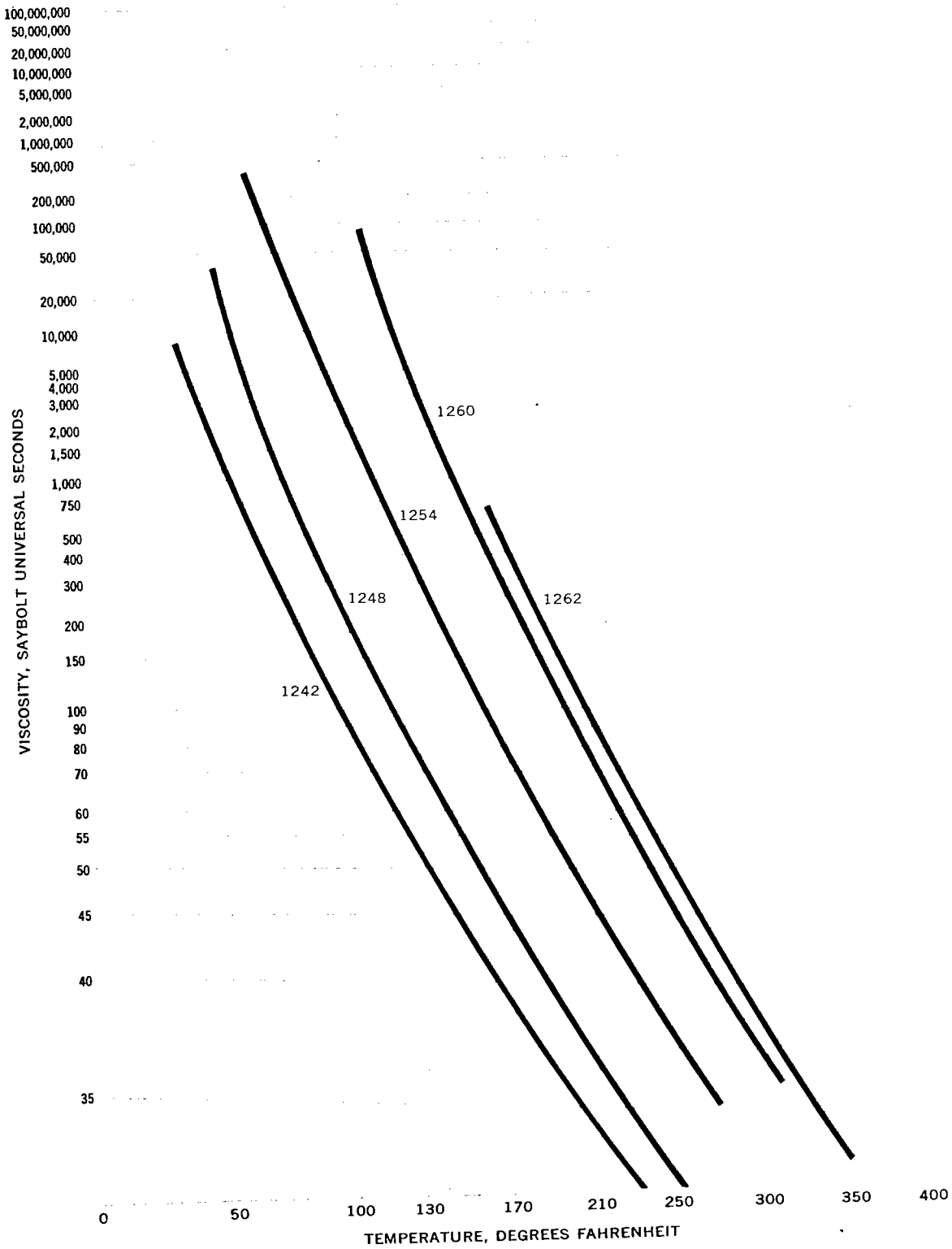
T—Material alone will not stand temperature.

DSW 441987



STLCOPCB4056522

## VISCOSITY RANGES OF SOME OF THE AROCLORS

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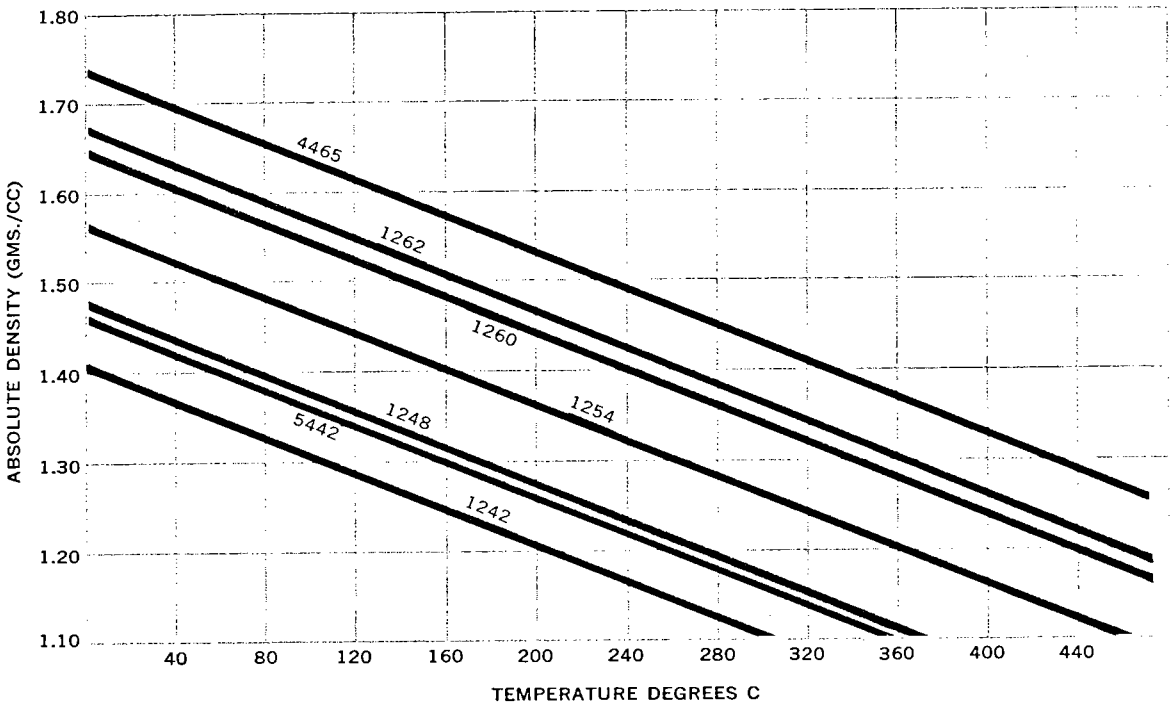
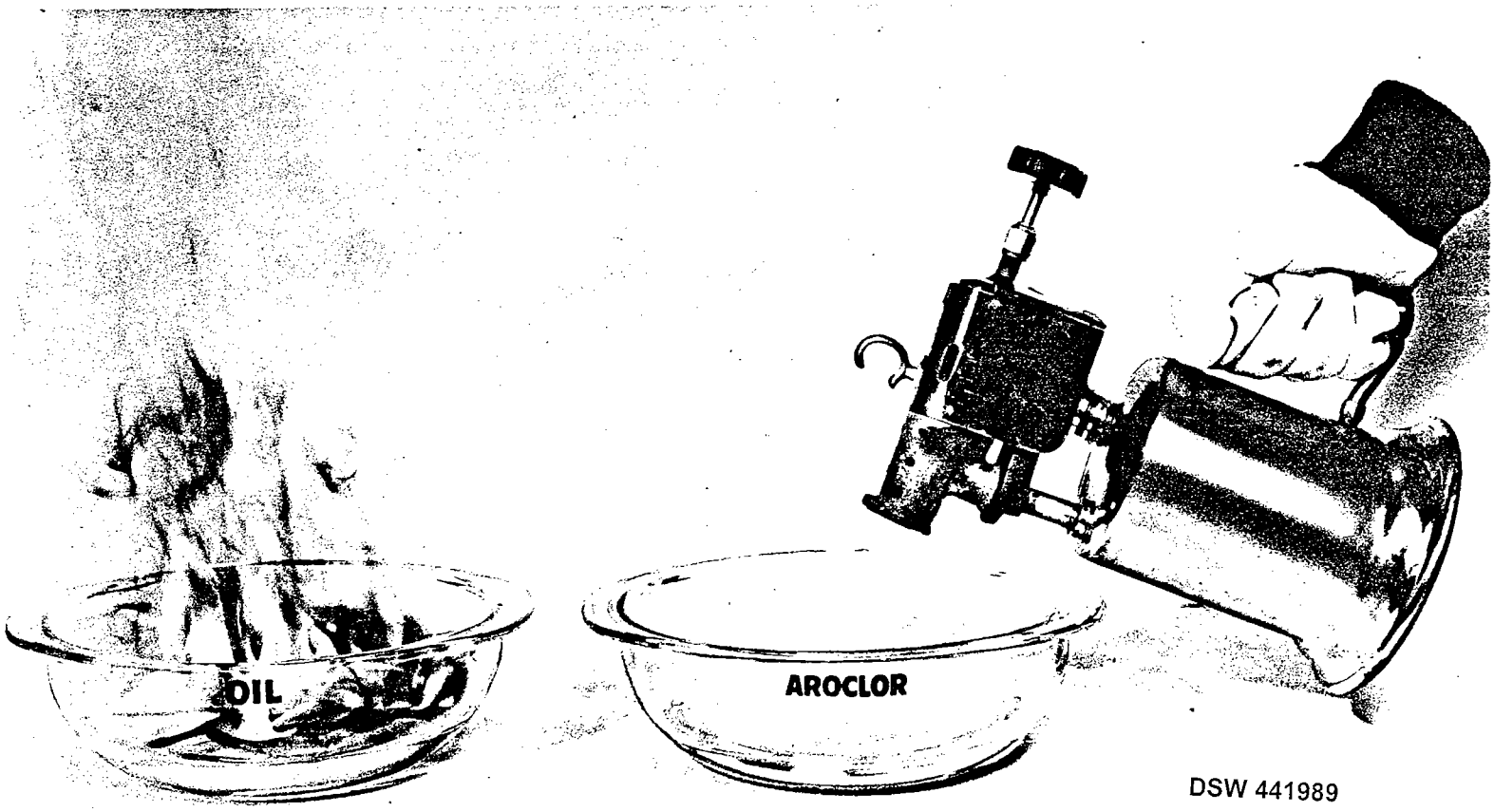
STLCOPCB4056523

## DENSITIES OF AROCLORS AT VARIOUS TEMPERATURES




DSW 441989

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

DSW 441990



STLCOPCB4056525

# aroclors for...

fire retardant
inert
shear resistant
heat stable
lubricating

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.

ivision • 800 North Lindbergh Blvd. • St. Louis 66, Missouri

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DSW 441991

041[illegible]



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DSW 441992

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# AROCLOR®

## resins and plasticizers for chlorinated rubber

TECHNICAL BULLETIN No. PL-311

REVISED
APRIL, 1962

Monsanto

monsanto chemical company • organic chemicals division • 800 north lindbergh blvd.
ST. LOUIS 66, MISSOURI

DSW 441993

STLCOPCB4056528

## AROCLOR® RESINS AND PLASTICIZERS FOR CHLORINATED RUBBER

Some important **applications** for protective and decorative chlorinated-rubber-based coatings plasticized with AROCLOR* compounds--

Wood and metal on yachts, barges, and other marine craft

Structural steel for bridges, buildings, roofs, and powerlines

Structural materials at chemical plants, pulp-and-paper mills, textile mills, petroleum refineries, and gas works for protection against acid fumes, alkalies, and gas

Tank cars and other railroad equipment and construction machinery for protection against corrosive materials and weathering

Equipment and stop-off lacquers used in electroplating

Masonry floors and walls, concrete swimming pools, and highway markings

Cable coatings requiring flame retardance, chemical resistance, and excellent electrical properties

Textile coatings resistant to chemicals, flame, and water

Food-processing buildings

Flame-retardant finishes

Important **properties** imparted to chlorinated-rubber coatings by AROCLOR plasticizers and resin extenders—

Chemical Resistance

Corrosion Resistance

Adhesivity

Flame Retardance

Flexibility

Electrical Resistance

Weather Resistance

*AROCLOR: Monsanto Chemical Company trademark, registered in the U. S. Patent Office.

DSW 441994

STLCOPCB4056529

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STLCOPCB4056530

## INTRODUCTION

Monsanto's AROCLOR chlorinated biphenyls and chlorinated triphenyls are used as plasticizers and resins for chlorinated-rubber-based lacquers, varnishes, and paints. These protective coatings are flame retardant, corrosion resistant, chemical resistant (to acids, alkalies, and water), and have good electrical insulating properties.

When properly pigmented, these coatings have unusually good weatherability. Chlorinated-rubber films plasticized with an AROCLOR compound grip common structural materials in strong adhesive bonds, and the addition of an AROCLOR compound improves the flexibility and life of chlorinated-rubber coatings.

The formulations suggested in this bulletin are common in commercial practice. They are given as starting points or guides for development of new formulations that capitalize on the outstanding qualities of these compounds.

## NUMBERING AROCLOR COMPOUNDS

The first two digits of the number of an AROCLOR compound represent its molecular type, as:

12—chlorinated biphenyls

25—blend of chlorinated biphenyls, 75 per cent, and chlorinated terphenyls, 25 per cent

44—blend of chlorinated biphenyls, 60 per cent, and chlorinated terphenyls, 40 per cent

54—chlorinated terphenyls

The last two digits indicate the weight percentage of chlorine in the product. For example:

AROCLOR 1248 is a chlorinated biphenyl that contains 48-weight-per cent chlorine

AROCLOR 4465 is a 60 biphenyl : 40 terphenyl mixture chlorinated to 65-per cent chlorine

AROCLOR 5460 is a chlorinated terphenyl with 60-weight-per cent chlorine

The physical properties of the AROCLOR plasticizers vary gradually with the degree of chlorination. Compounds with low percentages of chlorine, such as AROCLOR 1221 and 1232, are clear and very fluid. AROCLOR 1242, with 42-per cent chlorine, resembles vegetable oil; the product with 48-per cent chlorine is slightly more viscous and looks like a medium-grade mineral oil. At 54-per cent chlorine, the compound is quite viscous; if a bottle containing it is turned upside down, the bubble rises slowly to the top. At higher chlorine percentages, the chlorinated biphenyls become gumlike, and a fingerprint on the surface lasts several days. Then at 68-per cent chlorine, the range is complete; AROCLOR 1268 is a white powder. Both chlorinated terphenyls (AROCLOR 5442 and 5460) are yellow solids.

The gradual change in physical properties often allows a processor to select a plasticizer particularly suited for his operation. For example, if he wants to dry mix the plasticizer, AROCLOR 1268 could be used. It melts at higher processing temperature and can act as a solvent-plasticizer. Complete physical properties and specifications for the AROCLOR compounds are listed in technical bulletin PL-306, "AROCLOR Plasticizers."



DSW 441996

STLCOPCB4056531

## PROPERTIES OF CHLORINATED RUBBER

Chlorinated-rubber-based coatings are widely used because of their resistance to corrosive agents, moisture, fungus, mold, and other destructive agents.

*Parlon** chlorinated rubber is a mixture of two polymers, with an average chlorine content of 67 per cent, made by chlorination of natural rubber. Its typical properties, according to the manufacturer, Hercules Powder Company, Wilmington, Delaware, are listed in Table I:

### TABLE I—TYPICAL PROPERTIES OF CHLORINATED RUBBER

**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, cubic inches per pound | 16.9 |
| Bulking value, gallons per pound | 0.0735 |
| Refractive Index, at 25°C | 1.554 |

**Chemical 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 |

**Parlon* is a registered trademark of Hercules Powder Co.

DSW 441997



STLCOPCB4056532

**Electrical (clear, unplasticized film*)**

Specific surface resistance, ohms x $10^{10}$ .....2000

Dielectric strength, volts per mil (ASTM method) .....2300

Dielectric constant at 25°C and 1000 cycles....3.1

Power factor at 25°C and 1000 cycles .....0.0015 to 0.0030

Power factor at 25°C and 1000 cycles, after immersion in water for 140 hours and surface wiped dry .....0.0027

**Mechanical (clear, unplasticized film*)**

| | 20-cp. type | 1000-cp. type |
|---|---|---|
| Tensile strength, dry, pounds per square inch | 4270 | 4850 |
| Tensile strength, wet, pounds per square inch | 4100 | 4360 |
| Elongation, dry, per cent | 3.6 | 3.3 |
| Elongation, wet, per cent | 3.8 | 3.4 |
| Modulus of elasticity, pounds per square inch | 1.4 x $10^5$ | ..... |
| Hardness, Sward index, per cent of glass | 90 | ..... |

Note: Flexibility of *Parlon* film increases with viscosity of *Parlon* used.

**Thermal (clear, unplasticized film*)**

Burning rate .....nonflammable

Effect of dry heat on film .....stable at 125°C

Softening point, °C .....decomposes at 135 to 150

**Physical-Chemical (clear, unplasticized film*)**

Effect of sunlight .....Discolors and embrittles

Effect of aging .....Very slight

Effect of hot water .....Blushes

Effect of cold water .....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 $10^4$

DSW 441998

*laid down from toluene solution



STLCOPCB4056533

## VISCOSITY TYPES

TABLE II—"PARLON" VISCOSITY TYPES

| Viscosity Type | Viscosity Range (centipoises) |
|---|---|
| 5 cp. | 5 to 7 |
| 10 cp. | 8 to 12 |
| 20 cp. | 16 to 25 |
| 125 cp. | 110 to 190 |
| 1000 cp. | 800 to 2000 |

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

| Type | Example of Use |
|---|---|
| 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 |
| 1000 cp. | As a film-former in adhesives, textile finishes, and other finishes where flexibility is important |

## SOLVENT COMPATIBILITY

Solvents and solvent mixtures suggested for use in preparing formulations with AROCLOR and *Parlon* are given in Table III:

TABLE III—SUGGESTED SOLVENTS FOR COMPOSITIONS WITH AROCLOR AND PARLON

| | |
|---|---|
| *Amsco Solv*[a] B and E | Methyl isobutyl ketone |
| Amyl acetate | Methyl salicylate |
| Butyl acetate | *Mobilsol*[c] Nos. 74, 75 |
| Carbon tetrachloride | *Notol*[d] |
| *Cellosolve*[b] | Octyl acetate |
| Diacetone alcohol | *Solvesso*[e] 100 |
| Diethyl carbonate | *Tollac*[d] |
| Ethyl acetate | Toluene |
| Ethylene dichloride | Trichloroethylene |
| Hi-Flash naphtha | *Union*[f] Aromatic Solvent 3553-10 |
| Methyl acetate | *Union* Solvent No. 30 |
| Methyl ethyl ketone | Xylene |

a) Trademark of American Mineral Spirits Co.
b) Trademark of Union Carbide Chemical Co.
c) Trademark of Socony Mobil Oil Co.
d) Trademark of Neville Chemical Co.
e) Trademark of Esso Standard Oil Co.
f) Trademark of Union Oil Co.



DSW 441999

STLCOPCB4056534

## FORMULATIONS AND PROPERTIES OF CHLORINATED RUBBER

### Chlorinated-Rubber Films

Although chlorinated rubber is unaffected by acids, alkalies, salts, moisture, and fungus, it is very hard and brittle. Consequently plasticizers and plasticizing resins must be added to make useful coatings. To make chemical- and corrosion-resistant coatings, the modifiers must likewise be nonreactive with acids, alkalies, and salts. As little as five per cent of a saponifiable material, such as linseed oil, alkyd resin, or ester plasticizer, seriously detracts from the alkali resistance of the finished coating. Monsanto AROCLOR compounds, such as AROCLOR 5460 and AROCLOR 1254 or 1260, are the best available plasticizing resin and plasticizers, respectively, since they are unaffected by acids, alkalies, or salts. The following table summarizes some of the benefits imparted to chlorinated rubber coatings by the presence of AROCLOR plasticizers:

TABLE IV—BENEFITS OF AROCLOR PLASTICIZERS IN CHLORINATED RUBBER

| | GOOD ADHESION TO | | | | RESISTANCE TO | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Aroclor | Aluminum | Steel | Transite | Cellophane | 10% Hydrochloric Acid | 5% Sodium Hydroxide | Sodium Chloride | Water | Sward Hardness | Cold-Check Resistance |
| 1254 | — | — | X | X | X | X | X | X | 35 | 3 |
| 1260 | — | — | X | X | X | X | X | X | 40 | 4 |
| 5460 | X | X | X | — | X | X | X | X | 22 | 2 |

ARCOLOR 1262 and 5460, resinous types, show good compatibility in chlorinated-rubber films laid down from toluene solution containing 20-per cent of the plastic in ratios of 2:1 and 1:1 (*Parlon* to AROCLOR). The plasticizer types, AROCLOR 1252, 1254, and 1260, also show good compatibility. Formulations and properties of films derived from both resin- and plasticizer-type AROCLOR are listed in Table V:

TABLE V—FORMULATIONS CONTAINING AROCLOR RESINS OR PLASTICIZERS

| Ingredient | Parts by Weight | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Parlon,* 20-cp | 16 | 16 | 16 | 12 | 12 | 12 | 20 | 20 | 20 |
| AROCLOR 5460 | 8 | 8 | 8 | 12 | 12 | 12 | — | — | — |
| AROCLOR 1254 or 1260 | — | — | — | — | — | — | 4 | 7 | 20 |
| Dibutyl phthalate | — | 4 | — | — | 3 | — | — | — | — |
| Tung oil, Thermolyzed, 976 | — | — | 5 | — | — | 3.75 | — | — | — |
| Xylene or butyl acetate | 76 | 72 | 71 | 76 | 73 | 72.25 | 76 | 73 | 70 |



DSW 442000

STLCOPCB4056535

The AROCLOR compounds impart characteristics to the films cast from these lacquers, including the following advantages:

### Adhesion

Unplasticized chlorinated-rubber films have very poor adhesion. The lacquer film containing AROCLOR 5460 adheres well to aluminum, bare steel, primed steel, galvanized iron, and *Transite* surfaces. The lacquer films plasticized with AROCLOR 1254 or 1260 give good adhesion to *Transite,* cellophane, galvanized iron, and primed-steel surfaces.

Though compounds with an AROCLOR alone possess pronounced adhesion qualities, better adhesion to all of the surfaces results if mixtures of AROCLOR or varied contents are used.

### Resistance to Aqueous Solutions

Chlorinated-rubber films with AROCLOR 1254 or 1260 (plasticizers) and AROCLOR 5460 (resin) show satisfactory resistance to solutions of 10-per cent hydrochloric acid, 5-per cent sodium hydroxide, 5-per cent sodium chloride, and water-spot tests.

### Film Hardness

Softer films are produced with AROCLOR 5460 in ratios of 5:10 and 10:10 (AROCLOR-*Parlon*) than with other commercial resins in similar mixtures. Likewise, softer films result from AROCLOR 1254 or 1260 in ratios of 2:10 and 5:10 (AROCLOR:*Parlon*) than with other commercial plasticizers at these concentrations. These tests show that AROCLOR compounds have strong plasticizing action on chlorinated rubber.

### Cold-Check Resistance

AROCLOR 5460 is superior to phenol-formaldehyde resins in cold-check resistance imparted to chlorinated-rubber films, but not as good as long-oil-alkyd modification. AROCLOR 1260 is a somewhat better plasticizer than AROCLOR 1254.

### Weather Resistance

Pigmented chlorinated-rubber finishes containing AROCLOR have consistently withstood outdoor weather tests, but unpigmented finishes do not weather well regardless of the resin or plasticizer used.

Poor resistance to ultraviolet light is also a weakness of chlorinated rubber. Most pigments (except ultramarine blue) are usable with *Parlon* and are recommended if the coating is to be subjected to outdoor weather or ultraviolet light. However, pigment protection varies considerably. Inspection of alkyd enamels fortified with *Parlon* showed weatherability varied from 63 months with chrome green to 4 months for titanium dioxide-iron blue combinations.

### Sanding and Polishing Properties

Plastic films compounded with *Parlon* and AROCLOR 5460, 1254, or 1260 have showed satisfactory sanding and polishing characteristics.



DSW 442001

STLCOPCB4056536

## APPLICATIONS

### Alkali-Resistant Coatings

Products containing AROCLOR and chlorinated rubber are highly resistant to alkalies and moisture. Paints with combinations of AROCLOR and chlorinated rubber are used in large quantities for concrete floors, walls, swimming pools, and other surfaces. Paint formulations are suggested in Table VI:

TABLE VI—PAINTS FOR ALKALINE SURFACES

| Ingredients | Basement Floors (parts) | Fed-Spec. TT-P-91 (parts) | Concrete Swimming Pool (parts) |
|---|---|---|---|
| *Parlon* (20-cp.) chlorinated rubber | 100 | 100 | 100 |
| Medium-oil, drying alkyd resin | ..... | ..... | 50 |
| Long-oil, drying alkyd resin | 45 | ..... | ..... |
| AROCLOR 1254 | 55 | 56 | 50 |
| AROCLOR 5460 | ..... | 33 | ..... |
| Titanium Dioxide | 89 | 89 | 112 |
| Zinc Oxide | 11 | 11 | ..... |
| Silica Flour | 17 | ..... | ..... |
| Carbon Black | 1 | 3 | ..... |
| Magnesium Silicate | ..... | ..... | 115 |
| *Bentone** 34 gelling agent | 12 | 12 | 13 |
| Epichlorohydrin | ..... | ..... | 1 |
| Xylene | 239 | ..... | ..... |
| Hi-Flash naphtha | ..... | ..... | 450 |
| Turpentine | ..... | 26 | ..... |
| *Solvesso* 100 | ..... | ..... | 90 |
| *Solvesso* 150 | ..... | 237 | ..... |

*Trademark of National Lead Co.



DSW 442002

STLCOPCB4056537

## Chemical-Resistant Finishes

Particular care is necessary in choosing resins and plasticizers for chemical-resistant paints. Chlorinated-rubber formulations with an AROCLOR plasticizer have proved outstanding for acid and alkali resistance. Five suggested formulations are shown in Table VII.

### TABLE VII—FORMULATIONS FOR CHEMICAL-RESISTANT PAINTS

| Ingredients | Exterior[a] use, acids (parts) | Exterior[b] use, alkalies (parts) | Interior[c] use, acids and alkalies (parts) | Maximum[d] resistance, acids and alkalies (parts) | Soap[e] resistant (parts) |
|---|---|---|---|---|---|
| *Parlon*, (20-cp.) chlorinated rubber | 100 | 100 | 100 | 100 | 100 |
| Phenolic resin | ..... | 40 | ..... | ..... | ..... |
| Alkyd resin | 40 | ..... | ..... | ..... | ..... |
| AROCLOR 1254 | 30 | 30 | 50 | 45 | ..... |
| AROCLOR 1260 | ..... | ..... | ..... | 33 | ..... |
| AROCLOR 5460 | ..... | ..... | 40 | ..... | 50 |
| Tung oil, Thermolyzed, 976 | 30 | 30 | ..... | ..... | 64 |
| Iron oxide | 100 | 100 | 100 | 100 | ..... |
| Titanium dioxide | ..... | ..... | ..... | ..... | 150 |
| Zinc oxide | ..... | ..... | ..... | ..... | 50 |
| Epichlorohydrin | ..... | ..... | ..... | 0.5 | ..... |
| Stabilizer | ..... | ..... | ..... | 5 | ..... |
| Xylene | 325 | 325 | 330 | ..... | 245 |
| Toluene | ..... | ..... | ..... | ..... | 100 |
| *Solvesso* 100 | ..... | ..... | ..... | 250 | ..... |
| Hi-Flash naphtha | ..... | ..... | ..... | ..... | 86 |
| Turpentine | ..... | ..... | ..... | 28 | ..... |

These formulations were applied to metal bars or panels and tested for resistance:

*a*) Excellent outdoor protection to metal surfaces in acid-manufacturing plants

*b*) Good performance on exteriors of alkali-producing plants

*c*) Good resistance to 10-per cent hydrochloric acid and 5-per cent sodium hydroxide solutions

*d*) Excellent resistance to acids, alkalies, and salt solutions (Also adhered well to glass and other surfaces)

*e*) Good resistance to warm, soapy water

Note: No finishes with AROCLOR or chlorinated rubber are recommended for continuous exposure at temperatures above 140° F.



DSW 442003

STLCOPCB4056538

### Continuous Metal-Painting Process

A recently-developed continuous-painting process for finishing metal offers savings on capital investment, plant space, and operating costs. The technique utilizes the physical properties of trichloroethylene, the only solvent in the paint. Metal parts enter the unit covered with grease and leave the other end completely painted and dry to the touch. Detailed information about the process can be obtained from Du Pont, Wilmington, Delaware. The formulation in Table VIII has given good characteristics in this continuous-painting system:

TABLE VIII—FORMULATION FOR CONTINUOUS-PAINTING PROCESS

| Ingredients | Parts by Weight: Vehicle | Parts by Weight: Pigment[a] Dispersion |
|---|---|---|
| *Parlon* (20-cp) chlorinated rubber | 100 | ..... |
| Long-oil, drying, alkyd resin | 15 | 23.7 |
| AROCLOR 1254 | 50 | ..... |
| Titanium Dioxide (Rutile) | ..... | 100 |
| *Bentone* 38 gelling agent | ..... | 1.25[b] |
| Epoxy stabilizer | 3.9 | ..... |
| Trichloroethylene | 217 | 53.5 |

*a*) Add pigment dispersion to vehicle after 24 hours in pebble mill

*b*) Add gelling agent to pigment dispersion during last two hours of grind

### Marine Finishes

The marine industry makes great use of chlorinated-rubber coatings plasticized with AROCLOR compounds to protect wood and metal on boats, barges, and other marine equipment. They resist salt water, and their hard finish deters algae and other marine growth. A suggested formula for a white marine paint is given in Table IX:

TABLE IX—FORMULATION FOR A WHITE MARINE PAINT

| Ingredients | Parts by Weight |
|---|---|
| *Parlon* (20-cp) chlorinated rubber | 77 |
| Long-oil, oxidizing, alkyd resin | 23 |
| AROCLOR 1254 | 23 |
| Titanium dioxide | 96.5 |
| Xylene | 87.5 |
| Hi-Flash Naphtha | 77 |



DSW 442004

STLCOPCB4056539

### Emulsion Paints

If chemical resistance is required on porous surfaces, AROCLOR 1254 is often added to chlorinated-rubber-emulsion paints. Hercules Powder Company reports that preferred water phases for such paints are either a 1-per cent-distilled-water solution of *Aerosol** OT or a 4-per-cent-distilled-water solution of sodium oleate. A lacquer-to-water weight ratio of 2.5 to 1 is suggested for the complete emulsion. Chlorinated rubber of any viscosity may be used. A typical lacquer phase for such an emulsion paint is given in Table X:

TABLE X—FORMULATION FOR LACQUER PHASE OF EMULSION PAINT

| Ingredients | Parts by Weight |
|---|---|
| *Parlon* chlorinated rubber | 28 |
| AROCLOR 1254 | 14 |
| AROCLOR 5460 | 10 |
| Xylene | 24 |
| Hi-Flash naphtha | 24 |

### Mastics

Mastic compositions are used to deposit thick films with a minimum number of coats. Mastics modified with AROCLOR compounds can effectively seal cracks in concrete, smooth rough concrete surfaces for subsequent glossy coatings, give excellent corrosion resistance under severe conditions, and retard fire. A typical starting formulation is given in Table XI:

TABLE XI—MASTIC COMPOSITION

| Ingredients | Parts by Weight |
|---|---|
| *Parlon* (20-cp) chlorinated rubber | 100 |
| AROCLOR 1254 | 30 |
| AROCLOR 5460 | 49 |
| Asbestos | 160 |
| Titanium Dioxide (Rutile) | 25 |
| Toluene | 300 |

Although this mastic formulation adheres well to either wood or masonry, a primer is suggested before application to steel. To further increase fire retardance, replacement of 33 parts of the asbestos by 47 parts of antimony oxide is suggested as a starting formulation.

### Paper and Textile Coatings

Chlorinated-rubber coatings with AROCLOR plasticizers are worthy of consideration for specific end uses on paper and textiles, although they are generally restricted by odor. Unpigmented finishes are suitable for certain fabrics used indoors, but not for exposure to high temperatures or direct sunlight.

*Trademark of American Cyanamid Co.



DSW 442005

STLCOPCB4056540

### Adhesives

Chlorinated-rubber adhesives with an AROCLOR plasticizer were developed originally for acid-bottle labels because of their general resistance to chemicals. These adhesives are also of unusual interest because they are flame resistant. A typical formulation is given in Table XII:

TABLE XII—FORMULATION FOR ACID- AND FLAME-RESISTANT ADHESIVE

| Ingredients | Parts by Weight |
|---|---|
| *Parlon* (125-cp.) chlorinated rubber | 20 |
| AROCLOR 1254 | 6 |
| AROCLOR 1260 | 6 |
| Toluene | 68 |

### Electrical Coatings

Because of their desirable electrical properties, these compositions are useful for insulating and protecting electrical wire and apparatus from moisture. With selected fungistats and waxes, coatings of this type are used to protect electronic equipment in the tropics against moisture and fungi. The fire retardance of AROCLOR-*Parlon* combinations is an added dividend in the electrical field.

### Printing Inks

Printing inks requiring fast drying time and chemical resistance are often based on chlorinated-rubber compositions plasticized with an AROCLOR compound. These inks are especially useful on soap wrappers and boxes, bottle labels, and many other commodities because of their alkali resistance.

## OTHER MONSANTO PLASTICIZERS COMPATIBLE WITH CHLORINATED RUBBER

The following Monsanto plasticizers (Table XIII) are also compatible with chlorinated rubber, but none gives the over-all desired qualities attained by using an AROCLOR plasticizer:

TABLE XIII—OTHER MONSANTO PLASTICIZERS COMPATIBLE WITH CHLORINATED RUBBER

| | |
|---|---|
| Dibutyl phthalate | *Santicizer* M-17 |
| Diethyl phthalate | *Santolite** MHP |
| Dimethyl phthalate | Tricresyl phosphate |
| *Santicizer** B-16 | Triphenyl phosphate |

**Santicizer* and *Santolite* are Monsanto Chemical Company trademarks, registered in the U.S. Patent Office.



DSW 442006

STLCOPCB4056541

# TOXICITY AND SAFE HANDLING

## Inhalation

At ordinary temperatures the AROCLOR chlorinated polyphenyls have not presented industrial toxicological problems. The hazard of potential toxic exposure varies with their volatility: the lower-chlorinated, more-volatile ones present more of a potential problem from the standpoint of both inhalation and skin contact. When AROCLOR compounds are used at elevated temperatures, engineering controls must be applied, either by the use of closed systems or by effective local-exhaust ventilation together with general workroom exhaust.

Vapor of the liquid AROCLOR compounds at room temperature should not be breathed in a confined space, and no vapor of any AROCLOR compound evolved at elevated temperatures should be allowed to be dispersed into the general workroom.

Inhalation tests on animals indicate that the maximum safe concentration of vapor is in the range of from 0.5 to 1.0 milligram of the lower-chlorinated AROCLOR compounds per cubic meter of air. The threshold limits (maximum allowable concentration for an 8-hour working day) set by the American Conference of Government Hygienists are 1.0 milligram of the lower-chlorinated AROCLOR compounds per cubic meter of air and 0.5 milligram of the more-highly-chlorinated compounds, such as AROCLOR 1254, per cubic meter of air.

## Skin Contact

Schwartz patch tests on 200 volunteers showed that AROCLOR 1254 was neither a primary skin irritant or a sensitizer.

Continuous or repeated skin contact with the AROCLOR compounds must be avoided by the use of gloves and protective garments, because of the possible occurance of a condition called chloracne. Although reports of this condition caused by AROCLOR compounds are rare, it can be produced by excessive skin contact. If any AROCLOR compound is spilled on the skin, the skin should be washed in the usual manner with a soap solution.

A burn caused by contact with a hot AROCLOR compound should be treated like any ordinary burn. AROCLOR compound adhering to the burned area need not be removed immediately, unless treatment of the burn demands it, in which case either soap and water or repeated washings with a vegetable oil are recommended.



DSW 442007

STLCOPCB4056542

## SHIPPING

### Freight Classification

| | |
|---|---|
| AROCLOR 1221, 1243, 1242, 1248, 1254, 1260, 1262 | Synthetic Resin, Liquid, NOIBN |

### Rail Classification

| | |
|---|---|
| AROCLOR 1268, 2565, 4465, 5442, 5460 | Synthetic Resin, Other Than Liquid, NOIBN |

### Truck Classification

| | |
|---|---|
| AROCLOR 1268, 2565 | Synthetic Resin, Powder, NOI |
| AROCLOR 4465, 5442, 5460 | Synthetic Resin, Lumps or Solid Mass, NOI |

### Shipping Regulations

None

### Standard Containers

| | |
|---|---|
| AROCLOR 1221 | Tank car, 520-lb. steel drum, 50-lb. can |
| AROCLOR 1232 | Tank car, 550-lb. steel drum, 50-lb. can |
| AROCLOR 1242, 1248, 1254, 1260, 1262 | Tank car, 600-lb. steel drum, 50-lb. can |
| AROCLOR 1268 | 200-lb. fiber drum, 50-lb. can |
| AROCLOR 2565, 4465 | 500-lb. steel drum, 50-lb. can |
| AROCLOR 5442 | 450-lb. steel drum, 50-lb. can |
| AROCLOR 5460 (flaked) | 100-lb. bag |

WW:JRC—1M-1/58; rev. WFW:LSS-M-4/62

The information contained in this bulletin is, to our best 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.



DSW 442008

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DSW 442009

STLCOPCB4056544

# AROCLOR® PLASTICIZERS

*TECHNICAL BULLETIN No. PL-306*

Monsanto

*DECEMBER 1960*

DSW 442010

STLCOPCB4056545

AROCLOR
1242
OCLOR
248
AROCLOR
1254
AROCLOR
1260
AROCLOR
1268
AROCLOR
1262
AROCLOR
4465
DSW 442011

# AROCLOR COMPOUNDS

## ARE . . .

| | |
|---|---|
| Fire-Retardant | Adhesive |
| Inert | Nonvolatile |
| Chemical Resistant | Thermoplastic |
| Heat Stable | Nonoxidizing |
| "Adjustable" Properties | Low Cost |

## FOR . . .

| | |
|---|---|
| Plasticizing | Insulating |
| Impregnating | Coating |
| Bulking | Inert Matrixes |
| Reducing Volatility | Dedusting |
| Tackifying | Film Forming |

The AROCLOR* compounds—produced by Monsanto Chemical Company—are the only low-cost, inert, intercompatible liquids and solids that can be intermixed to provide plasticizing, fire-retardant, insulating, lubricating liquids, with tailored viscosities from the consistency of light mineral oil to that of the most viscous syrup (or solid resin) and with the capacity to perform such a variety of functions in so many industries.

*AROCLOR is registered in the U. S. Patent Office as the trademark for Monsanto Chemical Company's chlorinated aromatic hydrocarbons and their derivatives, including chlorinated biphenyl. Whenever in this bulletin, for the convenience of the reader, AROCLOR is used as a plural noun, the term refers to Monsanto's AROCLOR brand of chlorinated polyphenyl compounds.

The information contained in this bulletin is to our best 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.

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# INTRODUCTION

The unique AROCLOR plasticizers are among the most versatile chemically-produced materials known to industry. One outstanding characteristic—*inertness*—makes AROCLORS useful in many ways for many different applications. The major benefits offered by the AROCLORS include:

- Chemical Resistance
- Fire Retardance
- Compatibility with most resins
- Nonoxidation
- Adhesivity
- Low Cost

In this bulletin are described some of their many important plasticizing and related applications, including numerous suggested starting formulations. Examination of their physical properties, also given in considerable detail, may suggest scores of new uses that could not be performed by any other known material.

Additional information about the AROCLOR compounds is available from your nearest Monsanto district sales office in the following technical bulletins:

The AROCLOR Compounds (general, including mechanical, electrical, heat-transfer, and other non-plasticizer applications)
PL-307 .....Monsanto Plasticizers in Synthetic-Resin Adhesives
PL-311 .....AROCLOR Plasticizers for Chlorinated Rubber
PL-321 .....AROCLOR 1221, 1232, 1242 for Polyvinyl Acetate-Emulsion Adhesives
PL-327 .....Monsanto Plasticizers in Protective Coatings
PL-331 .....Monsanto Modifiers for Polysulfides
CS-14 .....AROCLOR Plasticizers in Epoxy Resins





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## DESCRIPTION

Monsanto's AROCLOR plasticizers comprise a series of chlorinated biphenyls and chlorinated polyphenyls. They vary from mobile, oily liquids to white crystals and hard, transparent resins.

Twelve of the AROCLOR compounds, each of which represents a series, are discussed in this bulletin. An understanding of the system for designation of each AROCLOR should prove useful in the evaluation of the property gradations among them: the last two digits indicate the approximate weight percentage of chlorine in the product, and the first two digits indicate the type of material, as follows:

12 — chlorinated biphenyls
25 — blend of chlorinated biphenyls and chlorinated triphenyls (60:40)
44 — blend of chlorinated biphenyls and chlorinated triphenyls (75:25)
54 — chlorinated triphenyls

For nearly every AROCLOR mentioned, a darker, less-pure grade exists, with about the same physical and chemical characteristics, but with a lower price.

AROCLOR compounds are nonoxidizing, inert, permanently thermoplastic, of low volatility, noncorrosive to metals, and low cost. AROCLOR compounds are not hydrolyzed by water and resist alkalies, acids, and corrosive chemicals. The viscous, more-highly-chlorinated liquids and resins do not support combustion, and they impart fire retardance to other materials.

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

AROCLOR compounds plasticize a great many resins without softening them unduly. The AROCLOR compounds are unsurpassed for the plasticizing of protective coatings, particularly for use in chemical plants and other facilities that require a tough, chemically resistant surface. AROCLOR plasticizers can also be used to flexibilize sealing compounds, adhesives, lacquers, inks, varnishes, free films, fabric coatings, and pigment dispersions. They are also used as components or extenders in elastomers and waxes. The properties of many end products can be improved — yet at reduced overall cost — by the use of an AROCLOR as either a primary or a secondary plasticizer.

The properties imparted by AROCLOR compounds (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 comparison of the properties, by "blending" two or more, and by adjusting the percentages used in the particular mixture in which the AROCLOR compounds are formulated.

Monsanto's Plasticizer Council can provide specific formulation guidance that many help you improve your product or lower your processing cost. Processors are invited to ask the nearest Monsanto office for help on special problems.



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## COMPATIBILITY

The AROCLOR plasticizers are compatible with most common plastics materials; they are compatible to the extent of practical use with the following:

| | |
|---|---|
| Asphalt | Polyethylene |
| Benzyl Cellulose | Polyester Resins |
| Carnauba Wax | Polystyrene Resins |
| Cellulose Acetate-Butyrate | Polyisobutylene |
| Chlorinated Rubber | Polysulfides |
| Coumarone-Indene Resins | Polyurethanes |
| Damar Resin | Polyvinyl Acetate |
| Ester Gum | Polyvinyl Butyral |
| Ethyl Cellulose | Polyvinyl Chloride |
| Epoxy Resins | Polyvinylidene Chloride |
| Nitrocellulose | Rosin |
| Paraffin | Rubber |
| Phenolic Resins | Styrene-Butadiene Copolymers |

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

AROCLOR compounds generally impart progressively increasing properties in the direction of the arrows in the following diagram:

| | Hardness | Flexibility | Flame Retardance | Volatility | Density | Viscosity |
|---|---|---|---|---|---|---|
| Liquid AROCLORS | ↓ | ↑ | ↓ | ↑ | ↓ | ↓ |
| Soft, Resinous AROCLORS | | | | | | |
| Hard, Resinous AROCLORS | | | | | | |

Usually the desired balance between flexibility and hardness can be obtained either by selection of an AROCLOR with the appropriate physical characteristics or by use of a blend of two or more AROCLOR compounds.

In evaluation of formulations that contain AROCLOR plasticizers, the compounder should thoroughly test an experimental product for compatibility, heat and light stability, and other properties, according to normal industry practices.



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## AROCLOR PLASTICIZERS IN SYNTHETIC RESINS

Low-cost AROCLOR plasticizers are valuable for a variety of applications. AROCLOR plasticizers improve chemical resistance, flame retardance, and oxidation resistance. Depending upon the use, the various AROCLOR compounds offer a number of benefits to the user. In almost all formulations, the use of an AROCLOR plasticizer reduces the over-all cost per pound.

### IN POLYVINYL CHLORIDE

The AROCLOR compounds are valuable in polyvinyl chloride and copolymers as secondary plasticizers or as plasticizer extenders. The AROCLOR plasticizers impart flame retardance and chemical resistance.

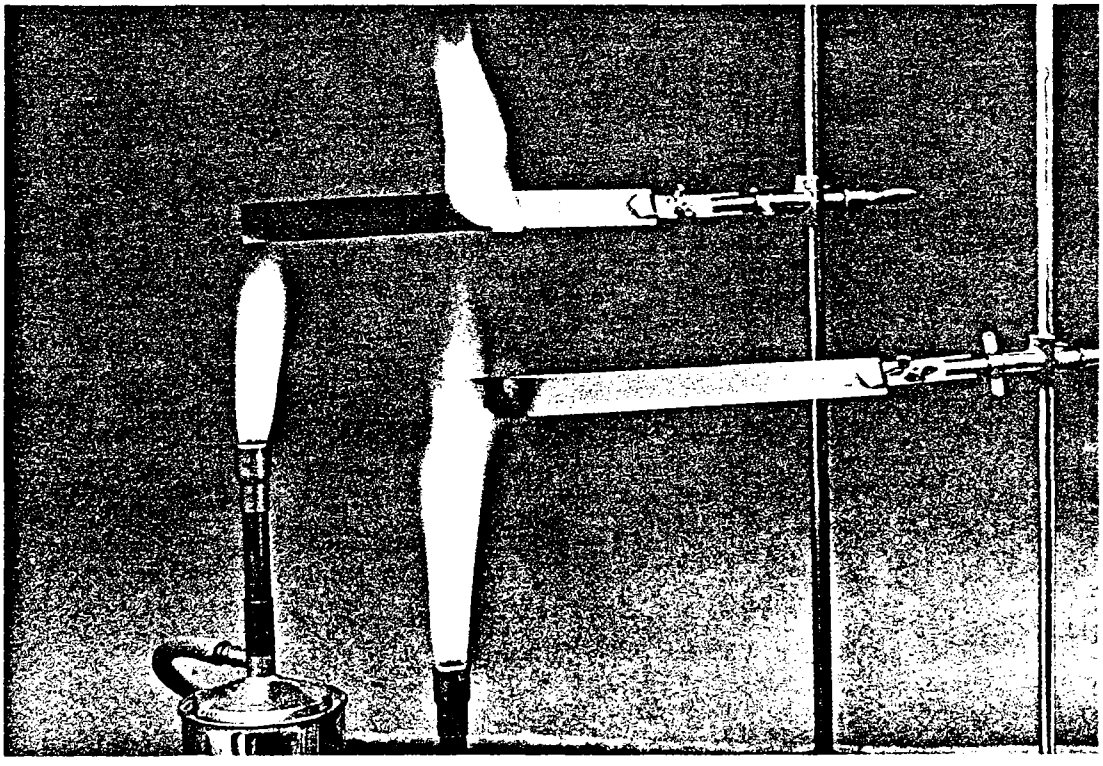
Selection of the proper AROCLOR enables compounders to impart such special properties to their formulations as:

Resistance to migration to nitrocellulose lacquers (AROCLOR 1260 and 1262).

Fine, uniform cell structure in vinyl foam (AROCLOR 1262 and 1268).

Adhesion in vinyl coatings (AROCLOR 1260 and 5460).

Viscosity stability in plastisols (AROCLOR 1248 and 1254).



**The control specimen burns rapidly; the one containing Aroclor does not even ignite.**



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## Compatibility

AROCLOR compounds (except AROCLOR 1268) are compatible to about 25 per cent of the total plasticizer content in polyvinyl chloride and usually somewhat greater in copolymer resins. At these levels, no exudation occurs in the loop-compatibility test, one of the most severe used by the industry.

## Performance

As an illustration of the performance of AROCLOR plasticizers, Table I shows evaluation of the five most commonly used in polyvinyl chloride.

### TABLE I — PERFORMANCE EVALUATION OF FIVE AROCLOR PLASTICIZERS IN POLYVINYL CHLORIDE

| AROCLOR | Concentration[a] (parts) | Hardness (Shore "A") | Volatility[b] (Plasticizer lost, %) | Kerosene[c] Extraction (Plasticizer lost, %) | Low-Temp Flexibility (Clash & Berg) ($T_{f/r}$ °C) | Tensile Strength (psi) | Modulus (psi) | Elongation (%) |
|---|---|---|---|---|---|---|---|---|
| 1248 | 15 | 87 | 19 | 23 | —26 | 2330 | 1320 | 342 |
| 1254 | 15 | 88 | 14 | 24 | —24 | 2310 | 1360 | 334 |
| 1260 | 15 | 89 | 11 | 32 | —22 | 2200 | 1330 | 315 |
| 4465 | 17.5 | 89 | 6 | 19 | —19 | —— | —— | —— |
| 5442 | 17.5 | 87 | 6 | 16 | —20 | —— | —— | —— |

| Ingredients | Parts by Weight |
|---|---|
| *a*) *Opalon** 660 PVC resin | 100 |
| Dioctyl Phthalate | 45 |
| Calcium Carbonate | 40 |
| Stabilizer | 3 |
| AROCLOR | indicated |

*b*) 24 hours at 87°C over activated carbon

*c*) 96 hours at 25°C

## Heat and Light Stability

AROCLOR compounds impart good heat stability but somewhat reduce the light stability of vinyl formulations, but no more so than do many other secondary plasticizers commonly used in the industry. Light stability of the system may be improved by incorporation of a small amount of light-screening agent, such as 0.1 per cent *Tinuvin P*.**

*Opalon: Monsanto Chemical Company trademark. Registered in U. S. Patent Office.
**Trademark of Geigy Chemical Co.

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## Chemical Resistance

For imparting resistivity to chemical attack, the AROCLOR compounds are unsurpassed. Independent evaluations of the chemical resistance of vinyl chloride-vinyl acetate copolymer paint. modified by eight types of materials (alkyd resin, phenolic-chinawood oil varnish, ester gum-linseed oil varnish, AROCLOR 1254, dioctyl phthalate, tricresyl phosphate, polymeric plasticizer, and acrylic polymer), showed that AROCLOR 1254 has the "best all-around chemical resistance, failing badly only in the gasoline test."

Paints were sprayed onto solvent-cleaned, unprimed, cold-rolled-steel panels, which were then immersed in seven types of solutions until failure. The data in Table II, excerpted from the November 1955 issue of *Official Digest* of the Federation of Paint and Varnish Production Clubs, compare the chemical resistance imparted by AROCLOR 1254 and by dioctyl phthalate.

TABLE II — COMPARATIVE CHEMICAL RESISTANCE OF PLASTICIZERS IN VINYL CHLORIDE - VINYL ACETATE COPOLYMER PAINT

| Plasticizers | | Time to Failure in Corrosive Media | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Dioctyl Phthalate (%) | AROCLOR 1254 (%) | 10% Sodium Hydroxide (days) | 10% Hydrochloric Acid (hours) | Gasoline (days) | 5% Sodium Hypochlorite (days) | 10% Acetic Acid (hours) | Linseed Oil Fatty Acids (days) | 1% Tide at 160°F (days) |
| 10 | — | 120[a] | 92 | 0.4 | 4 | 84 | 60 | 21 |
| — | 10 | 120[a] | 168[a] | 5 | 13 | 168[a] | 90[a] | 22 |
| 25 | — | 60 | 24 | 0.4 | 4 | 84 | 27 | 25 |
| — | 25 | 120[a] | 120 | 0.4 | 14.5 | 120 | 90[a] | 22 |
| 40 | — | 60 | 24 | 0.4 | 4 | 48 | 22 | 25 |
| — | 50 | 120[a] | 96 | 0.4 | 11 | 100 | 60 | 22 |

*a*) End of test

In other corrosion-resistance tests of polyvinyl chloride plastisols, containing 70 parts plasticizer per 100 parts resin a formulation that contained 1 part AROCLOR 1254 to 3 parts dioctyl phthalate was much more resistant to 15 per cent nitric acid at either 23° or 50°C for six months than a compound plasticized with dioctyl phthalate alone.

The plastisol modified with both AROCLOR 1254 and dioctyl phthalate was also more resistant to 25 per cent chromic oxide at 50°C for four weeks and was equivalent at 23°C for six months in comparison with the dioctyl phthalate-modified vinyl plastisol.

## Migration Resistance

The use of AROCLOR 1262 as a coplasticizer with dioctyl phthalate greatly enhances the resistance of plasticizer migration to nitrocellulose lacquers and films. Table III compares this property for four formulations.



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## TABLE III — PLASTICIZER MIGRATION TO NITROCELLULOSE LACQUERS AND FILMS

| Plasticizer [a] | AROCLOR and DOP (parts) | Control (DOP) (parts) | AROCLOR, DOP, and Polymeric (parts) | Polymeric and DOP (parts) |
|---|---|---|---|---|
| Dioctyl Phthalate | 66 | 71 | 36 | 38 |
| Polymeric Plasticizer | — | — | 33 | 35 |
| AROCLOR 1262 | 20 | — | 20 | — |
| Hardness, Shore "A" | 72 | 72 | 72 | 73 |
| **Time (weeks)** | | | | |
| Room Temperature | | | | |
| 1 | No Change | No Change | No Change | Slight Marking |
| 2 | No Change | No Change | No Change | Slight Marking |
| 3 | No Change | No Change | Very Slight Marking | Slight Marking |
| 4 | No Change | No Change | Very Slight Marking | Slight Marking |
| 5 | No Change | No Change | Very Slight Marking | Slight Marking |
| 10 | No Change | No Change | Very Slight Marking | Slight Marking |
| 50° C | | | | |
| 1 | No Change | Slight Marking | Moderate Marking | Very Slight Softening |
| 2 | No Change | Slight Marking | Severe Marking | Very Slight Softening |
| 3 | No Change | Slight Marking | Very Slight Softening | Slight Softening |
| 4 | No Change | Moderate Marking | Slight Softening | Slight Softening |
| 5 | No Change | Moderate Marking | Slight Softening | Slight Softening |
| 10 | No Change | Moderate Marking | Slight Softening | Moderate Softening |
| General Motors Lacquer Test (158°F; 72 hr.; ½-psi load) | Indentation, Very Slight Softening | Extreme Softening | Lifting | Extreme Softening |

*a*) Formulation

| Ingredients | Parts by Weight |
|---|---|
| *Opalon* 660 PVC Resin | 100 |
| Epoxy Soybean Oil | 3 |
| Barium-Cadmium Laurate | 3 |
| Calcium Carbonate | 25 |
| Plasticizer | as indicated |



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## Plastisols

The use of an AROCLOR as a coplasticizer with dioctyl phthalate in polyvinyl chloride plastisols or organosols contributes greatly to the viscosity stability of these materials, especially at elevated temperatures. This benefit is especially important whenever shelf stability is required. Although the initial viscosity of the pastisol or organosol is increased by the use of an AROCLOR in the formulation, the viscosity reduction upon temperature elevation (before the fusion temperature is reached) is much greater than when most other plasticizers are used.

A comparison of the viscosity stability of plastisol formulations with and without AROCLOR is given in Table IV.

TABLE IV — VISCOSITY STABILITY OF PLASTISOLS

| | Dioctyl Phthalate (80 PHR) Viscosity [a] (poises) | AROCLOR 1254 (20 PHR) Dioctyl Phthalate (60 PHR) Viscosity [a] (poises) | AROCLOR 5460 (20 PHR) Dioctyl Phthalate (60 PHR) Viscosity [a] (poises) |
|---|---|---|---|
| **25°C** | | | |
| Initial | 36 | 49 | 92 |
| 1 Day | 65 | 63 | 154 |
| 1 Week | 97 | 78 | 161 |
| 2 Weeks | 116 | 75 | 178 |
| 4 Weeks | 132 | 148 | 252 |
| **40°C** | | | |
| Initial | 37 | 48 | 68 |
| 1 Day | 84 | 98 | 136 |
| 1 Week | 215 | 108 | 139 |
| 2 Weeks | 305 | 110 | 164 |
| 4 Weeks | 426 | 209 | 274 |
| **50°C** | | | |
| Initial | 66 | 94 | 100 |
| 1 Day | gel | 660 | 470 |
| 1 Week | | 980 | 900 |
| 2 Weeks | | gel | gel |
| 4 Weeks | | | |

*a*) Brookfield LVF viscometer, No. 4 spindle, 12 rpm



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*Dipping Plastisols.* The chemical resistance of AROCLOR compounds is used to good advantage in chrome-plating-bath coatings and in glove coatings, as illustrated by the following formulation for a clear glove-dipping plastisol:

| Ingredients | Parts by Weight |
|---|---|
| *Opalon* 440 PVC resin | 100 |
| AROCLOR 1254 | 20 |
| Diisodecyl Phthalate | 50 |
| *Santicizer** 160 | 25 |
| *HB-40** Secondary Plasticizer | 20 |
| Liquid Barium-Cadmium Stabilizer | 2 |
| Liquid Chelator-Stabilizer | 0.5 |
| *Santocel** 54 Silica Aerogel | 3 |

*Sealers.* The adhesion-imparting characteristics of AROCLOR compounds, their oxidation stability, and their chemical resistance are utilized in the manufacture of automotive sealers, such as the following suggested starting formulations:

| Ingredients | Parts by Weight |
|---|---|
| *Opalon* 440 PVC resin | 96 |
| *Vinylite*** VMCH resin | 4 |
| AROCLOR 1260 | 50 |
| Diisodecyl Phthalate | 100 |
| *Santicizer* 160 | 28 |
| Calcium Carbonate | 125 |
| Epoxy Soybean Oil | 5 |
| Dibasic Lead Phosphite | 3 |

*Fabric-Coating Vinyl Dispersions.* The use of AROCLOR plasticizers in organosol or plastisol formulations enables the manufacture of fire-retardant free films and coated fabrics with a high degree of hardness, yet flexibility. The following typical starting formulation for a vinyl organosol to be used for free film or coated fabric illustrates this effect:

| Ingredients | Parts by Weight |
|---|---|
| *Opalon* 440 PVC resin | 100 |
| Dioctyl Phthalate | 33 |
| AROCLOR 1254 | 10 |
| Liquid Barium-Cadmium Stabilizer | 2.5 |
| Epoxy Soybean Oil | 3 |
| Thinner | 20-35 |
| Xylene | 15-25 |

*HB 40, Santicizer, and Santocel: Monsanto Chemical Company Trademarks. Registered in U. S. Patent Office.
**Trademark of Union Carbide Plastics Co.



DSW 442023

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*Rigid Plastisols.* The viscosity characteristics of the AROCLOR plasticizers are utilized in the following formulation for rigid, rotationally-cast objects. The formulation is very viscous when first made up, but when heat is applied, the viscosity decreases so that a smoothly-flowing plastisol is obtained. The finished object has a Shore "D" hardness of 63.

| Ingredients | Parts by Weight |
|---|---|
| *Opalon* 440 PVC resin | 55 |
| *Geon** 202 PVC resin | 45 |
| AROCLOR 1254 | 35 |
| *Santicizer* 141 | 10 |
| Epoxy Octyl Tallate | 5 |
| Liquid Barium-Cadmium Stabilizer | 2 |
| Liquid Zinc Stabilizer | 0.5 |
| Polyethylene Glycol 400 Monolaurate | 1 |

## Vinyl Foam

AROCLOR 1262 and 1268 impart fine, uniform cell structure and flame resistance to chemically-blown vinyl foam, as exemplified by the following formulations:

| Ingredients | Parts by Weight | | |
|---|---|---|---|
| *Opalon* 440 PVC resin | 100 | 100 | 100 |
| AROCLOR 1262 | — | 20 | — |
| AROCLOR 1268 | 20 | — | 10 |
| Dioctyl Phthalate | 40 | — | — |
| Diisodecyl Phthalate | — | 50 | 30 |
| Di-(*n*-Octyl, *n*-Decyl) Adipate | — | 10 | 30 |
| *Santicizer* 214 | — | 15 | — |
| *Santicizer* 409 | 50 | — | — |
| Butyl Oleate | 5 | — | — |
| Liquid Barium-Cadmium Stabilizer | 2 | 3 | 3 |
| Epoxy Resin | — | 2 | 2 |
| Neutral Calcium Petronate | 3.6 | 3.6 | 3.6 |
| Calcium Oxide | — | 1 | 1 |
| Sodium Lauryl Sulfate | — | 1.6 | 1.6 |
| *Nitrosan*** Chemical blowing agent | 10 | 10 | 5 |

## Flame-Retardant Floor Tile

The nonflammability of the AROCLOR compounds suggests their use in the manufacture of flame-retardant vinyl-asbestos floor tile for military applications. In Table V is presented an evaluation of three AROCLOR plasticizers in typical vinyl-asbestos-tile formulations. Substitution of antimony oxide for part of the limestone is suggested for still greater fire retardance.

*Trademark of B. F. Goodrich Chemical Co.
**Trademark of E. I. du Pont de Nemours & Co., Inc.



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TABLE V — EVALUATION OF AROCLOR IN FLAME-RETARDANT, VINYL-ASBESTOS FLOOR TILE

| | Control[a] (parts) | AROCLOR 1254 (parts) | AROCLOR 1260 (parts) | AROCLOR 5460 (parts) |
|---|---|---|---|---|
| *Santicizer* 160 | 37 | 30 | 36 | 40 |
| AROCLOR 1254 | — | 15 | — | — |
| AROCLOR 1260 | — | — | 17 | — |
| AROCLOR 5460 | — | — | — | 20 |
| McBurney Indentation Hardness | 7.8 | 9.6 | 10.4 | 11.2 |
| Banbury Time (to reach 280°F, sec.) | 99 | 96 | 102 | 115 |
| Time to band on roll mill (sec.) | 15 | 10 | 10 | 5 |
| Plasticity | Excellent | Excellent | Excellent | Excellent |
| Tack | Excellent | Excellent | Excellent | Excellent |
| Surface | Excellent | Fair | Excellent | Excellent |

*a*) Formulation

| Ingredients | Parts by Weight |
|---|---|
| *Opalon* 506 PVC Resin | 100 |
| *Santicizer* 160 | As Indicated |
| AROCLOR | As Indicated |
| Asbestos | 160 |
| Limestone | 290 |
| Titanium Dioxide | 15 |
| Stabilizer | 5 |

## IN POLYVINYL ACETATE

AROCLOR compounds are excellent plasticizers for polyvinyl acetate-emulsion adhesives and hot-melt adhesives. The excellent tack and strong bonding power they impart and their low cost contribute greatly to the profitability of these adhesives.

### Emulsion Adhesives

The liquid AROCLORS — such as AROCLOR 1221, 1232, and 1242 — blend readily by simple stirring with polyvinyl acetate emulsion at up to 11 parts per 100 parts of emulsion. They greatly improve the quick-tack and fiber-tear properties of the adhesive. The performance of AROCLOR plasticizers in polyvinyl acetate-emulsion adhesives is compared with that imparted by dibutyl



DSW 442025

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phthalate in Table VI. The following is suggested as a typical starting formulation for a low-cost, quick-tack adhesive:

| Ingredients | Parts by Weight |
|---|---|
| *Gelva** S-55 PVAc Emulsion | 100 |
| AROCLOR 1232 | 11 |

TABLE VI — PERFORMANCE OF PLASTICIZERS IN POLYVINYL ACETATE-EMULSION ADHESIVES

| | Dibutyl Phthalate (11 PHR) | AROCLOR 1221 (11 PHR) | AROCLOR 1232 (11 PHR) | AROCLOR 1242 (11 PHR) |
|---|---|---|---|---|
| **Hardness** (Shore "A") | 69 | 66 | 86 | 97 |
| **Low-Temperature Flexibility** (Clash & Berg, $T_f$, °C) | —10.2 | —5.9 | 4.0 | 5.3 |
| **Volatility** (24 hr., 86°C over activated charcoal) (Plasticizer lost, %) | 4.0 | 4.8 | 4.3 | 4.0 |
| **Kerosene Extraction** (24 hr., 25°C) (Plasticizer lost, %) | 4.1 | 4.5 | 3.8 | 4.2 |
| **Formulation Viscosity** (cp.) | | | | |
| Initial [a] | 2420 | 2240 | 2160 | —— |
| 1 Day | 2460 | —— | —— | —— |
| 3 Days | —— | 2200 | 2060 | —— |
| 4 Days | 2520 | —— | —— | —— |
| 5 Days | —— | 2200 | 2040 | —— |
| 7 Days | —— | 2180 | 2020 | —— |
| 10 Days | —— | 2260 | 2060 | —— |

*a*) Initial viscosity of unplasticized emulsion: 1500 centipoises

When the slight odor of AROCLOR is objectionable in an adhesive for certain applications, it can be easily masked, at negligible cost, by the addition of six grams of either *Odormasque*** 1004 (camphor) or *Odormasque* 1066 (fruit) per drum of adhesive.

*Gelva: Shawinigan Resins Corp. Trademark. Registered in U. S. Patent Office.
**Trademark of Polak & Schwarz, Inc.



DSW 442026

STLCOPCB4056561

### Hot-Melt Adhesives

AROCLOR compounds are widely used as plasticizers in polyvinyl acetate hot-melt adhesives for bookbinding and other applications. Four suggested started formulations for evaluation are as follows:

| Ingredient | Parts by Weight | | | |
|---|---|---|---|---|
| | Application Temperature 165° - 175°C | | Low-Melting | Alkali-Dispersable |
| Polyvinyl Acetate | 95 [a] | 100 [a] | 50 [b] | 38 [c] |
| *Opalon* 505 PVC resin | 5 | — | — | — |
| Modified Rosin | — | — | 25 | — |
| Coumarone-Indene Resin (soft) | — | — | — | 28.3 |
| AROCLOR 1254 | — | 55 | 12 | 27 |
| AROCLOR 1260 | 50-75 | — | — | — |
| Dibutyl Phthalate | — | — | 13 | 7 |
| *Santicizer* 160 (or dibutyl phthalate) | 50-75 | 30 | — | — |
| Clay | — | 25 | — | — |
| Fluxing Resin (*Filtros** Resin WW) | — | 75 | — | — |
| *Acrawax* C** | — | — | — | 1 |
| Sodium Benzoate | — | — | — | 0.76 |
| Viscosity (centipoises) | | | 2000 (120°C) Non-blocking | 3500 (175°C) Non-blocking |

*a*) *Gelva* V-7 (Shawinigan Resins Corp.)

*b*) *Gelva* C-3 V-10 (Shawinigan Resins Corp.)

*c*) *Gelva* C-5 V-16 (Shawinigan Resins Corp.)

## IN EPOXY RESINS

The AROCLOR compounds probably have greater compatibility with epoxy resins than any other available, nonreactive, plasticizer-modifiers. The excellent chemical resistance, oxidation resistance, and adhesive qualities imparted by the AROCLOR compounds reinforce these important beneficial properties of epoxies and thereby help the compounder reduce his formulation costs materially without significant adverse affect on performance.

The lower-molecular-weight, liquid AROCLOR compounds (such as 1221 and 1232) have maximum plasticizing efficiency and impart the most flexibilizing to epoxy compounds. The more viscous, resinous AROCLOR compounds have progressively less effect on epoxy flexibility: the high-molecular-weight, solid AROCLOR compounds (1268, 2565, 4465, 5460, etc.), in fact, tend to reinforce the compound.

The effects of AROCLOR 1221 and 1248 on the properties and performance of an epoxy resin are indicated by the data in Table VII.

*Filtros: Filtered Rosin Products Co. Trademark. Registered in U. S. Patent Office.
**Trademark of Glyco Chemicals.



DSW 442027

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TABLE VII — EFFECT OF AROCLOR 1221 AND 1248 ON PROPERTIES OF EPOXY RESINS

| Formulation [a] | | Viscosity [b] | | Physical Properties | | | Physical Property [c] After Heat Aging | |
|---|---|---|---|---|---|---|---|---|
| AROCLOR 1221 | AROCLOR 1248 | Before Curing Agent | After Curing Agent | Izod Impact Resistance | Clarity (Light Reflected) (%) | Hardness Shore "D" (10 sec.) | Hardness Shore "D" (10 sec.) | Weight Loss (%) |
| — | — | 12,800 (30 rpm) | 7900 | 0.2 | 3.0 | 76 | 86 | 0.012 |
| 25 | — | 1650 | 1200 | — | 3.0 | 8 | 81 | 2.118 |
| — | 25 | 7700 | 4300 | 0.6 | 3.0 | 40 | 88 | 0.682 |

| Ingredients | Parts by Weight |
|---|---|
| *a*) Liquid Epoxy Resin | 100 |
| -Tetraethylenepentamine | 8 |
| AROCLOR 1221 or 1248 | As Indicated |
| Cure: 30 minutes at 100°C | |

*b*) Brookfield LVF #4 spindle; 60 rpm unless otherwise specified

*c*) 24 hours at 86°C in activated charcoal

Development of flame-retardant epoxy resins is of wide-spread interest. Aliphatic amine-cured epoxy-resin formulations are made *self extinguishing* by the use of 20 parts of liquid AROCLOR per hundred parts of resin. The incorporation of antimony oxide at 5 PHR, with 15 parts of AROCLOR per hundred parts of resin, yields *nonburning* formulations (TABLE VIII).

The use of liquid AROCLORS in aliphatic amine-cured epoxies also improves flexural strength and compressive-yield strength, has little effect on tensile strength, and slightly lowers heat-distortion temperature and compressive ultimate strength.

The use of solid AROCLOR compounds in phthalic anhydride-cured epoxy systems also reduces flammability and, in combination with antimony oxide, produces nonburning formulations. The solid AROCLOR compounds also greatly improve such important properties as compressive strength, flexural strength, compressive-yield strength, and tensile strength, although they slightly lower the heat-distortion temperature (TABLE IX).

Extension of epoxy-resin adhesives with AROCLOR compounds greatly reduces the formulation cost, with minimum effect on the bonding characteristic of the adhesive or surface coating.



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## TABLE VIII — EFFECT OF AROCLOR 1242 AND 1260 ON FLAMMABILITY AND PHYSICAL PROPERTIES OF EPOXY RESINS

| Formulation [a] | | | Hardness | Flammability (ASTM 635-56T) | | Heat-Distortion | Flexural | Tensile | Compressive Yield | Compressive |
|---|---|---|---|---|---|---|---|---|---|---|
| AROCLOR 1242 (PHR) | AROCLOR 1260 (PHR) | Antimony Oxide (PHR) | (Rockwell "M") | inches burned | Rate (in/min.) | Temp. (°C) | Strength (psi) | Strength (psi) | Strength (psi) | Strength (psi) |
| — | — | — | 104 | 4 | 0.82 | 117.5 | 20,100 | 11,400 | 15,700 | 43,000 |
| 20 | — | — | 108 | 2.125 | *b* | 79.5 | 21,800 | 10,700 | 17,900 | 32,500 |
| — | 20 | — | 103 | 1.125 | *b* | 87 | 23,800 | 13,000 | 17,250 | 32,900 |
| 15 | — | 5 | 107 | 0 | *c* | 81 | 22,200 | 12,800 | 16,700 | 32,400 |
| — | 15 | 5 | 106 | 0 | *c* | 92 | 22,100 | 9,800 | 16,950 | 38,150 |

| Ingredients | Parts by Weight |
|---|---|
| *a*) Liquid Epoxy Resin | 100 |
| Diethylenetriamine | 13 |
| AROCLOR 1242 or 1260 | as indicated |
| Antimony oxide | as indicated |

cure: 16 hours at room temperature, plus 2 hours at 100°C

*b*) Self extinguishing

*c*) Nonburning

## TABLE IX — EFFECT OF SOLID AROCLORS ON FLAMMABILITY AND PHYSICAL PROPERTIES OF EPOXY RESINS

| Formulation [a] | | | Hardness | Flammability | Heat-Distortion | Flexural | Tensile | Compressive Yield | Compressive |
|---|---|---|---|---|---|---|---|---|---|
| AROCLOR 1268 (PHR) | AROCLOR 5460 (PHR) | Antimony Oxide (PHR) | (Rockwell "M") | (in./min.) | Temp. (°C) | Strength (psi) | Strength (psi) | Strength (psi) | Strength (psi) |
| — | — | — | 113 | 0.6 | 143 | 16,900 | 11,000 | 20,900 | 23,400 |
| 20 | — | — | 112 | 0.38 | 128 | 25,900 | 13,500 | 22,300 | 36,500 |
| — | 20 | — | 113 | 0.38 | 135.5 | 26,300 | 11,500 | 21.000 | 41,700 |
| 15 | — | 5 | 112 | *b* | 134 | 20,000 | 11,100 | 20,500 | 36,700 |
| — | 15 | 5 | 111 | *b* | 135 | 19,000 | 10,200 | 21,200 | 40,700 |

| Ingredients | Parts by Weight |
|---|---|
| *a*) Liquid Epoxy Resin | 100 |
| Phthalic Anhydride | 75 |
| *DMP-30** catalyst | 0.1 |
| AROCLOR 1268 or 5460 | as indicated |
| Antimony Oxide | as indicated |

Cure: 20 hours at 150°C

*b*) Nonburning

*Trademark of Rohm & Haas Co.

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In epoxy-resin protective surface coatings, the use of AROCLOR 1254, 1260, or 1262 economically imparts excellent chemical resistance, particularly to acids and alkalies. When resistance to solvents is desired, however, AROCLORS should not be used, since they are true plasticizers and do not combine chemically with the epoxy resin. Frequently, about 10 to 15 per cent AROCLOR 1260 or 1262 is added to increase the flexibility of the epoxy composition, with minimum effect on the corrosion resistance and adhesion of the film.

## IN POLYESTER RESINS

The highly chlorinated, less-volatile AROCLOR compounds such as AROCLOR 1260, 4465, and 5460, are very effective and economical fire retardants for polyester resins, and they do not significantly affect the physical properties of the resin.

The AROCLOR compounds are effectively used in combination with equal amounts of antimony oxide, since the two materials are synergistic: AROCLOR imparts self-extinguishing properties to the resin, and antimony oxide reduces afterglow.

Table X indicates the degree of flame resistance imparted to a general-purpose polyester resin (with a 35-per cent styrene content) by various equal concentrations of antimony oxide and one of these three AROCLOR compounds.

### TABLE X—FIRE RETARDANCE IMPARTED TO POLYESTER RESINS BY AROCLORS AND ANTIMONY OXIDE

| Antimony[a] Oxide and AROCLOR | 2.5% | 5% | 7.5% | 10% | 15% |
|---|---|---|---|---|---|
| 1260 | — | semiflammable | semiflammable | self-extinguishing *30 seconds* | self-extinguishing *immediate* |
| 4465 | — | flammable | self-extinguishing *5 seconds* | self-extinguishing *5 seconds* | self-extinguishing *immediate* |
| 5460 | flammable | self-extinguishing *60 seconds* | — | self-extinguishing *5 seconds* | self-extinguishing *immediate* |

*a*) Formulation

| Ingredients | Weight Per Cent |
|---|---|
| Polyester Resin (general purpose) | 62 |
| Styrene | 35 |
| Methyl Ethyl Ketone Peroxide (60% in dibutyl phthalate) | 2 |
| Cobalt Naphthenate (1% solution) | 1 |
| AROCLOR and Antimony Oxide | as indicated |



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Inclusion of an AROCLOR increases the flexural strength of the naturally brittle polyester and makes addition of a more-expensive plasticizing polyester unnecessary. At a concentration of 10 per cent (enough for fire retardency), none of the AROCLOR compounds reduced the flexural strength of the cure resin significantly (Table XI), and their effect was comparable to that of a plasticizing polyester. At 20-per cent addition, they improved the impact strength, whereas the plasticizing polyester reduced it. The solid AROCLOR compounds are preferred for fire-resistant surface coatings.

TABLE XI—EFFECT OF AROCLORS ON STRENGTH OF FIBER-GLASS-REINFORCED POLYESTER RESINS

| Plasticizer | (%) | Flexural Strength (psi) | Flexural Modulus (psi) | Impact Strength (ft.-lb./in.) |
|---|---|---|---|---|
| None | 0 | 47,210 | 2,190,000 | 1.73 |
| Plasticizing Polyester | 10 | 43,310 | 2,000,000 | 1.64 |
| | 20 | 39,930 | 1,560,000 | 1.24 |
| AROCLOR 1260 | 10 | 45,600 | 2,090,000 | 1.33 |
| | 20 | 33,880 | 1,690,000 | 2.04 |
| AROCLOR 4465 | 10 | 40,740 | 2,190,000 | 1.41 |
| | 20 | 33,390 | 1,290,000 | 2.48 |
| AROCLOR 5460 | 10 | 37,400 | 1,700,000 | 1.85 |
| | 20 | 35,890 | 1,550,000 | 3.06 |

## IN POLYETHYLENE

The need to make polyethylene and other polyolefins flame retardant is well recognized. The well-known flame retardancy of the AROCLOR compounds suggests their evaluation for polyolefin applications such as molded products, coatings, and hot-melt adhesives.

Preliminary evaluation of AROCLOR 5460 (20 per cent) and antimony oxide (10 per cent) showed good results in imparting flame retardancy to low-density, noncrystalline polyethylene. Compared to the use of chlorinated aliphatic hydrocarbons, the use of AROCLOR greatly improved the heat stability and had considerably less effect on tensile strength, yield, and elongation of the formulation.

DSW 442031



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## IN POLYSTYRENE

The AROCLOR compounds are good plasticizers for polystyrene. The lower - molecular - weight AROCLOR compounds have greater solvating power than the higher-molecular-weight AROCLOR compounds. The gelling rate of various plasticizers in polystyrene resin is shown in Table XII; each plasticizer was added to the polystyrene resin at a concentration of 2 parts plasticizer per part of resin, and the time required for the material to gel was noted.

TABLE XII — GELLING RATE OF PLASTICIZERS IN POLYSTYRENE

| Plasticizer (200 PHR) | Time to Gel (min.) |
|---|---|
| AROCLOR 1221 | immediate |
| Diethyl Phthalate | 0.6 |
| Dimethyl Phthalate | 0.75 |
| *HB-20** | 1 |
| AROCLOR 1242 | 2 |
| *Santicizer* 141 | 3 |
| *Santicizer* 160 | 6 |
| *Santicizer* B-16 | 18 |
| *HB-40* | 30 |

## IN POLYURETHANES

AROCLOR compounds are useful as plasticizers and flame retardants in polyurethane rubbers, foams, adhesives, and coatings. The following formulation illustrates the use of AROCLOR 1254 in a polyurethane flocking adhesive:

| | Ingredients | Parts by Weight |
|---|---|---|
| Part A | *Multranil*** FLD Urethane Resin | 100 |
| | *Mondur*** C Isocyanate | 5 |
| | AROCLOR 1254 | 20 |
| 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.

*HB-20: Monsanto Chemical Company Trademark. Registered in U. S. Patent Office.
***Multranil* and *Mondur*: Mobay Chemical Company trademarks. Registered in U. S. Patent Office.



DSW 442032

STLCOPCB4056567

Protective urethane coatings are unusually well suited for application to concrete and metal. AROCLOR 1254 is incorporated to improve adhesion and sealing. The first of the following formulations is the preferred prime coat for concrete storage tanks for gasoline and fuel oils. The second formulation is the base coat for a concrete wood-kiln coating, which remained in perfect condition after two-and-one-half-years' continuous exposure to heat, moisture, and wood distillates. The other two formulations, for primer and intermediate light-metal coating, contain AROCLOR 1254 for better adhesion to metal.

| Ingredients | Unsealed-Concrete Prime Coat (parts) | High-Temperature Concrete Primer (parts) | Light-Metal Coating Primer (parts) | Light-Metal Coating Intermediate (parts) |
|---|---|---|---|---|
| *Mondur* C | 19.0 | 12.0 | 21.0 | 25.1 |
| *Multron** R-4 Polyester Resin | — | — | 2.6 | 7.2 |
| *Multron* R-10 | 10.0 | 12.0 | 10.5 | 7.2 |
| AROCLOR 1254 | 5.0 | 2.9 | 2.7 | 1.8 |
| Polyvinyl Acetate | 0.2 | — | 0.3 | 0.3 |
| Polyvinyl Butyral | — | 0.4 | — | — |
| Methyl Glycol Acetate | 8.7 | 9.0 | — | — |
| Butyl Acetate | 8.7 | 5.4 | 8.0 | 7.5 |
| Ethyl Acetate | 8.7 | 4.0 | 8.0 | 7.5 |
| Toluene | 8.7 | 6.9 | 15.1 | 14.2 |
| Pigment (colored) | 12.5 | — | 6.7 | 21.0 |
| Zinc Chromate | — | — | 7.9 | — |
| Titanium Dioxide (rutile) | — | 15.0 | — | — |
| Talc (micronized) | 12.5 | 13.9 | 13.2 | 5.5 |

## IN PHENOLIC RESINS

Considerable interest has been shown in the use of AROCLOR compounds to make phenolic laminating resins flame retardant. The higher-molecular-weight AROCLOR compounds (1262 and 5460) are usually evaluated for this purpose.

AROCLOR 1268 and 2565 are useful in the manufacture of brake linings.

**Multron*: Trademark of Mobay Chemical Company. Registered in U. S. Patent Office.



DSW 442033

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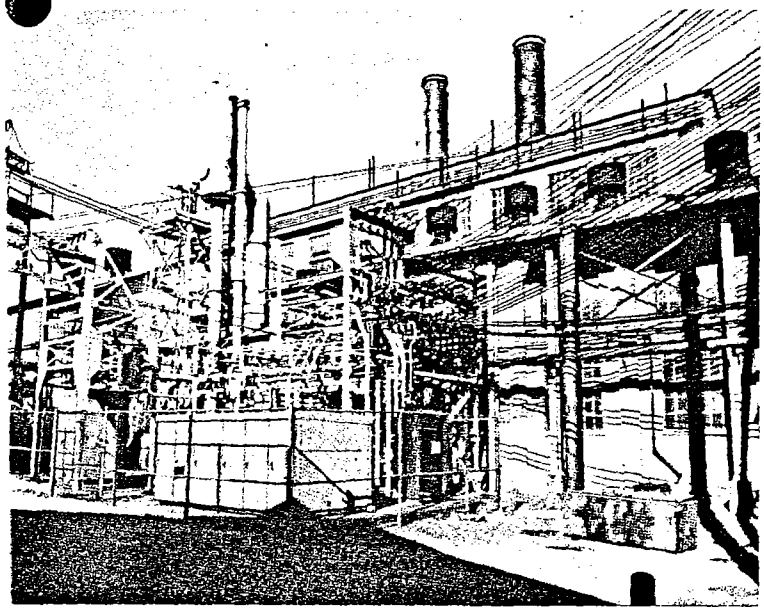
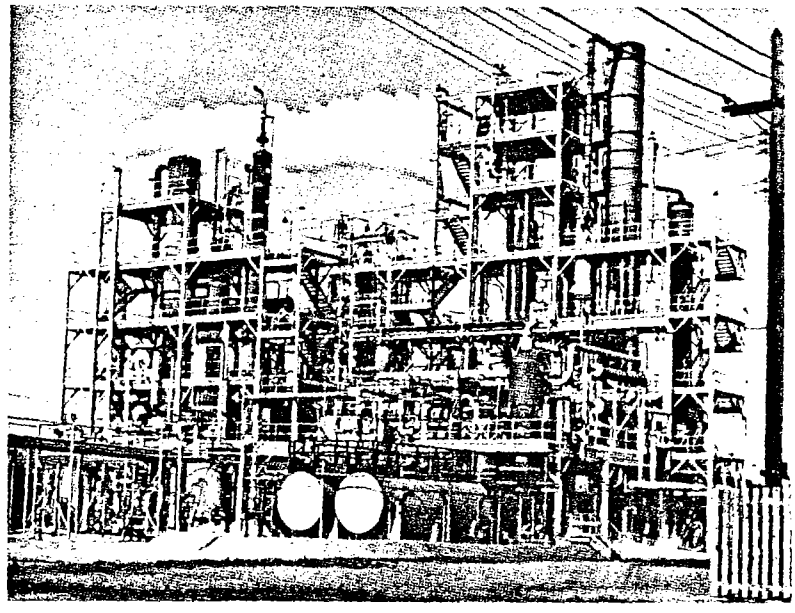


This power-distribution station, last painted three years before with chlorinated-rubber primer and topcoat, plasticized with AROCLOR, is exposed to outdoor weathering, nitric acid fumes, and high humidity from nearby water-cooling towers.



For seven years the chlorinated-rubber primer and topcoat (plasticized with AROCLOR) of this acetic anhydride plant have resisted outdoor weathering, acetic acid and acetic anhydride fumes, steam, and condensed-acid vapors.

## AROCLORS IN RUBBERS

### IN CHLORINATED RUBBER AND CHLORINATED POLYPROPYLENE

Protective coatings based on chlorinated rubber generally contain AROCLOR compounds to enhance their chemical resistance (to water, alkali, and acid), corrosion resistance, and electrical insulating properties and to impart flame retardance. When properly pigmented, they are unusually weather resistant. AROCLOR compounds strengthen the adhesive grip of chlorinated-rubber lacquers, varnishes, and paints to structural materials and improve the flexibility and life of the coating.

Typical applications include protective and decorative coatings for swimming pools, stucco homes, steel structures, tank cars, and both wood and metal maritime equipment. Their outstanding chemical resistance qualifies these coatings for use in manufacturing plants where chemical attack is prevalent. AROCLOR 1254 and 1260 are used in chlorinated-rubber coatings as flexibilizing plasticizers, commonly in combination with AROCLOR 5460, which serves as a resin fortifier. A variety of suggested starting formulations based on chlorinated rubber is given in the following table.



DSW 442034

STLCOPCB4056569

| Ingredients | Paints for Alkaline Surfaces<br>Fed. Spec. TT-P-91 (parts) | Concrete Swimming Pool (parts) | Maximum Acid and Alkali Resistance (parts) | White Marine Paint (parts) |
|---|---|---|---|---|
| *Parlon** (20 cp.) Chlorinated Rubber | 18 | 10.2 | 18 | 20 |
| AROCLOR 1254 | 10 | 5.1 | 8 | 6 |
| AROCLOR 1260 | — | — | 6 | — |
| AROCLOR 5460 | 6 | — | — | — |
| Long-oil, oxidizing, alkyd resin | — | — | — | 6 |
| Medium-oil, drying, alkyd resin | — | 5.1 | — | — |
| Carbon Black | 0.5 | — | — | — |
| Iron Oxide | — | — | 18 | — |
| Titanium Dioxide | 16 | 11.4 | — | 25 |
| Zinc Oxide | 2 | — | — | — |
| *Asbestine*** 3X (magnesium.silicate) | — | 11.7 | — | — |
| *Bentone**** 34 gelling agent | — | 1.3 | — | — |
| Epichlorohydrin | — | 0.1 | 0.09 | — |
| Stabilizer | — | — | 0.9 | — |
| *Solvesso***** 150 | 42.75 | — | — | — |
| *Solvesso* 100 | — | 9.1 | 45 | — |
| Turpentine | 4.75 | — | 5 | — |
| Xylene | — | 45.7 | — | 23 |
| Hi-Flash Naphtha | — | — | — | 20 |

AROCLOR compounds are also incorporated in chlorinated-rubber formulations used for heat-sealing adhesives, electrical coatings, paper and textile coatings, and printing inks. The following starting formulation is for an acid- and flame-resistant adhesive:

| Ingredients | Parts by Weight |
|---|---|
| Chlorinated Rubber (125-cp. type) | 20 |
| AROCLOR 1254 | 6 |
| AROCLOR 5460 | 6 |
| Toluene | 68 |

Chlorinated polypropylene, a new film-forming resin, produces clear, colorless films, appears equal to chlorinated natural rubber in chemical resistance, and is noticeably more heat and

*Trademark of Hercules Powder Company
**Trademark of International Talc Co.
***Trademark of National Lead Company
****Trademark of Standard Oil Company (N. J.)



DSW 442035

STLCOPCB4056570

light stable. AROCLORS are very compatible with the resin and are recommended in the following starting formulations:

| Ingredients | Composition (wt. %) | |
|---|---|---|
| Chlorinated Polypropylene | 50.0 [a] | 55.0 [b] |
| AROCLOR 5460 | 15.0 | 15.0 |
| AROCLOR 1254 | 24.0 | 24.0 |
| Dioctyl Sebacate | 4.3 | 4.3 |
| Epoxy stabilizer | 1.7 | 1.7 |
| Solids, wt. per cent in toluene | 50.0 | 50.0 |
| | **Film Properties** | |
| **300°F heat stability** | | |
| 1 hour | v. sl. yellow | v. sl. yellow |
| 2 hours | v. sl. yellow | sl. yellow |
| 3 hours | sl. yellow | mod. yellow |
| 5 hours | mod. yellow | —— |
| 18 hours | black | —— |
| **Fade-Ometer* stability** | | |
| 24 hours | sl. yellow | v. sl. yellow |
| 48 hours | sl. yellow | sl. yellow |
| 96 hours | mod. yellow | sl. yellow |
| 144 hours | mod. yellow | brown |
| **Two-week chemical resistance** | | |
| water | excellent | excellent |
| 10% hydrochloric acid | excellent | excellent |
| 1% sodium hydroxide | excellent | excellent |

*a*) *Parlon* P (10-cp, 20% in toluene) — Hercules Powder Co.
*b*) *Parlon* P (20-cp, 20% in toluene) — Hercules Powder Co.
*c*) Lacquers were sprayed on "bonderized" steel panels. Films were 2.5- to 3.0-mils thick after 72-hours' air drying.

## IN STYRENE-BUTADIENE COPOLYMERS

AROCLOR compounds are very often incorporated in coatings based on styrene-butadiene copolymers to impart resistance to acids, alkalies, moisture, and corrosive chemicals. These coatings are suited for use on masonry, wood, and metal for such applications as concrete floors; architectural finishes; metal primers and finishes on maritime equipment, structures, and tank cars; baking primers; corrosion-resistant industrial films; and oil- and grease-resistant coatings.

*Trademark of Atlas Electric Devices Co.



DSW 442036

STLCOPCB4056571

The following suggested formulations for typical applications of styrene - butadiene - copolymer coatings offer excellent performance:

| Ingredient | Clear Vehicle (wt. %) | Wall Sealer (lb./100 gal.) | Aluminum Enamel (wt. %) | Paint (lb.) | Traffic Paint (parts) |
|---|---|---|---|---|---|
| Styrene-Butadiene | 16.60 [a] | 123.2 [b] | 7.40 [c] | 147 [d] | 250 [e] |
| AROCLOR 1254 | 8.39 | 41.4 | 6.00 | — | 120 [f] |
| AROCLOR 1260 | — | — | — | 31 | — |
| AROCLOR 5460 | 9.11 | 41.4 | 13.40 | — | 130 |
| Raw Tung Oil | 1.655 | — | — | — | — |
| Hydrogenated Methyl Abietate | — | — | — | 8 | — |
| *Troykyd** ABC | — | — | — | 3 | — |
| Lecithin | 0.545 | — | — | — | — |
| Soya Lechithin | — | 5.9 | — | — | — |
| Petroleum Naphtha | 62.70 | 246.4 | — | — | — |
| Hi-Flash Naphtha | — | — | — | 395 | — |
| Mineral Spirits #10 | — | 185.3 | 33.60 | — | 340 |
| Toluene | — | — | — | — | 340 |
| Xylene | — | — | 22.40 | — | — |
| Lithopone | — | 339.3 | — | — | — |
| Titanium Dioxide | — | 59.2 | — | 179 | — |
| Aluminum Stearate | — | 5.9 | — | — | — |
| Aluminum Paste | — | — | 8.55 | — | — |
| Zinc Oxide | — | — | — | 60 | — |
| Barium Sulfate | — | — | — | 90 | — |
| *Asbestine* 3X (magnesium silicate) | — | 75.0 | — | — | — |
| Calcium Carbonate, ground | — | — | — | 236 | — |
| Diatomaceous Earth | — | — | — | 76 | — |
| Mica | — | — | 8.00 | 30 | — |

*a*) *Marbon* "9200" MV (Marbon Chemical Div., Borg-Warner Corp.)

*b*) *Pliolite* S-5A (Goodyear Tire and Rubber Company)

*c*) *Marbon* "9200" LV (Marbon Chemical Div., Borg-Warner Corp.)

*d*) Flaked *Piccoflex* 120 (Pennsylvania Industrial Chemical Corp.)

*e*) *Pliolite* S-5B (Goodyear Tire and Rubber Company)

*f*) or AROCLOR 1248

## IN SYNTHETIC AND NATURAL RUBBERS

The liquid AROCLOR compounds — 1221, 1232, 1242, and 1248— have a strong plasticizing action on both natural and synthetic rubbers. Solid AROCLORS — 1254 and 1260 — impart permanent tackiness and adhesion to the rubber composition.

*Trademark of Troy Chemical Co.



DSW 442037

STLCOPCB4056572

## Neoprene

Compositions containing up to 40 parts of AROCLOR 5460, 2565, 4465, or 1268 in 100 parts of neoprene rubber are extremely fire retardant. About 1.5 parts of AROCLOR 1268 per hundred parts of neoprene imparts excellent working qualities at 225° to 325° F for injection moldings. Neoprene modified with AROCLOR compounds has proved extremely useful as a wire and cable coating.

AROCLOR 5460 imparts plasticization and adhesion to decorative and protective coatings that have been commercially used on rubber products for many years. Suggested starting formulations for a clear, dull coating and for three pigmented coatings are as follows:

| | Parts by Weight | |
|---|---|---|
| Ingredients | clear, dull coating | base for pigmented coatings |
| AROCLOR 5460 | 3.70 | 16.00 |
| Neoprene GRN-10 | 3.50 | 8.00 |
| Chlorinated rubber (21 cps.) | 1.30 | —— |
| High-styrene resin | 1.00 | 4.38 |
| Isobutyl methacrylate | 0.40 | 1.75 |
| Toluene | 90.10 | 69.87 |

| Ingredients | green coating | white (high gloss) | white (luster modifier)* |
|---|---|---|---|
| **Paste:** | | | |
| Base | 20.0 | 43.0 | 29.0 |
| Chromium Oxide | 6.4 | —— | —— |
| Zinc Oxide #3 | 3.6 | 10.5 | —— |
| Titanium Dioxide | —— | 15.0 | —— |
| Aluminum Hydrate | —— | —— | 25.0 |
| Toluene | 10.0 | 31.5 | 52.0 |
| **Ready-to-Use Coating:** | | | |
| Base | 60.0 | 70.0 | * |
| Paste | 40.0 | 30.0 | * |

*To modify the luster of the white, high-gloss coating, the selected amount of the modifier composition is incorporated into the high-gloss paste to achieve the desired degree of flatness.

## Polybutene

AROCLOR plasticizers and *Indopol* polybutenes are blended in various proportions to make permanently tacky coatings for fabric or paper. Insecticides, for example, can be blended into such coatings to make insect traps or barriers on tree trunks for foliage or fruit protection. Such coatings can also be used for tape and sign backing.



DSW 442038

STLCOPCB4056573

Excellent sealing and caulking compounds are made with blends of AROCLOR compounds and polybutenes with inorganic fillers, such as:

| Ingredient | Per Cent |
|---|---|
| Whiting | 50 |
| Talc | 30 |
| Lithopone | 10 |
| Asbestos | 10 |

By various combinations of selected AROCLOR compounds and polybutenes, a wide range of hardness, viscosity, flow, and bonding characteristics can be produced in durable sealing and caulking compounds.

Specialty mastics, too, are obtained by selective blends of AROCLOR plasticizers with polybutenes. They have excellent adhesivity for such uses as automobile-body sealants.

Paper-transparentizing liquids (for making tracing paper, window envelopes, and special packaging) can be formulated with AROCLOR 5460 and polybutenes. A typical economical formulation is as follows:

| Ingredient | Per Cent |
|---|---|
| AROCLOR 5460 | 30 |
| Polybutene (*Indopol** H-300) | 25 |
| Toluene | 45 |

### Butadiene-Acrylonitrile Rubber

The AROCLOR compounds — particularly AROCLOR 5460 — are useful as softeners for Buna N rubber.

### Silicone Rubber

AROCLOR is a very effective flame retardant for silicone rubbers.

### Crepe Rubber (Natural)

AROCLOR 1262 is used as a low-cost plasticizer for crepe rubber in paint compositions. In concentrations of from 5 to 50 per cent of the weight of the rubber, the AROCLOR increases the film's alkali resistance, gloss, and adhesivity to steel.

*Trademark of Amoco Chemicals Corporation



DSW 442039

STLCOPCB4056574

## POLYSULFIDE RUBBER

AROCLOR compounds are widely used to flexibilize, improve the bonding strength, increase the chemical resistance, and reduce the cost of *Thiokol** polysulfide liquid rubbers. Among the many uses of polysulfide formulations are joint-sealant compounds used in construction, solvent-resistant gaskets, adhesives for concrete, potting and encapsulation, protective coatings, and binders.

Although the AROCLOR compounds are highly compatible with polysulfide rubbers — up to 100 PHR — the concentration to be used depends on the handling and performance properties required in the finished compounds. Suggested concentrations of AROCLOR range from about 15 PHR for sealant compounds to about 40 PHR for casting formulations.

Liquid AROCLOR compounds (such as AROCLOR 1248) are used to reduce the viscosity and permit the use of higher filler concentration, whereas the solid AROCLOR compounds (such as AROCLOR 5460) are useful where low volatility is desired.

The following suggested starting formulations illustrate the use of AROCLOR 1232 in a joint-sealant compound and of AROCLOR 1248 in a polysulfide casting formulation:

| Ingredient | Sealant (parts) | Casting Compound (parts) |
|---|---|---|
| *Thiokol* LP-32 polysulfide | 100 | — |
| *Thiokol* LP-2 polysulfide | — | 100 |
| AROCLOR 1232 | 5 - 15 | — |
| AROCLOR 1248 | — | 20 - 40 |
| Calcium Carbonate | 20 | — |
| Calcined Clay | 20 | — |
| Titanium Dioxide | 10 | — |
| Phenolic Resin | 5 | — |
| Stearic Acid | 1 | — |
| Zinc Sulfide | — | 40 |
| Sulfur | 0.1 | 0.1 |
| C-5 Paste[a] | 15 | 15 |

| Property | | |
|---|---|---|
| Cast sheets, after cure of 7 days at room temperature: | | |
| Tensile strength, psi | 150 - 200 | 150 - 200 |
| Elongation, per cent | 500 - 700 | 300 - 400 |
| Hardness, Shore "A" | 30 - 40 | 25 - 35 |

*a*) lead peroxide, 50%; dibutyl phthalate, 45%, stearic acid, 5%: passed three times through a tight paint mill.

*Trademark of Thiokol Chemical Corp.



DSW 442040

STLCOPCB4056575

# AROCLORS IN CELLULOSIC RESINS

## IN ETHYL CELLULOSE

Ethyl cellulose formulations plasticized with AROCLOR compounds are used as protective lacquers, adhesives, and strippable coatings. The solids, such as AROCLOR 5460, are widely used with ethyl cellulose or cellulose acetate-butyrate resins in hot-melt applications for the protection of tools and metal parts.

The AROCLOR plasticizers are highly compatible with ethyl cellulose: the liquid AROCLOR compounds impart flexibility; the solids, hardness. For example, 75 parts of *AROCLOR* 1242 with 100 parts of ethyl cellulose produces a very flexible, slightly tacky material. AROCLOR 5460 at the same concentration yields a very hard, somewhat brittle composition. Hard films that contain AROCLOR 4465 are not brittle at ordinary temperatures.

For high-gloss coatings with exceptional weathering qualities to be applied to rigid surfaces, compositions containing equal parts by weight of AROCLOR 5460 and ethyl cellulose are suggested. When a more-flexible coating is required, a softer AROCLOR should replace either all or part of the AROCLOR 5460.

The following five typical formulations indicate the versatility of various AROCLOR plasticizers in compounding for widely different types of applications. They are intended as guides to the use of AROCLOR compounds with ethyl cellulose.

| Ingredients | Lacquer (parts) | White Alkali-Resistant Lacquer (parts) | Liquid Adhesive (parts) | Strippable Coating (parts) | Hot-Melt Adhesive (parts) |
|---|---|---|---|---|---|
| Ethyl Cellulose | 50 | 25 | 50 | 49 | 24 |
| AROCLOR 1254 | — | 16 | — | 49 | — |
| AROCLOR 1260 | 50 | — | — | — | — |
| AROCLOR 5460 | — | 76 | 40 | — | 7 |
| Dow 276, V-9 | — | — | 8 | — | — |
| Octylphenol | — | 1 | 2 | 1 | — |
| Stearic Acid | — | — | — | 1 | — |
| Rutile Titanium Oxide | — | 50 | — | — | — |
| Epoxy Resin | — | 1 | — | — | — |
| *Santonox** Antioxidant | — | — | — | — | 1 |
| Mineral Oil | — | — | — | — | 57 |
| Castor Oil | — | — | — | — | 5 |
| Epoxidized Soya Oil | — | — | — | — | 3 |
| Paraffin Wax (m.p. 135° F) | — | — | — | — | 3 |

The first four of these formulations may be dissolved in suitable solvents, such as mixtures of about four parts of toluene to one part of butanol, to obtain the desired viscosity.

*Santonox: Monsanto Chemical Company Trademark. Registered in U. S. Patent Office.



DSW 442041

STLCOPCB4056576

## IN NITROCELLULOSE

In nitrocellulose lacquers, the AROCLOR compounds can function either as plasticizers to modify the properties of the film or as resin extenders to add film-forming body. They are highly compatible with nitrocellulose and with other resins and plasticizers commonly used in lacquer formulations. They impart weather resistance, luster, adhesion, and flame retardance. Their excellent electrical characteristics and their ability to retard the passage of moisture and gases through nitrocellulose films make the AROCLOR compounds especially valuable in coatings for electric-insulating materials.

The following trilinear diagrams (Figure 1), show the limits of practical compatibility of AROCLOR 1254, 1260, and 1262 when used in nitrocellulose lacquers in combination with some other resins or plasticizers. The less viscous AROCLOR compounds (1242 and 1248) are more compatible than those shown; the more resinous AROCLOR compounds (1268, 2565, 4465, 5442, and 5460) are less compatible.

In these trilinear diagrams, compositions represented by any point in an unshaded area produce homogenous nitrocellulose-lacquer films. On the other hand, compositions represented by points in the shaded areas produce impractical (segregated, brittle, or soft) films. For detailed information on the derivation and use of these diagrams, please refer to the following articles:

Jenkins & Foster, "Compatibility Relationship of the Aroclors in Nitrocellulose Lacquers," *I & E Chem.* **23,** 1362 (1931).

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

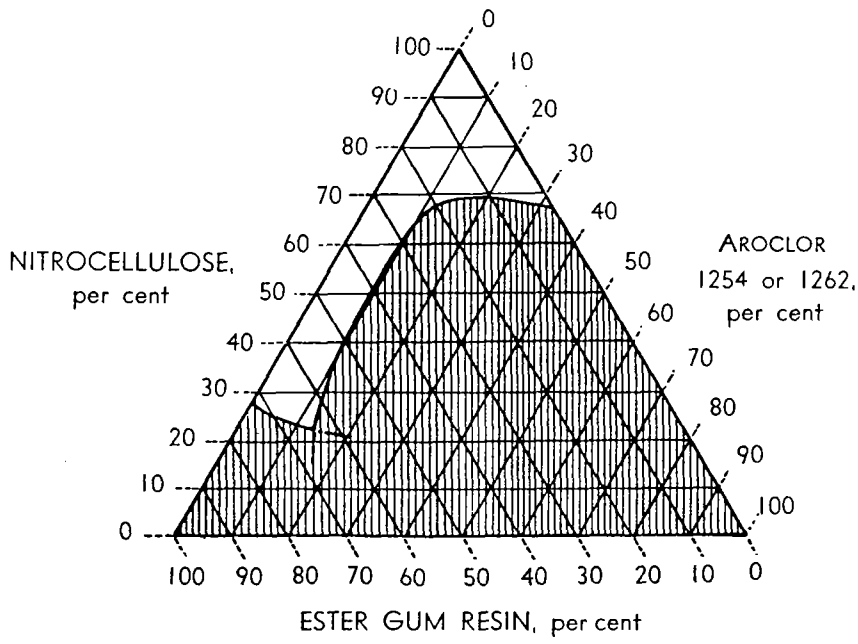



**Fig. 1—Limits of Practical Compatibility of AROCLORS in Nitrocellulose Lacquers**



DSW 442042

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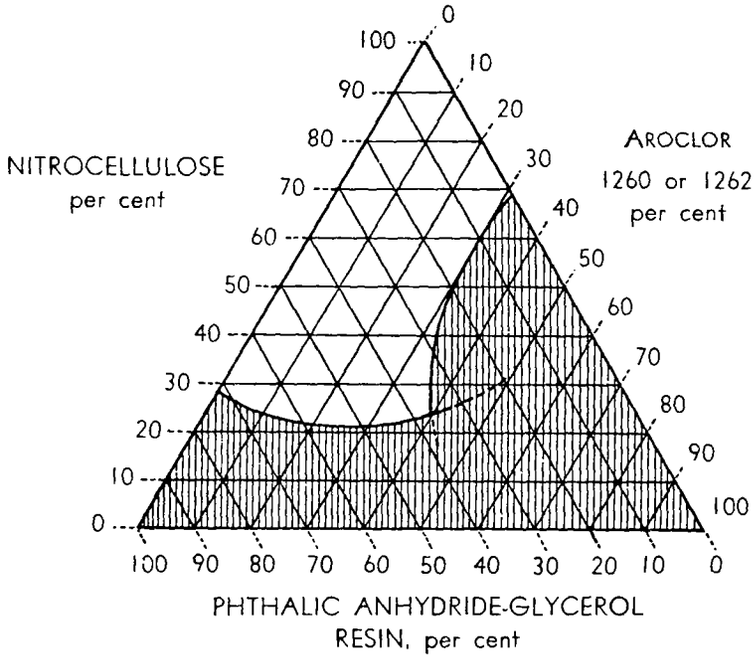
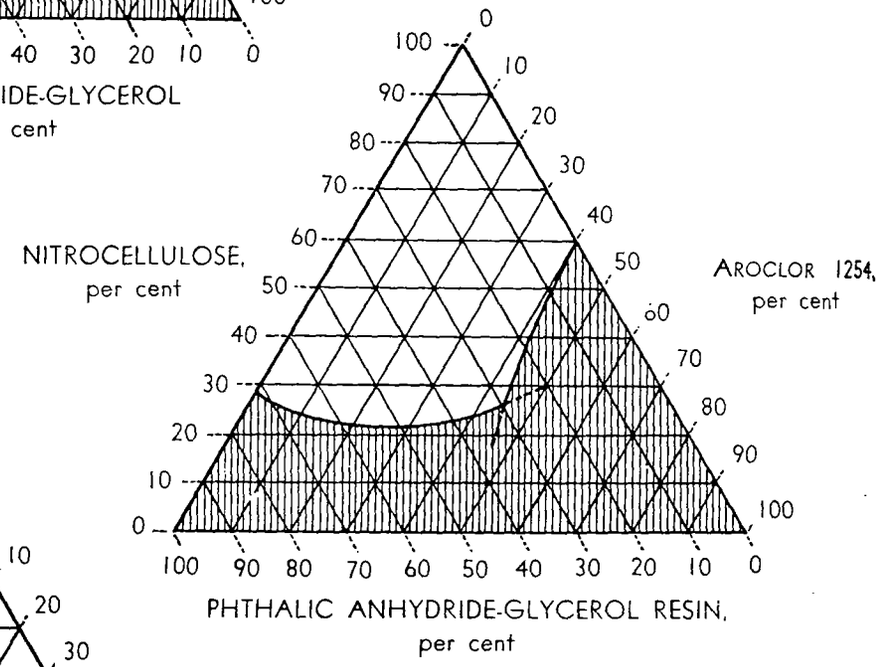
Fig. 1 (Continued)



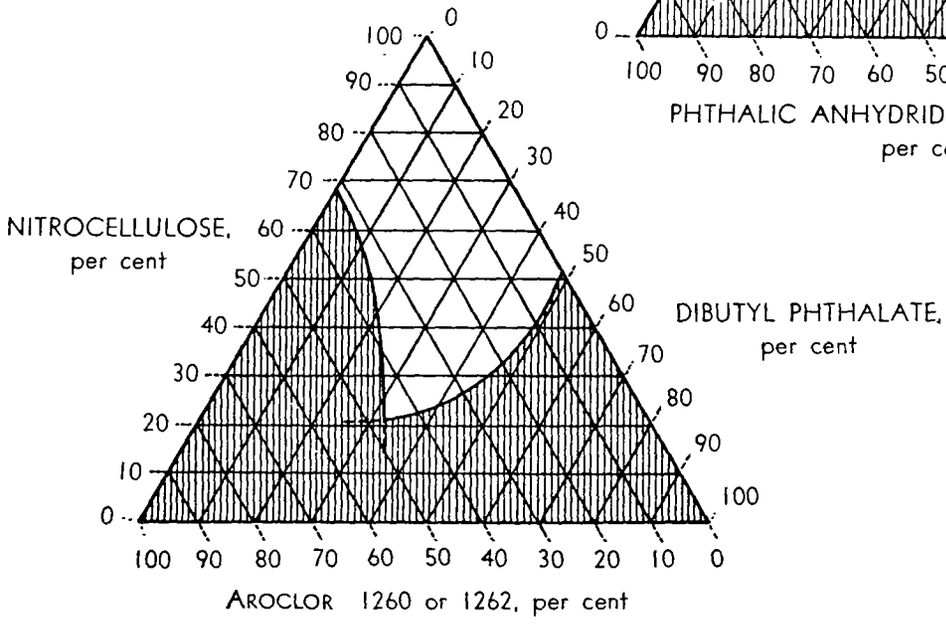






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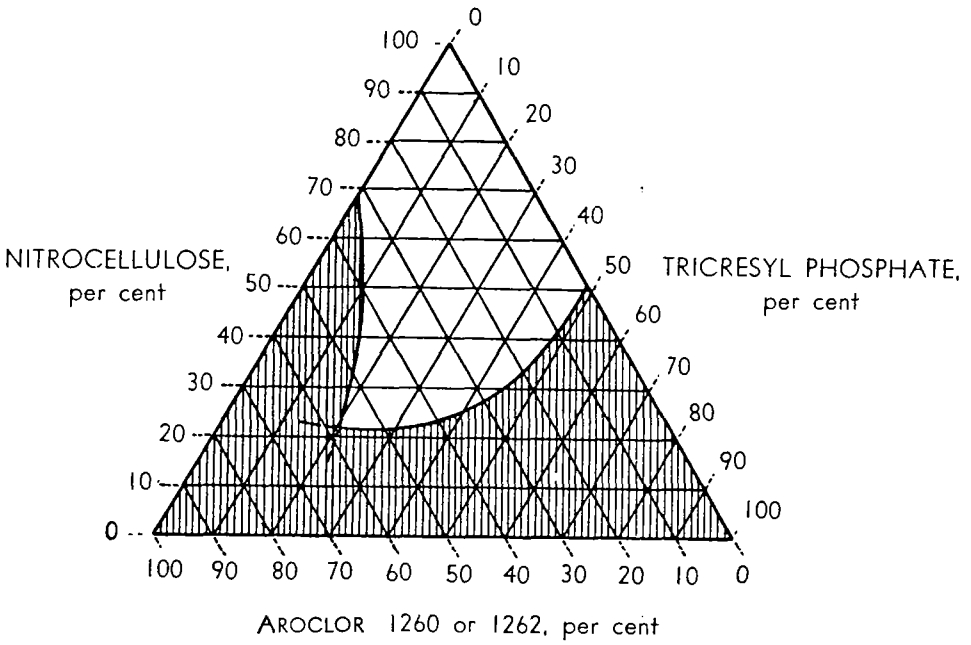
Fig. 1 (Continued)




The following formulations are given to illustrate modifications that can be obtained by variations in composition. They all have excellent durability, but the first two are much harder and less flexible that the third. The first two also have excellent sanding and polishing qualities, but No. 3 is too soft for sanding. The cable lacquer (no. 4) has extremely high flexibility, as required for high-tension automobile cables.

| Ingredient | No. 1 (parts) | No. 2 (parts) | No. 3 (parts) | No. 4 Cable Lacquer (parts) | No. 5 Chrome Lacquer (parts) |
|---|---|---|---|---|---|
| Nitrocellulose (¼ sec.) (wet) | — | — | — | — | 100 |
| Nitrocellulose (½ sec.) (dry) | 100 | 100 | 100 | — | — |
| Nitrocellulose (15-20 sec.) | — | — | — | 100 | — |
| AROCLOR 1242 | — | — | — | 80 | — |
| AROCLOR 1260 | 20-39 | 20 | 80-70 | — | — |
| AROCLOR 5460 | — | — | — | — | 47 |
| Dibutyl Phthalate | 20- 0 | 20 | — | — | 32.5 |
| Tricresyl Phosphate | — | — | 39-70 | 120 | — |
| Damar Resin | 80 | — | — | — | — |
| Ester Gum | — | 80 | — | — | — |



DSW 442044

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## IN CELLULOSE ACETATE-BUTYRATE

The high-chlorine-content AROCLOR plasticizers are highly compatible with cellulose acetate-butyrate and are widely used in the manufacture of low-cost, flame-resistant lacquers. Typical uses for these products include paper coatings, lacquers for plastics, strippable coatings for paint booths, and hot-melt adhesives. Typical starting formulations, illustrative of these uses, are suggested as follows:

| Ingredients | Paper Lacquers Low-Cost Flame-Resistant (wt. %) | Curl Resistant (wt. %) | Clear Wood Filler (wt. %) | Plastics [a] Lacquer (wt. %) | Paint-Booth Strippable Coating (wt. %) | Hot-Melt Adhesive (wt. %) |
|---|---|---|---|---|---|---|
| Half-Second Cellulose Acetate-Butyrate | 20 | 20 | 7 | 6 | 20 | 35 |
| AROCLOR 1260 | — | 20 | — | 1.5 | — | — |
| AROCLOR 1262 | 15 | — | — | — | — | — |
| AROCLOR 5460 | — | — | 15 | — | 9 | 30 |
| Dioctyl Phthalate | — | — | — | — | 9 | 15 |
| Epoxy Soybean oil | — | — | — | — | 9.5 | — |
| Acrylic Resin | — | — | — | 2.5 | — | — |
| Dow 276,V9 | — | — | — | 1.5 | — | — |
| Socony Vacuum 200 | — | — | — | — | 2.5 | — |
| Newport V-40 pine resin | — | — | — | — | — | 19.89 |
| Acetone | — | 10 | — | — | 10 | — |
| Methyl Ethyl Ketone | — | — | — | 10 | — | — |
| Methyl Isobutyl Ketone | — | — | — | 5 | — | — |
| Isobutyl Acetate | 5 | 10 | 22 | — | 5 | — |
| Ethanol | 12 | 10 | — | 33.5 | 10 | — |
| Butanol | — | — | 5 | — | — | — |
| Isobutanol | — | — | — | 25 | — | — |
| Toluene | 48 | 30 | 6 | 15 | 25 | — |
| *Santonox* Antioxidant | — | — | — | — | — | 0.1 |
| Syn Fleur #6 odorant | — | — | — | — | — | 0.01 |
| *Asbestine* X (magnesium silicate) | — | — | 45 | — | — | — |

*a*) Coatings for cellophane, cellulose acetate, and cellulose acetate-butyrate.



DSW 442045

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## IN PAINT AND VARNISH

AROCLOR compounds 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 and impart to the film properties that correspond to the particular character of the AROCLOR used: the hard, resinous AROCLORS tend to give increased hardness; the viscous AROCLORS impart flexibility.

AROCLOR 4465 and 5460 produce paints that are very quick drying and yet have excellent durability. The amount of AROCLOR used may be from 30 to 50 per cent of the weight of the oils.

AROCLOR 1260 is best for short-oil varnishes that are required to be flexible. The AROCLOR compounds impart water and alkali resistance and also enhance the value of the other resins used in the varnish. A suggested starting formulation is two parts of oil, one part of AROCLOR 1260, and one part of other resin. These proportions can be varied as required. The AROCLOR may be considered to play the same role in the varnish formulation as oil, except that it does not oxidize and lose its flexibility on exposure.

The AROCLOR compounds 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. The only reason to heat the AROCLOR compounds is to fluidize them so they can be more readily mixed with the oils. Alkyd, phenolic, or ester gum resins, with a harder AROCLOR such as 5460, may be used in making varnish formulations. To illustrate the use of AROCLOR compounds in alkyd resins the following suggested starting formulation is shown.

| Ingredients | Parts by Weight |
|---|---|
| Alkyd (60% Nonvolatile) | 81 |
| Kettle Bodied Linseed Oil (Gardner-Holdt Visc. Z-2) | 20 |
| Raw Linseed Oil | 35 |
| AROCLOR 5460 | 34 |
| Titanium Dioxide (Rutile) | 34 |
| Titanium Dioxide (Anatase) | 67 |
| Magnesium Silicate | 100 |
| Mineral Spirits | 38 |
| Drier-Absorption Agent | 1.3 |
| Phenyl Mercury Naphthenate (10% Mercury) | 2.7 |
| Cobalt Naphthenate (6% cobalt) | 1.5 |
| Lead Naphthenate (24% lead) | 3.2 |
| Anti-Skinning Agent (Volatile type) | 0.67 |



DSW 442046

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The following suggested starting formulation for a fire-retardant enamel illustrates use of the flame retardancy of an AROCLOR in alkyds:

| Ingredients | Parts by Weight |
|---|---|
| 38% Phthalic Anhydride-Soya Alkyd | 63 |
| AROCLOR 5460 Solution (AROCLOR 5460, 53; Hi-Flash Naphtha, 22) | 75 |
| Whiting | 84 |
| Colloidal Grinding and Dispersing Agent | 2.7 |
| Antimony Oxide | 42 |
| Titanium Dioxide (Rutile) | 33 |
| *Grind above ingredients, and thin with:* | |
| 38% Phthalic Anhydride-Soya Alkyd | 96 |
| Xylene | 38 |
| Cobalt Naphthenate (6% cobalt) | 1 |
| Manganese Naphthenate (6% manganese) | 1 |
| Lead Naphthenate (24% lead) | 2.3 |

AROCLOR compounds 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 that 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. Moreover, the composition does not support combustion.

AROCLOR compounds are important ingredients of heat-resistant aluminum paints and enamels that contain silicone resins. For example, the following suggested formuation for a heat-resistant coating can withstand a maximum temperature of 800° F and continuous-service temperature of 400° F. The heat-resistant enamel can withstand temperatures of 900° to 1000° F in such applications as jet-engine components, exhaust manifolds, and incinerators. The heat-resistant paint has excellent resistance to a programmed heat test, including 8 hours at 1200° F, and to salt-water spray after programmed heating to 500°, 600°, and 900° F.



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| | Heat-Resistant Coating (lb./100 gal.) | Heat-Resistant Enamel (lb./100 gal.) | Heat-Resistant Paint [a] (lb./100 gal.) |
|---|---|---|---|
| Dow Corning 805 Resin (50% Nonvolatile) | 220 | — | — |
| G E Silicone Resin SR-82 (60% in xylene) | — | 174.2 | 93.6 |
| G E Silicone Resin SR-112 (50% in xylene) | — | 313.3 | — |
| Styrene-Butadiene (50% in xylene) (*Pliolite* S-5B) | — | — | 207.9 |
| AROCLOR 4465 (90% nonvolatile) | 332 | — | — |
| 60% AROCLOR Solution (AROCLOR 4465, 36 wt. %) (AROCLOR 1262, 24 wt. %) (*Solvesso* 100, 24 wt. %) (Xylene, 16 wt. %) | — | 435.6 | — |
| AROCLOR 5460 (60% in xylene) | — | — | 93.6 |
| AROCLOR 1254 | — | — | 47.8 |
| Aluminum Paste (74% nonvolatile) | 384 | 250.0 | 240.0 |
| Cobalt Octoate (6% cobalt) | — | 4.4 | — |
| Xylene | 114 | — | 140.8 |
| Mineral Spirits | — | — | 113.1 |

*a*) Meets Spec. TT-P-0028

## IN WAXES

The AROCLOR compounds, especially 5460, are compatible with various natural waxes, and are blended with waxes for many uses, including "lost-wax" casting, impregnating compounds, and inexpensive sealers. Waxes formulated with AROCLOR compounds are nontacky and stable.

Much of the highest-quality precision-casting wax used in the "lost-wax" process is formulated with AROCLOR compounds, most frequently 5460, 4465, and 1254. Waxes containing AROCLOR compounds are widely used in making dental castings, costume jewelry, and precision-cast aircraft parts.

Usually from one-fourth to one-half the composition consists of AROCLOR 5460, which contributes these desirable properties to the formulation: hardness without brittleness, shrinkage resistance, sharp definition, sharp melting point, fire resistance, low volatility, and volatilization without carbonization during final curing.

Excellent impregnating compounds to prevent sticking of furniture drawers, double-hung windows, etc. are made from selected AROCLOR compounds, such as 5460, and various waxes. Combinations of resinous AROCLOR compounds with waxes make excellent and inexpensive sealers for masonry, wood, fiberboard, and paper.

AROCLOR compounds impart moisture and gas resistance, adhesion, alkali and chemical resistance, flame resistance, lubricity, and insulation to impregnants for cloth, paper, wood, and



DSW 442048

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asbestos. They are combined with such materials as waxes, asphalt, tars, sulfur, aluminum stearate, and inorganic pigments so as to provide exactly the physical characteristics required for the specific purpose. AROCLOR 1254, 4465, and 5460 are suggested as most applicable.

Wood is decidedly toughened, hardened, and made more moisture-resistant when impregnated by the vacuum-pressure method with the following mixture:

| Ingredients | Per Cent |
|---|---|
| AROCLOR 4465 | 70 |
| Microcrystalline Wax | 20 |
| Sulfur | 10 |

The coating is very resistant to acids and alkalies but can be attacked by aliphatic, aromatic, or chlorinated hydrocarbons. The paintable surface is not appreciably discolored. Various degrees of hardness and adhesion are obtained by variations in the proportions of the ingredients.

Blends of AROCLOR 1268 and 1242 have the unusual capability to extend carnauba wax satisfactorily and at an attractive saving in cost:

| Ingredients | Parts by Weight | | | | |
|---|---|---|---|---|---|
| AROCLOR 1268 | 10 | 19.6 | 30 | 35 | 35 |
| AROCLOR 1242 | 5 | 4.9 | 5 | 5 | 5 |
| Carnauba Wax | 5 | 6.8 | 10 | 30 | 50 |
| Ceresin Wax | 20 | 19.6 | 20 | 20 | 10 |
| Paraffin Wax | 60 | 49.0 | 35 | 10 | — |
| **Characteristics** | | | | | |
| Color | Pale Yellow, White | Pale Yellow | Pale Yellow | Pale Cream | Cream |
| Texture | Smooth, hard, non-tacky | Smooth, hard, non-tacky | Smooth, hard, slightly brittle | Slight surface crystallinity | Smooth; carnauba-ringed surface |
| Softening point, °C | 60 | 77 | 78 | 79 | 80.5 |
| Melting point, °C | 78 | 79 | 78 | 86 | 88 |

## IN ASPHALT

Self-extinguishing asphalt formulations for caulking, roof coatings, and sound-deadening coatings are obtained by incorporation of at least 30 per cent AROCLOR 5460 or other solid, resinous AROCLOR.

## IN ALLYL STARCH

Substitution of the hydroxy hydrogen atoms of the starch molecule by allyl groups produces allyl starch, which upon polymerization forms stable, cross-linked molecules. A minimum of 20-weight-per cent plasticizer is required to make the film flexible. The AROCLOR compounds are highly compatible and very efficient plasticizers for allyl starch.



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# MISCELLANEOUS APPLICATIONS OF AROCLORS

With their wide range of physical properties, their inertness, lubricity, and low vapor pressures — AROCLOR compounds are valuable ingredients in an incredible variety of formulated products. They are compatible with many solvents and oils and most resins. They are virtually nonvolatile and permanently thermoplastic; they do not react with other chemicals in the formulation. Finally, their low cost makes their use for special purposes eminently practical and economical.

## DUST PREVENTION AND DUST CATCHING

AROCLOR 1254 is a low-cost dedusting agent that "holds down" the dusting of a variety of chemical materials. Since AROCLOR 1254 resists both oxidation and combustion, it can even be used to control the dusting of highly reactive compounds. As a typical example, a few tenths of a per cent controls the dusting of calcium hypochlorite.

Since AROCLOR compounds are non-drying and tacky, they make excellent coatings to capture dust, lint, and other fine, airborne particles. Glass fiber, metal mesh, and other materials used to filter air and gas streams are coated with AROCLOR 1260 and 5460.

## VAPOR SUPPRESSION (FOR LONGER INSECTICIDE KILL-LIFE)

The effective kill-life of expensive chlorinated insecticides is extended as much as ten-fold by the incorporation of equal parts of AROCLOR 5460, which acts both as a vapor suppressant and as a sticking agent. Hard surfaces (painted or metallic) sprayed with lindane or benzene hexachloride fortified with AROCLOR 5460 remain toxic to flies, ants, roaches, and silverfish for as long as three months, compared with one week for unfortified sprays.

The AROCLOR retards the rapid evaporation of the volatile insecticides without adding odor or objectionable residue. Formulation into an insecticide is simple: a solution of the AROCLOR in a suitable solvent is merely added and mixed into the other ingredients.

AROCLOR 5460 is also recommended for noncrop insect formulations containing chlordane, aldrin, and dieldrin. The other resinous AROCLOR compounds (1254, 1260, 1262, 4465, and 5442), also nonvolatile and sticky or tacky, likewise merit evaluation as insecticide extenders.

## MOISTURE PROOFING

In moisture-proof coatings for wood, paper, concrete, or brick, the AROCLOR compounds are best combined with waxes, especially paraffin or Carnauba; oils such as mineral oil or drying oils; or synthetic resins, including modified alkyds, phenolics, chlorinated rubber, polystyrene, styrene-butadiene copolymers, ethyl cellulose, cellulose acetobutyrate, benzyl cellulose, or vinyl resins. The material to be used with the AROCLOR should be selected according to the end-use requirements of the specific application.

Some very simple compositions contain only AROCLOR and paraffin. One very efficient moisture-proofing compound, consisting of 96 weight per cent AROCLOR 5460 and 4 per cent paraffin (melting point 54°C), has an ASTM softening point of about 82°C. A similar compound, based on AROCLOR 4465, has a softening point of about 58°C.



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Softening point and viscosity when melted are further decreased by the use of mixtures of AROCLOR compounds. For example, a composition containing 40 per cent AROCLOR 1260, 56 per cent AROCLOR 5460, and 4 per cent paraffin, is very soft at room temperature. A higher concentration of paraffin also produces softer compounds.

An excellent melt coating for paper and cloth, made according to the following suggested formulation, may be applied by knife or roller at 350°F, requires no solvent, and provides an extremely flexible coating.

| Ingredients | Per Cent |
|---|---|
| Half-second Cellulose Acetate-Butyrate | 50 |
| Dioctyl Phthalate | 9.9 |
| AROCLOR 1260 | 40 |
| *Santonox* antioxidant | 0.1 |

## PIGMENT DISPERSION

AROCLOR 4465 is a useful resin in rotogravure and other printing inks. It is an important ingredient in the following mimeograph ink suitable for use on bond paper:

| Ingredients | Per Cent |
|---|---|
| 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 is also used in the preparation of imitation gold leaf. Bronze powder is spread upon a hot coating of AROCLOR on one side of a sheet of paper. When the paper treated with AROCLOR and bronze powder is placed on the object to be imprinted and a hot die is pressed against it, the AROCLOR softens, sticks the bronze to the object, and coats the powder to prevent tarnishing.

AROCLOR 1254 and 4465 serve as pigment vehicles for decoration of glass and ceramics. When the decorated object is fired, the AROCLOR volatilizes without carbonization and thus avoids discoloration. AROCLOR compounds are also valuable as grinding and dispersing mediums for pigments used in plastics.

## SEALING AND IMPREGNATION

The liquid AROCLOR compounds, 1221 and 1254, because of their low vapor pressures and fire resistance, are excellent sealants. These nonevaporating fluids have good flow at slightly elevated temperatures and are chemically stable at elevated temperatures. These liquid AROCLOR compounds therefore are excellent fluid seals wherever the use of oil would create a fire hazard. In the trough of annealing furnaces, for example, AROCLOR compounds are dependable, fire-safe roof sealants.



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Because of their nonflammability, high resistivity and dielectric strength, and low power factor, the liquid and resinous AROCLOR compounds are extremely valuable impregnants for many electrical applications. One important use of AROCLOR 1260, 4465, and 5460 is in wire and cable coatings and as impregnants for braided cotton-asbestos insulation. Their high purity and excellent electrical resistance make AROCLOR 1254, 5460, and 1268 excellent dielectric sealants: to close the pores of carbon resistors, and to seal electrical bushings and terminals.

AROCLOR compounds are essential components of coatings for flameproofing cotton drill for outer garments and for rendering olive-drab canvas fire-retardant, water-repellent, and rot-proof for tents, tarpaulins, etc., according to the following formulations:

### Flameproofing Formula for Cotton Drill

| Ingredients | Parts by Weight |
|---|---|
| (A) Urea-formaldehyde resin monomer | 9.62 |
| Catalyst for resin | 0.40 |
| Water | 22.26 |
| (B) Oil-modified alkyd resin | 3.89 |
| AROCLOR 1254 | 12.00 |
| AROCLOR 5460 | 14.40 |
| Stoddard solvent | 25.15 |
| (C) Antimony oxide, 300 mesh or finer | 12.28 |

Dissolve the solids in the indicated solvents, add the aqueous solution (A) to the hydrocarbon solution (B) with stirring, and then disperse the antimony oxide in the emulsion.

### Fire-Retardant, Water-Repellent, Rot-Proof Canvas Coating

| Ingredients | Per Cent |
|---|---|
| Modified phenol-formaldehyde resin | 4 |
| AROCLOR 1254 | 16 |
| AROCLOR 5460 | 4 |
| Antimony Oxide | 8 |
| Tricresyl Phosphate | 1.5 |
| Aluminum Stearate | 0.5 |
| Copper Naphthenate (8% copper) | 8 |
| Mica, ground | 3 |
| Limestone, ground | 6 |
| Iron Oxide, yellow | 7 |
| Chrome Orange | 2 |
| V M & P Naphtha | 40 |



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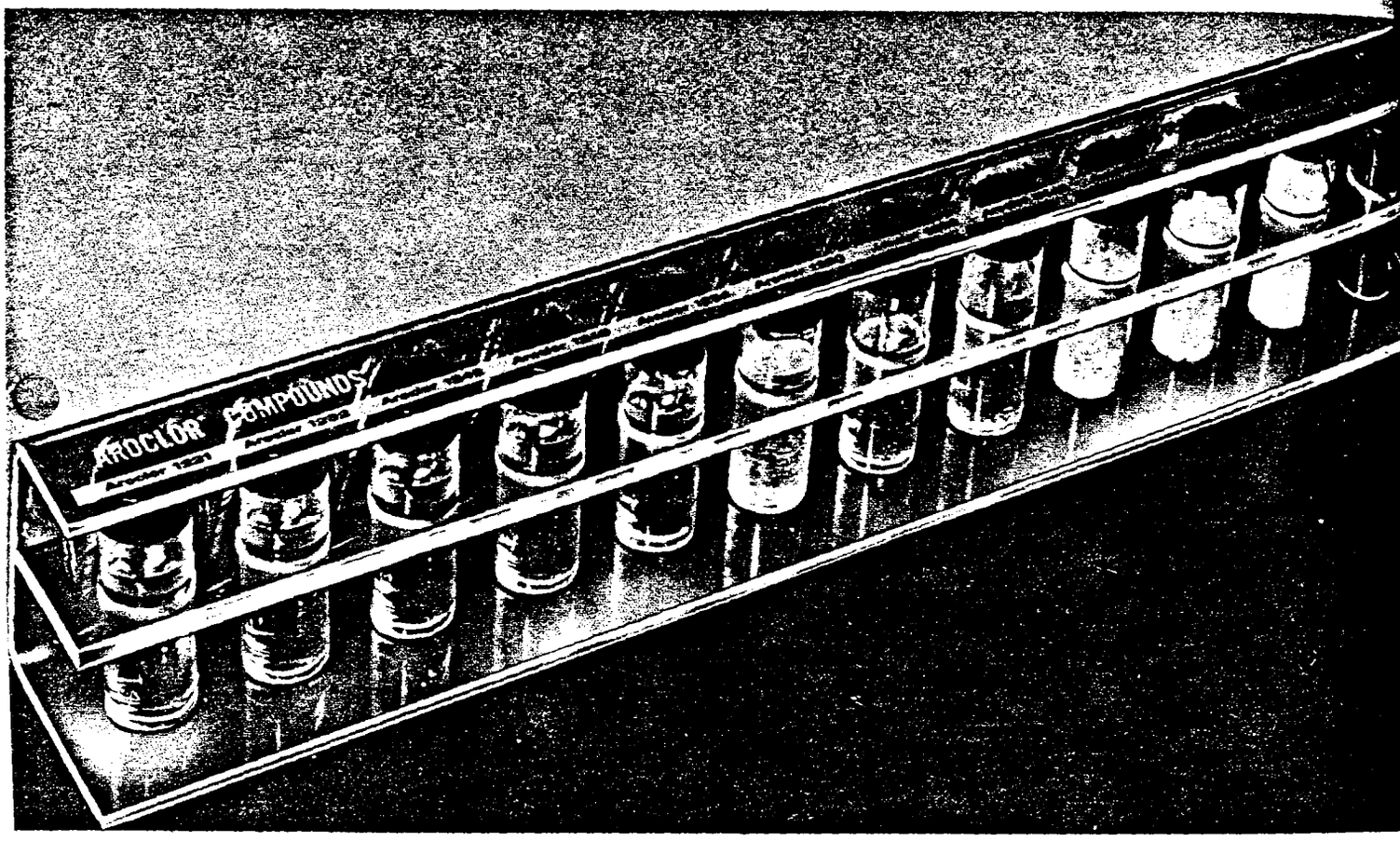
## PROPERTIES OF THE AROCLOR COMPOUNDS

MOBILE LIQUIDS

VISCOUS LIQUIDS

SOFT RESINS

BRITTLE RESINS




Numerous applications for the AROCLOR compounds have been suggested and described in the preceding sections of this bulletin. Their success depends on the general inertness of the compounds and on the range and gradation of their physical properties, including physical state, density, viscosity, melting and boiling points, volatility, and solubility. These and other properties, as well as handling and shipping information, are presented in detail in the remainder of the bulletin.



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## SOLUBILITY

The AROCLOR liquids and resins are readily soluble in most common organic solvents and drying oils. Although all AROCLORS are insoluble in water, the hard, crystalline materials are generally less soluble than the liquids and softer resins. Solubilities of some AROCLOR plasticizers are shown in Table XIII.

### TABLE XIII — SOLUBILITIES OF AROCLOR PLASTICIZERS IN VARIOUS SOLVENTS

| Solvent | AROCLOR 1242 25°C | AROCLOR 1242 Hot | AROCLOR 1248 25°C | AROCLOR 1248 Hot | AROCLOR 1254 25°C | AROCLOR 1254 Hot | AROCLOR 4465 Cold | AROCLOR 4465 Hot | AROCLOR 5460 25°C |
|---|---|---|---|---|---|---|---|---|---|
| Acid | | | | | | | | | |
| Acetic Acid | S | S | — | — | S | S | SS | S | — |
| Oleic Acid | S | S | — | — | S | S | S | VS | — |
| Benzoic Acid | 10.0 $^{51°C}$ | — | 10.0 $^{51°C}$ | — | — | — | — | — | — |
| 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 $^{50°C}$ | 440 $^{99°C}$ | — | — | 114 $^{51°C}$ | 425 $^{100°C}$ | 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 $^{31°C}$ | 307 $^{99°C}$ | VS | VS | 173 $^{26°C}$ | 259 $^{98°C}$ | SS | — | — |
| Cellosolve | S | S | S | S | S | S | S | — | — |
| Diethylene Glycol | — | — | — | — | — | — | S | — | — |
| *p,p'*-Dihydroxy Ethyl Ether | 16.9 $^{23°C}$ | 19 $^{99°C}$ | SS | SS | 8 $^{20°C}$ | 10 $^{100°C}$ | 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 $^{27.8°C}$ | S | 2.0 $^{28°C}$ | 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 $^{29°C}$ | 80.0 $^{70°C}$ | — | — | 10 $^{27°C}$ | 28 $^{78°C}$ | SS | — | — |
| Glycerine | I | I | I | I | I | I | I | I | — |
| Methyl Alcohol | 42.5 $^{29°C}$ | 88.5 $^{60°C}$ | — | — | 15 $^{29°C}$ | 22.2 $^{68°C}$ | SS | — | — |
| Phenol—90% | 194 $^{80°C}$ | 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 SS—Slightly Soluble S—Soluble VS—Very Soluble.
Figures show grams of AROCLOR per 100 milliliters of solvent at 25°C unless otherwise indicated.



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TABLE XIV — MONSANTO SPECIFICATIONS* AND GENERAL PHYSICAL

| PROPERTY | AROCLOR 1221 | AROCLOR 1232 | AROCLOR 1242 | AROCLOR 1248 | AROCLOR 1254 |
|---|---|---|---|---|---|
| Appearance | Colorless, clear, mobile oil | Practically colorless mobile oil | Practically colorless, clear, mobile oil | Colorless to light yellow-green, clear, mobile oil | Light-yellow viscous oil |
| Color, maximum | 100 APHA | 100 APHA | 100 APHA | 100 APHA | 100 APHA |
| Chlorine, per cent | 20.5-21.5 | 31.5-32.5 | 42 | 48 | 54 |
| Acidity, mg KOH/g, maximum | 0.014 | 0.014 | 0.010 | 0.010 | 0.010 |
| Moisture, ppm, maximum | | | 50 | 50 | 50 |
| Ave. 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) |
| 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) |
| Density, pounds per gallon, 25°C | 9.85 | 10.55 | 11.50 | 12.04 | 12.82 |
| Distillation Range, °C, corrected (ASTM D-20, modified) | 275-320 | 290-325 | 325-366 | 340-375 | 365-390 |
| Evaporation Loss, %, 100°C, 6 hours (ASTM D-6, mod.) 163°C, 5 hours | 1.0-1.5 | 1.0-1.5 | 0-0.4<br>3.0-3.6 | 0-0.3<br>3.0-4.0 | 0-0.2<br>1.1-1.3 |
| Flash Point (Cleveland Open Cup), °C<br>°F | 141-150<br>286-302 | 152-154<br>305-310 | 176-180<br>348-356 | 193-196<br>379-384 | NONE |
| Fire Point (Cleveland Open Cup), °C<br>°F | 176<br>349 | 238<br>460 | NONE** | NONE | NONE |
| Pour Point (ASTM E-97), °C<br>°F | 1 (crystals)<br>34 (crystals) | —35.5<br>—32 | —19<br>2 | —7<br>19.4 | 10<br>50 |
| Softening Point (ASTM E-28), °C<br>°F | | | | | |
| Refractive Index, $n_D^{20}$ | 1.617-1.618 | 1.620-1.622 | 1.627-1.629 | 1.630-1.631 | 1.639-1.641 |
| Viscosity, Seconds Saybolt Universal (ASTM D-88) 100°F (37.8°C) | 38-41 | 44-51 | 82-92 | 185-240 | 1800-2500 |
| 130°F (54.4°C) | 35-37 | 39-41 | 49-56 | 73-80 | 260-340 |
| 210°F (98.9°C) | 30-31 | 31-32 | 34-35 | 36-37 | 44-48 |

*Data in red indicate Monsanto Chemical Company specifications.

**NONE indicates no flash or fire up to boiling point.



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## PROPERTIES OF REPRESENTATIVE AROCLOR PLASTICIZERS AND RESINS

| AROCLOR 1260 | AROCLOR 1262 | AROCLOR 5442 | AROCLOR 4465 | AROCLOR 2565 | AROCLOR 5460 | AROCLOR 1268 |
|---|---|---|---|---|---|---|
| Light-yellow, clear, soft, sticky resin | Light-yellow soft, sticky clear resin (viscous liquid) | Yellow, clear, sticky resin | Light-yellow, clear, brittle resin | Black, opaque, brittle resin | Clear, yellow-to-amber, brittle resin | White to off-white powder |
| 150 APHA | 150 APHA | 2 NPA (molten) | 2 NPA (molten) | | 2 NPA (molten) | 1.5 NPA (molten) |
| 60 | 61.5-62.5 | 42 | 65 | 65 | 58.5-60.6 | 68 |
| 0.014 | 0.014 | 0.05 | 0.05 | 1.4 | 0.05 | 0.05 |
| 50 | | | | | | |
| 0.00067 (20°-100°C) | 0.00064 (25°-65°C) | 0.00123 (25°-99°C) | 0.00061 (25°-65°C) | 0.00066 (25°-65°C) | 0.00179 (25°-124°C) | 0.00067 (20°-100°C) |
| 1.555-1.566 (90°/15.5°C) | 1.572-1.583 (90°/15.5°C) | 1.470 (25°/25°C) | 1.670 (25°/25°C) | 1.734 (25°/25°C) | 1.670 (25°/25°C) | 1.804-1.811 (25°/25°C) |
| 13.50 | 13.72 | 12.24 | 13.91 | 14.44 | 13.91 | 15.09 |
| 385-420 | 390-425 | 215-300 (4 mm. Hg) | 230-320 (4 mm. Hg) | | 280-335 (5 mm. Hg) | 435-450 |
| 0-0.1<br>0.5-0.8 | 0-0.1<br>0.5-0.6 | 0.01<br>0.2 | 0-0.02<br>0.2-0.3 | 0.2-0.3 | 0.03 | 0-0 06<br>0.1-0.2 |
| NONE | NONE | 247<br>477 | NONE | NONE | NONE | NONE |
| NONE | NONE | 350<br>662 | NONE | NONE | NONE | NONE |
| 31<br>88 | 35-38<br>99 | 46<br>115 | | | | |
| | | 46-52<br>115-126 | 60-66<br>140-151 | 66-72<br>149-162 | 98-105.5<br>208-222 | 150-170 (hold point)<br>302-338 |
| 1.647-1.649 | 1.6501-1.6517 | | 1.664-1.667 | | 1.660-1.665 | |
| 3200-4500<br>72-78 | 600-850 (160°F; 71°C)<br>86-100 | 300-400 | 90-150 (266°F; 130°C) | | | |



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## DENSITY

All the AROCLOR compounds are heavier than water, a valuable property for many applications. Densities are shown in Figure 2.

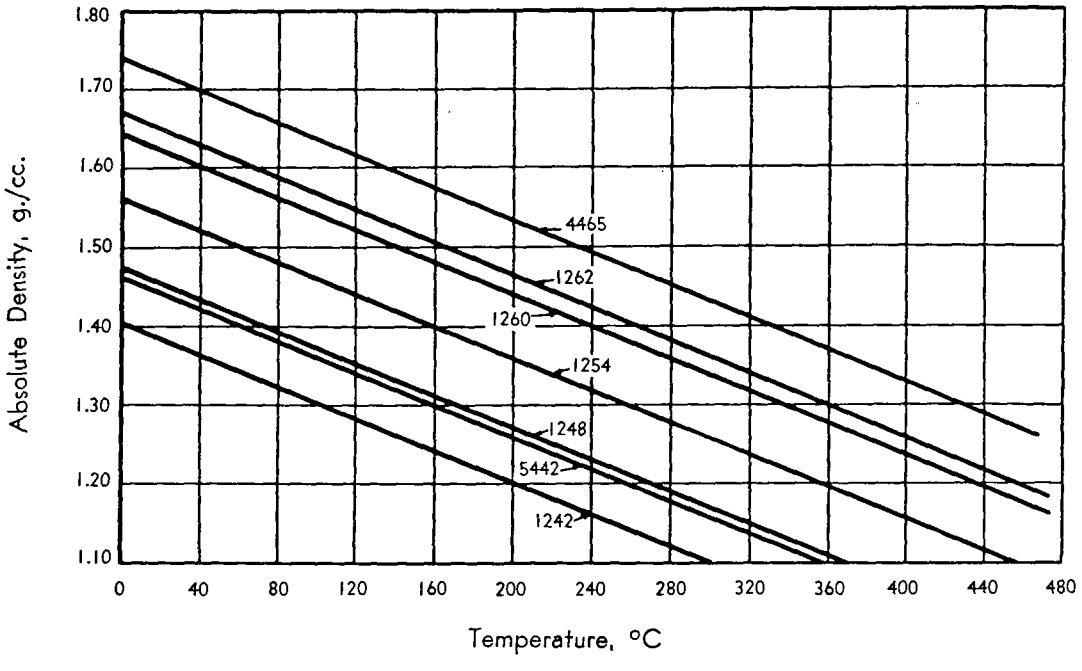


Fig. 2. DENSITIES OF AROCLORS AT VARIOUS TEMPERATURES

## SPECIFIC VOLUME

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

| Temperature (°F) | AROCLOR 1248 Specific Volume (ml/g) |
|---|---|
| 0 | 0.674 |
| 100 | 0.699 |
| 200 | 0.726 |
| 300 | 0.755 |
| 400 | 0.790 |
| 500 | 0.828 |
| 600 | 0.870 |



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## VOLATILITY

The low vaporization loss of AROCLOR compounds is indicated in Table XV.

TABLE XV—VAPORIZATION RATES OF AROCLOR COMPOUNDS

| Plasticizer (Surface area: 12.28 sq. cm.) | Wt. Loss (g) | Exposure at 100°C (hr.) | Vaporization Rate (g/sq. cm./hr.) |
|---|---|---|---|
| AROCLOR 1221 | 0.5125 | 24 | 0.00174 |
| AROCLOR 1232 | 0.2572 | 24 | 0.000874 |
| AROCLOR 1242 | 0.0995 | 24 | 0.000338 |
| AROCLOR 1248 | 0.0448 | 24 | 0.000152 |
| *Clorafin**-42-S | 0.0745 | 48 | 0.000126 |
| Dioctyl phthalate | 0.0686 | 48 | 0.000117 |
| *Dutrex*** 25 | 0.0256 | 24 | 0.000087 |
| AROCLOR 1254 | 0.0156 | 24 | 0.000053 |
| *Dutrex* 20 | 0.0047 | 24 | 0.000016 |
| AROCLOR 1262 | 0.0039 | 24 | 0.000013 |
| AROCLOR 1260 | 0.0026 | 24 | 0.000009 |
| AROCLOR 4465 | 0.0064 | 72 | 0.000007 |
| AROCLOR 5442 | 0.0039 | 72 | 0.000004 |
| AROCLOR 5460 | 0.0032 | 72 | 0.000004 |
| Tricresyl phosphate | 0.0010 | 24 | 0.000003 |

It is concluded that the vaporization rates of AROCLOR plasticizers — especially the most widely used 1254 and 1260 — compare most favorably with the similar constants of other plasticizers selected specifically for these tests because of their low vaporization rates.

*Trademark of Hercules Powder Co.
**Trademark of Shell Oil Co.



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## VAPOR PRESSURE

The vapor pressures of several AROCLOR compounds are indicated in Figure 3 over the temperature range 150° to 300°C.

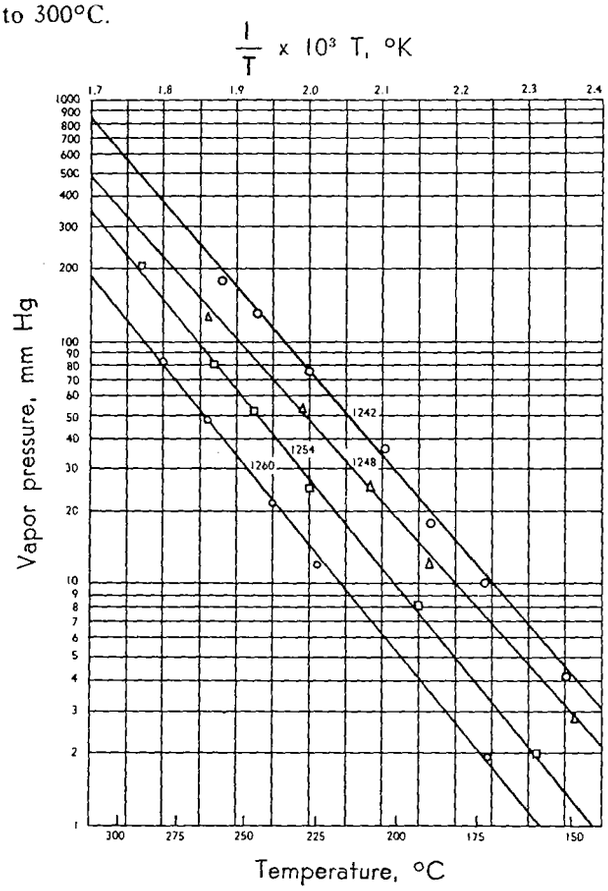


Fig. 3—VAPOR PRESSURES OF AROCLORS

The estimated vapor pressures of several AROCLOR plasticizers at 100°F shown in the following table were determined by extrapolation from the values shown in Figure 3.

**Approximate Vapor Pressure of AROCLORS**

**Estimated 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 |



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## VISCOSITY

The viscosities of the AROCLOR plasticizers vary according to whether the base material is a biphenyl or a polyphenyl and on the degree of chlorination. In general the low-chlorinated biphenyls have the lowest viscosities (Figure 4).

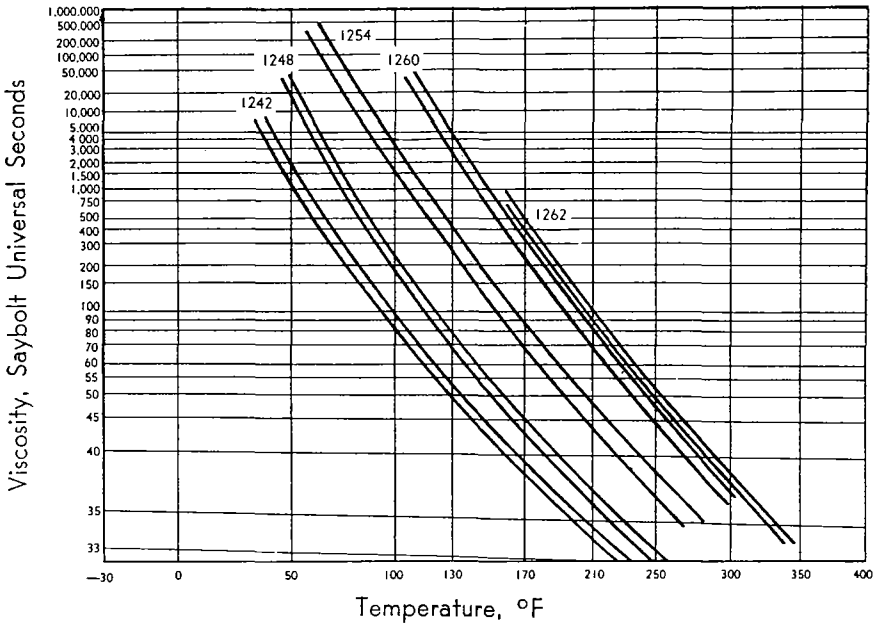


Fig. 4—VISCOSITY RANGES OF SOME AROCLORS

## STABILITY

### Toward Alkalies

The AROCLOR plasticizers 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

No hydrogen chloride was evolved when AROCLOR 1254 was stirred with an equal volume of 10 per cent sulfuric acid for 150 hours. Even after prolonged treatment (255 hours) with concentrated sulfuric acid only a slight trace (too small for quantitative measurement) of hydrogen chloride was evolved.

### Toward Heat

Because of their stability to heat, the AROCLOR compounds are useful heat-transfer media. AROCLOR 1254 and particularly the less viscous AROCLOR 1248 are recommended for this purpose, because they may be heated up to 315°C (600°F) in a closed system for long periods without appreciable decomposition, and because they are non-flammable.



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### Toward Light

The AROCLOR plasticizers have good light stability in heavily pigmented compounds and fair light stability in clear formulations. The materials become discolored, but their physical properties are not degraded. For critical applications, incorporation of a small amount of a light-screening agent greatly improves light stability at reasonable cost. The following data show that as little as 0.01 per cent *Tinuvin* P in AROCLOR 1254 nearly doubles the service life in the 50-to-100-hour range and that 0.1 per cent *Tinuvin* P results in a 10-fold improvement.

| Tinuvin P Concentration (%) | Fade-Ometer Exposure (hours) | | | | |
|---|---|---|---|---|---|
| | 0 | 50 | 100 | 150 | 500 |
| | Color (Gardner Units) | | | | |
| 0 | 0 | 5 | 10 | 11 | 14 |
| 0.01 | 0 | 1 | 6 | 7 | 14 |
| 0.05 | 0 | 0 | 3 | 4 | 11 |
| 0.1 | 0 | 0 | 1 | 2 | 6 |

### Toward Oxidation

When AROCLOR compounds are heated to 140° C with oxygen in a bomb at 250 psi, no evidence of oxidation occurs, as judged by absence of sludge formation or increased acidity. Also, no increase in acidity occurred after 4 hours heating with air at 260°C and 210 psi.

## NONFLAMMABILITY

The viscous AROCLOR liquids and the resins do not support combustion when heated alone, even at their boiling points - above 350°C. Most of the AROCLOR compounds flux readily with resinous and pitch-like materials to give products with decreased fire hazard. AROCLOR products incorporated in plastic products and rubber foams retard the rate of burning.

## NON-DRYING PROPERTIES AND THERMOPLASTICITY

The AROCLOR compounds are non-drying. When exposed to the air, even in thin films, no noticable oxidation or hardening takes place. Despite this property, AROCLOR plasticizers do not retard the drying rate of lacquer films. Quick-drying varnishes and paints may be made with AROCLOR resins without affect on drying characteristics.

The AROCLOR plasticizers are permanently thermoplastic. They apparently undergo no condensation or hardening upon repeated melting and cooling. Clear AROCLOR resins are available with softening points up to 105°C. The opaque crystalline solids are available with melting points up to about 160°C.

## ELECTRICAL PROPERTIES

The electrical properties of AROCLOR compounds are extremely interesting: high resistivity and dielectric strength and low power factor, as listed in Table XVI. The dielectric constants of the various AROCLOR compounds range from 3.3 to 4.9 at 100° C and 1000 cycles.



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## TABLE XVI—ELECTRICAL PROPERTIES OF AROCLORS

| AROCLOR | Dielectric Constant (ASTM D-150-47T) 1000 cycles 25°C | 100°C | Volume Resistivity (ASTM D-257-46) 500 Volts D.C., 100°C (ohm-cm.) | Dielectric Strength (ASTM D-149-44) (KV) | Power Factor (ASTM D-150-47T) 1000 cycles, 100°C (%) |
|---|---|---|---|---|---|
| 1232 | 5.7 | 4.6 | | | |
| 1242 | 5.8 | 4.9 | Above 500 x $10^9$ | Above 35 | Below 0.1 |
| 1248 | 5.6 | 4.6 | Above 500 x $10^9$ | Above 35 | Below 0.1 |
| 1254 | 5.0 | 4.3 | Above 500 x $10^9$ | Above 35 | Below 0.1 |
| 1260 | 4.3 | 3.7 | Above 500 x $10^9$ | Above 35 | Below 0.1 |
| 1268 | 2.5 | | | | |
| 5442 | 3.0 | 4.9 | Above 500 x $10^9$ | | |
| 5454 | 2.7 | 4.2 | | | |
| 5460 | 2.5 | 3.7 | | | |
| 4465 | 2.7 | 3.3 | | | |

## HOW TO EMULSIFY AROCLORS

Emulsions of AROCLOR plasticizers can be made simply in several ways; the method can be selected to suit the particular AROCLOR and the type of formulation in which it will be used.

### Emulsifiable Concentrated Stock Solutions of Aroclors

Stock solutions made according to the following formulation are readily emulsified with water. The amount of toluene may be increased as needed to dissolve the more resinous AROCLOR compounds.

| Ingredient | Parts by Weight |
|---|---|
| AROCLOR | 79 |
| Toluene | 16.70 |
| Isopropanol | 3.55 |
| *Sterox** CD (nonionic emulsifier) | 1.00 |
| *Santomerse** #3 (anionic wetting agent) | 0.75 |

### Emulsifying Liquid Aroclors

| Ingredient | Parts by Weight |
|---|---|
| *Portion 1* | |
| AROCLOR 1254 | 100 |
| Oleic Acid | 4 |
| *Portion 2* | |
| Water | 100 |
| Ammonium Hydroxide (28%) | 2 |
| *Lustrex** X-810 Polystyrene | 2 |

*Sterox, Santomerse, and Lustrex: Monsanto Chemical Company Trademarks. Registered in U. S. Patent Office.



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Mix the polystyrene and ammonium hydroxide in warmed water with vigorous agitation. Mix the AROCLOR 1254 and oleic acid, heat to 45° C, and agitate vigorously. Maintain the 45° C temperature and agitation, and *slowly* add in the aqueous portion (Portion 2). Continue agitation for one-half hour until phase inversion is complete.

**Emulsifying Viscous Aroclors**

| Ingredient | Parts by Weight |
|---|---|
| *Portion 1* | |
| AROCLOR 1254 | 64 |
| Stearic Acid | 4 |
| *Portion 2* | |
| Water | 32 |
| Triethanolamine | 1 |

Heat the AROCLOR to a workable viscosity (180° F or higher) and stir in the stearic acid thoroughly. Heat the water almost to boiling (207° F) and stir in the triethanolamine thoroughly. Pour the AROCLOR-stearic acid portion into the water-triethanolamine portion with vigorous agitation. Process the combined portions either with a high-speed emulsifying stirrer or through a colloid mill.

## DERMATOLOGY AND TOXICOLOGY

At ordinary temperatures the AROCLOR chlorinated polyphenyls have not presented industrial toxicological problems. The hazard of potential toxic exposure varies with their volatility: the lower-chlorinated ones, being more volatile, present more of a potential problem from the standpoint of both inhalation and skin contact. When AROCLOR compounds are used at elevated temperatures, engineering controls must be applied, either by the use of closed systems or by effective local-exhaust ventilation together with general workroom exhaust.

Inhalation tests on animals indicate that the maximum safe concentration of vapor is in the range of from 0.5 to 1.0 milligram of the lower-chlorinated AROCLOR compounds per cubic meter of air. The threshold limits (maximum allowable concentration for an 8-hour working day) set by the American Conference of Government Hygienists are 1.0 milligram of the lower-chlorinated AROCLOR compounds per cubic meter of air and 0.5 milligram of the more-highly-chlorinated compounds, such as AROCLOR 1254, per cubic meter of air.

Schwartz patch tests on 200 volunteers showed that neither AROCLOR 1254 alone when applied to gauze nor a polyvinyl chloride film containing 11.5-weight-per cent AROCLOR 1254 was a primary irritant or a sensitizer. Canvas coated with an oil-modified alkyd resin (17-weight-per cent of the paint-film solids and 7-weight-per cent of the painted fabric was AROCLOR 5460) likewise did not produce primary skin irritancy or sensitization according to the same Schwartz technique.

Continuous or repeated skin contact with the AROCLOR compounds must be avoided because of the possible occurance of a condition called chloracne. Although reports of this condition caused by AROCLOR compounds are rare, it can be produced by excessive skin contact.



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## SAFE HANDLING

Vapor of the liquid AROCLOR compounds at room temperature should not be breathed in a confined space, and no vapor of any AROCLOR compound evolved at elevated temperatures should be allowed to be dispersed into the general workroom.

Continuous or repeated skin contact with the AROCLOR compounds must be avoided by the use of gloves and protective garments. If any AROCLOR is spilled on the skin, the skin should be washed in the usual manner with a soap solution.

A burn caused by contact with a hot AROCLOR should be treated like any ordinary burn. AROCLOR adhering to the burned area need not be removed immediately, unless treatment of the burn demands it, in which case either soap and water or repeated washings with a vegetable oil are recommended.

## SHIPPING

| | |
|---|---|
| **Freight Classification** | |
| AROCLOR 1221, 1243, 1242, 1248, 1254, 1260, 1262 | Synthetic Resin, Liquid, NOIBN |
| **Rail Classification** | |
| AROCLOR 1268, 2565, 4465, 5442, 5460 | Synthetic Resin, Other Than Liquid, NOIBN |
| **Truck Classification** | |
| AROCLOR 1268, 2565 | Synthetic Resin, Powder, NOI |
| AROCLOR 4465, 5442, 5460 | Synthetic Resin, Lumps or Solid Mass, NOI |
| **Shipping Regulations** | None |
| **Standard Containers** | |
| AROCLOR 1221 | Tank car, 520-lb. steel drum, 50-lb. can |
| AROCLOR 1232 | Tank car, 550-lb. steel drum, 50-lb. can |
| AROCLOR 1242, 1248, 1254, 1260, 1262 | Tank car, 600-lb. steel drum, 50-lb. can |
| AROCLOR 1268 | 200-lb. fiber drum, 50-lb. can |
| AROCLOR 2565, 4465 | 500-lb. steel drum, 50-lb. can |
| AROCLOR 5442 | 450-lb. steel drum, 50-lb. can |
| AROCLOR 5460 (flaked) | 100-lb. bag |

WFW: LSS 5M-12/60; 3M-3/62



DSW 442064

STLCOPCB4056599

AKRON
ATLANTA
BOSTON
CHICAGO
CINCINNATI
CLEVELAND
DETROIT
HOUSTON
LOS ANGELES
MINNEAPOLIS
NEW YORK
PITTSBURGH
SAN FRANCISCO
SEATTLE
SYRACUSE
WILMINGTON
MONSANTO CHEMICALS
MONSANTO CHEMICALS
(AUSTRALIA) LTD.
MONSANTO (CANADA) LTD.

Monsanto

MONSANTO CHEMICAL COMPANY
ORGANIC CHEMICALS DIVISION
ST. LOUIS, MISSOURI 63166

DSW 442065

STLCOPCB4056600

"This is an inorganic compound, containing toxic substances.
Handle carefully. Avoid prolonged contact with the skin. Avoid inhaling dust.
For use only in the Arts or Ceramic Industries."

B. F. DRAKENFELD & CO., INC.
45 - 47 Park Place New York 7, N. Y.

DSW 442066

Aroclor Sales To B. F. Drakenfeld

| | | |
|---|---|---|
| 1955 | A-1248 | |
| | A-1262 | - 2400# |
| | A-4465 | - 9000# |
| 1956 | A-1248 | - 450# |
| | A-1262 | - 3000# |
| | A-4465 | - 10,000# |
| 1957 | A-1248 | - 600# |
| | A-1262 | - 600# |
| | A-4465 | - 5100# |
| 1958 | A-1248 | - |
| | A-1262 | - |
| | A-4465 | - 8000# |
| 1959 | A-1248 | - |
| | A-1262 | - 600# |
| | A-4465 | - 10,000# |
| 1960 | A-1248 | - $1200# |
| | A-1262 | - 500# |
| | A-4465 | - 8000# |
| 1961 | - - | |
| 1962 | - - - | |

DSW 442067

STLCOPCB4056602

B-61

*This Package Contains*

AROCLOR

(A chlorinated diphenyl, technical)

AVOID REPEATED CONTACT WITH SKIN AND INHALATION OF THE FUMES AND DUSTS

AROCLOR labeling

← used from before May 2, 1947 on all aroclor drums + Packages.

CHLORINATED Diphenyl-TECH

CAUTION! AVOID PROLONGED OR REPEATED CONTACT WITH SKIN. AVOID PROLONGED BREATHING OF VAPOR AND FUMES.

← used when the trademarks Aroclor could not be used

The May 7, 59 dated label replaced these

The labels July 25, 60 + Oct 18, 61 read same as May 7, 59. Size change for print cost benefit!

May 7, 1959

CAUTION! CONTAINS CHLORINATED HYDROCARBONS

Avoid prolonged breathing of vapors or mists.

Avoid contact with eyes or prolonged contact with skin.

If skin contact occurs remove by washing with soap and water. Following eye contact flush with water.

If clothing becomes soaked with fluid, launder before wearing again.

Caution! Contains chlorinated hydrocarbons

Avoid prolonged breathing of vapors or mists.

Avoid contact with eyes or prolonged contact with skin.

If skin contact occurs, remove by washing with soap and water. Following eye contact flush with water.

If clothing becomes soaked with fluid, launder before wearing again.

Oct 18, 1961

Caution! Contains chlorinated hydrocarbons

Avoid prolonged breathing of vapors or mists.

Avoid contact with eyes or prolonged contact with skin.

If skin contact occurs, remove by washing with soap and water. Following eye contact flush with water.

If clothing becomes soaked with fluid, launder before wearing again.

Attachment to 16 (a)

DSW 442068

STLCOPCB4056603

| | | |
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| BESSIE T. BOYD<br><br>Plaintiff<br><br>vs.<br><br>B. F. DRAKENFELD & CO., INC., a corporation, and MONSANTO CHEMICAL COMPANY, a corporation<br><br>Defendants | ) | No. 607 February Term, 1964, A. D.<br>In Assumpsit |
| RUTH BRUNING<br><br>Plaintiff<br><br>vs.<br><br>B. F. DRAKENFELD & CO., INC., a corporation, and MONSANTO CHEMICAL COMPANY, a corporation<br><br>Defendants | ) | No. 608 February Term, 1964, A. D.<br>In Trespass |
| RUTH BRUNING<br><br>Plaintiff<br><br>vs.<br><br>B. F. DRAKENFELD & CO., INC., a corporation, and MONSANTO CHEMICAL COMPANY, a corporation<br><br>Defendants | ) | No. 609 February Term, 1964, A. D.<br>In Assumpsit |

DEFENDANT MONSANTO CHEMICAL COMPANY
PRE-TRIAL NARRATIVE STATEMENT

Plaintiffs allege that in the duties of their employment with the International Bent Glass Company in St. Louis, Missouri, they came into contact with a certain glass enamel known as 24-018 enamel in 487 oil, and that as a result thereof, they were affected by an acneiform skin condition which has resulted in the damages complained of in these lawsuits.

DSW 442069



STLCOPCB4056604

Plaintiffs allege that B. F. Drakenfeld & Co. manufactured these enamels and sold them to their employer, International Bent Glass Company. They allege that one of the ingredients in these enamels is a product known as Aroclor 4465, which was manufactured by Monsanto Chemical Company and sold by Monsanto to Drakenfeld. This enamel, containing the Aroclor compound, is alleged to be the cause of the Plaintiffs' skin conditions.

## A. THE ASSUMPSIT CASES

The pleadings establish that there was no privity of contract between the Plaintiffs and Monsanto (nor was there privity between the Plaintiffs and Drakenfeld). Monsanto made no express warranties to either these Plaintiffs or the public. Pennsylvania law requires privity of contract where breach of implied warranty is asserted in cases involving other than products produced for human consumption. Therefore, Plaintiffs cannot rely on any alleged breach of warranty and must prove negligence.

Monsanto therefore expects to make an appropriate motion to terminate the Assumpsit cases which have been filed against it.

## B. THE TRESPASS CASES

Plaintiffs allege that both Defendants knew and intended that the products in question would be used, handled, or touched by the consuming public, and that fumes therefrom would be inhaled by the public. This is categorically denied by Monsanto which did not know and did not intend that its product would be used by the public. Monsanto had never warranted that its Aroclor compound was fit and safe for use by the public generally and in fact has never attempted to sell Aroclor compounds to the general public.

Monsanto's Aroclor 4465 was sold to Drakenfeld in containers which



DSW 442070

STLCOPCB4056605

carried appropriate warnings and information as to its use. Monsanto had no control over the uses made of Aroclor 4465 by Drakenfeld; had no duty to ascertain to whom Drakenfeld would sell its products containing Aroclor 4465; and had no duty to warn either Drakenfeld's ultimate vendees or the employees of such vendees of the properties of the Aroclor compound nor of the properties of the Drakenfeld products.

Monsanto will establish that its labeling, the technical literature furnished to Drakenfeld, and the oral representations of its employees to Drakenfeld, clearly spelled out the toxicity of Aroclor compounds and warned against contact with the skin and inhalation of any vapor from the product. Monsanto will also establish that Drakenfeld similarily communicated appropriate warnings to International Bent Glass Company, a purchaser which was engaged in the ceramics industry, which had been engaged in it for many years, which knew of the Drakenfeld enamel's toxic properties, and which knew that proper safeguards of ventilation, protective apparel, etc. were advised. It is clear that the duty to warn is not as stringent where the product is marketed to purchasers with special training, knowledge and experience.

It is the position of Defendant Monsanto that the Plaintiffs' employer, International Bent Glass Company, was responsible for any negligence that may be found to exist. Monsanto will assert that these Plaintiffs, working together, had known for some years prior to the commencement of these lawsuits that the skin conditions complained of were caused by materials and conditions at their place of employment and that by failing to take corrective measures they assumed the risk which necessarily followed from continued employment in the surroundings existing in the International Bent Glass Company plant.

DSW 442071

C. EXPIRATION of the STATUTE OF LIMITATIONS

In most, if not all, of these cases, Defendant Monsanto expects to be



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able to prove that the Plaintiffs had sufficient information and reason to know that their skin conditions were being caused by elements and conditions existing at their place of employment; that they sought and received medical advice and treatment therefor; and that all of this occurred more than five years prior to the filing of these suits. Monsanto will thereby establish that the applicable Statute of Limitations has expired, and that the causes of action are fully barred under applicable Missouri law.

LIABILITY WITNESSES:

1. Any or all of the persons identified in Monsanto's Answers to Plaintiffs' Interrogatories.

2. Any or all of the persons identified in the pleadings, discovery, or Pre-Trial Statements.

3. Present employees of Monsanto who may have replaced any of the above persons because of retirement, change of job, incapacity, or death.

MEDICAL WITNESSES:

Defendant reserves the right to have Plaintiffs examined by a qualified medical specialist prior to trial.

DOCUMENTS:

1. Any or all of the documents furnished to the Plaintiffs in response to and in connection with Plaintiffs' Interrogatories.

2. Aroclor labels.

3. Depositions of Monsanto Chemical Company by James D. Wright, and of B. F. Drakenfeld & Co., by Ray Andrews and Scott J. Courtney, taken by Plaintiff Dorothy Berry in New York City on August 5 and 6, 1963, for a suit then pending in Circuit Court of the City of St. Louis, Missouri.

SCHMIDT & ALLISON

DSW 442072

By

DATED: May 23, 1967.

Attorneys for Monsanto Chemical Company

| | | |
|---|---|---|
| RUTH BRUNING, Plaintiff, vs. B. F. DRAKENFELD & CO., INC., a corporation, and MONSANTO CHEMICAL COMPANY, a corporation, Defendants. | : | NO. 608 FEBRUARY TERM, 1964, A. D. In Trespass<br>NO. 609 FEBRUARY TERM, 1964, A. D. In Assumpsit |

PRE-TRIAL STATEMENT
OF B. F. DRAKENFELD & CO., INC.

A. NARRATIVE:

B. F. Drakenfeld & Co., Inc., was a manufacturer of inorganic colors in the years from 1951 to 1962, inclusive. Its head offices were in New York, New York. It owned and operated a manufacturing plant in Canton Township, Washington County, Pennsylvania. It is now a Division of Hercules, Incorporated.

In the years pertinent to these lawsuits B. F. Drakenfeld & Co., Inc. manufactured various inorganic colors used in the ceramic and glass industries. Among these was a high fire glass enamel paste composed in part of a printing vehicle known to Drakenfeld as Squeegee Oil Number 487. One of the ingredients of Squeegee Oil Number 487 was Aroclor Number 4456, a product manufactured by Monsanto Chemical Company and purchased from it by Drakenfeld.

Drakenfeld made no changes in Aroclor Number 4456 after it was delivered to it other than to combine it with other chemicals to form Squeegee Oil Number 487. This was done by subjecting the ingredients to heat and milling.

Drakenfeld has sold glass enamel colors to International Bent Glass Company for many years. International Bent Glass Company is located in St. Louis, Missouri and is a manufacturer of glass light shades. In the years from 1951 to 1962, inclusive, all of the colors sold by Drakenfeld to International

DSW 442073

STLCOPCB4056608

Bent Glass Company contained Squeegee Oil Number 487.

Colors containing Squeegee Oil Number 487 were widely used in the glass and ceramics industry from and after 1940. Eliminating the plaintiffs, none of Drakenfeld's customers or their employees suffered any ill effects from its use. Drakenfeld's own employees were exposed to it and suffered no ill effects.

All of the shipments of colors made by Drakenfeld to International Bent Glass Company bore the label of which a copy is enclosed.

3. WITNESSES:

1. Liability:

Victor N. Remington, Manager
Drakenfeld Division of Hercules, Incorporated
West Wylie Avenue
Washington, Pennsylvania

J. A. Stewart
Drakenfeld Division of Hercules, Incorporated
West Wylie Avenue
Washington, Pennsylvania

Ray Andrews
Drakenfeld Division of Hercules, Incorporated
West Wylie Avenue
Washington, Pennsylvania

John N. Porter
Drakenfeld Division of Hercules, Incorporated
West Wylie Avenue
Washington, Pennsylvania

Kennedy Jenkins
Drakenfeld Division of Hercules, Incorporated
West Wylie Avenue
Washington, Pennsylvania

Irwin F. Zeiller
150 Mason Drive
Manhasset, New York

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2. Medical:

None

The defendant, B. F. Drakenfeld & Co., Inc., reserves the right to request an examination of the plaintiffs by a physician of its choice when the plaintiffs come to Washington, Pennsylvania to attend the trial.

3. Condition:

None

D. OUT-OF-POCKET LOSS:

None of the out-of-pocket loss claimed by the plaintiffs is admitted; proof of all of it is demanded.

PATRONO, CEISLER AND EDWARDS

By /s/ Francis E. Patrono
Attorneys for B. F. Drakenfeld
& Co., Inc., one of the defendants

DSW 442075

"This is an inorganic compound, containing toxic substances.
Handle carefully. Avoid prolonged contact with the skin. Avoid inhaling dust.
For use only in the Arts or Ceramic Industries."

**B. F. DRAKENFELD & CO., INC.**

45 - 47 Park Place New York 7, N. Y.

DSW 442076

STLCOPCB4056611

IN THE COURT OF COMMON PLEAS OF WASHINGTON COUNTY, PENNSYLVANIA

| | |
|---|---|
| MILDRED BARRETT<br>Plaintiff<br>vs.<br>B. F. DRAKENFELD & CO., INC., a corporation, and MONSANTO CHEMICAL COMPANY, a corporation<br>Defendants | No. 518 February Term, 1964, A. D.<br>In Assumpsit |
| MILDRED BARRETT<br>Plaintiff<br>vs.<br>B. F. DRAKENFELD & CO., INC. a corporation, and MONSANTO CHEMICAL COMPANY, a corporation<br>Defendants | No. 519 February Term, 1964, A. D.<br>In Trespass |
| DOROTHY BERRY<br>Plaintiff<br>vs.<br>B. F. DRAKENFELD & CO., INC. a corporation, and MONSANTO CHEMICAL COMPANY, a corporation<br>Defendants | No. 520 February Term, 1964, A. D.<br>In Assumpsit |
| DOROTHY BERRY<br>Plaintiff<br>vs.<br>B. F. DRAKENFELD & CO., INC. a corporation, and MONSANTO CHEMICAL COMPANY, a corporation<br>Defendants | No. 521 February Term, 1964, A. D.<br>In Trespass |
| WALTER F. MILLER<br>Plaintiff<br>vs.<br>B. F. DRAKENFELD & CO., INC. a corporation, and MONSANTO | DSW 442077<br>No. 522 February Term, 1964, A. D.<br>In Assumpsit |

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| WALTER F. MILLER<br><br>Plaintiff<br><br>vs.<br><br>B. F. DRAKENFELD & CO., INC., a corporation, and MONSANTO CHEMICAL COMPANY, a corporation<br><br>Defendants | ) | No. 523 February Term, 1964, A. D.<br>In Trespass |
| HAZEL SCHNEIDER<br><br>Plaintiff<br><br>vs.<br><br>B. F. DRAKENFELD & CO., INC., a corporation, and MONSANTO CHEMICAL COMPANY, a corporation<br><br>Defendants | ) | No. 524 February Term, 1964, A. D.<br>In Assumpsit |
| HAZEL SCHNEIDER<br><br>Plaintiff<br><br>vs.<br><br>B. F. DRAKENFELD & CO., INC., a corporation, and MONSANTO CHEMICAL COMPANY, a corporation<br><br>Defendants | ) | No. 525 February Term, 1964, A. D.<br>In Trespass |
| CHARLOTTE SHOEMAKER<br><br>Plaintiff<br><br>vs.<br><br>B. F. DRAKENFELD & CO., INC., a corporation, and MONSANTO CHEMICAL COMPANY, a corporation<br><br>Defendants | ) | No. 526 February Term, 1964, A. D.<br>In Assumpsit |
| CHARLOTTE SHOEMAKER<br><br>Plaintiff<br><br>vs.<br><br>B. F. DRAKENFELD & CO., INC., a corporation, and MONSANTO CHEMICAL COMPANY, a corporation | ) | No. 527 February Term, 1964, A. D.<br>In Trespass |

DSW 442078

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| RONALD SIMPSON<br><br>Plaintiff<br><br>vs.<br><br>B. F. DRAKENFELD & CO., INC., a corporation, and MONSANTO CHEMICAL COMPANY, a corporation<br><br>Defendants | No. 528 February Term, 1964, A.D.<br>In Assumpsit |
| RONALD SIMPSON<br><br>Plaintiff<br><br>vs.<br><br>B. F. DRAKENFELD & CO., INC., a corporation, and MONSANTO CHEMICAL COMPANY, a corporation<br><br>Defendants | No. 529 February Term, 1964, A.D.<br>In Trespass |
| MARTHA SYLER<br><br>Plaintiff<br><br>vs.<br><br>B. F. DRAKENFELD & CO., INC., a corporation, and MONSANTO CHEMICAL COMPANY, a corporation,<br><br>Defendants | No. 530 February Term, 1964, A.D.<br>In Assumpsit |
| MARTHA SYLER<br><br>Plaintiff<br><br>vs.<br><br>B. F. DRAKENFELD & CO., INC., a corporation, and MONSANTO CHEMICAL COMPANY, a corporation<br><br>Defendants | No. 531 February Term, 1964, A.D.<br>In Trespass |

DSW 442079

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| JAMES A. WHITE<br><br>Plaintiff<br><br>vs.<br><br>B. F. DRAKENFELD & CO., INC., a corporation, and MONSANTO CHEMICAL COMPANY, a corporation<br><br>Defendants | ) | No. 532 February Term, 1964, A. D.<br>In Assumpsit |
| JAMES A. WHITE<br><br>Plaintiff<br><br>vs.<br><br>B. F. DRAKENFELD & CO., INC., a corporation, and MONSANTO CHEMICAL COMPANY, a corporation<br><br>Defendants | ) | No. 533 February Term, 1964, A. D.<br>In Trespass |
| THELMA WIENERS<br><br>Plaintiff<br><br>vs.<br><br>B. F. DRAKENFELD & CO., INC., a corporation, and MONSANTO CHEMICAL COMPANY, a corporation<br><br>Defendants | ) | No. 534 February Term, 1964, A. D.<br>In Assumpsit |
| THELMA WIENERS<br><br>Plaintiff<br><br>vs.<br><br>B. F. DRAKENFELD & CO., INC., a corporation, and MONSANTO CHEMICAL COMPANY, a corporation<br><br>Defendants | ) | No. 535 February Term, 1964, A. D.<br>In Trespass |
| MARY CHAPMAN<br><br>Plaintiff<br><br>vs.<br><br>B. F. DRAKENFELD & CO., INC., a corporation, and MONSANTO CHEMICAL COMPANY, a corporation<br><br>Defendants | ) | No. 536 February Term, 1964, A. D.<br>In Assumpsit |

DSW 442080

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| MARY CHAPMAN<br><br>Plaintiff<br><br>vs.<br><br>B. F. DRAKENFELD & CO., INC., a corporation, and MONSANTO CHEMICAL COMPANY, a corporation<br><br>Defendants | No. 537 February Term, 1964, A. D.<br>In Trespass |
| MARIE CLIFFORD<br><br>Plaintiff<br><br>vs.<br><br>B. F. DRAKENFELD & CO., INC., a corporation, and MONSANTO CHEMICAL COMPANY, a corporation<br><br>Defendants | No. 538 February Term, 1964, A. D.<br>In Assumpsit |
| MARIE CLIFFORD<br><br>Plaintiff<br><br>vs.<br><br>B. F. DRAKENFELD & CO., INC., a corporation, and MONSANTO CHEMICAL COMPANY, a corporation<br><br>Defendants | No. 539 February Term, 1964, A. D.<br>In Trespass |
| THEODORE CZARNECKI<br><br>Plaintiff<br><br>vs.<br><br>B. F. DRAKENFELD & CO., INC., a corporation, and MONSANTO CHEMICAL COMPANY, a corporation<br><br>Defendants | No. 540 February Term, 1964, A. D.<br>In Assumpsit |
| THEODORE CZARNECKI<br><br>Plaintiff<br><br>vs.<br><br>B. F. DRAKENFELD & CO., INC., a corporation, and MONSANTO CHEMICAL COMPANY, a corporation<br><br>Defendants | No. 541 February Term, 1964, A. D.<br>In Trespass |

DSW 442081

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| RITA B. KING<br><br>Plaintiff<br><br>vs.<br><br>B. F. DRAKENFELD & CO., INC., a corporation, and MONSANTO CHEMICAL COMPANY, a corporation<br><br>Defendants | ) | No. 542 February Term, 1964, A. D.<br>In Assumpsit |
| RITA B. KING<br><br>Plaintiff<br><br>vs.<br><br>B. F. DRAKENFELD & CO., INC., a corporation, and MONSANTO CHEMICAL COMPANY, a corporation<br><br>Defendants | ) | No. 543 February Term, 1964, A. D.<br>In Trespass |
| VERGEL A. MANESS<br><br>Plaintiff<br><br>vs.<br><br>B. F. DRAKENFELD & CO., INC., a corporation, and MONSANTO CHEMICAL COMPANY, a corporation<br><br>Defendants | ) | No. 544 February Term, 1964, A. D.<br>In Assumpsit |
| VERGEL A. MANESS<br><br>Plaintiff<br><br>vs.<br><br>B. F. DRAKENFELD & CO., INC., a corporation, and MONSANTO CHEMICAL COMPANY, a corporation<br><br>Defendants | ) | No. 545 February Term, 1964, A. D.<br>In Trespass |
| BESSIE T. BOYD<br><br>Plaintiff<br><br>vs.<br><br>B. F. DRAKENFELD & CO., INC., a corporation, and MONSANTO CHEMICAL COMPANY, a corporation<br><br>Defendants | ) | No. 606 February Term, 1964, A. D.<br>In Trespass |

DSW 442082

STLCOPCB4056617

NARRATIVE WRITTEN STATEMENT OF THE FACTS

Plaintiff is an individual who is a resident of the City of St. Louis, Missouri.

Defendant, B. F. Drakenfeld & Company, hereinafter referred to as "Drakenfeld", is a New York corporation, which maintains its manufacturing facilities in Washington County, Pennsylvania.

Defendant Monsanto is a Delaware corporation, which is duly licensed to do business as a foreign corporation in Pennsylvania.

Among the products manufactured by Drakenfeld are high-fire glass enamels dispersed in squeege oil. These high-fire glass enamels are intended for application to glass fixtures by means of a silk screen process. Among the principal ingredients used by Drakenfeld in the preparation of its high-fire glass enamels are substances called arochlor compounds which are manufactured and supplied to Drakenfeld by Monsanto.

During the period of time involved in this litigation, plaintiff was an employee of the International Bent Glass Company, a Missouri corporation which operates a plant in the City of St. Louis, Missouri. International Bent Glass Company was engaged in the business of manufacturing ornamental bent glass components for lighting fixtures.



DSW 442083

STLCOPCB4056618

The manufacturing operation included cutting and boring holes in the glass, applying high-fire glass enamels to the glass by a silk screen process, baking and shaping the glass in a high temperature oven, and frosting and packaging the completed product.

International Bent Glass Company purchased its high-fire glass enamels from Drakenfeld. This product, known as Squeege Oil 437, contained a large percentage of Monsanto's arochlor 4465, a blend of chlorinated napthalenes and phenyls, 65% chlorinated. The enamel, after being thinned, was applied through a silk screen to the glass in various ornamental designs. The painted glass was then partially dried by air and placed on top of a metal mold that was slowly conveyed through a long oven. The temperature of the oven, 1200 to 1400 degrees F., baked the painted design onto the glass and simultaneously softened the glass sufficiently so that it flowed down into and thus conformed to the shape of the metal mold on which it was placed. As the final step, the glass was frosted by a sandblasting machine. The oven and the sandblasting machine had separate exhausts, and the sandblasting machine was bagged.

Some time in 1958, the plaintiff was affected with an acneiform eruption. It consisted of yellowish-white papules and



DSW 442084

STLCOPCB4056619

cysts on the face, neck and on the covered parts of the body at the various sites of friction with clothes. Comedomes and inflammatory lesions were present.

An investigation was commenced to determine the cause of the skin condition of the plaintiff and the other employees in the plant, most of whom were also affected in similar fashion. Several dermatologists were employed to render treatment to the affected employees and to discover the cause of their ailments. The best efforts of these experts did not lead to the discovery of the cause of the skin disease of the workers which persisted over the years. It was not until the summer of 1962, following an inspection on March 12th and 13, 1962, by Dr. Donald J. Birmingham and Marcus M. Key of the Occupational Health Research and Training Facility, Division of Occupational Health, Public Health Service, that the cause of the workers' skin disease was discovered. The cause was determined by these Public Health Service experts to be the arochlor compounds used in the high-fire glass enamel of Drakenfeld. As a result of that report and the recommendations it contained, the use of Drakenfeld's high-fire glass enamel was discontinued in the operation of International Bent Glass Company's manufacturing process.



DSW 442085

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Arochlor compounds are a blend of chlorinated napthalenes and chlorinated phenyls. During the years involved in this litigation and for many years prior, there was a general agreement within the medical profession that arochlor compounds were highly toxic substances which required careful management and handling. They were known to cause acneiform eruptions of the skin, known as chloracne, the precise skin disease from which the plaintiff and the other employees suffered. The inhaling or ingestion of vapor from arochlor compounds was known to cause definite systemic effects.

During the years involved in this litigation and for many years prior, the medical and technical literature contained many articles setting forth these toxic properties of arochlor compounds. This literature also contained many articles in which methods were set forth to safeguard industrial workers who used products containing arochlor compounds in the course of their employment.

The medical and technical literature specifically stated that the use of arochlor compounds at high temperatures should be accompanied by a program for the prevention of occupational acnes, which can be divided into (1) general measures, (2) personal measures, and (3) medical measures:



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1. The heating of the compounds should be done in enclosed processes so that the fumes do not come in contact with the workers, and ventilating apparatus to carry off the fumes is needed.

2. The workers should be provided with clean coveralls and underclothes daily. These should be laundered at the plant and cleaned in such a way that none of the compound remains on them. Shower baths after work should be compulsory and supervised, and there should be sufficient shower facilities provided so that the workers are not unduly delayed after work. Suitable cleaners should be provided to efficiently remove the compounds from the skin. If exposure of the face and neck to fumes or contact with soiled hands is unavoidable, transparent hoods covering the heads and neck can be provided. These can be made of cellophane, pliofilm, or other transparent resin film. If for any reason these cannot be had, protective ointments of the invisible glove type may be used.

(3) Periodic liver function tests should be performed every month on the workers. In addition to this, monthly dermatologic examinations should be made to detect early evidence of acne.

Drakenfled began to purchase arochlor compounds from Monsanto in 1940 and thereupon commenced using these compounds in



DSW 442087

STLCOPCB4056622

its high-fire glass enamels. Drakenfeld commenced selling its high-fire glass enamels to International Bent Glass Company sometime prior to 1955 and continued to supply these products to International Bent Glass Company until discontinuation by International in 1962 after the Public Health Service report. A representative of Drakenfeld tested its high-fire glass enamel containing arochlor compound in the equipment of International Bent Glass Company and recommended to International that this product be used. Pursuant to that recommendation International began the use of the product.

Drakenfeld has never made a study of the applicable literature to determine whether or not the arochlor compounds in its high-fire glass enamels could cause injury or disease to industrial workers using these high-fire glass enamels in the course of their work, nor has Drakenfeld ever caused such a study to be made.

Drakenfeld has never given any specific warning to International Bent Glass Company with regard to the toxic characteristics of its product, either orally or in its literature. Drakenfeld conducts no research at all with regard to the toxic characteristics of any of its products. Drakenfeld has never given any recommendations or instructions to International Bent Glass Company with regard to specific precautions to be taken with regard to the use of its products, either



DSW 442088

STLCOPCB4056623

orally or in its literature. The labeling on Drakenfeld's product does not disclose that arochlor compounds are an ingredient in its high-fire glass enamels. In effect, the labeling on Drakenfeld's high-fire glass enamel merely warns in broad and general terms against prolonged contact with the skin and inhalation of any vapor from the product.

Monsanto has done research with regard to the toxic characteristics of the arochlor compounds which it produces. Monsanto was aware that the arochlor compound which it sold to Drakenfeld was to be used in high-fire glass enamels and subjected to high temperatures in the hands of the ultimate consumers. Monsanto never made any recommendations or issued any instructions to International Bent Glass Company with regard to specific precautions to be taken by ultimate consumers of Drakenfeld's products, either orally or in its literature. No recommendations were made by Monsanto to Drakenfeld with regard to labeling. Although the technical literature of Monsanto referred from time to time to the toxicity of arochlor compounds, and that was furnished to Drakenfeld, that literature minimized the real risks of use of arochlor compounds and made no specific recommendations as to use and handling. In effect, the references in Monsanto's



DSW 442089

STLCOPCB4056624

literature to arochlor compounds merely warned in broad and general terms against prolonged contact with the skin and inhalation of any vapor from the product.

Arochlor compounds are products which are unreasonably dangerous to the user or consumer unless adequate and full warning accompany them. The state of the available medical and scientific knowledge is such that both Monsanto and Drakenfeld should have known this and taken the necessary precautions to protect the ultimate consumers. This neither defendant did.

The defendants have heretofore required the plaintiff to answer interrogatories, and in connection therewith, medical reports were attached to the answers to interrogatories. It is suggested that it would serve no useful purpose to attach medical reports to this Narrative, since they are already a matter of record.

Respectfully submitted,

ZEMAN AND ZEMAN

Adolph W. Zeman

Attorneys for Plaintiff



DSW 442090

STLCOPCB4056625

PLAINTIFFS' SUPPLEMENTAL NARRATIVE STATEMENT

Liability Witnesses:

Dr. Donald J. Birmingham, or Dr. Marcus M. Key
1014 Broadway, Cincinnati 2, Ohio

Herman Goralnik
1825 North 19th Street, St. Louis, Missouri

Ray Andrews
45 Park Place, New York, N Y.

Respective plaintiffs

Medical Witnesses:

Dr. James C. Sisk
141 North Meramec Avenue
Clayton, Missouri

Condition Witnesses:

Respective plaintiffs

Medical Reports are attached

Hospital Authorizations:

Leave is requested to furnish the same when available

List of Damages:

Permanent personal injuries, including disfigurement.

Loss of wages to date and future impairment of earning power.

Cost of medical care and treatment, including medicines.

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See consolidated out-of-pocket statement attached. It will be noted that some bills have not as yet been made available to plaintiffs and leave is requested to set forth the same when received. The addresses of the physicians and pharmacies referred to on the consolidated out-of-pocket statement are as follows:

Drs. Edward F. Burkhart, William T. Stryker and Oliver A. McKee, Missouri Theatre Building, St. Louis, Missouri

Dr. William A. Knight, Jr., 6744 Clayton Road, St. Louis, Missouri

Dr. James H. Allen, 634 N. Grand Street, St. Louis, Missouri

Dr. A. H. Conrad, 911 S. Brentwood Boulevard, St. Louis, Missouri

Dr. Louis Keller, 35 N. Central, St. Louis, Missouri

Dr. Arthur Wright Neilson, 3720 Washington St., St. Louis, Missouri

Dr. Castrina - address unknown at present

Dr. F. G. Pernoud, Missouri Theatre Building, St. Louis, Missouri

Dr. Cecila Reichert, 16 Hampton Village Plaza, St. Louis, Missouri

Dr. James Sisk, 141 N. Meramec Avenue, Clayton, Missouri

Dr. Clyde R. Milster - Frisco Building, St. Louis, Missouri

Johannes-Tate Pharmacy, 636 N. Grand St., St. Louis, Missouri

Antles Madison Street Pharmacy, 1901 Madison St., St. Louis, Missouri

L. Weitzman Prescription Pharmacy, 3552 Washington St., St. Louis, Missouri

Allen Medical Laboratories, 634 N. Grand St., St. Louis, Missouri

Beaumont Pharmacy, 3722 Washington St., St. Louis, Missouri

ZEMAN AND ZEMAN

Rudolph P. Zeman

Attorneys for Plaintiffs



DSW 442092

STLCOPCB4056627

[illegible] C. [illegible], M. D.
[illegible]
[illegible]
[illegible]
[illegible]

DECEMBER 10, 1962

MR. REXFORD CARUTHERS
430 PAUL BROWN BUILDING
ST. LOUIS 1, MISSOURI

RE: MRS. MILDRED BARRETT
EMPLOYEE: INTERNATIONAL BENT GLASS

DEAR MR. CARUTHERS:

YOUR CLIENT MRS. MILDRED BARRETT, AN EMPLOYEE OF INTERNATIONAL BENT GLASS COMPANY WAS SEEN IN MY OFFICE TODAY AND THE FOLLOWING HISTORY AND PHYSICAL FINDINGS WERE ELICITED AT THIS TIME.

MRS. BARRETT STATED THAT SHE BEGAN WORKING AT INTERNATIONAL BENT GLASS IN SEPTEMBER OF 1958 DOING VARIOUS JOBS, ALL OF WHICH REQUIRED EXPOSURE TO PAINT AND OIL FUMES FROM THE OVENS AT WORK. IN LATE 1959 SHE BEGAN TO DEVELOP BLACKHEADS ON THE CHEEKS AND APPROXIMATELY ONE YEAR LATER, BEGAN TO DEVELOP A FEW ON THE CHEST. SHE HAS BEEN UNDER TREATMENT BY DR. OLIVER MC KEE ON SEVERAL OCCASIONS SINCE 1960. SHE LAST SAW HIM IN 1961 AND HAS HAD NO PROFESSIONAL CARE SINCE THAT TIME. THERE HAVE BEEN NO EYE LESIONS. SHE HAS CONTINUED TO GET THE SAME NUMBER OF NEW LESIONS EVEN SINCE A CHANGE OF OIL IN THE PAINT IN JANUARY OF 1962.

PAST HISTORY REVEALED THAT MRS. BARRETT IS TAKING HIGH BLOOD PRESSURE MEDICINE FROM DR. D.E. KILKER. THERE WAS NO HISTORY OF ALLERGY TO MEDICATION AND SHE DENIES ANY HISTORY OF ACNE DURING HER ADOLESCENT YEARS.

PHYSICAL EXAMINATION REVEALED MANY BLACKHEADS, MAINLY OVER THE TEMPLES AND CHEEKS. THERE WERE A FEW BEHIND THE EARS AND ON THE MID-CHEST. THERE WERE NO CYSTIC LESIONS; THERE WERE NO EYE LESIONS.

IN MY OPINION, MRS. BARRETT HAS A BLACKHEAD ACNE FORM ERUPTION

CONFIDENTIAL PRIVILEGED INFORMATION SENSITIVE OR
RELATED DATABASE

DSW 442093

STLCOPCB4056628

RE: MRS. MILRED BARRETT

DUE TO THE OIL AND PAINT FUMES SHE IS EXPOSED TO AT WORK. SHE HAS BEEN ADVISED THAT FURTHER PROFESSIONAL CARE MIGHT BE HELPFUL IN CLEARING HER CONDITION. IT IS MY OPINION THAT IT IS ALMOST IMPOSSIBLE TO CLEAR THESE PATIENTS WHILE THEY CONTINUE TO WORK IN THE ADVERSE ENVIRONMENT. I WOULD ALSO SUGGEST THAT MRS. BARRETT HAVE ROUTINE LIVER FUNCTION TESTS.

PLEASE FEEL FREE TO CONTACT ME, IF YOU REQUIRE ANY FURTHER INFORMATION CONCERNING MRS. BARRETT'S CASE.

VERY TRULY YOURS,

JAMES C. SISK, M.D.

JCS:IB

DSW 442094

STLCOPCB4056629

Barrett, et al. vs. Monsanto Chemical
P442-20395R and PD831-9416

not the treating physician in any case and his testimony would be subject to criticism and censure on that account. There are a certain line of cases in Pennsylvania which hold that the Plaintiff has not met the burden imposed upon the Plaintiff if they fail to call the treating physician, and rely solely on the testimony of a doctor who has merely examined the Plaintiff for the purpose of trial. For these reasons, we think at the present time that we may be ahead medically on these cases, and we have not arranged any further medical examination of these Plaintiffs by a doctor of our choice because if we did so by a doctor here in Washington, we would be merely furnishing the Plaintiff with medical material which he now does not have.

These cases are now set for Pre-Trial before the Court Administrator on June 21 at 9:30 a.m. We will advise you further of any happenings that may occur in the meantime. We would also be glad to give you any information which you think may be necessary for you and which you do not have.

Very truly yours,

H Gelmore Schmidt

HGS:wm

Enclosures 4

cc: Morris E. Stokes, Esquire
Mr. Charles Bovard

DSW 442095

WILLIAM O. SHAW M. D.
CLAYTON CENTRAL BUILDING
110 SOUTH CENTRAL AVENUE
CLAYTON 5, MISSOURI
TELEPHONE PA 5-7007

NOVEMBER 29, 1962

MR. REXFORD CARUTHERS
430 PAUL BROWN BUILDING
ST. LOUIS 1, MISSOURI.

RE: MRS. DORTHA BERRY
EMPLOYEE: INTERNATIONAL BENT GLASS CO.,

DEAR MR. CARUTHERS:

YOUR CLIENT, MRS. DORTHA BERRY, AN EMPLOYEE OF THE INTERNATIONAL BENT GLASS COMPANY WAS SEEN IN MY OFFICE ON NOVEMBER 28, 1962 AND THE FOLLOWING HISTORY AND PHYSICAL FINDINGS WERE ELICITED AT THAT TIME.

MRS. BERRY STATED THAT SHE HAD STARTED WORKING AT THE INTERNATIONAL BENT GLASS COMPANY IN JANUARY OF 1955-WORKING THE SANDING MACHINE AND PACKING. IN THIS JOB SHE WAS EXPOSED TO THE FUMES FROM THE BAKING OVENS. IN JUNE OR JULY OF 1955 SHE NOTE THE ONSET OF A BREAKING OUT ON HER FACE, ARMS AND SHOULDERS WHICH CONSISTED MAINLY OF SMALL CYSTS OR BUMPS BENEATH THE SKIN AND BLACKHEADS ON THE SURFACE OF THE SKIN, PARTICULARLY AROUND THE EYES. SHE TREATED THESE HERSELF WITH NORZEMA AND EXPRESSIONS OF THE MATERIAL FROM THE CYSTS UNTIL LATE IN 1957 WHEN SHE WAS SENT TO SEE DR. ARTHUR NEILSEN. HE TREATED HER FOR APPROXIMATELY ONE YEAR WITH SOAKS, SHOTS AND A LOCAL MEDICATION PLUS PILLS BY MOUTH. HER CASE WAS THEN TRANSFERRED BY THE INSURANCE COMPANY TO THE OFFICE OF DRS. BURKHARDT AND MCKEE WHERE SHE HAS REMAINED UNDER TREATMENT UNTIL THE PRESENT TIME, RECEIVING SHOTS, USING A LOTION, TAKING A CAPSULE BY MOUTH, WEARING A PROTECTIVE CREAM AT WORK AND TAKING A PILL BEFORE HER PERIOD TO PREVENT THE FLARE AT THAT TIME. IN ADDITION, DRS. BURKHARDT AND MCKEE HAVE OPENED AND EXCISED CYSTS AS THEY HAVE DEVELOPED. AT THE PRESENT TIME SHE HAS A CYST ON HER LIP AND ONE ON HER CHEST WHICH THEY PLAN TO REMOVE SHORTLY.

SUPPLEMENTAL PRE-TRIAL NARRATIVE STATEMENT

OF DORTHA BERRY

DSW 442096

RE: MRS. DORTHA BERRY
EMPLOYER: INTERNATIONAL BENT GLASS CO.,

MRS. BERRY STATED THAT SHE WORKED MAINLY AS A PACKER FOR THE PAST FIVE YEARS BUT DURING HER WHOLE EMPLOYMENT HAS BEEN EXPOSED TO THE OIL AND PAINT FUMES FROM THE BAKING OVENS AT WORK. IN ADDITION FOR THE PAST FIVE TO SIX MONTHS SHE HAS BEEN EXPOSED TO A BLACK DUST FROM A BUFFING MACHINE AND SHE FEELS THAT IT MAY BE LIKELY THAT THIS HAS ADDED TO THE AGGRAVATION. AT ANY RATE SHE IS CONTINUING TO GET "AS MANY, IF NOT MORE BLACKHEADS" SINCE A CHANGE WAS MADE IN THE OIL IN THE PAINT AT WORK IN JANUARY OF 1962.

PAST HISTORY REVEALS NO PRIOR ACNE-LIKE ERUPTION IN HER TEENS. HER GENERAL HEALTH HAS BEEN GOOD.

PHYSICAL EXAMINATION REVEALED MANY LARGE BLACKHEADS ON THE FACE, GREATER OVER THE CHEEK BONES AND CHIN, WITH A FEW SMALL SEBACEOUS CYSTS ON THE LOBES OF THE EARS, A LARGE SEBACEOUS CYST ON THE LEFT LOWER LIP AND ON THE LEFT CROWN. THERE WERE MANY SMALL COMEONES AND CYSTS BENEATH THE BRA STRAPS AND WHERE THE CLOTHING WAS TIGHT AROUND THE BRA, BENEATH THE BREASTS AND ALONG THE BELT LINE. THERE WERE SIMILAR LESION IN THE CRURAL AREA AND OVER THE BUTTOCKS. ONE OF THE CYSTS ON THE MID CHEST WAS INFECTED. THERE WERE NO LESIONS IN THE EYES.

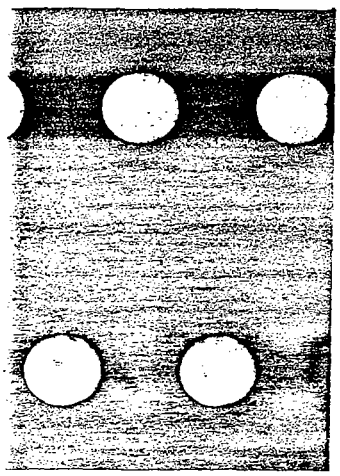
IN MY OPINION MRS. BERRY HAS A BLACKHEAD ACNEIFORM ERUPTION WITH SEBACEOUS CYSTS SECONDARY TO THE PAINT AND OIL FUMES TO WHICH SHE IS EXPOSED AT WORK AT THE INTERNATIONAL BENT GLASS COMPANY. I WOULD RECOMMEND THAT SHE CONTINUE TREATMENT WITH DRS. BURKHARDT AND MCKEE AND, IN LIGHT OF THE POSSIBILITY OF ASSOCIATED LIVER TOXICITY, THAT LIVER FUNCTION TESTS BE DONE SOMETIME IN THE NEAR FUTURE.

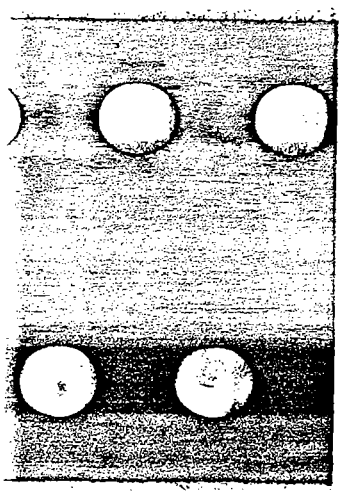
PLEASE FEEL FREE TO CONTACT ME, IF YOU HAVE ANY OTHER QUESTIONS CONCERNING MRS. BERRY'S CASE.

VERY TRULY YOURS,

JAMES C. SISK, M.D.

JCS:ib





DSW 442097

STLCOPCB4056632

[illegible] M. D.
CLAYTON CENTRAL BUILDING
[illegible] SOUTH CENTRAL AVENUE
CLAYTON 5, MISSOURI
TELEPHONE PA 2-7507

DECEMBER 11, 1962

MR. REXFORD CARUTHERS
430 PAUL BROWN BUILDING
ST. LOUIS 1, MISSOURI

RE: MR. WALTER MILLER
EMPLOYEE: INTERNATIONAL BENT GLASS CO.

DEAR MR. CARUTHERS:

YOUR CLIENT, MR. WALTER MILLER, AN EMPLOYEE OF INTERNATIONAL BENT GLASS COMPANY WAS SEEN BY ME IN MY OFFICE TODAY AND THE FOLLOWING HISTORY AND PHYSICAL FINDINGS WERE ELICITED AT THAT TIME.

MR. MILLER STATED THAT HE HAD STARTED WORKING AT INTERNATIONAL BENT GLASS COMPANY ON SEPTEMBER 11, 1958 AS A SAND-BLASTER AND SINCE THAT TIME HAS WORKED ON THE OVENS AND ON VARIOUS OTHER JOBS. APPROXIMATELY ONE YEAR AFTER HE BEGAN EMPLOYMENT AT INTERNATIONAL BENT GLASS HE STARTED TO DEVELOP PIMPLES, BLACKHEADS AND BUMPS ON HIS FACE, WHICH WERE RAPIDLY FOLLOWED BY THE DEVELOPMENT OF SIMILAR LESIONS ON THE BACK OF THE NECK, THE TRUNK, BELT LINE, HIPS AND ANTERIOR THIGHS. HE WAS CONTINUOUSLY EXPOSED TO THE FUMES FROM THE OVENS AT THIS TIME.

HE WAS REFERRED TO DRS. MCKEE AND BURKHARDT IN 1959 AND WAS UNDER THEIR CARE FOR APPROXIMATELY FIVE MONTHS UNTIL AUTHORIZATION FOR TREATMENT WAS DISCONTINUED BY THE INSURANCE COMPANY. THE ONLY ADDITIONAL PROFESSIONAL CARE THAT HE HAS HAD SINCE THAT TIME, WAS AN INCISION AND DRAINAGE OF A LARGE LESION BEHIND HIS EAR APPROXIMATELY FIVE MONTHS BY DR. BURKHARDT. THIS WAS DONE AT THE PATIENT'S OWN EXPENSE.

SUPPLEMENTAL PRE-TRIAL NARRATIVE STATEMENT OF

WALTER MILLER

DSW 442098

STLCOPCB4056633

MR. MILLER STATED THAT HE DOES NOT BELIEVE HE IS DEVELOPING ANY NEW LESIONS SINCE THEY CHANGED THE CHEMISTRY OF THE PAINT IN JANUARY OF 1962, BUT THAT HE CANNOT GET RID OF THE OLD ONES AND THAT AN OLD CYST WILL BECOME INFLAMMED FROM TIME TO TIME. HE HAS NEVER HAD ANY LESIONS IN THE EYES OR ANY SYSTEMATIC COMPLAINTS.

PAST HISTORY REVEALS THAT MR. MILLER'S GENERAL HEALTH HAS ALWAYS BEEN GOOD AND HE DENIED ANY HISTORY OF ACNE OR COMPLEXION TROUBLES DURING HIS ADOLESCENCE OR PRIOR TO THE PRESENT ILLNESS.

PHYSICAL EXAMINATION REVEALED NUMEROUS BLACKHEADS AND CYSTS ON THE FACE AND BEHIND THE EARS, TO A LESSER EXTENT ON THE SHOULDERS, ALONG THE BELT LINE, ANTERIOR THIGHS, SHAFT OF THE PENIS AND BUTTOCKS. THERE WERE A FEW INFLAMMED CYSTS ON THE BUTTOCKS AND TWO SYMMETRICAL PATCHES OVER EACH SCAPULA WHICH WERE LOADED WITH BLACKHEADS.

IN MY OPINION, MR. MILLER DEMONSTRATES THE BLACKHEAD CYSTIC ACNEIFORM ERUPTION THAT EFFECTS PEOPLE WHO ARE EXPOSED TO OIL AND PAINT FUMES IN THEIR OCCUPATION SUCH AS HE IS. I HAVE SUGGESTED THAT HE REINSTITUE ACTIVE TREATMENT AND FEEL THAT LIVER FUNCTION TESTS WOULD BE IN ORDER.

PLEASE FEEL FREE TO CONTACT ME, IF YOU REQUIRE ANY FURTHER INFORMATION CONCERNING MR. MILLER'S CASE.

VERY TRULY YOURS,

JAMES C. SISK, M.D.

JCS:lb

DSW 442099

STLCOPCB4056634

JAMES C. SISK M. D.
CLAYTON CENTRAL BUILDING
110 SOUTH CENTRAL AVENUE
CLAYTON 5, MISSOURI
TELEPHONE PA 5-7007

OCTOBER 5, 1962

MR. JAMES COOK
SCHUCHAT & COOK
705 OLIVE STREET
ST. LOUIS 1, MISSOURI

RE: MRS. HAZEL SCHNEIDER
EMPLOYEE: INTERNATIONAL BENT
GLASS COMPANY

DEAR MR. COOK:

YOUR CLIENT MRS. HAZEL SCHNEIDER WAS SEEN IN MY OFFICE ON OCTOBER 2, 1962 AND THE FOLLOWING HISTORY AND PHYSICAL FINDINGS WERE ELICITED AT THAT TIME.

MRS. SCHNEIDER STATED THAT SHE BEGAN WORKING AT INTERNATIONAL BENT GLASS COMPANY APPROXIMATELY EIGHT YEARS AGO AS A GLASS CUTTER AND DEVELOPED AN ERUPTION CONSISTING OF BLACK HEADS ON THE FACE, ARMS, NECK AND LEGS APPROXIMATELY SIX MONTHS THEREAFTER.

SHE WAS REFERRED TO DR. ARTHUR NIELSON AND WAS TREATED BY HIM UNTIL HER CASE WAS TRANSFERRED BY THE INSURANCE COMPANY TO THE OFFICES OF DR. STRYKER AND BURKHART. SHE WAS TREATED BY THIS OFFICE UNTIL APPROXIMATELY TWO YEARS AGO AND SINCE THAT TIME HAS USED ONLY SELF MEDICATION WITH NOXZEMA, ETC. ONE LARGE CYSTIC LESION ON HER RIGHT CHEEK WAS REMOVED BY DR. ADOLPH CONRAD IN THE SPRING OF 1962.

MRS. SCHNEIDER IN ADDITION STATED THAT SHE HAD BEEN SEEN BY AN OPHTHALMOLOGIST, DR. PERNOUD FOR PLUGGED UP OIL GLANDS INSIDE THE EYELID MARGINS THAT SHE SAID WERE ASSOCIATED WITH THE SKIN DISEASE.

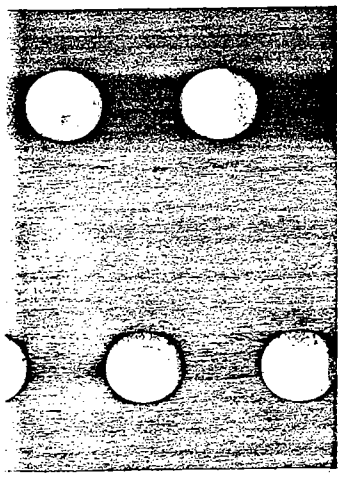
MRS. SCHNEIDER HAD WORKED AS A SILK SCREENER FOR THE LAST FOUR YEARS AND THOUGHT THAT HER ERUPTION WAS DUE TO THE PAINT AND OIL FUMES FROM THE OVENS. THERE WAS A CHANGE IN THE TYPE OF PAINT AND OIL USED AT WORK IN APPROXIMATELY JANUARY 1962. MRS. SCHNEIDER STATED THAT

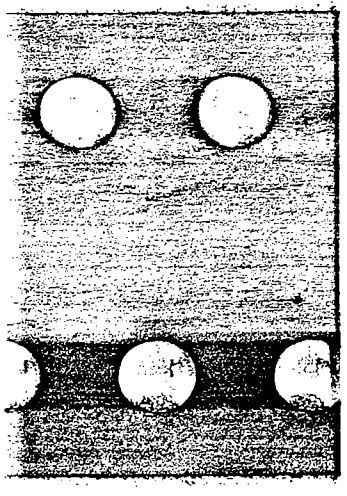
SUPPLEMENTAL PRE-TRIAL NARRATIVE STATEMENT OF

HAZEL SCHNEIDER

DSW 442100

STLCOPCB4056635





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[illegible] AGE [illegible] 53.

[illegible] NEW LESIONS HAVE [illegible], ALTHOUGH [illegible] HAS CONTINUED TO [illegible] IN THE OLD ONES.

[illegible] HISTORY WAS ESSENTIALLY NEGATIVE FOR ANY SERIOUS DISEASE OR ANY PRIOR ACNEFORM ERUPTIONS.

[illegible] PHYSICAL EXAMINATION REVEALED SLIGHTLY ENLARGED SEBACEOUS GLANDS [illegible] THE [illegible] NARES AND A MINIMAL NUMBER OF BLACK HEADS AND SMALL SEBACEOUS CYSTS UNDER [illegible] ARMS, ALONG THE CHEEKS AND AN ISOLATED CYSTIC LESION ON THE ANTERIOR SURFACE OF THE RIGHT THIGH. THERE WAS AN INCREASE IN PIGMENTATION ALONG THE SIDES OF THE NECK AND FACE SUCH AS IS SEEN IN PATIENTS IN [illegible] AGE GROUP OF OCCASION. THIS HAS NOTHING TO DO WITH [illegible] ACNEFORM ERUPTION.

[illegible] OPINION MRS. SCHNEIDER HAS [illegible] ACNEFORM ERUPTION [illegible] EXPOSURE TO OILS IN THE [illegible] PAINT [illegible] AT WORK [illegible] ARE ALL MINIMAL RESIDUAL BLACK HEADS AND SMALL SEBACEOUS CYSTS VISIBLE TODAY.

PLEASE FEEL FREE TO CONTACT ME IF YOU REQUIRE ANY FURTHER INFORMATION [illegible] MRS. SCHNEIDER'S CASE.

[illegible] YOURS,

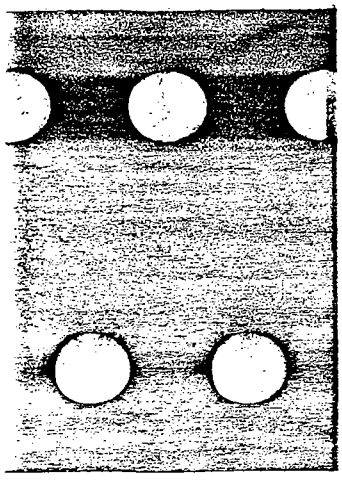
[illegible]
[illegible] D. SISK, M.D.

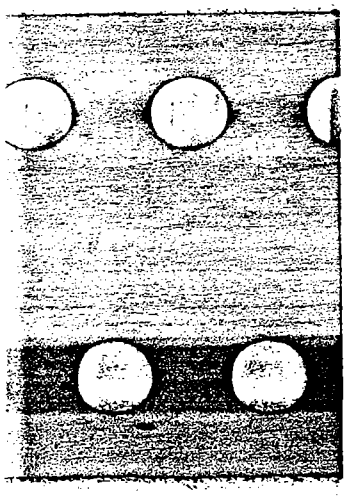
DSW 442101

STLCOPCB4056636

JAMES D. BASH, M. D.
CLAYTON GENERAL BUILDING
110 SOUTH CENTRAL AVENUE
CLAYTON 5, MISSOURI
TELEPHONE PA 5-7557

DECEMBER 10, 1962





MR. RENFORD H. CARUTHERS
1930 PAUL BROWN BUILDING
ST. LOUIS 1, MISSOURI.

RE: MRS. CHARLOTTE SHOEMAKER
EMPLOYEE: INTERNATIONAL BENT GLASS CO.

DEAR MR. CARUTHERS:

YOUR CLIENT, MRS. CHARLOTTE SHOEMAKER, AN EMPLOYEE OF INTER-NATIONAL BENT GLASS COMPANY WAS SEEN IN MY OFFICE TODAY AND THE FOLLOWING HISTORY AND PHYSICAL FINDINGS WERE ELICITED.

MRS. SHOEMAKER STATED THAT SHE BEGAN WORKING AT INTERNATIONAL BENT GLASS IN AUGUST OF 1955 AS A CUTTER, DOING SCREENING, PACKING, SANDING, ETCHING, ETC. AND OCCASIONALLY WORKING ON THE OVENS. IN ALL OF THESE JOBS SHE HAS BEEN EXPOSED TO THE OIL AND PAINT FUMES FROM THE OVEN. APPROXIMATELY SIX MONTHS AFTER STARTING WORK SHE BEGAN TO DEVELOP BLACKHEADS AND CYSTS ON THE FACE. SEVERAL MONTHS LATER THESE WERE FOLLOWED BY SIMILAR LESIONS ON THE TRUNK, BENEATH THE BRA STRAPS AND PARTICULARLY WHERE THE CLOTHING WAS TIGHT AROUND THE BELT LINE. SHE ALSO DEVELOPED SOME LESIONS ON THE BACK OF THE NECK AND IN THE GROIN. SHE WAS SENT TO DR. NIELSEN IN 1957 AND HE TREATED HER FOR APPROXIMATELY ONE YEAR WITH SHOTS, SOAKS, A LOTION AND VARIOUS OTHER MEDICATIONS. THE PLANT WAS MOVED AT APPROXIMATELY THIS TIME BUT THE FUMES WERE STILL PRESENT IN THE NEW WORK AREA. SHE WAS THEN TRANSFERED BY THE INSURANCE COMPANY TO DRS. MCKEE AND BURKHARDT WHO HAVE TREATED HER SINCE THAT TIME WITH LIGHT TREATMENTS, SOAKS, SHOTS, PILLS, A PROTECTIVE OINTMENT, A NIGHT LOTION AND INCISION AND DRAINAGE OF ACTIVELY INFECTED CYSTS.

SHE STATED THAT SHE IS CONTINUING TO GET "ACTIVE" BUMPS SINCE THEY HAVE CHANGED THE COMPOSITION OF THE PAINT AT WORK IN JANUARY OF 1962, HOWEVER, SHE THINKS THAT THEY MAY BE SOMEWHAT FEWER IN NUMBER. SHE HAS DEVELOPED NO EYE LESIONS. THE RASH HAS ALWAYS BEEN WORSE DURING HER

SUPPLEMENTAL PRE-TRIAL DEPOSITION STATEMENT OF
CHARLOTTE SHOEMAKER

DSW 442102

STLCOPCB4056637

RE: MRS. CHARLOTTE SHOEMAKER

MENSTRUAL PERIOD, WHEN THE INFECTED LESIONS WOULD BECOME MORE INFLAMMED.

MRS. SHOEMAKER HAS BEEN UNDER THE CARE OF DR. TISHLER FOR ARTHRITIS, RECEIVING SHOTS AND TABLETS BY MOUTH, FOR THE PAST SEVERAL YEARS. FROM TIME TO TIME SHE HAS BEEN ON A CORTISONE DERIVATIVE FOR AS LONG AS TWO TO THREE WEEKS AT A TIME. THIS HAS HAD NO EFFECT ON THE RASH. SHE DENIED ANY ACNE OR SKIN ERUPTION PRIOR TO WORKING AT 'INTERNATIONAL BENT GLASS'.

PHYSICAL EXAMINATION REVEALED A MARKED NUMBER OF BLACKHEADS AND OIL GLANDS CYSTS ON THE CHEEKS, SIDE OF THE NECK, EAR LOBES, INNER THIGHS, BENEATH THE BREASTS AND TO A LESSER EXTENT ALONG THE BELT LINE AND BENEATH THE PRESSURE AREAS UNDER THE BRA. THERE WERE ASSOCIATED PUNCHED OUT SCARS IN THE AREA ON THE CHEEKS AND EAR LOBES AND INNER THIGHS IN PARTICULAR.

IN MY OPINION, MRS. SHOEMAKER HAS A BLACKHEAD CYSTIC ACNEIFORM ERUPTION OF THE SKIN, PARTICULARLY OVER THE FACE AND EARS BUT ALSO INVOLVING MANY AREAS OF THE TRUNK DUE TO THE PAINT AND OIL FUMES SHE MUST BE EXPOSED TO AT WORK.

MRS. SHOEMAKER HAS BEEN ADVISED TO CONTINUE TREATMENT WITH DRS. BURKHARDT AND MCKEE, I DOUBT, HOWEVER, IF SHE WILL CLEAR AS LONG AS SHE IS EXPOSED TO THE ADVERSE ENVIRONMENT. I FEEL THAT THE ROUTINE LIVER FUNCTION TESTS ADVISED FOR OTHER PATIENTS SHOULD BE DONE ON MRS. SHOEMAKER, AS WELL.

PLEASE FEEL FREE TO CONTACT ME, IF YOUR REQUIRE ANY FURTHER INFORMATION CONCERNING HER CASE.

VERY TRULY YOURS,

JAMES C. SISK, M.D.

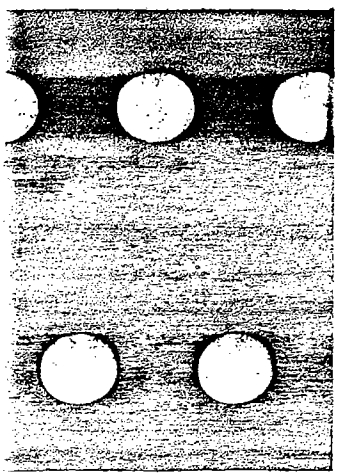
JCS:rs

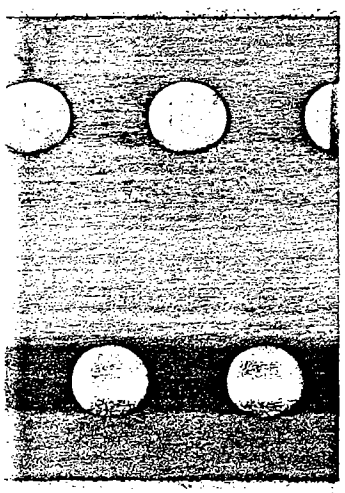
DSW 442103

STLCOPCB4056638

[illegible]
[illegible]
[illegible]
[illegible]
[illegible]

November 26, 1962





Mr. Rexford Caruthers
400 Paul Brown Building
St. Louis 1, Missouri

Re: Mr. Ronald Simpson
Employee: International Bent Glass Co.,

Dear Mr. Caruthers:

Your client, Mr. Ronald Simpson, an employee of the International Bent Glass Company was seen by me on November 26, 1962 and the following history and physical findings were elicited at that time.

Mr. Simpson stated that he had started working at International Bent Glass Company in September of 19[illegible] as an oven operator but did not begin to develop an eruption on the skin of the face and other parts of the body until approximately 1960. This rash then took the form of many blackheads and an occasional small cystic lesion. The worst eruption was on the face. They would occasionally become infected.

He worked on the ovens off and on until January of 1962 when he was promoted but there was still exposure to the oven fumes in the new area where he worked. New lesions continued to form and were at their worst in hot weather. Approximately two months ago he left International Bent Glass and is now working at the Purex Corporation.

During the early part of 1961, Mr. Simpson was sent to Dr. Oliver McKee for treatment and received a cleansing lotion, shots, pills by mouth and manual extraction of the blackheads there. He remained under treatment for approximately three

SUPPLEMENTAL PRE-TRIAL INTERROGATORY RESPONSE OF
RONALD SIMPSON

DSW 442104

STLCOPCB4056639

RE: MR. RONALD SIMPSON
EMPLOYEE: INTERNATIONAL BENT GLASS CO.

MONTHS AND SINCE THAT TIME HAS REMOVED THE BLACKHEADS HIMSELF.

PAST HISTORY REVEALS THAT MR. SIMPSON'S GENERAL HEALTH HAS BEEN GOOD AND HE DENIES THAT HE HAD ANY PRIOR TENDENCY TO ACNE OR BLACKHEAD FORMATION.

PHYSICAL EXAMINATION REVEALED A FEW BLACKHEAD CYSTS ON HIS CHEST, BUTTOCKS AND ALONG THE BELT LINE. THE MAIN ERUPTION CONSISTED OF NUMEROUS BLACKHEADS OVER THE FACE AND CHEEK BONES AND LOWER ARMS. THERE WAS ONE SMALL SEBACEOUS CYST ON THE LEFT EAR LOBE AND FEW SIMILARL LESIONS ON THE BACK OF THE NECK.

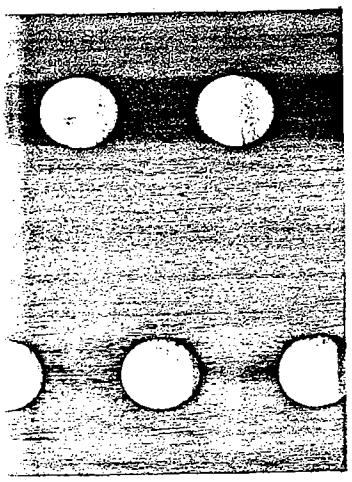
IN MY OPINION, MR. SIMPSON HAS A BLACKHEAD ACNEIFORM ERUPTION DUE TO THE OIL AND PAINT FUMES.THAT HE WAS EXPOSED TO AT THE INTERNATIONAL BENT GLASS COMPANY.

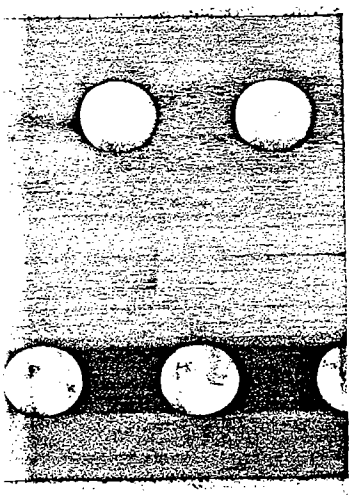
PLEASE FEEL FREE TO CONTACT ME, IF YOU REQUIRE ANY FURTHER INFORMATION CONCERNING MR. SIMPSON'S CASE.

VERY TRULY YOURS,

JAMES C. SISK, M.D.

JCS:ls





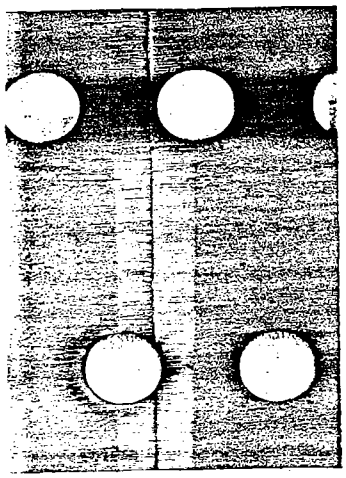
DSW 442105

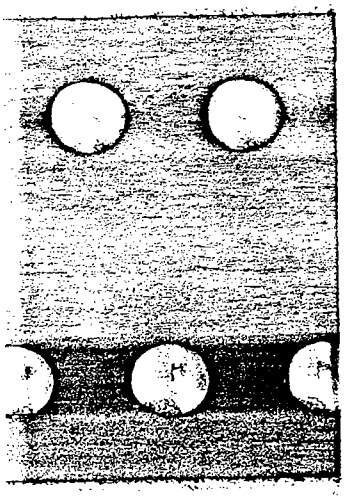
STLCOPCB4056640

WILLIAM C. SHAW, M. D.
CLAYTON CENTRAL BUILDING
110 SOUTH CENTRAL AVENUE
CLAYTON 5, MISSOURI

TELEPHONE PA 5-7037

NOVEMBER 21, 1962





MR. REXFORD CARUTHERS, ATTORNEY
818 OLIVE STREET
ST. LOUIS 1, MISSOURI

RE: JAMES WHITE , EMPLOYEE
INTERNATIONAL DENT GLASS CO.,

DEAR MR. CARUTHERS:

YOUR CLIENT, MR. JAMES WHITE WAS SEEN IN MY OFFICE ON NOVEMBER 20, 1962 AND THE FOLLOWING HISTORY AND PHYSICAL FINDINGS WERE ELICITED AT THAT TIME.

MR. WHITE STATED THAT HE HAS WORKED AT INTERNATIONAL DENT GLASS COMPANY SINCE 1952 ON THE GLASS BENDING OVEN, WHICH DOES NOT REQUIRE HANDLING OF WET PAINTS AND OILS BUT DOES NECESSITATE EXPOSURE TO THE FUMES FROM THE PAINTED GLASS WHEN IT IS BAKED IN THE OVEN.

APPROXIMATELY ONE YEAR AFTER BEGINNING WORK AT INTERNATIONAL DENT GLASS HE STARTED TO DEVELOP LARGE BLACKHEADS AND CYSTS ON THE FACE, NECK AND EARS WHICH HAVE PERSISTED UNTIL THIS TIME. THE HEIGHT OF THE ERUPTION OCCURED APPROXIMATELY FIVE TO SIX YEARS AGO AND HAS BEEN RELATIVELY UNCHANGED FOR THE PAST TWO YEARS. THE LAST NEW CYST DEVELOPED ON THE BRIDGE OF THE NOSE APPROXIMATELY THREE TO FOUR MONTHS AGO. THE PATIENT STATED THAT IT TAKES THE LESION SEVERAL YEARS TO FULLY DEVELOP. HE FELT THAT HE HAS DEVELOPED FEWER LESIONSTHAN OTHER EFFECTED EMPLOYEES BECAUSE OF THE FACT THAT HE WORKS ONLY FOUR HOURS PER NIGHT AND "THE PAINT FUMES ARE THINNER AT THAT TIME". HE STATED THAT TO HIS KNOWLEDGE THERE WAS SOME CHANGE IN THE PAINTING ROUTINE ON APPROXIMATELY JANUARY 1, OF THIS YEAR AND THE PAINT TABLES WERE MOVED UNDER A LARGE FAN. THERE ARE STILL PAINT FUMES IN THE AIR, HOWEVER.

MR. WHITE HAS NEVER SOUGHT TREATMENT FOR THE LESIONS, BUT HAS DRAINED THEM HIMSELF. PAST HISTORY REVEALED NO EVIDENCE OF ACNE IN HIS TEENS AND NO HISTORY OF SKIN TROUBLE PRIOR TO THE PRESENT ILLNESS.

SUPPLEMENTAL PRE-TRIAL NARRATIVE STATEMENT OF

JAMES WHITE

DSW 442106

STLCOPCB4056641

RE: MR. JAMES WHITE
INTERNATIONAL DENT GLASS CO.,

PHYSICAL EXAMINATION REVEALED NUMEROUS BLACKHEADS AND UNDERLYING SEBACEOUS CYSTS ON THE BACK OF THE NECK, MANY BLACK HEADS IN THE EARS, AND ONE AND A HALF CENTIMETERS CYSTIC LESIONS ON THE BRIDGE OF THE NOSE AND ON THE LEFT CHEEK. THERE WAS SOME SCARRING ON THE BACK OF THE NECK.

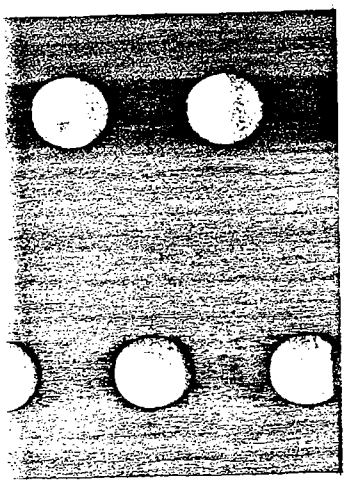
IN MY OPINION MR. WHITE HAS AN ACNEIFORM ERUPTION WITH MANY BLACK HEADS AND SEBACEOUS CYSTS ON THE BACK OF THE NECK IN PARTICULAR, SUCH AS ARE SEEN IN PATIENTS WHO MUST COME IN CONTACT WITH OIL FUMES IN THEIR OCCUPATIONS. CUTTING OILS AND OILS THAT ARE CHLORINATED ARE THE WORST OFFENDERS.

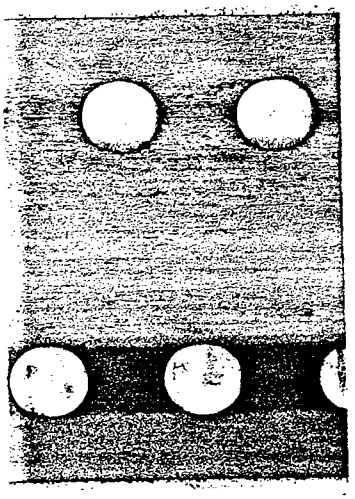
PLEASE FEEL FREE TO CONTACT ME, IF YOU REQUIRE ANY FURTHER INFORMATION CONCERNING MR. WHITE'S CASE.

VERY TRULY YOURS,

JAMES C. SISK, M.D.

JCS:ib





DSW 442107

STLCOPCB4056642

[illegible]

[illegible]

NOVEMBER 27, [illegible]

MR. REMFORD H. CARUTHERS
450 PAUL BROWN BUILDING
ST. LOUIS 1, MISSOURI

RE: MRS. MARTHA SYLER
EMPLOYEE: INTERNATIONAL [illegible]

DEAR MR. CARUTHERS:

THIS IS A [illegible] REPORT ON YOUR [illegible] MRS. MARTHA SYLER AN EMPLOYEE OF THE INTERNATIONAL [illegible] [illegible] 1966. A REPORT WAS SENT TO MR. [illegible] TIME.

MRS. SYLER [illegible] A COLLEGE [illegible]

MRS. SYLER STATES [illegible] DEAN [illegible] [illegible] THE INFORMATION [illegible] THE INFORMATION [illegible] HELP THE INFORMANT [illegible] HAVE [illegible]

THEREFORE [illegible] SEES [illegible] MRS. SYLER'S [illegible] THE INFORMANT [illegible] THERE WERE ONLY [illegible] THE LAST [illegible] REPORT.

MRS. SYLER IS [illegible] WOULD PREFERRED [illegible] PROBT AND HONEST.

PLEASE FEEL FREE TO CONTACT US IF YOU NEED ANY FURTHER INFORMATION, IN REGARD WITH THIS.

VERY TRULY YOURS

[illegible]

JOS:ID

JAMES [illegible]

SUPPLEMENTAL PRELIMINARY NARRATIVE STATE REPORT

MARTHA SYLER

DSW 442108

STLCOPCB4056643

ALBERT G. BIRK, M. D.
CLAYTON CLINIC BUILDING
710 SOUTH CLEMENS AVENUE
CLAYTON 5, MISSOURI
TELEPHONE PA 8-7507

NOVEMBER 28, 1962

MR. REXFORD CARUTHERS
830 PAUL BROWN BUILDING
ST. LOUIS 1, MISSOURI.

RE: MRS. THELMA WIENERS
EMPLOYER: INTERNATIONAL BENT GLASS CO.

DEAR MR. CARUTHERS:

YOUR CLIENT, MRS. THELMA WIENERS WAS SEEN IN MY OFFICE ON NOVEMBER 28, 1962 AND THE FOLLOWING HISTORY AND PHYSICAL FINDINGS WERE ELICITED AT THAT TIME.

MRS. WIENERS STATED THAT SHE HAD STARTED AT THE INTERNATIONAL BENT GLASS COMPANY IN MARCH OF 1956 CUTTING GLASS, SCREENING, DRILLING AND WORKING ON THE OVEN. IN ALL OF THESE JOBS SHE WAS EXPOSED TO THE OIL AND PAINT FUMES WHICH WERE AROUND THIS WORK AREA.

APPROXIMATELY ONE YEAR AFTER STARTING TO WORK THERE, SHE BEGAN TO DEVELOP BLACKHEADS AND OIL GLAND CYSTS, PARTICULARLY ON THE FACE AND AROUND THE EYES AND TO A LESSER EXTENT ON THE THIGHS, CALFS OF THE LEGS AND WHERE HER CLOTHING WAS TIGHT. SHE ALSO DEVELOPED CYSTIC LESIONS INSIDE THE EYES. APPROXIMATELY SIX MONTHS AGO, MRS. WIENERS WAS SENT TO DRS. BURKHARDT AND MCKEE FOR TREATMENT WHERE SHE HAS RECEIVED VITAMIN INJECTIONS AND A LOCAL CLEANSING LOTION AND CAPSULES BY MOUTH AND MANUAL EXTRACTION OF THE LESIONS. FOR THE LAST FIVE TO SIX MONTHS SHE HAS TREATED HERSELF BY OPENING THE LESIONS AND APPLYING NORZEMA. SHE HAS NEVER HAD ANY TREATMENT TO THE EYE LESIONS.

MRS. WIENERS ALSO STATED THAT SHE DEVELOPED LIVER TROUBLE "FROM THE POISON IN THE FUMES" APPROXIMATELY TWO YEARS AGO

SUPPLEMENTAL PRE-TRIAL NARRATIVE STATEMENT OF
THELMA WIENERS

DSW 442109

STLCOPCB4056644

RE: MRS. THELMA WIENERS
EMPLOYED: INTERNATIONAL BENT GLASS CO.

AND WAS HOSPITALIZED BY DR. REICKERT IN DE PAUL HOSPITAL WHO ADVISED HER TO STAY AWAY FROM THE SCREENING PROCESS AT WORK. HE ALSO PLACED HER ON VITAMIN SHOTS AND A DIET. SHE HAS HAD NO RECENT CHECK-UP OF THIS CONDITION.

MRS. WIENERS HAS BEEN ON SICK LEAVE SINCE FEBRUARY OF 1962 FOLLOWING A HYSTERECTOMY BY DR. BOEDEKER. THE BLACKHEAD LESIONS HAVE PERSISTED AND SOME NEW ONES HAVE FORMED. SHE THOUGHT THAT THIS WAS TO LESSER DEGREE THAN WHEN SHE WAS AT WORK, HOWEVER.

MRS. WIENERS' PAST HEALTH WAS GOOD PRIOR TO THE ABOVE MENTIONED ILLNESS. SHE HAS BEEN GAINING WEIGHT RECENTLY AND HAS TAKEN NO MEDICATION, SHE DID HAVE PNEUMONIA IN HER TEENS AND WAS OPERATED FOR APPENDICITIS IN 1955. MRS. WIENERS DENIED ANY EVIDENCE OF ACNE DURING HER TEEN AGE YEARS AND STATED THAT SHE "ALWAYS HAD A GOOD COMPLEXION".

PHYSICAL EXAMINATION REVEALED NUMEROUS NON-INFLAMMATORY BLACKHEADS OVER BOTH CHEEKS AND AROUND THE EYES, THERE WERE SEVERAL OTHERS JUST INSIDE THE LOWER LID UNDERNEATH THIS MEMBRANE. THERE WERE FEW LESIONS ON THE LEGS AND SALVES THE REST OF THE BODY WAS CLEAR EXCEPT FOR A BLOOD VESSEL BIRTH MARK ON THE RIGHT CHEST AND BREAST AND A WELL HEALED MID-LINE ABDOMENAL SCAR FROM HER PREVIOUS SURGERY.

IN MY OPINION, MRS. WIENERS HAS A BLACKHEAD ACNEIFORM ERUPTION ON THE SKIN OF THE FACE WITH SEBACEOUS CYSTS HERE AND AROUND THE EYES, SUCH AS IS SEEN IN PATIENTS WHO ARE IN CONTACT WITH OIL AND PAINT FUMES SUCH AS MRS. WIENERS HAS BEEN AT WORK.

I WOULD SUGGEST THAT SOME ATTEMPT BE MADE BY HER LOCAL PHYSICIAN TO RE-CHECK HER LIVER FUNCTION TESTS AND FEEL THAT SOME ACTIVE TREATMENT OF THE LESIONS IN THE EYES IS INDICATED AT THIS TIME.

PLEASE FEEL FREE TO CONTACT ME, IF YOU HAVE ANY FURTHER QUESTIONS CONCERNING MRS. WIENERS' CASE.

VERY TRULY YOURS,

James C. Sisk M.D.

JAMES C. SISK, M.D.

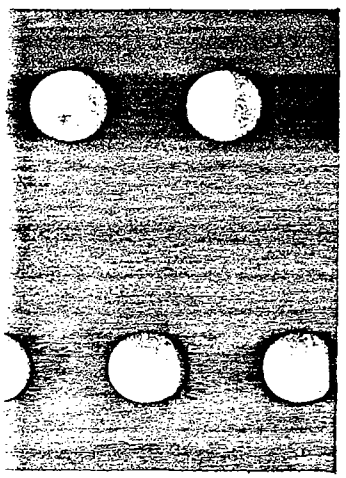
JCS:ib

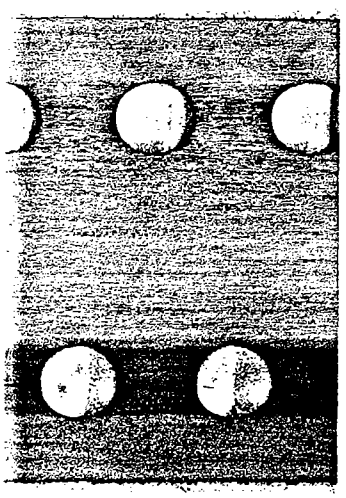
DSW 442110

STLCOPCB4056645

JULIAN C. SIDA M. D.
CLAYTON CENTRAL BUILDING
110 SOUTH CENTRAL AVENUE
CLAYTON 5, MISSOURI
TELEPHONE PA 5-7007

DECEMBER 7, 1962





MR. REXFORD H. CARUTHERS
450 PAUL BROWN BUILDING
ST. LOUIS 1, MISSOURI.

RE: MRS. MARY CHAPMAN
EMPLOYEE: INTERNATIONAL BENT GLASS CO.,

DEAR MR. CARUTHERS:

YOUR CLIENT, MRS. MARY CHAPMAN AN EMPLOYEE OF THE INTERNATIONAL LIGHT COMPANY - THE PARENT ORGANIZATION OF THE INTERNATIONAL BENT GLASS COMPANY - WAS IN TO SEE ME TODAY AND THE FOLLOWING HISTORY AND PHYSICAL FINDINGS WERE ELICITED.

MRS. CHAPMAN STATED THAT SHE HAS WORKED AT INTERNATIONAL LIGHT SINCE 1952 MAKING LAMP FIXTURES. AT THE TIME SHE STARTED WORKING THERE, THEIR DIVISION WAS IN THE SAME AREA AS THE BENT GLASS DIVISION AND SHE WAS EXPOSED TO THE PAINT AND OIL FUMES IN THAT SECTION OF THE BUILDING. APPROXIMATELY FOUR YEARS AFTER STARTING TO WORK THERE, SHE BEGAN TO BREAK OUT ON HER ARMS, NECK AND FACE AND TO A LESSER EXTENT ON THE SHOULDERS, ARMS, LEGS AND THIGHS. THIS RASH CONSISTED OF BLACKHEADS AND CYSTS WHICH WOULD AT TIMES BECOME INFECTED. SHE FIRST SAW HER LOCAL DOCTOR, DR. BAUER WHO DRAINED SEVERAL OF THE LESIONS IN 1956. IN 1957 TO 1958 SHE WAS TREATED BY DR. NEILSEN AND SINCE THAT TIME, HAS BEEN TREATED BY DRS. MCKEE AND BURCKHARDT WITH INJECTIONS, ANTIBIOTICS BY MOUTH WHEN THEY BECOME INFECTED, NIGHT CREAMS, PROTECTIVE CREAMS, FOSTEX SOAP, ETC.

SHE DENIES ANY EYE LESIONS OR ANY SYMPTOMS SUGGESTING GENERAL TOXEMIA.

SUPPLEMENTAL PRE-TRIAL NARRATIVE STATEMENT OF

MARY CHAPMAN

DSW 442111

STLCOPCB4056646

RE: MRS. MARY CHAPMAN

THE INTERNATIONAL LIGHT COMPANY WAS MOVED APPROXIMATELY FIVE YEARS AGO AT WHICH TIME, THE BENT GLASS DIVISION WAS PUT IN A SEPERATE BUILDING. THERE IS A TYPE OF PAINT SPRAYED IN THE FIXTURE AREA THAT DIFFERS FROM THAT USED IN THE BENT GLASS AREA. NO EMPLOYEES IN THE FIXTURE DIVISION HAVE DEVELOPED LESIONS SIMILAR TO MRS. CHAPMAN, BUT IT IS OF INTEREST TO NOTE THAT SHE HAS HAD PERSISTENCE OF HER BLACKHEADS AND CYSTS AND HAS HAD AN OCCASIONAL NEW CYST APPARENTLY FORM AND BECOME INFECTED. SHE GENERALLY FEELS, HOWEVER, THAT THE LESIONS ARE FEWER THAN THEY WERE BEFORE THE MOVE OF THE PLANT.

PAST HISTORY REVEALED THAT MRS. CHAPMAN HAD ARTHRITIS APPROXIMATELY FOUR YEARS AGO AND WAS TREATED WITH GOLD SHOTS BY DR. BAUER AT THAT TIME. SHE DID HAVE AN ALLERGIC REACTION TO THE GOLD WHICH CLEARED PROMPTLY AND SHE HAS HAD NO TROUBLE WITH THE ARTHRITIS FOR APPROXIMATELY THREE YEARS. SHE DENIED ANY DIFFICULTY WITH ACNE IN HER TEENS.

PHYSICAL EXAMINATION REVEALED MANY BLACKHEADS AND CYSTS AND SCARS, ESPECIALLY BEHIND THE EARS, ON THE INNER CHEEKS AND UNDER THE ANGLES OF THE MANDIBLES. THE LESIONS WERE FEWER ON THE CHIN, FOREHEAD, UPPER BACK AND LATERAL ARMS. THERE WERE NO APPARENT EYE LESIONS.

IN MY OPINION, MRS. CHAPMAN HAS A CYSTIC ACNEIFORM ERUPTION ON THE SKIN, PARTICULARLY OF THE FACE, EARS AND NECK DUE TO THE PAINT AND OIL FUMES THAT SHE WAS EXPOSED TO AT WORK AT THE INTERNATIONAL BENT GLASS COMPANY. IT IS OF INTEREST TO NOTE THAT THE LESIONS HAVE PERSISTED EVEN THOUGH SHE HAS BEEN AWAY FROM THE OFFENDING AGENTS FOR SEVERAL YEARS. I HAVE ASKED MRS. CHAPMAN TO CONTINUE TREATMENT WITH DRS. MCKEE AND BURKHARDT AND WOULD SUGGEST THAT ROUTINE LIVER FUNCTION TESTS BE DONE.

PLEASE FEEL FREE TO CONTACT ME, IF YOU REQUIRE ANY FURTHER INFORMATION CONCERNING HER CASE.

VERY TRULY YOURS,

James C. Sisk M.D.

JAMES C. SISK, M.D.

JCS:ib

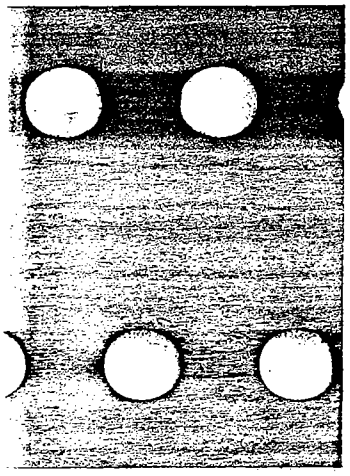
DSW 442112

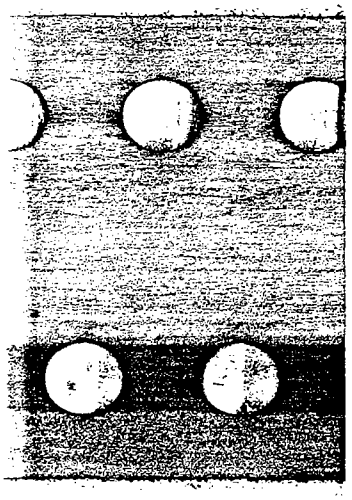
STLCOPCB4056647

[illegible]

[illegible]

November 20, 1962





Mr. Renford H. Carothers
400 Paul Brown Building
St. Louis 1, Missouri.

Re: Mrs. Marie Clifford
Employee: International Dent Glass Co.,

Dear Mr. Carothers:

Your client, Mrs. Marie Clifford was seen in my office on November 20, 1962 and the following history and physical finding were elicited at that time.

Mrs. Clifford stated that she started working at International Dent Glass Company in 1957 etching glass with acid and working in the vicinity of cyclo where the paint was baked on to the glass. Approximately six months after she started working there, she began to develop blackheads and small bumps and cysts beneath the skin, especially on the face and to a lesser extent on the chest, under the arms and the chin. Approximately two months after the appearance of the first lesion she was sent by a Mr. Gladrick, the plant superintendent, to see Dr. Arthur Nelson and subsequently her case was transferred to the care of Drs. Dunnaret and Stryker by the insurance company. She remained under their care from 1957 until last year using various local soaps, ointments and cleansers and attempting to use a protective cream at work which was too messy. She had not been treated by them for the past year, but did have one infected cyst under her arm drained by Dr. Adolph Conrad, on approximately six months ago.

Mrs. Clifford feels that the treatment has kept the skin lesions from becoming large cysts. Since professional treatment has been discontinued she has developed a habit of draining the small cysts herself when they form. She has noted the continued appearance of new lesions even since there was an apparent change in the type of paint approximately six months ago. The fumes at work

SUPPLEMENTAL PRE-TRIAL RELATIVE STATEMENT OF

MARIE CLIFFORD

DSW 442113

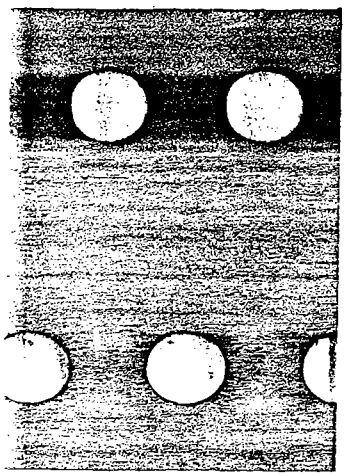
STLCOPCB4056648

PAGE -2-

RE: MRS. MARIE CLIFFORD

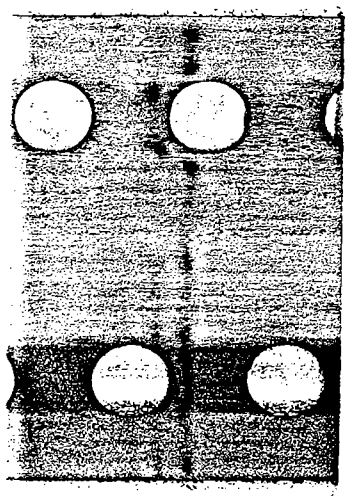
CONTINUED TO BE TAKEN.

MRS. CLIFFORD HAS FROM TIME TO TIME DEVELOPED CYSTIC LESIONS BENEATH THE EYELIDS AS WELL WHICH HAVE BEEN TREATED BY DR. MILSTEN. THE LAST ONE DEVELOPED APPROXIMATELY TWO MONTHS AGO AND SHE IS TREATING IT AT HOME WITH HOT COMPRESSES AT THIS TIME.



MRS. CLIFFORD'S PAST HISTORY REVEALS THAT SHE HAS BEEN IN GOOD HEALTH AND HAD NO ADOLESCENT ACNE. SHE IS TAKING NO MEDICATION.

PHYSICAL EXAMINATION REVEALED MANY BLACKHEADS ON THE FACE, PARTICULARLY OVER THE CHEEK BONES. THERE WERE FEW LESIONS ON THE NECK, THERE WERE SEVERAL SMALL SCARS UNDER THE ARMS AND IN THE GROIN WHERE INFECTED AREAS HAVE DRAINED IN THE YEARS PAST. THERE WAS ONE FIRM PAPULE REPRESENTING A CYSTIC LESION BENEATH THE RIGHT UPPER EYELID.



IN MY OPINION, MRS. CLIFFORD HAS A BLACKHEAD ACNEIFORM ERUPTION WITH THE HISTORY OF FORMATION OF SMALL OIL BLAND CYSTS SUCH AS ARE SEEN IN PATIENTS WHO MUST COME IN CONTACT WITH OIL FUMES, PARTICULARLY CUTTING OILS AND CHLORINATED OILS. THE ACTIVITY OF THE LESIONS IS MODERATE AT THE PRESENT TIME.

PLEASE FEEL FREE TO CONTACT ME, IF YOU REQUIRE ANY FURTHER INFORMATION CONCERNING MRS. CLIFFORD'S CASE.

VERY TRULY YOURS

JAMES C. SIGK, M.D.

JCS:ID

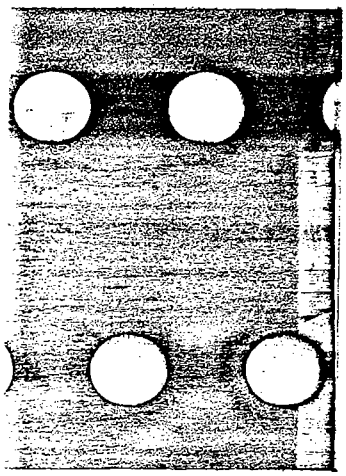
DSW 442114

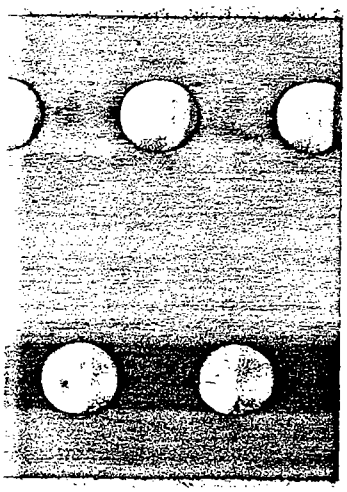
STLCOPCB4056649

WILLIAM C. BOSH, M. D.
CLAYTON CENTRAL BUILDING
110 SOUTH CENTRAL AVENUE
CLAYTON 5, MISSOURI

TELEPHONE PA 5-9500

NOVEMBER 21, 1962





MR. RENFORD CARUTHERS
818 OLIVE STREET
ST. LOUIS 1, MISSOURI

RE: MR. THEODORE CZARNECKI
EMPLOYEE: INTERNATIONAL DENT
GLASS COMPANY

DEAR MR. CARUTHERS:

YOUR CLIENT, MR. THEODORE CZARNECKI WAS SEEN IN MY OFFICE ON NOVEMBER 21, 1962 FOR FOLLOW-UP EXAMINATION.

ON HIS FIRST VISIT ON MAY 2, 1962 IT WAS MY OPINION THAT MR. CZARNECKI SUFFERED FROM AN ACNEIFORM ERUPTION WITH SEBACEOUS CYST FORMATION WHICH AFFLICTS PEOPLE WHO ARE IN AN OCCUPATION REQUIRING CONTACT WITH CUTTING OILS AND CHLORINATED OILS, SUCH AS HE IS.

MR. CZARNECKI HAS CONTINUED TO WORK AT THE INTERNATIONAL DENT GLASS COMPANY IN CHARGE OF THE PAINTS AND IS STILL EXPOSED TO THE PAINT AND OIL FUMES. HE IS CONTINUING TO DEVELOP NEW BLACK HEADS AND CYSTS. HE FELT THAT THERE WAS A CHANGE IN THE PAINTS USED AT WORK ON APPROXIMATELY JANUARY 1, 1962.

FOR THE PAST FIVE MONTHS HE HAS BEEN UNDER THE CARE OF DR. ADOLPH CONRAD, JR. WITH A SOAP, CLEANSER AND WHITE LOTION.

PHYSICAL EXAMINATION TODAY IS ESSENTIALLY UNCHANGED FROM HIS EXAMINATION ON MAY 2, 1962. SOME OF THE CYSTS ON HIS BUTTOCKS ARE INFLAMED TODAY AND THERE ARE STILL NUMEROUS BLACK HEADS AND CYSTS ON HIS FACE, NECK AND POST AURICULAR AREA.

SUPPLEMENTAL PRE-TRIAL NARRATIVE STATEMENT OF

THEODORE CZARNECKI

DSW 442115

STLCOPCB4056650

Page 2-

RE: THEODORE CHARNECKI
INTERNATIONAL BENT GLASS CO.,

PLEASE FEEL FREE TO CONTACT ME, IF YOU REQUIRE ANY FURTHER INFORMATION CONCERNING MR. CHARNECKI'S CASE.

VERY TRULY YOURS,

JAMES C. STOK, M.D.

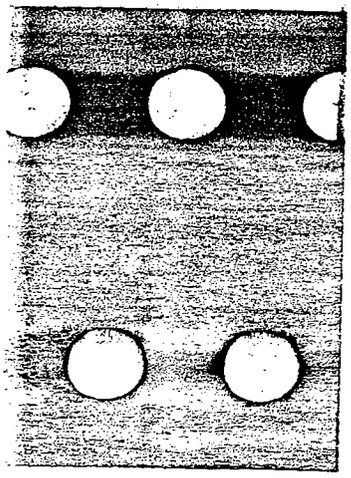
JCS:ib

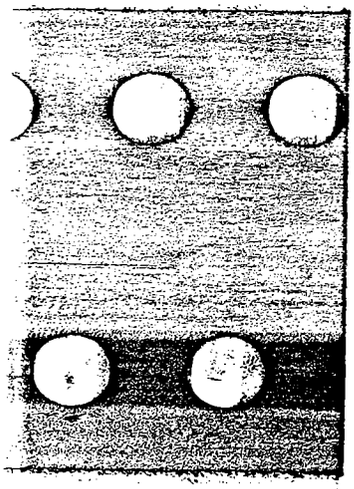
DSW 442116

STLCOPCB4056651

[illegible] M. D.
[illegible]
[illegible]
CLAYTON [illegible]
TELEPHONE PA [illegible]

DECEMBER 6, 1962





MR. REXFORD H. CARUTHERS
430 PAUL BROWN BUILDING
ST. LOUIS 1, MISSOURI.

RE: MRS. RITA KING
EMPLOYER: INTERNATIONAL BENT GLASS CO.

DEAR MR. CARUTHERS:

YOUR CLIENT, MRS. KING WAS SEEN IN MY OFFICE TODAY AND THE FOLLOWING HISTORY AND PHYSICAL FINDINGS WERE ELICITED.

MRS. KING STATED THAT SHE HAS WORKED AT THE INTERNATIONAL BENT GLASS COMPANY SINCE 1959 AND ON VARIOUS JOBS - FIRST AS A GLASS CUTTER AND THEN AS A SCREENER AND NOW ON VARIOUS JOBS INCLUDING DRILLING, OVEN WORK, ETC. ALL OF THESE JOBS ARE IN THE SAME AREA WHERE MRS. KING IS CONTINUOUSLY EXPOSED TO THE OIL AND PAINT FUMES FROM THE OVENS.

APPROXIMATELY ONE YEAR AFTER STARTING AT INTERNATIONAL BENT GLASS COMPANY, MRS. KING BEGAN TO DEVELOP CYSTS AND LUMPS ON HER SKIN AND CHEEKS AND TO A LESSER EXTENT BEHIND HER EARS. THERE WERE ALSO A FEW BLACKHEADS AND IN ADDITION SHE DEVELOPED MANY CYSTIC LESIONS IN THE EYELID MARGINS AND INSIDE OF THE EYES. SHE HAS CONTINUED TO DEVELOP LESIONS SINCE THEY FIRST STARTED AND HAS NOTED NO DECREASE IN THE INCIDENCE OF ONES SINCE JANUARY OF 1962. IN ADDITION MRS. KING HAS BEEN HOSPITALIZED THREE TIMES WITHIN THE PAST YEAR FOR A NERVOUS DISORDER AND MOST RECENTLY WAS IN ST. VINCENT'S HOSPITAL FOR APPROXIMATELY ONE MONTH UNDER THE CARE OF DR. IRVIN. THE LESIONS CONTINUED WHILE SHE WAS THERE. THE ONLY MEDICATION THAT SHE HAS CONTINUED TO TAKE SINCE HER DISCHARGE FROM THE HOSPITAL HAS BEEN ONE FOR THE NERVES.

MRS. KING DENIED THAT SHE HAD DEVELOPED ANY SIGNIFICANT NUMBER OF BLACKHEAD OR ACNE-LIKE LESIONS IN HER ADOLESCENCE.

MRS. KING HAS HAD VERY LITTLE TREATMENT FOR HER CONDITION, HAVING SEEN DR. ADOLPH CONRAD JR. APPROXIMATELY ONE YEAR AGO ON ONE VISIT AT WHICH TIME HE PRESCRIBED TWO BROWN LOTIONS.

SUPPLEMENTAL PRE-EMPLOYMENT LABORATORY SCREENING

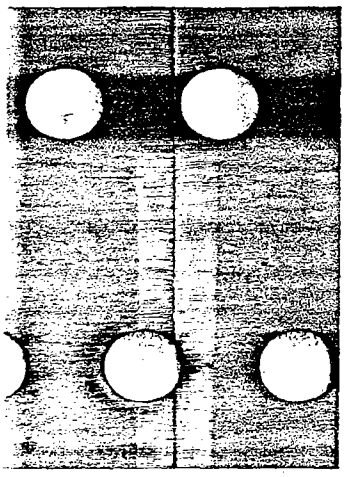
[illegible]

DSW 442117

STLCOPCB4056652

RE: MRS. RITA KING

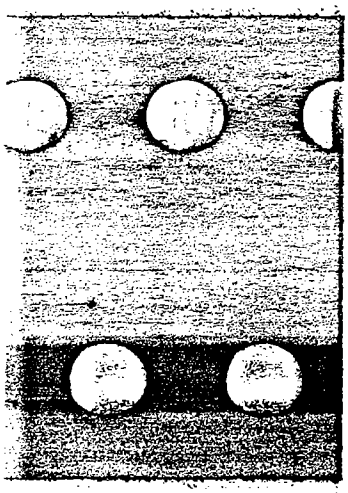
IN ADDITION SHE ALSO SAW DR. MILLSTEN AT APPROXIMATELY THAT SAME TIME FOR THREE VISITS IN TREATMENT OF THE CYSTIC LESIONS IN HER EYES. HE OPENED SEVERAL LESIONS ON EACH VISIT AND ADVISED SURGERY. NO FURTHER TREATMENT HAS BEEN AUTHORIZED FOR MRS. KING SINCE THEN AND SHE HAS USED ONLY SELF-APPLIED HOT PACKS TO THE NODULES ON HER CHEEKS AND CHIN WHEN THEY BECOME INFLAMMED.



PHYSICAL EXAMINATION REVEALED FEW BLACKHEADS; HOWEVER THE LESIONS CONSISTED MAINLY OF DEEP CYSTIC NODULES UP TO HALF CENTIMETER IN DIAMETER ON THE CHIN AND CHEEKS. THERE WERE A FEW LESIONS BEHIND THE EARS WITH SOME ASSOCIATED SCARRING. THE LESIONS ON THE CHEEKS WERE EXCORIATED AND THERE WAS SOME SUPERIMPOSED INCREASE IN PIGMINTATION IN THE TOP LAYERS OF THE CHIN. THERE WERE MANY CYSTIC LESIONS EVIDENT ALONG THE LOWER LID MARGINS AND SOME SCARRED AREAS INSIDE THE MEMBRANE OF THE EYE AS REPRESENTED BY SMALL WHITISH AREAS IN THE MEMBRANE.

IN MY OPINION, MRS. KING HAS A CYSTIC ACNEIFORM ERUPTION OF THE SKIN OF THE FACE AND EARS WITH SUPERIMPOSED EXCORIATIONS AND CYSTIC LESIONS INSIDE THE EYES SUCH AS ARE SEEN IN PATIENTS WHO ARE EXPOSED TO OIL AND PAINT FUMES AT WORK.

MRS. KING HAS BEEN ADVISED THAT FURTHER TREATMENT IS IN ORDER BOTH FOR THE EYES AND FOR THE SKIN AND IN ADDITION I FEEL THAT LIVER FUNCTION TESTS SHOULD BE DONE IN SPITE OF THE ABSENCE OF ANY HISTORY SUGGESTING DAMAGE THERE.



PLEASE FEEL FREE TO CONTACT ME, IF YOUR HAVE ANY OTHER QUESTIONS CONCERNING MRS. KING'S CASE.

VERY TRULY YOURS,

JAMES C. SISK, M.D.

JCS:ib

DSW 442118

STLCOPCB4056653

[illegible]
[illegible]
[illegible]
CLAYTON 5, MISSOURI
[illegible]

DECEMBER 19, 1962

MR. RENFORD CARUTHERS
430 PAUL BROWN BUILDING
ST. LOUIS 1, MISSOURI

RE: MR. VIRGIL MANES
EMPLOYEE: INTERNATIONAL BENT GLASS CO.

DEAR MR. CARUTHERS:

YOUR CLIENT, MR. VIRGIL MANES WAS SEEN IN MY OFFICE TODAY AND THE FOLLOWING HISTORY AND PHYSICAL FINDINGS WERE ELICITED AT THAT TIME.

MR. MANES STATED THAT HE HAD WORKED AT INTERNATIONAL BENT GLASS BETWEEN SEPTEMBER 15, 1956 AND SEPTEMBER 30, 1960, BEING PROMOTED FROM A JOB AS SWEEPER ALL THE WAY THROUGH TO THE JOB OF FOREMAN. IN ALL OF THESE POSITIONS, HOWEVER, HE WORKED EITHER ON THE OVENS OR AROUND THE OVENS AND WAS EXPOSED TO THE PAINT AND OIL FUMES AT ALL TIMES WHILE ON THE JOB.

APPROXIMATELY APRIL OF 1957 HE BEGAN TO DEVELOP BLACKHEADS AND INFECTED ACNE-LIKE BUMPS AND CYSTS, ESPECIALLY ON THE FACE THEN SPREADING TO THE NECK, UNDER HIS ARMS, THE GROIN, PRESSURE POINTS ALONG THE BELT LINE, THE PENIS, ETC. HE DRAINED MANY OF THESE HIMSELF. HE DEVELOPED NO EYE LESIONS AND FELT GENERALLY QUITE WELL.

HE WAS REFERRED TO DR. ARTHUR NEILSON IN 1958 WHERE HE WAS TREATED FOR APPROXIMATELY SIX MONTHS WITH PROTECTIVE CREAMS, A DRYING LOTION, SOAKS, PILLS AND SHOTS. HE WAS THEN SWITCHED TO THE CARE OF DRS. MCKEE AND BURKHARDT WHERE HE REMAINED UNDER TREATMENT UNTIL HE LEFT INTERNATIONAL BENT GLASS COMPANY. AGAIN TREATMENT CONSISTED OF PROTECTIVE CREAMS, SOAKS, SHOTS, SOAP, BLOOD COUNTS, INCISION AND DRAINAGE OF CYSTIC INFECTED LESIONS AND A PROTECTIVE CREAM. THE PHYSICIAN TOLD HIM THAT IT WOULD NEVER CLEAR COMPLETELY.

[illegible]

[illegible]

DSW 442119

STLCOPCB4056654

RE: MR. VIRGIL MANES

WHILE HE CONTINUED TO WORK AT INTERNATIONAL BENT GLASS COMPANY.

HE HAS HAD TWO INFECTED LESIONS DURING THE LAST YEAR, OPENED AT THE LABOR HEALTH INSTITUTE BY THEIR STAFF SURGEON. THE LAST ONE WAS OPENED APPROXIMATELY ONE WEEK AGO. MR. MANES FELT THAT HE CONTINUES TO GET AN OCCASIONAL CYSTIC LESION; THAT THE BLACKHEADS HAVE DECREASED IN NUMBER SINCE HE LEFT HIS JOB, BUT THAT THEY ARE STILL PREVALENT.

PAST HISTORY WAS SIGNIFICANT, SO FAR AS HE STATED THAT HE HAD MINIMAL ACNE DURING ADOLESCENCE AND PRIOR TO STARTING WORK AT INTERNATIONAL BENT GLASS HAD BEEN A CARPENTER WITH NO SKIN TROUBLE DURING THAT PERIOD. HIS GENERAL HEALTH HAS BEEN GOOD. HE HAD AN APPENDECTOMY SEVERAL YEARS AGO.

PHYSICAL EXAMINATION REVEALED MANY BLACKHEADS, ESPECIALLY BEHIND THE EARS AND ON THE NECK WITH A HEALING-RECENTLY OPENED-CYSTIC LESION BEHIND THE LEFT EAR. THERE WERE MANY SCARS BEHIND THE EARS AND A MODERATE NUMBER OF SCARS ON THE NECK. THERE WERE SIMILAR BLACKHEAD LESIONS ON THE FACE AND BACK, FLEXORS OF THE ARMS AND THE PUBIC AREA BUT TO A LESSER EXTENT THAN ON THE NECK. THERE WERE SEVERAL SCARS IN THE CRURAL FOLDS AND ON THE FORESKIN. THERE WAS A RIGHT SIDE ABDOMINAL SCAR FROM HIS OLD APPENDECTOMY SURGERY.

IN MY OPINION, MR. MANES HAS A BLACKHEAD CYSTIC ACNEIFORM ERUPTION, SECONDARY TO THE PAINT AND OIL FUMES TO WHICH HE WAS EXPOSED AT WORK AT INTERNATIONAL BENT GLASS COMPANY. IT IS OF INTEREST TO NOTE THAT THE LESIONS HAVE PERSISTED ALTHOUGH HE HAS BEEN AWAY FROM THIS JOB FOR APPROXIMATELY TWO YEARS AND I FEEL THAT HE WILL CONTINUE TO HAVE DIFFICULTY FOR SOME YEARS TO COME.

IN LINE WITH MY RECENT GRADING OF THE OTHER EMPLOYEES FROM INTERNATIONAL BENT GLASS, AS TO AMOUNT AND TYPE OF INVOLVEMENT, I HAVE LISTED BELOW ON A FOUR PLUS SCALE, MR. MANES TYPE OF INVOLVEMENT.

| BLACKHEADS | CYSTS | SCARS | EYE INVOLVEMENT | HISTORY LIVER INVOLVEMENT |
|---|---|---|---|---|
| III+ | III+ | II+ | 0 | — |

I WOULD RECOMMEND FURTHER TREATMENT IN MR. MANES' CASE AND

DSW 442120

STLCOPCB4056655

RE: MR. VIRGIL MANES

LIVER FUNCTION TESTS.

PLEASE FEEL FREE TO CONTACT ME, IF YOU HAVE ANY OTHER QUESTIONS CONCERNING THIS MATTER.

VERY TRULY YOURS,

JAMES C. SISK, M.D.

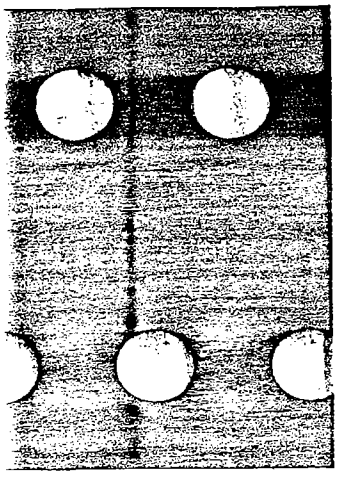
JCS:ls

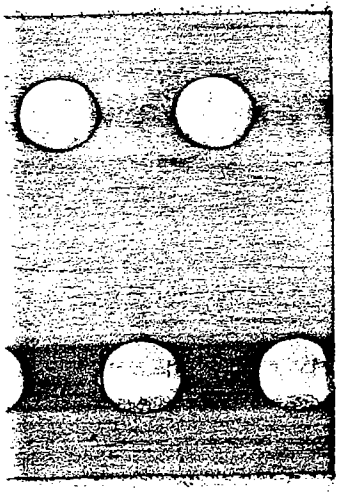
DERMATOLOGY

EDWARD F. BURKHART, M. D.
OLIVER A. McKEE, M. D.
634 NORTH GRAND BOULEVARD
ST. LOUIS, MO. 63103

Patient: Ruth Bruning
5640 Acme

Date of Initial Examination: May 11, 1959
Age: 35





History: The patient stated that she had been working at the International Lighting Company for fifteen years. She said that she had changed jobs many times. She has been working in the Bent Glass department as an overseer and did all kinds of jobs there. At time of examination she had been in the wiring department for one year.

She stated that her skin problems had begun two or three years before initial examination. Onset was noted as lumps of the face and arms, with lesions also appearing on the back. She experienced marked pain on lying down because of the lesions, she said. She has never had skin trouble before, she says. The menstrual periods are regular with no particular association of the dermatitis with the cycles.

She says that she had medical care for several months for her back and took penicillin injections and tablets.

Physical Examination: Physical examination showed a heavy concurrence of lesions of the cheeks, angles of the mandibles, pre-, post-, and infra-aural regions, lateral aspects of the neck, lateral-posterior neck, lateral forehead, upper anterior and posterior back and mid-back. The lesions are comedones, milia-like cysts, varying in size and varying from skin colored to erythematous.

Dates of visits: 1959 May 11-18-25 June 1-5-9-15-22 July 6-13-20-27 Aug. 3-10-17-24-31 Sept. 14-21-28 Oct. 5-26 Nov. 2-9-16-23-30 Dec. 7-14-21-28 1960 Jan. 4-14-18-25 Feb. 1-15-22-29 March 7-14-17-21-28 April 4-11-18-25 May 5-6-9-12-17-20-23-26-31 June 6-13-20-27 July 25 Aug. 1-8-15-22-29 Sept. 8-19-26-30 Oct. 3-31 Nov. 14-21-28 Dec. 12-19 1961 Jan. 9-16-23- Feb. 13-20-27 Mar. 6-13-20-27 Apr. 3-10-17-24 May 8-22-26 June 2-5-12-19 July 17-24-31 Aug. 7-14- Sept. 11-18-25- Oct. 2-9-30 Nov. 13-20-27 Dec. 4 1962 Jan. 22-29 Feb. 19-26 Mar. 19-26 Apr. 2-9-16-30 May 7-14-21-28 June 4-11-15-18-26 July 10-17-31 Aug. 7-21 Sept. 4-11 Oct. 2-9- Nov. 6-13-27 Dec. 18-28 1963 Jan. 4-11-18 Feb. 1-8-15-22-28 Mar. 8-15-22-29 Apr. 5-19-26 May 3-10-24 June 7-14-28 July 30 Aug. 6-20 Sept. 3-17- Oct. 1-29 Nov. 12 Dec. 3-17 1964 Jan. 21 Feb. 4-25 Mar. 17-31 Apr. 14-28 May 12-19 June 2-16 July 14-28 Aug. 4-11-18 Sept. 1-15-29 Oct. 13-27 1965 Apr. 9-23 May 18 June 1-15 July 13 Sept. 21 Oct. 5-19 Nov. 9 Dec. 7 1966 Jan. 11 Feb. 21

SUPPLEMENTAL PRE-TRIAL NARRATIVE STATEMENT OF

RUTH BRUNING

DSW 442122

DERMATOLOGY

EDWARD F. BURKHART, M. D.
OLIVER A. McKEE, M. D.
634 NORTH GRAND BOULEVARD
ST. LOUIS, MO. 63103

#2 Ruth Bruning

Course: During her therapy, the patient has received various local and systemic medications. The contents of the retention lesions were removed manually or surgically, as the need indicated. At various times, cysts were incised and drained or excised and sutured.

Conclusions: In view of the clinical aspects of this eruption and the patient's employment it is my impression that this represents a follicular retention syndrome or acneform eruption associated with occupational factors. It is my impression also that individuals who have an active pilo-sebaceous system have a greater tendency under the proper conditions to develop this type of eruption on exposure to follicular irritants.

March 29, 1966 (Signed) _____

Drs. Burkhart and McKee

efb/bs

EDWARD F. BUNKHART, M. D.
OLIVER A. McKEE, M. D.

DERMATOLOGY

634 N. GRAND BOULEVARD
ST. LOUIS, MISSOURI 63103

392 N. KIRKWOOD ROAD
KIRKWOOD, MO. 63122

January 14, 1960

Patient: Mrs. Bessie Thelma Boyd
4157 Prairie

Employer: International Lighting Mfg. Co.
1825 N. 19th St.

Age: 35(at time of examination) Occ: Screener in heat sheen dept.

Duration of Employment: Worked for the company for eight years, lived in Denver for three years, came back to St. Louis and began work for the company in late November, 1959.

Chief Complaint and Duration: Patient says onset of dermatitis was four years ago, before she ended her first period of employment with the company. Onset was noted over the face, with spread to shoulders and back of neck. At the present time, the face is the main area of involvement, with some involvement of the neck. The dermatitis is asymptomatic, she says, but makes her nervous when she picks at the places.

History: She says she reported the onset of the dermatitis to the company, but received no treatment. During her stay in Denver, she says, the neck and shoulders cleared, but the eruption of the face and skin remained. She says she has not noticed any appreciable increase in severity of the eruption during the short time she has been re-employed by the Company. She was laid off right after Christmas, 1959, and is to report back to work a few days after examination.

Operation and Contacts: During her first period of employment with the company she worked in wiring for about four years, then worked as a screener with occasional work on the ovens. In November, 1959, she began working on ovens, with occasional screening.

Past History: General health is good. Past history negative for skin trouble. Is not under the care of a doctor at this time for any other ailment.

COPY

SUPPLEMENTAL PRE-TRIAL DEPOSITIVE STATEMENT OF

BESSIE T. BOYD

DSW 442124

STLCOPCB4056659

EDWARD F. BURKHART, M. D.
OLIVER A. McKEE, M. D.

DERMATOLOGY

634 N. GRAND BOULEVARD
ST. LOUIS, MO. 63103

925 N. KIRKWOOD ROAD
KIRKWOOD, MO. 63122

72 Bessie Thelma Boyd

Dates of visits: 1960 Jan. 14-21-29 Feb. 2-5-12-16-19-22-29 Mar. 4-7-11-14-18-21-25-28 Apr. 1-4-8-11-18-21-25 May 2-9-16-24-31 June 3-6-13-17-20-24 July 1-11-18- Aug. 1-8-15-22-29 Sept. 8-19-26 Oct. 10-17-24-31 Nov. 7-21-15-29 Dec. 5-12-29 1961 Jan. 5-9-16-23-30 Feb. 13-20-27 Mar. 6-13-20 Apr. 3-10-17-24 May 1-15-22-29 June 12-19 July 17-24-31 Aug. 7-14-28 Sept. 11-18 Oct. 2-9-30 Nov. 6-20 Dec. 4-22-29 1962 Jan. 4-22 Feb. 5-19-26 Mar. 19-26 April 9-16-30 May 14-28 June 11-18-25 July 2-6-9-16-30 Aug. 6-20-27 Sept. 10-17-24 Oct. 1-8-15-21-29 Nov. 5-19-26 Dec. 3-17-27 1963 Jan. 7-14-28 Feb. 4-18-25 Mar. 4-18 Apr. 1-8-15-29 May 6-13-20-27 June 3-10-24 July 8-22 Aug. 5-19 Sept. 16-30 Oct. 14-28 Nov. 11-25 Dec. 9-23 1964 Jan. 6-27 Feb. 10-24 Mar. 9-23 Apr. 20-28 May 11-18-25 June 8-15-22 July 13-20 Aug. 3-17-31 Sept. 14-28 Oct. 19-26 Nov. 9-23 Dec. 7-21 1965 Jan. 4 Feb. 1 Mar. 1-15 Apr. 5-26 May 10 June 7-21 July 12 Aug. 9-30 Sept. 20 Oct. 11 Nov. 8. Dec. 6 1966 Jan. 3-31 Feb. 21

Physical Examination: Physical examination showed multiple comedones with sebaceous retention cysts of the chin, infra-chin, superior anterior neck, medial neck. The menstrual periods are regular and there is no flare of the dermatitis associated. The mandibular margins, the periaural area and the lateral aspects of the neck also show lesions. There were comedones of the malar areas of the cheeks, lateral to the eyes. The cysts vary in size up to 1-1.5 cm. in diameter.

Course: During her therapy, the patient has received various local and systemic medications. The contents of the retention lesions were removed manually or surgically, as the need indicated. At various times, cysts were incised and drained, or excised and cultured.

Conclusions: In view of the clinical aspects of this eruption and the patient's employment it is my impression that this represents a follicular retention syndrome or acneform eruption associated with occupational factors. It is also my impression that individuals who have an active pilosebaceous system have a greater tendency under the proper conditions to develop this type of eruption on exposure to follicular irritants.

March 29, 1966 (Signed) _____
Drs. Burkhart and McKee

cfb/bs

COPY

DSW 442125

STLCOPCB4056660

DSW 442126

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL

MAR 11 1977

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
ROBERT A. TAFT LABORATORIES
4676 COLUMBIA PARKWAY, CINCINNATI, OHIO 45226

PCB FILE

March 1, 1977

Mr. Paul E. Heisler
Monsanto
Route 3
Sauget, Illinois 62201

Dear Mr. Heisler:

Enclosed is a draft of the industrial hygiene survey conducted at the W.G. Krummrich plant on July 21-22, 1976. I would appreciate you reviewing this report for any trade secret information that may have been inadvertently included and for technical correctness. Upon receiving your response, the report will be finalized with copies forwarded to you, NIOSH Assistant Regional Director, OSHA Regional Director, local union representative and the Illinois Department of Labor. It should be noted that investigative findings and reports are subjected to mandatory disclosure, upon request, under the provisions of the Freedom of Information Act.

I apologize for the delay in sending you this report; however, we were delayed in obtaining the analytical results and I have been traveling very much recently.

Sincerely,

Mark W. Jones

Mark W. Jones
Industrial Hygienist
Industrywide Studies Branch

cc: J.T. Garrett

DSW 442127

STLCOPCB4056662

# INDUSTRIAL HYGIENE SURVEY OF THE

Polychlorinated Biphenyl Production Operation
**Monsanto Industrial Chemicals Company**
Sauget, Illinois

SURVEY DATE

July 21-22, 1976

SURVEY CONDUCTED BY

Mark Jones
Janson Becker

REPORT WRITTEN BY

Mark Jones

DATE OF REPORT

Industrial Hygiene Section
Industrywide Studies Branch
Division of Surveillance, Hazard Evaluations and Field Studies
National Institute for Occupational Safety and Health
Cincinnati, Ohio

DSW 442128

STLCOPCB4056663

| | |
|---|---|
| PLACE VISITED: | Monsanto Company<br>W.G. Krummrich<br>Sauget, Illinois |
| DATE OF VISIT: | July 21-22, 1976 |
| PEOPLE CONTACTED: | Mr. Art Leisy<br>Manufacturing Superintendent<br><br>Mr. Paul Heisler<br>Supervisor - Air Pollution<br><br>Mr. Bruce Eley<br>Corporate Industrial Hygienist<br><br>Mr. Virgil Brawley<br>Supervisor - PCB Production<br><br>Mr. John Peduzzi<br>Supervisor - Incineration<br><br>Mr. Julio Mundoz - Air Pollution Group<br>Mr. Neil Sullivan - Air Pollution Group<br>Mr. Frank Basile - Air Pollution Group<br>Mr. Ed Newman - Air Pollution Group<br><br>Mr. Dale Rachel - Foreman, PCBs Production<br>Mr. Tom Carraco - Foreman, PCBs Production |
| PERSONS MAKING VISIT: | Mark Jones<br>Janson Becker |
| PURPOSE: | To conduct an industrial hygiene survey to determine the workers' level of exposure to chemicals present in the polychlorinated biphenyls production area at the Sauget, Illinois facility. |

DSW 442129

## INTRODUCTION

Recent literature has linked polychlorinated biphenyls with possible carcinogenic effects. Because this literature is incomplete, the Division of Surveillance, Hazard Evaluations and Field Studies of the National Institute for Occupational Safety and Health has underway an "industrywide" study of industries using polychlorinated biphenyls. Since Monsanto is the sole producer of polychlorinated biphenyls in the United States, an industrial hygiene survey was conducted at their PCBs production area in Sauget, Illinois, on July 21-22, 1976. This survey was conducted by Janson Becker and Mark Jones.

During the visit, 18 air samples were collected for evaluation of polychlorinated biphenyls exposure. In addition, samples were collected for exposure to iron silica and chlorine.

## DESCRIPTION OF THE FACILITY

The polychlorinated biphenyls production operation is one of many operations present at the Monsanto facility in Sauget, Illinois. Sulfuric acid, benzene, and benzene derivatives, rubber chemicals (antioxidants, etc.), activated chlorine and phosphorous products are other products produced at the facility.

The facility began production of polychlorinated biphenyls around 1929. Production continued to grow until 1970 when Monsanto began restricting the sale of PCBs for use in closed systems.

The entire work force at the facility is approximately 1300 persons, with approximately 835 of these persons being hourly employees. Approximately 25 employees are involved with the production of PCBs. The union representing this group is the International Chemical Workers, Local #12.

## MEDICAL, INDUSTRIAL HYGIENE AND SAFETY PROGRAMS

A dispensary is located at the plant. Nurses are present at the dispensary 24 hours a day and a physician is present during the day. All employees are required to take a pre-employment physical examination. Certain employees are then required to take periodic physical examinations.

Industrial hygiene matters at the facility are handled by the Air Pollution Group. The six people, who are assigned to this group, work in conjunction with the safety department. The only sampling that has been done for polychlorinated biphenyls is the discharge from the area is monitored twice a week and the collection of a few air samples (Appendix B).

Four people work in the safety department. Safety meetings are held every month and safety information is provided to the different work areas through safety committees. Personal protection programs used at the plant include safety shoes, safety glasses, hard hats, protective clothing and respirators (where needed).

Corporate industrial hygienists also give support to the industrial hygiene and safety programs.



DSW 442131

STLCOPCB4056666

## DESCRIPTION OF PROCESS

Three products are made in the PCBs production area: Aroclor 1016, Aroclor 1242, and Aroclor 1254. Aroclor 1016 is used in capacitors and Aroclor 1242 and 1254 are used in transformers. The operation is outdoor and consists mainly of pipeline, reaction vessels, distillation columns and storage tanks. Even though the system is theoretically a closed system, samples are drawn off and leaks occur which give a potential for employee exposure.

Biphenyl is brought to the facility by tank car and pumped to storage tanks. The chlorine used for the operation comes by pipeline from another part of the plant. The chlorine and biphenyl are piped into a chlorinator in the presence of an iron catalyst and allowed to react. There are two separate groups of chlorinators, one group for producing Aroclor 1254 and the other for Aroclor 1242. The product from the Aroclor 1254 chlorinators goes through a purifying operation which includes a still, receiving tank and filtering system. From this operation the polychlorinated biphenyls go to the appropriate storage tank. The product from the Aroclor 1242 chlorinators goes to an intermediate storage tank and then either through a similar operation as the Aroclor 1254 or to a distillation column which separates the different polychlorinated biphenyl isomers for producing Aroclor 1016. From here it goes to the storage tanks.

The mixing tanks are used to formulate the final product by the introduction of the appropriate additives needed to give the polychlorinated

biphenyls the properties desired by the customer. To give the polychlorinated biphenyls better electrical properties a small amount of diatomaceous earth is added to the blend tanks once a week and then filtered out.

## INSPECTION OF PLANT

### Potential Health Hazards

Potential health hazards observed during this survey were as follows:

1. Polychlorinated biphenyls exposure
2. Chlorine exposure
3. Free silica exposure

### Ventilation

Since the operation is outdoors there is very little ventilation. Local exhuast ventilation is used in two operations. The drumming operation is equipped with a hose which is placed near the opening of the 55 gallon drum while it is filled. Near the chlorinators is a work station where employees perform specific tests on samples drawn from the chlorinators. This work station has a hood over the area where the tests are performed.

### Housekeeping

Housekeeping in the polychlorinated biphenyls production area was taken care of fairly well. The aisleways were kept clean and clear.

DSW 442133



STLCOPCB4056668

## SURVEY PROCEDURES

### General

Air samples were collected in the polychlorinated biphenyls production area for evaluating exposure to polychlorinated biphenyls, iron chloride, and chlorine. A bulk sample of the diatomaceous earth used was analyzed for free silica content. The following paragraphs describe the methods used to collect and analyze the air samples.

### Polychlorinated Biphenyls

Both personal and area air samples were collected in the polychlorinated biphenyls production area. Sipin SP1 pumps were used to collect the air samples on florosil tubes. The tubes contain a magnesium silicate absorbent called florosil and have a 100 mg primary section and a 50 mg backup section. Samples were collected for six to eight hours at a flow rate of approximately 200 cc/min. The polychlorinated biphenyls were desorbed from the florosil with hexane and analyzed by using a gas chromatograph with an electron capture detector.

### Iron Chloride

Area air samples were collected for iron chloride while the employees poured the iron chloride (powder) catalyst into the reactors. MSA Model G pumps were used to collect the air samples on a 0.8 micrometer pore size mixed cellulose ester filter (37 mm in diameter). Samples were collected for the duration of the task which was approximately three minutes at a flow rate of 1.7 liters per minute. The samples were analyzed for iron by atomic absorption and are reported as such.

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## Free Silica

One bulk sample of the diatomaceous earth used was collected for analysis of free silica content. The per cent free silica was determined by x-ray diffraction.

## Chlorine

Detector tubes were used to evaluate concentrations of chlorine in the PCBs production area. Chlorine measurements were made using "Bendix Gastec Analyzer Tubes - Low Range (1-8 ppm)."

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## RESULTS AND DISCUSSION

### Polychlorinated Biphenyls

The results of the area and personal air samples are given in Table I and the job descriptions corresponding to the job titles are in Appendix A.

Eleven personal and seven area air samples were collected for analysis for polychlorinated biphenyls. The polychlorinated biphenyls being produced at the time of the survey were for Aroclor 1016 (42% chlorine). The personal air samples ranged from a concentration of 20 $\mu g/m^3$ to 86 $\mu g/m^3$ while the area air samples ranged from 16 $\mu g/m^3$ to 55 $\mu g/m^3$. These are all well below the current standard for chlorodiphenyl (42% of chlorine) of 1 $mg/m^3$. However, this standard is based upon skin irritation and recent literature has linked carcinogenic effects to polychlorinated biphenyls. Therefore, this standard may not adequately protect the workers health.

### Iron Chloride

The results of the air samples are given in Table II. Two samples were collected for determining worker exposure to iron chloride. No iron could be detected on one of the samples, but the other sample had an iron concentration of 8.1 $mg/m^3$. Since this procedure of adding the iron catalyst to the reactor only takes 3 minutes and is done once a shift the workers time weighted average is well below the current standard for iron salts of 1 $mg/m^3$ based upon soluble iron. The big difference in sample results was probably due to the differences in operating procedures observed each time the task was performed.



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Free Silica

The bulk sample of diatomaceous earth was analyzed and determined to have a free silica content of 9.8%. Since the procedure of adding diatomaceous earth to the blend tank is done usually only once a week, the survey team was unable to observe this procedure.

Chlorine

No concentrations of chlorine were detected.

## CONCLUSIONS AND RECOMMENDATIONS

Based on the observations made during this survey and the results of the air samples, the following conclusions are drawn and recommendations for improvements made:

1) Even though the concentration of iron chloride found during the addition of the catalyst to the reactor is below the Federal Standard, it would be good industrial hygiene practice to continue wearing an approved respirator when this task is performed.

2) Since the diatomaceous earth contains 9.8% free silica, an approved dust respirator should be worn when the worker performs this task if this practice is not presently employed.

3) Because of the recent concern of the possible carcinogenic effects of polychlorinated biphenyls, engineering methods should be used to prevent employee exposure to polychlorinated biphenyls.

4) Emergency equipment (self-contained breathing apparatus) should be readily available in case of a chlorine leak.



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Table I

CONCENTRATIONS OF POLYCHLORINATED BIPHENYL
(detected as Aroclor 1016) IN A FACILITY
MANUFACTURING POLYCHLORINATED BIPHENYLS

Personal Air Samples

| Job Title | Date | Total Time (min.) | Volume (liters) | Concentration ($\mu g/m^3$) | TWA ($\mu g/m^3$) |
|---|---|---|---|---|---|
| Premium Operator<br>" | 7/21<br>7/22 | 436<br>451 | 91.0<br>97.8 | 47<br>20 | 33 |
| Second Operator<br>" | 7/21<br>7/22 | 432<br>448 | 80.0<br>95.3 | 46<br>43 | 44 |
| Column Operator<br>" | 7/21<br>7/22 | <br>446 | 74.9<br>85.7 | 64<br>51 | 57* |
| Still Operator<br>" | 7/21<br>7/22 | 432<br>444 | 94.6<br>67.6 | 40<br>86 | 63 |
| Standard Operator | 7/22 | 445 | 96.1 | 61 | 61 |
| Distribution Operator<br>" | 7/21<br>7/22 | 413<br>419 | 88.3<br>91.3 | 54<br>36 | 45 |

Area Air Samples

| Location | Date | Total Time (min.) | Volume (liters) | Concentration ($\mu g/m^3$) | Average ($\mu g/m^3$) |
|---|---|---|---|---|---|
| Drumming<br>" | 7/21<br>7/22 | 418<br>418 | 89.1<br>87.6 | 45<br>51 | 48 |
| Temperature Testing<br>" | 7/21<br>7/22 | 417<br>455 | 201.6<br>105.4 | 25<br>52 | 39 |
| Chlorinators<br>" | 7/21<br>7/22 | 419<br>459 | 89.0<br>70.3 | 55<br>36 | 46 |
| Incinerator Burner | 7/21 | 409 | 81.6 | 16 | 16 |

*Arithmetic Average

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Table II

CONCENTRATIONS OF IRON CHLORIDE
FOUND WHILE OPERATOR ADDED IT AS A CATALYST

| Location | Date | Total Time (min.) | Volume (liters) | Concentration of Iron ($mg/m^3$) | Concentration of Iron Chloride ($mg/m^3$) |
|---|---|---|---|---|---|
| Near Reactor Lid | 7/21 | 3 | 5.1 | N.D. | -- |
| " | 7/22 | 3 | 5.1 | 8.1 | 18.4 |

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## Appendix A

### JOB DESCRIPTIONS

Premium Operator - Operates both the continuous and batch chlorinators. This includes keeping the chlorinators running, adding the iron chloride catalyst once a shift and drawing samples off twice a shift.

Second Operator - Loads the tank cars for shipment and takes care of the tank farm and blend tanks.

Standard Operator - In charge of making sure area is clean and does all the filling of the 55 gallon drums.

Column Operator - Operates the distillation column used to produce Aroclor 1016.

Still Operator - Operates both stills used in producing Arolcor 1254 and 1242.

Distribution Operator - Works in a different area of the plant and is in charge of operating the incinerator.

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Appendix B

CONCENTRATION IN THE ATMOSPHERE IN THE
MANUFACTURING DEPARTMENT BATTERY LIMITS AS MEASURED IN OCTOBER, 1975

| Date | Location | $mg/m^3$ |
|---|---|---|
| 10/ 9/75 | 12 ft. operating level at batch chlorinator | 0.022 |
| 10/ 9/75 | 12 ft. operating level at continuous chlorinator | 0.012 |
| 10/13/75 | 12 ft. operating level at batch chlorinator | 0.057 |
| 10/13/75 | 12 ft. operating level at continuous chlorinator | 0.058 |
| 10/14/75 | Ground floor operating level | 0.006 |
| 10/16/75 | Ground floor, scrubber discharge area | 0.338 |

SOURCE: Monsanto

DSW 442141

Monsanto

W. B. Papageorge - B3NB

RAP JAN 22 1976

January 20, 1976

EPA-PCB Audit

R. E. Bilger - B3NJ
R. A. Pohl - B2SB
R. Flint - 1740
A. E. Leisy - 1740
J. C. Weber - B2SK

TO

D. B. Hosmer - E1SF

Attached are copies of EPA memoranda relating to PCB's which were sent to state and regional personnel. These memoranda outline the programs which EPA, Washington, expects the regional offices to complete.

WB Papageorge
W. B. Papageorge

gw
Attachment

DSW 442142

STLCOPCB4056677

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

December 22, 1975

MEMORANDUM

OFFICE OF ENFORCEMENT

TO: Regional Administrators
Regional Enforcement Directors
Regional Surveillance & Analysis Directors

FROM: Assistant Administrator for Enforcement

SUBJECT: Identification and Control of Environmental Sources of PCBs

As the Administrator enunciated in his statement to the press today, attached as Exhibit A, the elimination of the introduction of PCBs into the environment is a high Agency priority. His statement outlines several measures EPA is undertaking to accomplish this. He has asked the Office of Enforcement to coordinate the efforts of the Regional Offices to accomplish the first of these measures: the elimination of PCBs from discharges from facilities using PCBs, particularly those facilities manufacturing transformers and capacitors, and the elimination of PCBs, related wastes and by products from discharges from facilities manufacturing and formulating PCBs. The steps necessary to implement this task are set forth below and are summarized in the work schedule attached as Exhibit B.

1. By 12/31/75 each Regional Office should identify each manufacturer, formulator and user of PCBs within its jurisdiction, including the manufacturers of PCBs, capacitors and transformers listed on Exhibit C.

2. By 1/9/76 submit to the Office of Water Enforcement, to the attention of Blake Biles, a schedule to survey such facilities. All surveys of the facilities listed in Exhibit C should be completed by 2/28/76 and surveys of other facilities, as appropriate, should be completed as soon thereafter as is possible. The survey of the facilities listed in Exhibit C should follow the format outlined in Exhibit D to determine all points at which PCBs enter the environment from the subject facilities and to identify appropriate corrective measures. The surveys will develop information on PCB losses to water, air and land. The resulting water data will be used by the Regional Offices to accomplish steps 4 and 5, discussed below. The air and land data will be forwarded by the Office of Water Enforcement to other offices for the development of appropriate remedial measures. Since the land disposal data may ultimately be used by Regional solid waste personnel, in conjunction with state and local solid waste authorities, Regional solid waste personnel



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should accompany your survey teams. It will be impossible to survey all users of PCBs. As indicated above, all facilities listed on Exhibit C should be surveyed. Priority should be given to facilities concerning which little information is presently available. Surveys of other facilities should focus on larger users of PCBs and can be incorporated as priority items into routine compliance monitoring visits. A meeting will be held in Washington, D. C. on January 7, 1976, to discuss in detail the surveys and appropriate remedial controls. Your lead person on the surveys from the Surveillance and Analysis Division and your lead person on the permit effort from the Permit Branch should plan to attend this meeting. Further information on the meeting will be forthcoming from Carl Schafer, Acting Director of the Permit Division. Please contact Tom Gallagher, Director of the NEIC, immediately if you will require NEIC assistance to complete these surveys.

3. By 1/31/76 review the NPDES permit status of all known dischargers of PCBs and commence enforcement actions where appropriate. Check DMRs and other data on discharges to identify noncompliance with existing PCB effluent limitations. Determine whether enforcement actions should be taken for any failure to identify PCB discharges in permit applications. Immediately commence actions against any non-filers and expedite issuance of permits to any dischargers who have applications on file. Include a summary of all such activities in your February status report described in item 8 below.

4. By 3/31/76 issue a public notice of the proposed issuance of a permit to any facility listed on Exhibit C which has a direct discharge and which does not currently have a permit, and issue public notices of proposed modifications of permits previously issued to facilities listed on Exhibit C. All such proposed permits and modifications should contain conditions requiring the elimination of PCBs from the discharges as expeditiously as possible.

5. By 3/31/76 commence negotiations with all facilities listed on Exhibit C which discharge into municipal treatment systems to eliminate PCBs from their discharges, utilizing jawboning, public pressure, proposed zero PCB limitation in municipal permits, and possible section 504 actions. Since success in regard to these facilities may require municipal as well as Federal action, municipal facilities should be fully briefed and their active cooperation should be solicited. A municipal inspector should be invited to accompany surveys of these facilities. It should be noted that some states require permits for dischargers of industrial wastes into municipal treatment systems. Where this is the case, active state participation should also be sought to the end of modifying such state permits to require a final zero PCB limitation.

In regard to items 4 and 5, it should be noted that the Administrator will be meeting in January with the presidents of companies utilizing PCBs in the manufacture of transformers and capacitors. At the meeting he will outline the measures we expect them to undertake to eliminate PCB contamination. This should lay the groundwork for your subsequent contacts with these facilities. A range of measures designed to accomplish the elimination of PCB contamination is discussed in Exhibit D.

In regard to items 4 and 5 it should be further noted that some of the facilities discharging PCBs are located in states with NPDES authority. You should coordinate your activities with them to make sure that all actions called for are accomplished expeditiously. In this regard, attached as Exhibit E is a copy of a memorandum sent today to those states outlining the problem and the requested course of action. Please note that EPA may modify an outstanding EPA issued permit, unless the state wishes to use the occasion to issue a state NPDES permit with a zero final PCB discharge. Where a state wishes to issue its own NPDES permit incorporating a zero final PCB discharge, EPA should terminate its permit after the state permit is effective.

6. By 3/31/76 submit a schedule to accomplish the same actions, as appropriate, for all PCB dischargers not listed on Exhibit C.

7. Some Power plants use capacitors and transformers which contain significant quantities of PCBs. You should assure that permits for all such power plants contain zero PCB limitations. For power plants with permits that presently contain no PCB limitations, the facility should be contacted by telephone to determine whether it has transformers or large capacitors that contain PCBs. If it does, its permit should be modified to contain a zero PCB limitation. As you know, the effluent guideline for the Steam Electric Power Generating Category contains a zero discharge PCB limitation.

8. The Administrator has expressed a strong desire to be kept completely informed of EPA's activities with regard to PCBs. My memorandum of August 29, 1975, attached as Exhibit F, was designed to initiate regional activities to control PCB discharges and provide appropriate feedback to the Administrator. In order to provide the Administrator with the information he needs, please provide, by the first Friday of each month, a detailed account of your activities during the previous month.

The first report is due on January 9, 1976, and should describe fully all of your activities to date in response to the August 29th memo together with the dates on which such actions were taken. Items to be covered in the January 9th report are:

(a) The complete list of PCB manufacturers, formulators, users compiled pursuant to item 1. above;

(b) A brief statement of what specific actions (if any) have been taken with regard to each facility on the list in item 1. above;

(c) Where no action has taken place with regard to a facility on the list in item 1. above, a reason for the non-action and a schedule of what will be done;

(d) Additional activities performed or to be performed in response to the August 29th memo; and

(e) A full description of all activities that NPDES states have performed regarding PCBs.

Blake Biles and Murray Strier are the appropriate contact persons in the Office of Enforcement for these activities. In particular, all information and reports requested herein should be directed to Blake Biles (202-755-8731) and all questions relating to the technical aspects of PCBs and their control should be directed to Murray Strier (703-557-7420).

Stanley W. Legro

Stanley W. Legro

Enclosures

Exhibit B

## PCB WORK SCHEDULE

| | |
|---|---|
| 12/31/75 | Identify each manufacturer, formulator and user of PCBs. (Item #1) Commence review of NPDES permit status of all known dischargers of PCBs. |
| 1/7/76 | Attend meeting in Washington, D.C. to discuss plant surveys and appropriate remedial controls. (Item #2) |
| 1/9/76 | Submit monthly activity report to Blake Biles, EN-338, Office of Water Enforcement. (Item #8) This report should cover the items described on page 4 of the attached cover memo. |
| | Submit (with monthly activity report) a schedule to survey all facilities listed in Exhibit C. (Item #2) |
| 1/31/76 | Complete review of NPDES permit status of all known dischargers of PCBs and commence appropriate enforcement actions. (Item #3) |
| 2/6/76 | Submit monthly report of January activities. (Item #8) |
| 2/28/76 | Complete surveys of all facilities listed in Exhibit C. (Item #2) |
| 3/5/76 | Submit monthly report of February activities. (Item #8) |
| 3/21/76 | No later than this date, issue public notices of proposed issuance or modification of NPDES permits to require the elimination of PCBs from the discharges from facilities listed in Exhibit C as expeditiously as possible. (Item #4) |
| | No later than this date, commence negotiations and other activities to eliminate PCBs from the discharges into municipal treatment systems from facilities listed in Exhibit C. (Item #5) |
| | Submit a schedule to accomplish plant surveys, permit issuances and modifications, elimination of discharges of PCBs by industrial contributors into municipal treatment systems, and similar activities for all PCB dischargers not listed in Exhibit C. (Item #6) |
| 4/2/76 | Submit monthly report of March activities. (Item #8) |
| 5/7/76 | Submit monthly report of April activities. (Item #8) |

In addition to the items listed in the above work schedule, you should review the NPDES permit status of power plants as soon as possible, and act promptly to make any modifications and take necessary enforcement action. (Item #7) Furthermore, you should review the NPDES permit status of all PCB dischargers whose identity you learn after 1/31/76, and you should take appropriate enforcement actions for any discharges in violation of the NPDES permit program.

Exhibit C

Region I - PCB Users

AEROVOX Industries, Inc.
740 Belleville Ave.
New Bedford, Mass. 02741
617-994-9661

contact - Norman Butterworth
Manager of Environmental Control

Cornell Dubilier Electric Corp.
1605 East Rodney French Blvd.
New Bedford, Mass. 02741

contact - Philip Murray, General Manager

Jard Company, Inc.
Bennington, Vermont 05201

contact - Richard L. Rollins

Sanders Associates, Inc.
95 Canal Street
Nashua, New Hampshire 03060

contact - E.J. Boutin

Sprague Electric Company
Brown Street
North Adams, Mass.

contact - Fred A. Windover

Tobe Deutschmann Laboratories
Canton, Mass. 02021

contact-Tobe Deutschmann

Universal Manufacturing Corp.
Capacitor Division
902 Crescent Ave.
Bridgeport, Conn. 06607

corporate offices:
Universal Manufacturing Corp.
29-51 East Sixth St.
Paterson, N.J. 07509

contact - N. Ray Clark

Region II - PCB Users

Axel Electronics, Inc.
134-20 Jamaica Avenue
Jamaica, New York 11418

contact - Robert H. Elkes, Data Manager

General Electric Corp.
570 Lexington Ave.
New York, N.Y. 10017

contact - Stu Richel 518-374-2211

Inductotherm Corp.
10 Indel Ave.
Rancocas, N.J. 08073

contact - Roy T. Ruble 609-267-9000

R.F. Interonics, Inc.
100 Pine Aire Drive
Bay Shore, Long Island N.Y. 11706

contact - Mervin H. First 516-231-6400

Niagra Transformer Corp.
1747 Dale Road
P.O. Box 233
Buffalo, New York 14225

contact: Herman E. Gabel, Jr. 716-896-6500

Research Cottrell, Inc.
Radel Ave.
Finderne, N.J. 08805
Bridgewater Township

corporate offices:
P.O. Box 750
Bound Brook, N.J. 08805

contact - Frank L. Armour
Associate Counsel

Universal Voltronics
27 Radio Circle Dr.
Mt. Kisco, N.Y. 10549

contact: Lewis Cohen

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Region II - continued

York Electronics Corp.
104 South Fourth St.
Brooklyn N.Y. 11217

contact - H. Dubilier

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Region III - PCB Users

Buell
Division of Envirotech Corp.
200 North Seventh St.
Lebanon, Pa. 17042

corporate offices:
253 North Fourth St.
Lebanon, Pa. 10742

contact: D.J. St. John

Energy Systems Company
Division of Aydin Corp.
960 River Road
Croydon, Pa. 19020

corporate offices:
Energy Systems Co.
Division of Aydin Corp.
401 Commerce Dr.
Fort Washington, Pa. 19034

contact: Nicholas J. Scafidi

H.K. Porter Company, Inc.
Transformer Manufacturing Plant
Lynchburg, Va. 24505

corporate offices:
H.K. Porter Company, Inc.
Porter Building
Pittsburgh, Pa. 15219

contact - F.M. Vignovitch 412-391-1800

R.E. Uptegraff Manufacturing Co.
P.O. Box 182
Scottsdale, Pa. 15683

contact - R.E. Uptegraff, Jr.
President

Westinghouse Electric Corp.
Power Systems
Transformer Division
469 Sharpsville Ave.
Sharon, Pa. 16146

Region III - continued

Westinghouse Electric Corp.
Small Power Transformer Division
Box 920, Highway 58W
South Boston, Va. 24592

corporate offices:
Westinghouse Building
Gateway Center
Pittsburgh, Pa. 15222

contact - Roger Wills, Jr., Attorney

Western Electric
Baltimore Works
2500 Broening Highway
Baltimore, Maryland 21224

corporate offices:
Western Electric
222 Broadway
New York, New York 10038

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Region IV - PCB Users

Carolina Capacitors, Inc.
Division of Baldour Electric Co.
P.O. Box 125
Ridgeville, South Carolina 29472

contact - E.J. Wershey

Helena Corp
Helena Industrial Park
P.O. Box 251
Helena, Alabama 35080

contact - K.A. Thallner
General Manager & Vice President

Sangamo Electric Co.
Capacitor Division
P.O. Box 128
Pickens, South Carolina 29671

contact - Jessie L. Butner
Manager, Manuracturing Services

McGraw Edison Power Systems Division
1520 Emeral Road
Greenwood, South Carolina 29646

corporate offices
McGraw Edison Power Systems Division
P.O. Box 440
Cannonsburg, Pa 15317

contact - F.P. Campeau
Buildings & Grounds Section

Hevi-Duty Electric
Division of Sola Basic Industries, Inc.
P.O. Box 268
Goldsboro, North Carolina 27530

corporate offices:
Hevi-Duty Electric
Marine Plaza
Guite 1934
Milwaukee, Wis. 53202

contact: Harry Eikenberry, President

Region IV - continued

Kuhlman Electric Co.
Division of Kuhlman Corp.
198 Porter St.
Crystal Springs, Miss. 39059

corporate offices:
Kuhlman Corp.
P.O. Box 288
Birmingham, Michigan 48012

contact: J.A. Smelko, Vice Presdient

P.R. Mallory & Co., Inc.
Mallory Capacitor Co.
Waynesboro, Tennessee

corporate offices:
P.R. Mallory & Co., Inc.
3029 E. Washington, St.
Indianapolis, Ind. 46202

contact: S.P. Wolsky - Director, R&D

Middle South Transformer Co.
Highway 49W
Belzoni, Miss. 39038

corporate offices:
Standard Transformer Co.
212 Dana St., N.E.
Warren Ohio 44481

contact - O.M. Olivier, Vice President of Operations

Baldor Electric Co.
Carolina Capacitors, Inc.
P.O. Box 125
Ridgeville, South Carolina 29472

corporate offices:
Baldor Electric Co.
P.O. Box 2860
St. Louis, Missouri 63122

contact: E.J. Wershey 803-873-2481

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Region V - PCB Users

Dings Company
4740 W. Electric Ave.
Milwaukee, Wisconsin 53246

contact - Dennis M. Pural

Electrical Utilities
2427 St. Vincent Ave.
La Salle, Ill. 61301

contact - Richard L. Hauser, President

Westinghouse Electric Corp.
Distribution Apparatus Division
Curry Pike
Bloomington, Ind. 47401

Westinghouse Electric Corp
Outdoor Lighting Division
1216 West 58th Str.
Cleveland, Ohio 44102

corporate offices:
Westinghouse Building
Gateway Center
Pittsburgh, Pa. 15222

contact - Roger Wills, Jr., Attorney

Cornell Dubilier Electric Corp.
Distribution Center
2070 Maple Ave.
Des Plaines, Illinois 60018

contact - Philip Murray
General Manager

McGraw Edison Power Systems Division
P.O. Box 300
11131 Adams Road
Franksville, Wis. 53126

corporate offices
McGraw Edison Power Systems Division
P.O. Box 440
Cannonsburg, Pa 15317

contact - F.P. Campeau
Buildings & Grounds Section

DSW 442155

Region V - continued

Standard Transformer Co.
212 Dana St., N.E.
Warren, Ohio 44481

Elgin Transformer Co.
560 Chester St.
Elgin, Ill. 60120

Western Electric
Hawthorne Works
Hawthorne Station
Chicago, Ill. 60623

corporate offices:
Western Electric

222 Broadway
New York,N.Y. 10038

contact: J.R. Lauritzen 212-571-2345

Van Tran Electric Corp.
1505 Van Tran Ave.
Vandalia, Ill. 62471

contact - A.E. Bolin, Jr., President

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Region VI - PCB Users

Van Tran Electric Corp.
7711 Imperial Dr.
Waco, Texas 76710

corporate offices:
Van Tran Electric Corp
1505 Van Tran Ave.
Vandalia, Ill. 62471

contact - A.E. Bolin, Jr., President

McGraw Edison Power Systems Division
P.O. Box 627
Nacogdoches, Texas 75961

corporate offices
McGraw Edison Power Systems Division
P.O. Box 440
Cannonsburg, Pa 15317

contact - F.P. Campeau
Buildings & Grounds Section

DSW 442157

Region IX - PCB Users

Capacitor Specialists, Inc.
P.O. Box 2052
Del Dios Highway
Escondido, Calif. 92025

contact - C. Wayne White, Vice President, Engineering

Electro Engineering Works
401 Preda St.
San Leandro, Calif 94577

contact - Richard Maycock
Manufacturing Manager 415-569-3326

Electro Magnetic Filter Co.
4083 Transport St.
Palo Alto, Calif. 94303

corporate offices:
Cine-Chrome Laboratories, Inc.
4075 Transport St.
Palo Alto, Calif. 94303

contact - Harold E. Martin
Vice President - Cine-Chrome 415-321-5678

Federal Pacific Electric Co.
1200 Piper Dr.
Milpitas, Calif 95108

contact - Ralph H. Moore - Manager, Transformer Marketing

Glenn-Gibson Corp
205 Teal Court
Benicia, Calif 94510

contact - Robert G. Glenn 707-745-3100

H.K. Porter Company, Inc.
Transformer Manufacturing Plant
Belmont Works
1777 Industrial Way
Belmont, Calif. 94002

corporate offices:
Standard Transformer Co.
212 Dana St., N.E.
Warren Ohio 44481

contact - O.M. Olivier, Vice President of Operations

Region X - PCB Users

Pacific Standard Transformer Co.
8001 Table Rock Road
Medford, Oregon 97501

corporate offices:
Standard Transformer Co.
212 Dana St., N.E.
Warren Ohio 44481

contact - O.M. Olivier, Vice President of Operations

McGraw Edison Power Systems Division
7533 Ave. 304
Visalia, Calif. 93277

corporate offices
McGraw Edison Power Systems Division
P.O. Box 440
Cannonsburg, Pa 15317

contact - F.P. Campeau
Buildings & Grounds Section

DSW 442159

STLCOPCB4056694

Exhibit D

# TRANSFORMER AND CAPACITOR PLANT DESCRIPTIONS

## Introduction

The purpose of the inspection program for transformer and capacitor plants is to determine how filling fluid is lost and what can be done in each case to eliminate the losses so that the requirement of "zero" discharge of toxic fluid or any of its components can be met.

The filling fluid for transformers may be mineral oil or a mixture of polychlorinated biphenyls (PCBs). For capacitors, they will usually be a mixture of polychlorinated biphenyls (PCBs) or, in certain cases, other oily liquids such as castor oil. Polychlorinated biphenyls are sold under various trade names, but most commonly as Aroclor. Aroclors are manufactured by Monsanto Chemical Co. The PCB liquids are commonly called "Askarel" in the electrical equipment industry. A list of trade names under which PCBs are sold in provided herein.

The way our inspections will be oriented is to try to account for all the PCBs brought into the plant; this means to establish a weight balance of purchases, uses of products, and losses to air, water, and landfills.

Typical transformer and capacitor plant operations are described herein, including the important filling operations and specific ways that PCBs would be expected to be lost from the process. Thereby, it would be possible to make the necessary recommendations for loss control.

A check list is provided to assure that all key points of the plant have been adequately covered and for conveniently recording the values necessary for performing the weight balance for each plant in a uniform manner.

## Inspection Details

### (A) General

Before a plant site visit is made, it is important to review the details of the section 308 letter response for that plant.

Pertinent areas of the plant include the following:

(1) receipt, transfer, and storage;
(2) process --
  (a) electrode, insulator, and container fabrication and preparation,
  (b) filling liquid purification, and
  (c) vacuum filling;

(3) laboratory;
(4) process waste treatment; and
(5) land disposal.

All parts of transformer and capacitor manufacture are performed under clean and sterile conditions, since performance is dependent on the absence of foreign matter, especially water.

(B) Plant Operation

The filling fluid is received by tank car, tank truck or 55-gallon drums. It is likely to be transferred into stainless storage containers under inert gas pressure. Transfer hoses, pipes and nozzles and, in fact, all transfer equipment and procedures must be scrupulously clean. The filling liquid may be stored under vacuum or inert gas pressure.

The filling liquid is purified prior to inclusion in transformer or capacitor by treatment with filter-aid clay-like material to effect removal of last traces of impurities. This is done while the liquid is heated. The spent clays may be reactivated by heating at elevated temperatures prior to reuse. Suitability of the liquid for capacitor or transformer filling is determined by electrical measurement.

Prior to filling with liquid, capacitors and transformers are assembled in the dry state, including electrodes and insulating material in appropriate inert containers. Last traces of moisture are removed by heating under vacuum. Filling with liquid is done under heat and vacuum (direct) for the larger devices. Smaller capacitors may be filled under flooding conditions (submersion under liquid) under vacuum. Then, the device is sealed and tested for leaks. The sealed capacitor or transformer is finally tested electrically for its appropriate circuitry.

Assembled capacitors and transformers failing to pass the sealing and electrical tests and which cannot be readily repaired are dismantled, with essential components salvaged and reused accordingly. When a liquid other than PCBs is used prior to PCBs for capacitor filling in the same manufacturing line, the line must be scrupulously cleansed of the other liquid.

The plant would have a laboratory for performing tests of a quality control nature on filling liquids such as dielectric constant and loss tangent and miscellaneous mechanical and electrical tests on solid component materials. The larger plants of 1000 employees or greater are likely to be performing research on filling liquid modification, advance purification, component modification, and advanced design prototype testing.

Waste treatment practices for handling PCBs in water by direct dischargers consist of oil-water separation at various degrees of sophistication from simple settling to dissolved air flotation. Included would be filtration by filter-aid, incineration of the oil phase, and use of activated carbon to achieve the most refined separation of organic phase from the water effluent. Process wastes and possibly storm runoff wastes will be treated here. Cooling water blowdown may be included as well.

Land disposal sites for the plant's solid wastes are likely to contain such items as discarded transformers and capacitors and solid components, spent filter-aid (clays), spent sorbents, miscellaneous solids removed during the oil-water separation in the waste treatment operations, and various solid residue, including slags from incineration. All of these solids could contain PCBs.

(C) Significant Points of PCB Losses

In general, it may be said that the principal cause for losses of filling liquid during plant operations will occur during various liquid transfer operations. These will now be highlighted.

Receiving and Storage: Transfer of filling liquid from the tank car or tank truck to the storage vessel is a likely area for leaks and spills. Joints, valves, pipes, and hoses are potential loss points. At this point samples of liquid would be taken for loss tangent (dissipation factor) measurement to assure quality of the liquid. The condition of the areas around joints, valves, and pumps would be indicative of the amount of care exercised in liquid transfer. Routine internal cleaning and disposal of rinsings, especially when other liquids have been used in advance, contribute to losses.

This area is likely to contribute most significantly to storm runoff owing to its openness and the nature of the operation. The general housekeeping condition will determine the contribution of storm runoff to filling liquid loss.

Purification of Filling Liquid: This is likely to be a source of filling liquid and its vapor. The loss would occur during filtration by means of clay-like filter-aid under heat and vacuum. Filling liquid vapors are exhausted through vents or hoods. Spent filter-aid is reactivated by furnace (dynamic gas draft) or oven heating without draft. Expelled vapors are exhausted through hoods, vents or vapor condensers. Unreactivated filter-aid destined for discard is likely to contain sorbed filling liquid. Overall, the purification of filling liquid and regeneration of filter-aid processes will be conducive to those losses associated with handling and

transfer operations involving vacuum, heating filtration, and regeneration of clay-like material at elevated temperatures. Drip pans, pumps, valves, pipes, filtration equipment, and miscellaneous chemicals are involved.

The purified filling liquid is sampled for electrical insulating quality prior to vacuum impregnation of capacitors or transformers.

The preparation and assembly of dry capacitors and transformers with associated heating and vacuum to attain an optimal moisture-free state is obviously free of any loss of filling liquid.

Capacitor Liquid Filling: This operation is performed under scrupulously clean conditions in order to minimize chances of any foreign matter entering the device. In this operation the filling is performed under heat and vacuum from a filling liquid tank. Once again, various connecting hoses, valves, and adapters are used. Direct vacuum filling is less likely to lead to liquid losses than flood filling. In the former operation, losses will occur around connecting points at the top. In the latter operation, the entire outside of the device container will be wet with filling liquid; therefore some losses will be expected during wash and cleaning procedures with organic solvent, i.e., trichlorethylene. Further filling liquid may be lost during seal testing for maintenance of vacuum, especially if a leak is detected and the seal or cover must be replaced. The techniques for vacuum seal testing and repair are likely to vary to different degrees of refineness. In the entire vacuum filling operation losses may be associated with transfer and filling operations, i.e., the manner by which this is generally being handled. Drip pans, hoses, mechanical pumps, steam ejectors, liquid condensers, vents and exhausts, and gas scrubbers (wet or dry), will be associated with lost filling liquid.

Transformer Filling: Same losses as for direct filling of capacitors.

Laboratory: In this area tests are performed on the filling liquid for quality control purposes. The most frequent test would be "loss tangent" or otherwise known as "dissipation factor," which is a measure of the impurity of the liquid. Although the amount of liquid required for the test may not be more than an ounce or so, there will be some losses due to cleaning of test equipment before each test. Disposal of test liquid may vary but it is likely to be returned for further purification. Other tests such as distillation, density (specific gravity), electical breakdown, etc., would result in further losses. If the plant is large enough to perform its own R&D, then larger-scale uses and losses of filling liquid would occur.

LISTING OF NAMES AND MANUFACTURERS OF PCBs
IN CAPACITORS AND TRANSFORMERS

| Name | Manufacturer | Capacitor | Transformer |
|---|---|---|---|
| Aroclor | Monsanto | X | X |
| Asbestol | -- | -- | X |
| Askarel | -- | X | -- |
| Asbestol | American Corporation | -- | X |
| Chlorextol | Allis Chalmers | -- | X |
| Diaclor | Sangamo Electric | -- | -- |
| Dykanol | Cornell Dubilier | -- | -- |
| Elemex | McGraw Edison | -- | -- |
| Hyvol | Aerovox | -- | -- |
| Inerteen | Westinghouse Electric | -- | X |
| Fenclor | Caffaro (Italy) | -- | -- |
| Clophen | Bayer (Germany) | -- | -- |
| Kennechlor | Kenneclor (Japan) | -- | -- |
| No-Flamol | Wagner Electric | -- | X |
| Phenoclor | Prodelec (France) | -- | -- |
| Pyranol | General Electric | -- | X |
| Pyrolene | Prodelec (France) | -- | -- |
| PK | Caffaro (Italy) | -- | -- |
| Saf-T-Kuhl | Kuhlman Electric | -- | X |
| Santotherm | Mitsubishi (Japan) | -- | -- |
| Soval | -- | -- | X |

## Check List -- Capacitors

| | Yes | No |
|---|---|---|
| Date of Inspection | | |
| Company Identification | | |
| Plant (name, address, telephone) | | |
| Parent company or headquarters (name, address, telephone) | | |
| Responsible Officials | | |
| Plant (name, title) | | |
| Parent company or headquarters (name, title) | | |
| Inspection Team | | |
| Federal (name, title, division, organization) | | |
| State (name, title, division, organization) | | |
| Municipal (name, title, division, organization) | | |
| Other (name, title, division, organization) | | |
| Disposition of Wastes | | |
| Receiving waters (for direct discharge) | | |
| Municipal treatment system (including receiving waters) | | |
| Landfill (name, address) | | |
| Incineration (name, address) | | |
| Other (such as disposal) | | |
| Filling or impregnating fluids used | | |
| Receipt, Transfer, and Storage | | |
| How received (tank cars, trucks, drums) | | |
| Where received (how far from use area) | | |
| How unloaded into storage tanks | | |
| Are tank cars cleaned after unloading? | | |
| How? | | |
| What happens to flushings or contaminated cleaning solutions? | | |
| Drip pans under hose or pipe connections to tank car or trucks? | | |
| Transfer hose or pipes drained where? | | |
| Unloading area paved and diked? Collection sump? | | |
| How are sumps emptied and to where? | | |
| Unloading area roofed? | | |
| How are samples taken? | | |
| Where is excess sample disposed of? | | |
| What disposition is made of samples after testing? | | |
| Storage tank area paved and diked? Collection sump? | | |

DSW 442165

| | Yes | No |
|---|---|---|
| Receipt, Transfer, and Storage -- cont. | | |
| Are raw filling fluids stored open to the atmosphere or under inert gas or under specially dried atmosphere or vacuum? | | |
| If vacuum, how is vacuum obtained? | | |
| Where does vacuum system exhaust to? | | |
| Is exhaust equipped with vapor condenser? | | |
| If so, where does condensate go? | | |
| Where is vacuum pump cooling water obtained? | | |
| Where does vacuum pump cooling water go? | | |
| Is vacuum pump equipped with drip pans? | | |
| How is contaminated vacuum pump oil disposed of? | | |
| If stored under special atmosphere: | | |
| What is it (nitrogen, dry air, etc.)? | | |
| What pressure maintained on tank? | | |
| Where does tank vent to? | | |
| Is vent equipped with vapor condensor? | | |
| If so, where does condensate go? | | |
| Are transfer pumps in the storage area provided with drip pans? | | |
| In all cases where drip pans are used, what disposition is made of accumulated drips? | | |
| General Observations | | |
| Workers handling of fluids | | |
| Housekeeping | | |
| Other | | |
| Filling or Impregnating Fluid Purification | | |
| Are pumps and filters equipped with drip plans or diked, with sumps? | | |
| If filter aid blending tank surrounded by paved, diked area? | | |
| How is spent filter aid taken off the filter? | | |
| How is spent filter aid packaged for disposal? | | |
| Is spent filter aid handled by employees? How? | | |
| What is disposition of spent filter aid? | | |
| If regenerated on site, where does regeneration process exhaust to? | | |
| Is exhaust equipped with vapor condensor? | | |
| If so, where does condensate go? | | |

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| | Yes | No |
|---|---|---|
| **Purification -- cont.** | | |
| Is purified fluid sampled? | | |
| How are samples taken? | | |
| What is done with excess sample?. | | |
| If fluid does not meet requirements, what happens? | | |
| What disposition is made of samples after testing? | | |
| How are miscellaneous floor spills of fluid cleaned up? | | |
| What happens to the sweepings? | | |
| What happens to rage, wiping cloths, etc.? | | |
| What happens to workers' clothing, gloves, etc.? | | |
| **General Observations** | | |
| Workers handling of PCBs | | |
| Housekeeping | | |
| Other | | |
| **Capacitor Impregnation-Submersion or Flood Filling Process** | | |
| Is impregnation tank cleaned before each filling? | | |
| What is done with any filling fluid removed from the tank in cleaning it? | | |
| What is done with any rags used in the cleaning? | | |
| What is done with workers' clothing worn in cleaning? | | |
| Are PCB vapors given off in preheating the tank prior to loading with capacitors? | | |
| Where is tank vented to during preheating? | | |
| How is vacuum obtained? | | |
| Where does vacuum system exhaust to? | | |
| Is exhaust equipped with vapor condensor? | | |
| If so, what happens to condensate? | | |
| Is vacuum pump equipped with drip pans? | | |
| What oil is used in vacuum pump and how much? | | |
| What happens to contaminated oil: | | |
| After capacitors have been flooded, where is impregnation tank drained to? | | |
| Are drainings sampled? How? | | |
| What happens to excess sample? | | |
| What happens to sample after testing? | | |
| What happens if drained fluid is defective: | | |
| to the fluid? | | |
| to the capacitors? | | |
| What happens if drained fluid is good? | | |
| Are pumps equipped with drip pans? | | |

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| | Yes | No |
|---|---|---|
| Are tanks surrounded by paved, diked areas? With sumps? What disposition is made of contents of sumps and drip pan? | | |
| After impregnation tank is drained, are capacitors allowed to drip in tank, or taken out? | | |
| If the capacitors are taken out for dripping, are drip pans provided? What is done with the contents of the drip pans? | | |
| Is the area where newly filled capacitors allowed to drip adequately ventilated? How? Where does ventilation system exhaust to? Is the exhaust equipped with vapor condensor and, if so, what happens to the condensate? | | |
| How are capacitors transferred to the sealing area? Are drip pans provided? What disposition of contents? | | |
| How are spills or overflows of PCBs collected in the sealing area? | | |
| After sealing, how are capacitors cleaned of residual fluid on the outside? If by solvent or vapor degreasing, how is solvent reclaimed? How is filling fluid residue from the solvent recycle system collected? How is it disposed of? If by washing with water or detergent solution, how are contaminated washings disposed of? Are capacitors rinsed after washing? If so, is rinse water reused? How is contaminated rinse water disposed of? | | |
| What happens to solid waste contaminated with filling fluid? Especially, what happens to wiping rags and workers' clothing? If solvent cleaned, how is filling fluid residue from the solvent system collected? How is it disposed of? | | |

General Observations

Use of protective clothing, gloves, etc.
Workers' handling of fluids
Housekeeping
Other

Note in particular whether walls and ceilings are coated with filling fluid in the vicinity of the impregnation tank and drip area.

DSW 442168

| | Yes | No |
|---|---|---|
| Observe workers who come in contact with filling fluid for chloroacne or pigment discoloration. | | |
| If oil-water separator is used to separate filling fluid from water, what is done with oil layer? With the water layer? | | |
| Large Capacitor Impregnation/Transformer filling -- Direct Filling process | | |
| Is area around filling operation paved and diked? | | |
| How are spills cleaned up? | | |
| What disposition is made of contaminated solid waste? | | |
| How is vacuum pulled on the capacitor or transformer? | | |
| If by vacuum pump; where does pump exhaust to? | | |
| Is exhaust equipped with vapor condenser? | | |
| Where does condensate go? | | |
| Where does pump cooking water go? | | |
| How is contaminated vacuum pump oil disposed of? | | |
| If by steam jet, how is steam condensed? | | |
| What disposition is made of condensate? | | |
| How is filling line drained? | | |
| Laboratory | | |
| No. of employees | | |
| Quality control | | |
| Types of test performed and amount of sample used | | |
| (a) dieletric constant and loss tangent | | |
| (b) electrical breakdown | | |
| (c) distillation range | | |
| (d) density (specific gravity) | | |
| (e) others | | |
| R&D | | |
| Types of equipment used, test performed and amount of samples used? | | |
| Samples to be taken: | | |
| Soil scrapings in tank car unloading area | | |
| Vacuum pump cooling water | | |
| Oil-water separators (water layer) | | |
| Spent detergent solutions | | |
| Contaminated rinse water, etc. | | |
| Plant effluent a) direct discharge | | |
| b) to municipality | | |
| Steam jet condensate | | |
| General | | |
| How are defective capacitors or transformers disposed of? | | |
| Is filling fluid recovered? | | |
| Is rejected unit storage area paved and diked? | | |

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

DEC 2 2 1975

Exhibit E.

OFFICE OF ENFORCEMENT

MEMORANDUM

TO: State NPDES Directors

FROM: Assistant Administrator for Enforcement (EN-329)

SUBJECT: Identification and Control of Environmental Sources of PCBs

As you know, the discharge of PCBs into the environment represents a substantial national problem. Attached as Exhibit A is a copy of a press statement made today by the Administrator outlining the problem and EPA's response to it. Since the control of PCB discharges into the Nation's waters represents the most positive action the Agency has authority to undertake at the present time, the issuance and modification of NPDES permits to require the expeditious elimination of PCB discharges naturally assumes primary importance in our PCB program. Insofar as dischargers of PCBs are located in your states, your active cooperation and participation will be necessary to assure the success of this program.

Attached as Exhibit B is a memorandum that I am sending today to our Regional Offices outlining the steps we are requesting of them to implement. I am asking you, as partners in our national regulatory program, to cooperate fully in these efforts and to take any necessary implementing actions with regard to dischargers of PCBs subject to your jurisdiction within the same time frame outlined in my memorandum to the Regional Offices. Insofar as your efforts could be strengthened by field assistance in conducting appropriate surveys, please contact EPA's Regional Offices for assistance.

I am not asking you to report to me on your actions taken to implement this program, but do ask you to keep EPA's Regional Offices fully informed so that they can do so. Please feel free after contacting the Regional Offices to make specific inquiries of Murray Strier and Blake Biles of this office regarding any questions you have on these efforts. Murray Strier is the appropriate contact on technical matters regarding plant surveys and permit issuance and modification (703-557-7420).

Blake Biles is the appropriate contact on the broad range of EPA's PCB efforts (202-755-8731). The attendance of your representatives at the technical meeting on PCBs on January 7, mentioned in my memorandum to the Regional Offices, is also invited.

Stanley W. Legro

Stanley W. Legro

Attachments

DSW 442171

Exhibit F

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

August 29, 1975

OFFICE OF ENFORCEMENT

MEMORANDUM

TO: All Regional Administrators

FROM: Assistant Administrator for Enforcement

SUBJECT: Enforcement Activities Concerning Discharges of PCB Compounds and Mixtures

As a part of the Agency's efforts to limit discharges into the environment of Polychlorinated Byphenyls (PCBs) and comparable chemical substances, we must ensure that all known discharges of PCBs are in compliance with all applicable provisions of the FWPCA, particularly those concerning NPDES permits.

I am therefore requesting that you review the permits held by those companies in your Region which have been identified as possible users of PCBs. Such companies include those to whom EPA recently addressed Section 308 letters, plus any others which have been identified by personnel in your Region.

For permits which contain limitations or prohibitions upon the discharge of PCBs, you should in the near future determine whether the permittees are complying with such limitations or prohibitions. In any cases of noncompliance, appropriate enforcement actions should be taken immediately. Where no application is on file from a discharger of PCBs enforcement action should be undertaken immediately.

Enforcement actions should also be taken against any dischargers of PCBs whose permits contain no PCB limitations and who did not identify PCBs either directly or by a general term (e.g. chlorinated hydrocarbons) as present in their discharges in their Refuse Act or NPDES permit applications. In order to aid in the identification of such dischargers, your staff should review the responses to the recent 308 letters. Please inform Blake Biles of the Legal Branch at (202)755-8731 of all such PCB users whose permits contain no limitations or prohibitions for the discharge of PCBs. You should also contact Blake regarding proposed modifications of limitations contained in permits which were previously issued by the Agency.

If your Region is proposing to issue permits which will contain limitations upon PCBs, (other than through the application of effluent guidelines) or if permits with such limitations are the subject of adjudicatory hearings, please contact Bob Schaffer of the Permits Division at (703)557-7470 for assistance in developing the precise effluent limits which should be included in such permits.

Thank you for your prompt attention to this important matter.

Sincerely yours,

Stanley W. Legro

Stanley W. Legro

DSW 442173

Monsanto

MAR 5 - 1976

FROM (NAME & LOCATION): B2SK Cole Weber

DATE: March 5, 1976

SUBJECT: PCBs
OTS Review

REFERENCE:

TO: D. B. Hosmer - E1SF
A. Leisy - 1740
J. P. Mieure - T2F
R. A. Pohl
G. Roush
W. W. Withers
D. Wood

CC: K. W. Easley - 1920
R. G. Potter
D. L. Sliney
J. J. Zeman
W. C. Hammann - T3A

Attached for your information is a "Review of PCB Levels in the Environment" prepared by the EPA Office of Toxic Substances in January, 1976.

Cole

Cole Weber

cs
Att.

DSW 442174

IN - 10 REV

STLCOPCB4056709

# REVIEW OF PCB LEVELS IN THE ENVIRONMENT

JANUARY 1976

OFFICE OF TOXIC SUBSTANCES
ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, DC 20460

DSW 442175

STLCOPCB4056710

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STLCOPCB4056712

## 1.0 Introduction

Polychlorinated biphenyls (PCB's) were first manufactured commercially in 1929. They are currently manufactured in the United States, Great Britain, France, Germany, USSR, Spain, Italy and Czechoslovakia. The sole producer of PCB's in the United States is the Monsanto Industrial Chemicals Company, where products are marketed under the trade name "Aroclor". Various Aroclor products that have been marketed include Aroclor 1221, 1232, 1242, 1248, 1254, 1260, 1262 and 1268. The latter two digits designate the percent chlorine in each formulation. Since their introduction, PCB's have been used in a variety of commercial and industrial products such as transformers, capacitors, paints, inks, paper, plastics, adhesives, sealants and hydraulic fluids. Through this widening product useage and their resistance to degradation, PCB's have been identified in the environment since 1966 with increasing frequency.

On September 1, 1971 an interdepartmental task force was established in the United States to review the data linking PCB's with adverse health and environmental effects and "to coordinate a government-wide investigation into PCB contamination of food and other products". The task force concluded in its report of May 1972 that PCB's were highly persistent, could bioaccumulate to relatively high levels in fish and could have serious adverse effects on human health. It recommended the discontinuance of all PCB uses except in closed electrical systems. Since the 1972 Task Force Report, environmental sampling and laboratory studies have indicated that PCB's were a more serious and continuing environmental and health threat than had been originally realized. These concerns were highlighted this past November at the National Conference on Polychlorinated Biphenyls held in Chicago, Illinois.

This study reviews the current PCB data base to assess the PCB levels in the environment on a national level; the full spectrum of PCB levels reported in man and the environment were of interest. Data were obtained from a number of national monitoring programs, the literature and many unpublished reports. The data examined was inclusive to December 1, 1975 and it is anticipated that this review will be updated in October 1976.

It should be stressed at the outset, that due to the complexity and difficulty of PCB identification and measurement, that levels reported are not really comparable between different investigators. This aspect could not be compensated for or identified in the data presented. In addition, some of the Aroclor identifications reported may only have been best estimates of the pattern observed and may not have really identified the true Aroclor discharged or the quantitative level of the polychlorinated biphenyl found in the sample. However, the levels reported do give an indication of the contamination levels in different media for a given locality.

DSW 442178

STLCOPCB4056713

Recognizing the faults of combining different data bases, the sheer mass of data supports the conclusion that there is widespread contamination of the environment by PCB's. There are regional variations, but effects are consistent across all media (e.g., water, sediment, fish, birds), generally showing greater concentrations of PCB's in highly developed areas and in areas of industrial activity. Over the years examined, the situation has shown no improvement nationally.

This report is divided into five major sections:

PCB's in the environment

Behavior in the environment

Occurrence in food

Bioaccumulation in man

Environmental trends

Wherever possible, the level of data reported has been greatly reduced over that originally reported, especially for the older studies, however every effort has been made to indicate the locality and the level of contamination originally reported. More recent studies are presented in greater detail. Trend assessments, cross media comparisons and conclusions are drawn where justified.

# 2.0 PCB Levels in the Environment

## 2.1 Data from National Monitoring Programs

### 2.1.1 Water

There is no national monitoring program for PCB's in water. PCB monitoring is a limited activity of the overall National Pesticides Monitoring Program operated by the U.S. Geological Survey. Analysis of the PCB data in EPA's STORET water quality file has provided little information, although scattered whole water measurements have been taken by a number of states over the years. Those states reporting nonzero readings are few in relation to the number of states showing zero concentrations.

At the direction of various local, state and federal agencies, the USGS collects and analyzes water data, producing a data file of uniform integrity. Current data from this file[8] covering the period October 1972 to 1975 provides the best available national data and the basis for the following analyses.

PCB levels, gathered by the USGS during the period January 1971 to June 1972 were reported by Crump-Wiesner, Feltz and Yates[2]. While the data suffers from the lack of representative sampling within states and multiple samples from the same locations, they concluded that significant concentrations of PCBs were widespread in the water resources of the nation. Their published summary of PCB residue data for surface and ground waters has been updated with the 1972-1975 data and is presented in Table 2.1-1.

The preponderance of zero readings in whole water and the low levels of scattered non-zero readings could be masking widespread PCB contamination in the nation's waters. Zero readings are due to the low solubility of PCBs and the analytical procedure commonly used which limits detection to 0.1 ppb.

There is a disparity between whole water and bottom deposit measurements. In almost all cases in which samples of both whole water and bottom sediment were taken simultaneously and the latter reading was non-zero, the whole water concentration was measured at zero ppb This occurred even when the concentration in bottom sediment was as high as 4000 ppb[8]. More recent water studies[3] to the ppt level have consistently shown measureable PCB levels.

Table 2.1-1
Summary of PCB Residue Data for Surface and Ground Waters, January 1971-(partial) 1975

| State | Year | No. of Samples | Occurences | Concentration (ppb) | Median Concentration (ppb) |
|---|---|---|---|---|---|
| Alaska | 71 | 3 | 0 | ----- | ----- |
| | 73 | - | - | ----- | ----- |
| Alabama | 73 | 4 | 0 | ----- | ----- |
| | 74 | 2 | 0 | ----- | ----- |
| Arizona | 71 | 8 | 0 | ----- | ----- |
| | 72 | 8 | 0 | ----- | ----- |
| | 73 | 38 | 0 | ----- | ----- |
| | 74 | 14 | 0 | ----- | ----- |
| | 75 | 4 | 0 | ----- | ----- |
| Arkansas | 71 | 32 | 0 | ----- | ----- |
| | 72 | 8 | 0 | ----- | ----- |
| | 73 | 28 | 1 | 0.2 | ----- |
| | 74 | 22 | 0 | ----- | ----- |
| | 75 | 1 | 0 | ----- | ----- |
| California | 71 | 161 | 2 | 0.1, 0.1 | ----- |
| | 72 | 27 | 0 | ----- | ----- |
| | 73 | 110 | 0 | ----- | ----- |
| | 74 | 99 | 2 | 0.1, 0.1 | ----- |
| | 75 | 42 | 0 | ----- | ----- |
| Colorado | 71 | 32 | 0 | ----- | ----- |
| | 72 | 3 | 0 | ----- | ----- |
| | 73 | 6 | 0 | ----- | ----- |
| | 74 | 9 | 0 | ----- | ----- |
| Connecticut | 71 | 13 | 6 | 0.1-0.2 | 0.1 |
| | 72 | 16 | 6 | 0.1 | 0.1 |
| | 73 | 45 | 1 | 0.1 | ----- |
| Delaware | NO ACTIVITY | | | | |
| D.C. | NO ACTIVITY | | | | |
| Florida | 72 | 16 | 0 | ----- | ----- |
| | 73 | 106 | 4 | 0.1-1.0 | 0.1 |
| | 74 | 60 | 0 | ----- | ----- |
| | 75 | 22 | 0 | ----- | ----- |

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Table 2.1-1 (cont.)

| State | Year | No. of Samples | Occurences | Concentration (ppb) | Median Concentration (ppb) |
|---|---|---|---|---|---|
| Georgia | 73 | 1 | 0 | ----- | ----- |
| | 74 | 29 | 0 | ----- | ----- |
| Hawaii | 71 | 5 | 0 | ----- | ----- |
| | 72 | 1 | 0 | ----- | ----- |
| | 73 | 1 | 0 | ----- | ----- |
| | 74 | 1 | 0 | ----- | ----- |
| Idaho | 72 | 1 | 0 | ----- | ----- |
| | 73 | 1 | 0 | ----- | ----- |
| | 74 | 6 | 0 | ----- | ----- |
| Illinois | 74 | 1 | 0 | ----- | ----- |
| | 75 | 1 | 0 | ----- | ----- |
| Indiana | 74 | 1 | 0 | ----- | ----- |
| Iowa | 71 | 24 | 0 | ----- | ----- |
| | 72 | 1 | 0 | ----- | ----- |
| | 73 | 27 | 1 | 0.1 | ----- |
| | 74 | 2 | 0 | ----- | ----- |
| Kansas | 71 | 10 | 0 | ----- | ----- |
| | 72 | 4 | 0 | ----- | ----- |
| | 73 | 24 | 1 | 0.2 | ----- |
| | 74 | 3 | 0 | ----- | ----- |
| Kentucky | 71 | 7 | 0 | ----- | ----- |
| Louisiana | 71 | 9 | 0 | ----- | ----- |
| | 73 | 195 | 0 | ----- | ----- |
| | 74 | 147 | 0 | ----- | ----- |
| | 75 | 22 | 2 | 0.1-0.2 | ----- |
| Maine | 71 | 2 | 0 | ----- | ----- |
| | 72 | 1 | 0 | ----- | ----- |
| | 73 | 6 | 0 | ----- | ----- |
| | 74 | 1 | 0 | ----- | ----- |
| Maryland | 71 | 6 | 1 | 0.1 | ----- |
| Massachusetts | 71 | 5 | 1 | 0.2 | ----- |
| | 73 | 5 | 1 | 0.1 | ----- |
| | 74 | 6 | 1 | 0.1 | ----- |
| | 75 | 5 | 1 | 0.1 | ----- |

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Table 2.1-1 (cont.)

| State | Year | No. of Samples | Occurences | Concentration (ppb) | Median Concentration (ppb) |
|---|---|---|---|---|---|
| Michigan | 71 | 2 | 0 | ----- | ----- |
| | 72 | 2 | 1 | 0.1 | ----- |
| | 73 | 6 | 0 | ----- | ----- |
| | 74 | 23 | 0 | ----- | ----- |
| | 75 | 18 | 0 | ----- | ----- |
| Minnesota | 71 | 3 | 2 | 0.1-0.3 | ----- |
| | 73 | 1 | 0 | ----- | ----- |
| | 74 | 1 | 0 | ----- | ----- |
| Mississippi | 71 | 8 | 0 | ----- | ----- |
| | 73 | 1 | 0 | ----- | ----- |
| | 74 | 52 | 0 | ----- | ----- |
| | 75 | 60 | 0 | ----- | ----- |
| Missouri | 71 | 21 | 0 | ----- | ----- |
| | 72 | 7 | 0 | ----- | ----- |
| | 73 | 19 | 0 | ----- | ----- |
| Montana | 71 | 47 | 0 | ----- | ----- |
| | 72 | 9 | 0 | ----- | ----- |
| | 73 | 32 | 0 | ----- | ----- |
| | 74 | 8 | 0 | ----- | ----- |
| Nebraska | 71 | 44 | 0 | ----- | ----- |
| | 72 | 3 | 0 | ----- | ----- |
| | 73 | 24 | 0 | ----- | ----- |
| | 74 | 17 | 0 | ----- | ----- |
| | 75 | 2 | 0 | ----- | ----- |
| Nevada | 72 | 4 | 0 | ----- | ----- |
| | 73 | 6 | 0 | ----- | ----- |
| | 74 | 5 | 0 | ----- | ----- |
| New Hampshire | 73 | 3 | 0 | ----- | ----- |
| | 74 | 3 | 0 | ----- | ----- |
| New Jersey | 71 | 11 | 3 | 0.1 | 0.1 |
| | 72 | 5 | 1 | <0.5 | ----- |
| | 73 | 29 | 2 | <0.1,<0.1 | ----- |
| | 74 | 29 | 0 | ----- | ----- |
| New Mexico | 71 | 36 | 0 | ----- | ----- |
| | 72 | 10 | 0 | ----- | ----- |
| | 73 | 5 | 0 | ----- | ----- |
| | 74 | 5 | 0 | ----- | ----- |

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Table 2.1-1 (cont.)

| State | Year | No. of Samples | Occurences | Concentration (ppb) | Median Concentration (ppb) |
|---|---|---|---|---|---|
| New York | 71 | 325 | 52 | 0.1-4.0 | 0.3 |
| | 73 | 32 | 1 | 0.1 | ----- |
| | 74 | 16 | 0 | ----- | ----- |
| North Carolina | 72 | 3 | 0 | ----- | ----- |
| | 73 | 1 | 0 | ----- | ----- |
| | 74 | 1 | 0 | ----- | ----- |
| North Dakota | 71 | 40 | 0 | ----- | ----- |
| | 72 | 3 | 0 | ----- | ----- |
| | 73 | 4 | 0 | ----- | ----- |
| | 74 | 3 | 0 | ----- | ----- |
| Ohio | 72 | 14 | 2 | 0.1-E.2 | ----- |
| | 73 | 1 | 0 | ----- | ----- |
| | 74 | 3 | 0 | ----- | ----- |
| Oklahoma | 71 | 19 | 0 | ----- | ----- |
| | 72 | 5 | 0 | ----- | ----- |
| | 73 | 77 | 2 | 0.1-2.9 | ----- |
| | 74 | 37 | 5 | 0.1-0.2 | 0.1 |
| | 75 | 11 | 2 | 2.0-3.0 | ----- |
| Oregon | 71 | 13 | 0 | ----- | ----- |
| | 72 | 2 | 0 | ----- | ----- |
| | 73 | 9 | 0 | ----- | ----- |
| | 74 | 9 | 0 | ----- | ----- |
| | 75 | 1 | 0 | ----- | ----- |
| Pennsylvania | 71 | 2 | 0 | ----- | ----- |
| | 73 | 1 | 0 | ----- | ----- |
| | 74 | 25 | 0 | ----- | ----- |
| | 75 | 20 | 0 | ----- | ----- |
| Rhode Island | 73 | 3 | 0 | ----- | ----- |
| South Carolina | 72 | 2 | 0 | ----- | ----- |
| | 73 | 2 | 0 | ----- | ----- |
| | 74 | 12 | 0 | ----- | ----- |
| South Dakota | 71 | 18 | 0 | ----- | ----- |
| | 72 | 1 | 0 | ----- | ----- |
| | 73 | 5 | 0 | ----- | ----- |
| | 74 | 1 | 0 | ----- | ----- |
| Tennessee | 73 | 1 | 0 | ----- | ----- |
| | 74 | 2 | 0 | ----- | ----- |

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Table 2.1-1 (cont.)

| State | Year | No. of Samples | Occurences | Concentration (ppb) | Median Concentration (ppb) |
|---|---|---|---|---|---|
| Texas | 71 | 660 | 12 | 0.1-3.0 | 0.4 |
| | 72 | 82 | 1 | 0.1 | ----- |
| | 73 | 385 | 6 | 0.1-0.6 | 0.3 |
| | 74 | 297 | 4 | 0.2-0.7 | 0.3 |
| Utah | 72 | 1 | 0 | ----- | ----- |
| | 73 | 8 | 0 | ----- | ----- |
| | 74 | 16 | 0 | ----- | ----- |
| Vermont | 73 | 1 | 0 | ----- | ----- |
| Virginia | 71 | 4 | 1 | 0.1 | ----- |
| | 72 | 12 | 0 | ----- | ----- |
| | 73 | 5 | 0 | ----- | ----- |
| | 74 | 1 | 0 | ----- | ----- |
| Washington | 71 | 25 | 0 | ----- | ----- |
| | 72 | 1 | 0 | ----- | ----- |
| | 73 | 6 | 0 | ----- | ----- |
| | 74 | 6 | 1 | 0.1 | ----- |
| West Virginia | 71 | 4 | 0 | ----- | ----- |
| | 74 | 1 | 0 | ----- | ----- |
| Wisconsin | 71 | 3 | 0 | ----- | ----- |
| | 72 | 1 | 0 | ----- | ----- |
| | 73 | 12 | 0 | ----- | ----- |
| | 74 | 30 | 0 | ----- | ----- |
| | 75 | 2 | 0 | ----- | ----- |
| Wyoming | 71 | 18 | 0 | ----- | ----- |
| | 72 | 1 | 0 | ----- | ----- |
| | 73 | 6 | 0 | ----- | ----- |
| | 74 | 3 | 0 | ----- | ----- |
| Puerto Rico | 73 | 34 | 0 | ----- | ----- |
| | 74 | 63 | 1 | 0.8 | ----- |

E - estimated.

SOURCE: This table is an extension of Table 2 in Crump-Wiesner, J.S., H.R. Feltz and M.L. Yates, J. Research USGS, 1, 603-607; (1972) incorporating the newer data of PCB Data Base, October 1972 to (partial) 1975, The U.S. Geological Survey, Quality of Water Branch, Reston, VA.

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### 2.1.2 Sediment

Nationwide sampling of bottom sediments have shown PCB concentrations to have widespread occurrence. Data from Crump-Wiesner, et. al.,[7] January 1971-June 1972 are summarized in Table 2.1-2. The October 1972 to 1975 USGS data are summarized in Table 2.1-3. Table 2.1-3 permits distinguishing between those states where the non-zero PCB readings were from one or a limited number of stations with multiple readings and those states where the non-zero readings come from a number of stations within the state. The map in Figure 2.1-1 indicates the distribution of PCB contamination from 1972-1974 based on the figures in the tables.

States which monitored sediment concentrations to any appreciable extent detected the presence of PCB's in concentrations often higher than 40 ppb. A greater proportion of states are reporting PCB's in bottom sediment each year, as displayed in Table 2.1-4.

Although the sediment data is meaningful, some caution is necessary in interpretation: measurements may be the result of past contamination, not present discharges; mean readings and ranges are somewhat inadequate to summarize the data - geographic locations are essential since readings show patterns only in particular water basins.

Table 2.1-2
Summary of PCB Residue Data for Bottom Sediments
January 1971 - June 1972

| State | No. of Samples | Occur-rences | Concentration (ppb) | Median Concentration (ppb) |
|---|---|---|---|---|
| Alaska . . . . . | 3 | 0 | ----- | ----- |
| Arkansas . . . . . | 23 | 4 | 20-2,400 | 60 |
| California . . . . . | 13 | 3 | 20-190 | 85 |
| Connecticut . . . . . | 1 | 1 | 40 | ----- |
| Hawaii . . . . . | 4 | 0 | ----- | ----- |
| Georgia . . . . . | 12 | 10 | 10-1,300 | 300 |
| Maryland . . . . . | 11 | 5 | 10-1,200 | 30 |
| Mississippi . . . . . | 8 | 2 | 50;170 | ----- |
| New Jersey . . . . . | 12 | 10 | 8-250 | 20 |
| Oregon . . . . . | 4 | 2 | 15;140 | ----- |
| Pennsylvania . . . . . | 16 | 11 | 10-50 | 20 |
| South Carolina . . . . . | 11 | 8 | 30-200 | 50 |
| Texas . . . . . | 293 | 23 | 7.9-290 | 80 |
| Virginia . . . . . | 10 | 8 | 5-80 | 40 |
| Washington . . . . . | 10 | 0 | ----- | ----- |
| West Virginia . . . . . | 2 | 1 | 10 | ----- |

SOURCE: Crump-Wiesner, J.S., H.R. Feltz and M.L. Yates, J. Research USGS, 1, 603-607, (1972).

Table 2.1-3
Summary of PCB Residue Data for Bottom Sediments
# Stations measuring/#Stations with at least one non zero reading
Range of non-zero readings (mean), in ppb

| STATE | 1972 | 1973 | 1974 | (partial) 1975 |
|---|---|---|---|---|
| Alabama | ---- | 1/0 | 2/0 | ---- |
| Alaska | ---- | 1/0 | ---- | ---- |
| Arizona | 1/0 | 1/0 | 1/0 | ---- |
| Arkansas | 6/0 | 6/0 | 15/4 <2-29 (12.8) | ---- |
| California | 1/0 | 15/0 | 18/2 <2-65 (33.5) | ---- |
| Colorado | 1/0 | 1/0 | 1/0 | ---- |
| Connecticut | 16/8 <5-E800 (127.5) | 16/11 <5-40 (14.1) | 40/31 <2-350 (71.5) | ---- |
| Delaware | | NO ACTIVITY | | |
| Florida | 27/7 <5-400 (93.6) | 64/34 <2-600 (35.8) | 68/16 <2-530 (43.3) | 20/2 <140-430 (285 |
| Georgia | ---- | 1/0 | 9/7 <1-51 (13.6) | ---- |
| Hawaii | 1/0 | 1/0 | ---- | ---- |
| Idaho | 1/0 | 1/0 | 1/0 | ---- |
| Illinois | ---- | 1/1 (20) | ---- | 1/0 |
| Indiana | ---- | ---- | 4/2 <9-61 (35) | ---- |
| Iowa | ---- | 2/0 | ---- | ---- |
| Kansas | 1/0 | 1/0 | 2/0 | ---- |
| Kentucky | | NO ACTIVITY | | |
| Louisiana | ---- | 3/0 | 18/0 | 4/1 (5) |
| Maine | 1/0 | 1/0 | ---- | ---- |
| Maryland | | NO ACTIVITY | | |
| Massachusetts | | NO ACTIVITY | | |
| Michigan | 1/1 (<2) | | 13/8 <4-60 (17.6) | 15/4 <10-58 (29.5) |
| Minnesota | ---- | 1/0 | 1/0 | ---- |
| Mississippi | ---- | 1/0 | 50/13 <3-56 (16.4) | ---- |
| Missouri | | NO ACTIVITY | | |
| Montana | 4/0 | 6/0 | 4/0 | ---- |
| Nebraska | 1/0 | 3/0 | 1/0 | ---- |
| Nevada | 3/0 | 3/0 | 3/0 | ---- |
| New Hampshire | | NO ACTIVITY | | |
| New Jersey | 2/2 <5,<10 | 20/18 <3-4000 (230.2)* | 15/7 <1-800 (172.2) | ---- |
| New Mexico | 3/0 | 4/0 | 1/0 | ---- |

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Table 2.1-3 (cont.)

| STATE | 1972 | 1973 | 1974 | 1975 |
|---|---|---|---|---|
| New York | ---- | 17/5 | 17/14 | ---- |
| | | <2-1300 (519)* | <2-450 (95.8) | |
| North Carolina | ---- | 1/0 | ---- | ---- |
| North Dakota | 2/0 | 2/0 | ---- | ---- |
| Ohio | ---- | 1/0 | ---- | ---- |
| Oklahoma | 1/0 | 3/0 | 1/0 | ---- |
| Oregon | 1/0 | 1/0 | 2/0 | ---- |
| Pennsylvania | 9/7 | 5/3 | 23/16 | 3/3 |
| | <5-E100 (50.7) | <5-20 (11.7) | <6-700 (105.6) | <42-240 (144) |
| Rhode Island | NO ACTIVITY | | | |
| South Carolina | 2/0 | 2/0 | 5/1 (6) | ---- |
| South Dakota | 1/0 | 1/0 | ---- | ---- |
| Tennessee | ---- | 1/0 | 1/0 | ---- |
| Texas | 41/3 | 58/8 | 58/17 | ---- |
| | <4-120 (61.7) | <3-45 (17.6) | <1-153 (45.5) | ---- |
| Utah | ---- | 3/0 | 1/0 | ---- |
| Vermont | NO ACTIVITY | | | |
| Virginia | NO ACTIVITY | | | |
| Washington | 1/0 | 3/0 | 2/0 | ---- |
| West Virginia | NO ACTIVITY | | | |
| Wisconsin | ---- | 9/1 (10) | 21/0 | 2/0 |
| Wyoming | ---- | 3/0 | 1/0 | ---- |
| Puerto Rico | ---- | 6/0 | 16/5 | ---- |
| | | | <10-640 (242) | |

E - estimated

*mean figure does not include anomalous values

SOURCE: PCB Data Base, October 1972 to (partial) 1975, U.S. Geological Survey, Quality of Water Branch, Reston, VA.

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Table 2.1-4
States Reporting PCB's in Bottom Deposits

| 1971-72 | 1973 | 1974 | 1975 (partial) |
|---|---|---|---|
| 29/15 (51.72%) | 39/8 (20.51%) | 32/14 (43.75%) | 6/4 (66.67%) |

# states measuring PCB's in bottom sediments/# with at least one non-zero reading

SOURCE: PCB Data Base, October 1972 to (partial) 1975, U.S. Geological Survey, Quality of Water Branch, Reston, VA.

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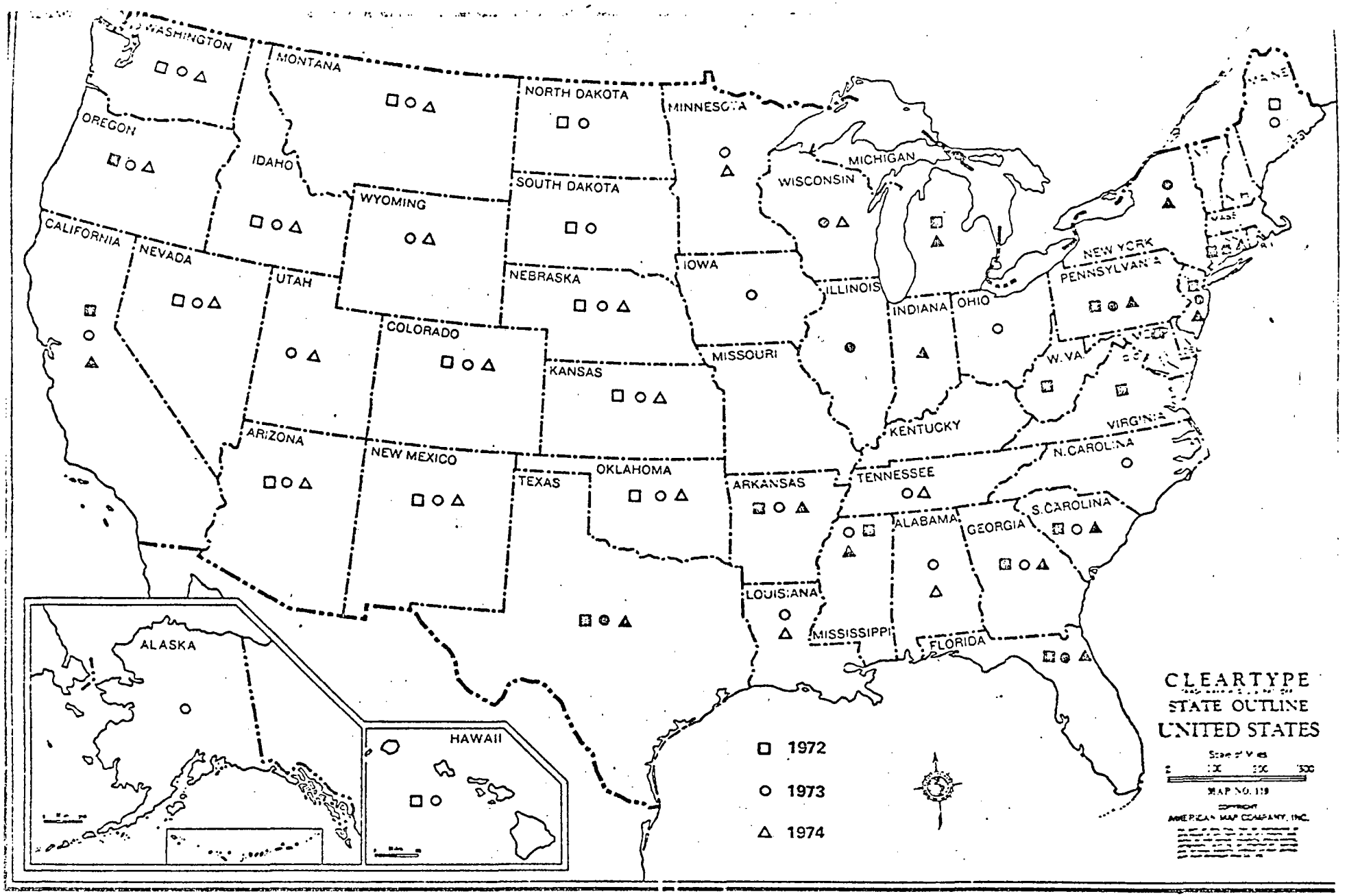


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FIGURE 2.1-1 STATES MONITORING PCB's IN BOTTOM SEDIMENTS 1972-1974
⊙ DARKENED SYMBOL REPRESENTS AT LEAST ONE DETECTION



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### 2.1.3 Soils

Two national soils monitoring programs are conducted by EPA as part of its Pesticides Monitoring Program covering both cropland and urban soils. In 1973, the only year in which PCB's were analyzed in cropland soils, virtually no occurrences were detected[1].

The urban soils program is a small one, consisting of 5 different urban locations each year. The sampling design recovers one analytical sample per square mile in the city proper and one per twenty square miles in the suburbs. The results of the program for the years 1971-1973 are summarized in Table 2.1-5 and Figure 2.1-2[1].

Assuming that sites were randomly selected within the cities sampled, 60% (3 of 5) of the cities sampled each year had at least one positive PCB sample. Over the three years an average of 2.68% of the sites in these cities (roughly corresponding to 2.68% of the total area) showed PCB concentrations in ranges from 0.9-11.94 ppm. The anomalous reading of 11.94 was found in a residential lawn in Gadsden, Alabama. Seventeen of the twenty two positive readings were below 1 ppm.

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Table 2.1-5
National Urban Soil Monitoring Program
PCB Detections 1971 - 1973

| | Total No. of Sites | No. of Positive Detections | Percent Positive Detections | Range of Positive Detections (ppm) | Arithmetic Mean (ppm) | PCB Type(s) |
|---|---|---|---|---|---|---|
| 1971 | | | | | | |
| Baltimore, MD. | 156 | 6 | 3.9 | 0.09 - 0.74 | 0.02 | 1260 1-lawn, 5 waste |
| Gadsden, AL. | 55 | 1 | 1.8 | 11.94 | 0.21 | Not identified, residential lawn |
| Hartford, CT. | 48 | ND | - | | | |
| Macon, GA. | 43 | ND | - | | | |
| Newport News, VA. | 78 | 1 | 1.3 | 3.30 | 0.04 | 1254 lawn |
| 1972 | | | | | | |
| Des Moines, IA | 82 | 3 | 3.7 | 0.34 - 0.94 | 0.03 | Not identified, 2-lawn 1-waste |
| Lake Charles, LA. | 70 | 1 | 1.4 | 1.31 | 0.02 | 1254 |
| Fitchburg, MA | 35 | ND | - | | | |
| Pittsburgh, PA. | 189 | 1 | 0.5 | 1.01 | 0.01 | Not identified, lawn |
| Reading, PA. | 49 | ND | - | | | |
| 1973 | | | | | | |
| Evansville, IN. | 82 | ND | - | | | |
| Greenville, SC | 86 | 3 | 3.5 | 0.13 - 1.59 | 0.02 | 1254 3-lawn |
| Pittsfield, MA. | 45 | ND | - | | | |
| Tacoma, WA. | 95 | 6 | 6.3 | 0.18 - 0.63 | 0.03 | 1-1254, Others not identified, 2 lawn, 4 waste |
| Washington, D.C. | 116 | 2 | 1.7 | 0.32 - 0.80 | <0.01 | 1-1254, Others not identified, 1 lawn, 1 waste |

SOURCE: Carey, Ann, 1975, EPA National Soil Monitoring Program, unpublished.



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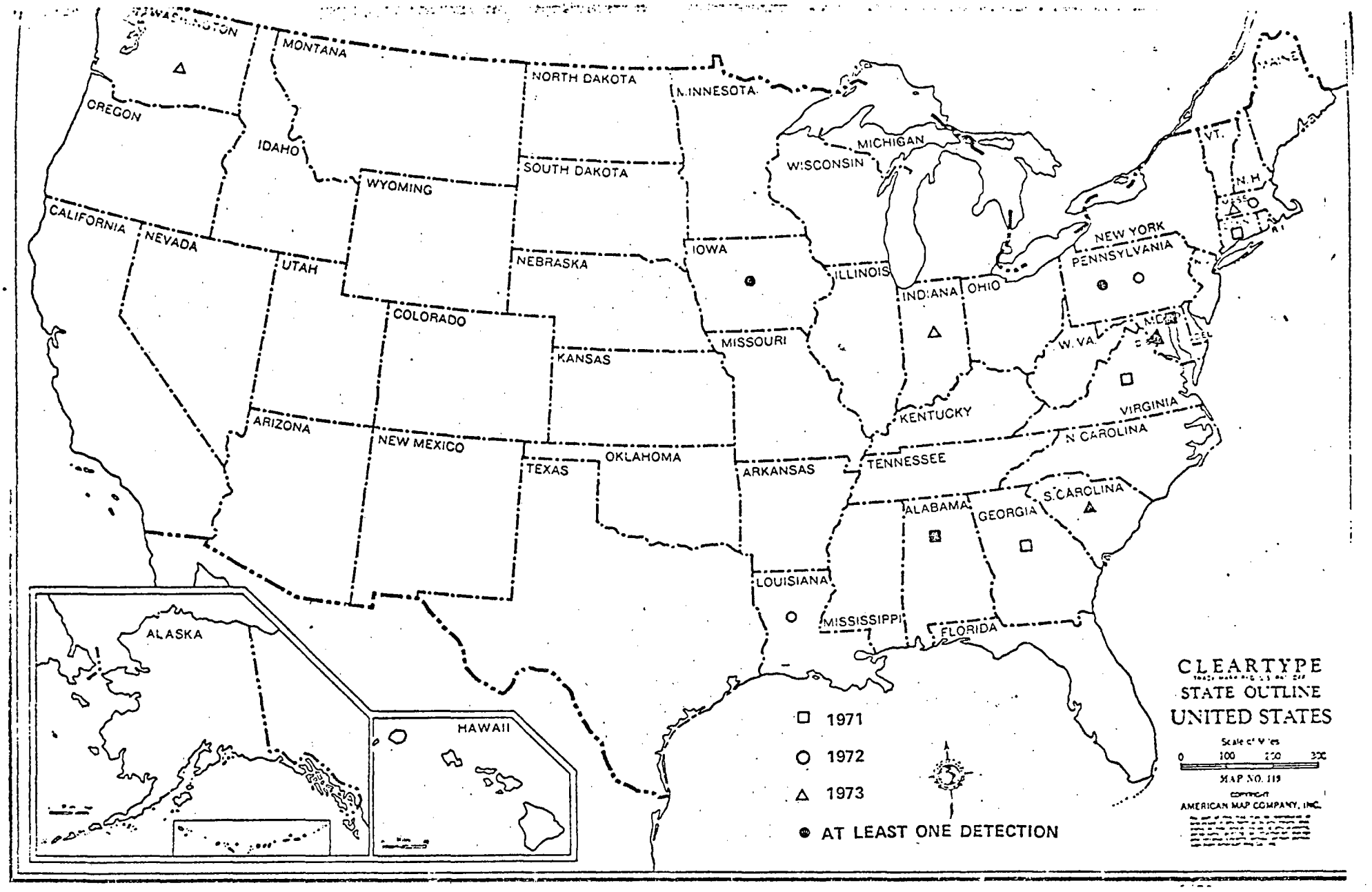


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FIGURE 2.1-2 NATIONAL URBAN SOIL MONITORING PROGRAM—PCB's



STLCOPCB4056729

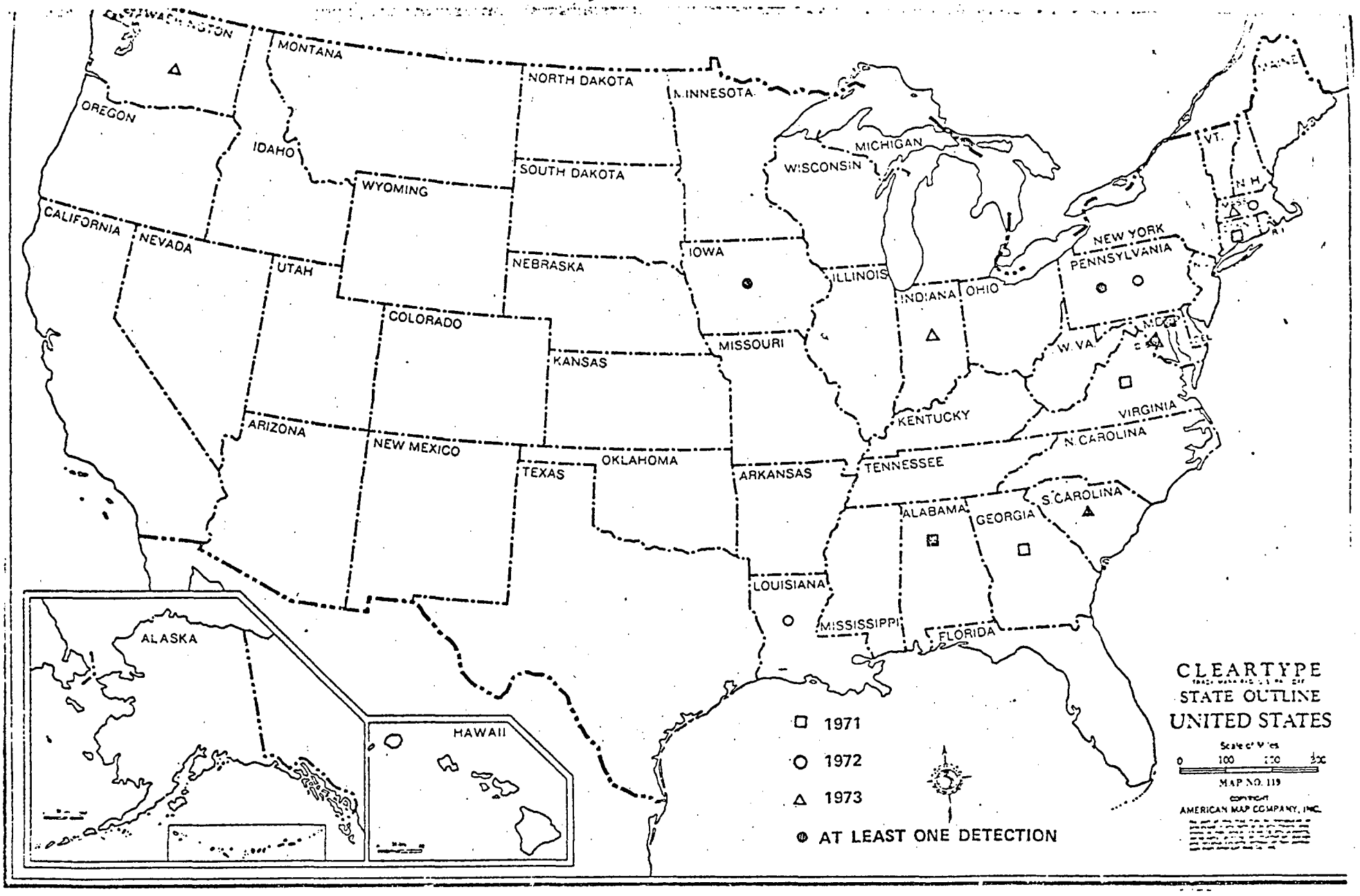


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FIGURE 2.1-2 NATIONAL URBAN SOIL MONITORING PROGRAM—PCB's



STLCOPCB4056730

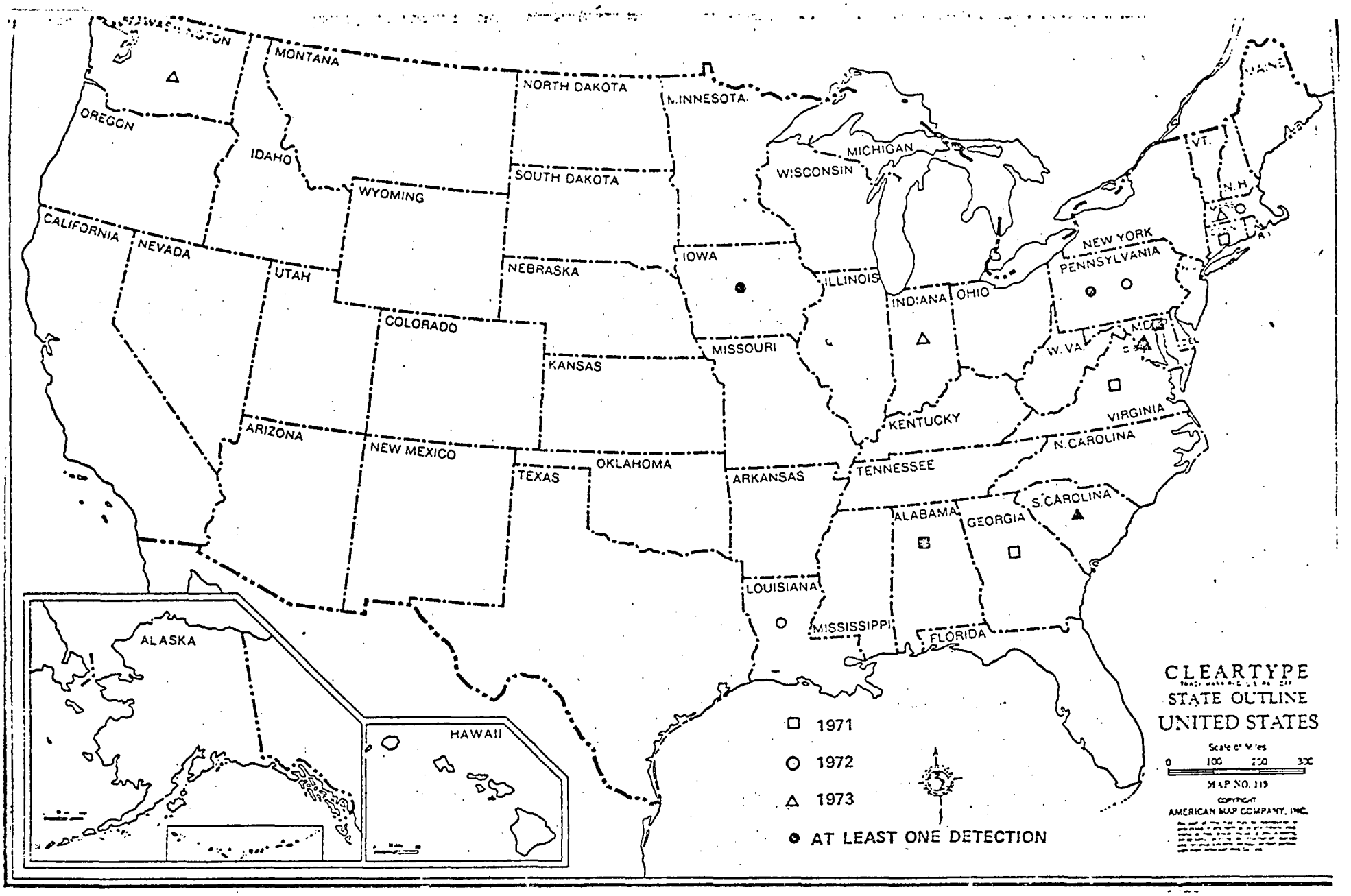


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FIGURE 2.1-2 NATIONAL URBAN SOIL MONITORING PROGRAM—PCB's



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### 2.1.4 Air

Polychlorinated biphenyls have not been measured in air on a nationwide basis.

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### 2.1.5 Fish

Fish have long been a popular sampling medium for PCB levels primarily due to the minimal difficulties of sampling and analysis relative to other media. Data on residue levels in fish, however, present problems of interpretation: the eating habits, lipid content, age, sex and size affect PCB levels; residue levels in fish, like those in sediment indicate past, not necessarily current, exposure; residue levels in fish are slow to reflect changes in levels of contamination of the water; distinguishing Aroclor 1254 from 1016 is difficult.

The U.S. Fish and Wildlife Service of the Department of the Interior provides the best national overview with the National Fish and Wildlife Monitoring Program. One of the elements of this program is the annual sampling of freshwater fish at 100 stations (as of 1970). Beginning with the 1969 collections, whole fish samples were analyzed for PCB's.

The most recent data from this program are the unpublished results of the 1973 collection. While many species of fish are sampled throughout the country, a reasonable summary of the data is provided in Table 2.1-6, which concentrates on the four most commonly sampled species of fish, largemouth bass, channel catfish, carp and yellow perch.

The great number of stations reporting "no detection" for those four species in 1973 is significant. Generally lower levels were reported for other species in 1973 also. Furthermore, when sampling data is totalled, ignoring both species and geographic location, as in Table 2.1-7, marked declines in both the proportion of composites with some PCB residues and the proportion with residues above the recommended maximum of 0.5 ppm are exhibited. While there is a downward trend in the number of stations reporting significant residue levels, those which have reported high concentrations in the past continue to do so. Walker[9] notes that PCB residues have been found in forty to sixty percent of the samples in residue concentrations exceeding 0.5 ppm and that the geographic dispersion shows that the higher concentrations appear to be associated with certain river systems having industrial activity: thirty-one of thirty-five stations in the Mississippi river system reported residues in excess of 0.5 ppm in the 1970-73 sampling program; all stations in the Great Lakes drainage area reported concentrations exceeding 0.5 ppm. Several factors related to interpretation of this data must be recognized: the PCB residues prior to 1973 are reported as "estimated", while those for 1973 are the result of the analysis for three Aroclors (1242, 1254 and 1260) totalled; a trend cannot be inferred from the data of one year, regardless of how dramatic it is, although such data may signal a turning point; analytic protocols for sample analysis, especially determination of specific Aroclors, are suspect and the results of cross check analyses show that some laboratories used for the analysis typically expressed PCB levels of only 5 to 20 percent of those discovered by more sophisticated analytic protocols of the Fish Pesticide Research Laboratory[9].

Table 2.1-6
PCB Residues in Selected Species of Fish
(averages of composite samples, expressed in ppm, wet weight, whole fish)

| State | Waterway/ Station Location | Species | 1969[a] | 1970[a] | 1971[a] | 1972[a] | 1973[b] |
|---|---|---|---|---|---|---|---|
| AL | Alabama R. | | | | | | |
| | Chrysler | Largemouth bass | <0.10 | 3.70 | 1.35 | 6.5 | N.D. |
| | | Channel catfish | | | | 1.5 | |
| | Tombigbee R. | | | | | | |
| | McIntosh | Carp | | 0.86 | 0.17 | | N.D. |
| | | Largemouth bass | | 1.30 | 0.93 | ** | N.D. |
| | | Channel catfish | | | | ** | |
| AZ | Colorado R. | | | | | | |
| | Imperial Reservoir | Largemouth bass | 0.40 | 0.11 | | N.D. | N.D. |
| | | Carp | 0.25 | 0.13 | 0.03 | 0.01 | N.D. |
| | | Channel catfish | 0.64 | 0.17 | 0.17 | | |
| | Colorado R. | | | | | | |
| | L. Havasu | Carp | | 0.17 | 0.05 | N.D. | N.D. |
| | | Largemouth bass | | 0.14 | | N.D. | N.D. |
| | | Channel catfish | | 0.21 | 0.14 | | |
| | Colorado R. | | | | | | |
| | L. Powell | Carp | | 0.09 | 0.06 | <0.10 | N.D. |
| | | Largemouth bass | | 0.09 | 0.10 | 0.16 | N.D. |
| | Gila R. | | | | | | |
| | San Carlos Res. | Carp | | 0.04 | 0.08 | ** | N.D. |
| | | Largemouth bass | | 0.08 | 0.03 | ** | N.D. |
| | | Channel catfish | | | 0.21 | ** | |
| AR | Arkansas R. | | | | | | |
| | Pine Bluff | Carp | 1.69 | 1.25 | 0.52 | ** | N.D. |
| | | Channel catfish | | | | N.D. | |
| CA | Sacramento R. | | | | | | |
| | Sacramento | Carp | 0.10 | 2.62 | 1.04 | 4.35 | 2.53 |
| | | Largemouth bass | <0.10 | 0.73 | 0.28 | 3.7 | |
| | San Joaquin R. | | | | | | |
| | Los Banos | Carp | 0.10 | 3.74 | 0.12 | ** | N.D. |
| | | Channel catfish | 0.10 | 1.72 | 0.21 | | N.D. |
| | | | | 0.14 | 0.06 | | |
| | Klamath R. | | | | | | |
| | Hornbrook | Yellow perch | | 0.24 | 0.12 | | <0.10 |
| | | Largemouth bass | | 0.09 | | | |
| CO | Rio Grande | | | | | | |
| | Alamosa | Carp | | 0.26 | 0.06 | N.D. | |
| | Arkansas R. | | | | | | |
| | John Martin Res. | Carp | | 0.09 | 0.05 | 0.05 | N.D. |
| | | Channel catfish | | 0.15 | 0.11 | | N.D. |

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Table 2.1-6 (cont.)

| State | Waterway/ Station Location | Species | 1969[a] | 1970[a] | 1971[a] | 1972[a] | 1973 |
|---|---|---|---|---|---|---|---|
| CT | Connecticut R. | | | | | | |
| | Windsor Locks | Yellow perch | 3.40 | 2.45 | 17.1 | 6.6 | 5.6 |
| FL | St. John's R. | | | | | | |
| | Welaka | Channel catfish | 0.14 | 0.18 | 0.07 | N.D. | N.D. |
| | | Largemouth bass | 0.31 | 0.37 | 0.28 | N.D. | N.D. |
| | St. Lucie Canal | | | | | | |
| | Indiantown | Channel catfish | 1.25 | 0.26 | 0.09 | N.D. | N.D. |
| | | Largemouth bass | 0.56 | 0.62 | 0.08 | N.D. | N.D. |
| | Suwanee R. | | | | | | |
| | Old Town | Largemouth bass | | 0.31 | 0.5 | 0.35 | 0.3 |
| | Apalachicola R. | | | | | | |
| | Jim Woodruff Dam | Channel catfish | 0.69 | 0.67 | 0.62 | | N.D. |
| | | Largemouth bass | <0.10 | 0.53 | 0.12 | 2.5 | N.D. |
| | | Carp | <0.10 | | | N.D. | |
| GA | Savannah R. | | | | | | |
| | Savannah | Largemouth bass | 1.18 | 0.70 | 0.14 | 0.64 | 0.5 |
| | | Channel catfish | | | | 2.30 | |
| | | Carp | 0.58 | 2.92 | 0.12 | | 3.2 |
| | Altamaha R. | | | | | | |
| | Doctortown | Largemouth bass | | 0.79 | 0.27 | 1.20 | N.D. |
| ID | Bear R. | | | | | | |
| | Preston | Carp | | 0.89 | 0.82 | 1.9 | 0.8 |
| | | Yellow perch | | 1.29 | 0.42 | 1.0 | 2.35 |
| | Salmon R. | | | | | | |
| | Riggins | Carp | | 0.14 | 0.06 | | |
| | Snake R. | | | | | | |
| | Lewiston | Carp | | 0.29 | 0.65 | 0.11 | N.D. |
| IL | Ohio R. | | | | | | |
| | Metropolis | Carp | | 2.01 | 3.16 | 7.1 | 1.4 |
| | | Channel catfish | | 3.78 | 6.07 | 5.7 | 5.45 |
| | Illinois R. | | | | | | |
| | Beardstown | Carp | 11.3 | 0.82 | 0.64 | 2.1 | 1.45 |
| IN | Wabash R. | | | | | | |
| | New Harmony | Carp | | 3.10 | 1.13 | 1.6 | 2.1 |
| | | Channel catfish | | 1.07 | 3.95 | 3.3 | 1.27 |
| IA | Des Moines R. | | | | | | |
| | Keosauqua | Carp | 0.54 | 0.22 | 0.16 | 1.33 | 1.00 |
| | | Channel catfish | | 0.40 | 0.86 | 1.60 | 0.90 |
| | | Largemouth bass | | | | N.D. | |
| | Mississippi R. | | | | | | |
| | Guttenberg | Carp | | 0.30 | 1.21 | 1.0 | 1.2 |
| | | Largemouth bass | 1.41 | 1.79 | 1.11 | 1.25 | 0.96 |

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Table 2.1-6 (cont.)

| State | Waterway/ Station Location | Species | 1969[a] | 1970[a] | 1971[a] | 1972[a] | 1973[1] |
|---|---|---|---|---|---|---|---|
| KS | Kansas R. | | | | | | |
| | Bonner Springs | Carp | | 0.55 | 1.28 | 1.30 | 1.2 |
| | | Channel catfish | | | 0.77 | | |
| LA | Mississippi R. | | | | | | |
| | Luling | Carp | 0.46 | 0.86 | 0.28 | 4.5 | |
| | | Channel catfish | 0.66 | 0.58 | 1.95 | 6.6 | |
| | Red R. | | | | | | |
| | Alexandria | Channel catfish | | | | N.D. | |
| | | Carp | | | | | 0.80 |
| ME | Penobscot R. | | | | | | |
| | Old Town | Yellow perch | 0.31 | 0.33 | 0.30 | 0.36 | 0.3 |
| | Kennebec R. | | | | | | |
| | Hinckley | Yellow perch | | 0.23 | 0.15 | 0.20 | N.D. |
| MD | Susquehanna R. | | | | | | |
| | Conowingo | Carp | 0.69 | 2.6 | 0.69 | 1.9 | 0.60 |
| | | Channel catfish | 1.21 | 1.77 | 0.94 | 4.5 | 1.2 |
| | | Yellow perch | 1.31 | 2.39 | 0.95 | 1.9 | |
| | Potomac R. | | | | | | |
| | Little Falls | Carp | 1.04 | 0.63 | 0.81 | 1.1 | |
| | | Channel catfish | | | | | 0.5 |
| | | Largemouth bass | 1.04 | | | | N.D. |
| MA | Merrimac R. | | | | | | |
| | Lowell | Yellow perch | | 6.12 | 21.2 | 9.5 | 12.0 |
| MI | L. Huron | | | | | | |
| | Bay Port | Carp | | 2.76 | 5.50 | | 4.30 |
| | | Channel catfish | | 3.80 | 1.53 | | 6.6 |
| | | Yellow perch | | 3.33 | 2.83 | 0.49 | 4.25 |
| MN | Red R. (north) | | | | | | |
| | Noyes | Channel catfish | | 0.68 | 2.29 | 0.17 | N.D. |
| MS | Yazoo R. | | | | | | |
| | Redwood | Carp | | 1.95 | 0.68 | N.D. | N.D. |
| | | Channel catfish | | | 1.63 | | N.D. |
| MO | Mississippi R. | | | | | | |
| | Cape Girardeau | Carp | | 5.26 | 1.89 | 2.42 | 1.9 |
| | | Largemouth bass | | 3.51 | 3.20 | | 1.0 |
| | Missouri R. | | | | | | |
| | Hermann | Carp | | 1.29 | 7.6 | 2.8 | 4.6 |
| | | Channel catfish | | 0.21 | | 2.00 | |

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STLCOPCB4056736

Table 2.1-6 (cont.)

| State | Waterway/ Station Location | Species | 1969[a] | 1970[a] | 1971[a] | 1972[a] | 1973[b] |
|---|---|---|---|---|---|---|---|
| MT | Big Horn R. | | | | | | |
| | Hardin | Carp | | 0.42 | 0.05 | N.D. | N.D. |
| | | Channel catfish | | 0.55 | | | N.D. |
| | Yellowstone R. | | | | | | |
| | Sidney | Channel catfish | | 0.14 | | | 0.20 |
| | | Carp | | | | 0.10 | N.D. |
| NE | Missouri R. | | | | | | |
| | Nebraska City | Carp | | 1.38 | 0.53 | 0.67 | 0.30 |
| | | Channel catfish | | | | 0.50 | |
| | North Platte R. | | | | | | |
| | L. McConaughy | Carp | | 0.24 | 0.06 | N.D. | N.D. |
| | | Channel catfish | | 0.21 | 0.09 | N.D. | N.D. |
| | South Platte R. | | | | | | |
| | Brule | Carp | | 0.08 | 0.22 | 1.15 | 0.50 |
| | Platte R. | | | | | | |
| | Louisville | Carp | | 0.71 | 0.23 | 1.50 | 0.33 |
| | | Channel catfish | | 0.62 | 0.43 | 4.30 | 1.70 |
| NV | Colorado R. | | | | | | |
| | L. Mead | Carp | | 0.13 | 1.68 | N.D. | 0.20 |
| | | Largemouth bass | | 0.09 | 0.09 | 0.26 | N.D. |
| | | Channel catfish | | | 0.13 | 0.76 | 0.20 |
| | Truckee R. | | | | | | |
| | Fernley | Carp | 0.54 | 0.51 | 1.21 | 1.8 | 0.83 |
| | | Largemouth bass | <0.10 | 0.73 | 0.42 | 2.1 | 1.00 |
| NJ | Raritan R. | | | | | | |
| | Highland Park | Largemouth bass | | | | 4.9 | |
| | | Carp | | | | | 2.1 |
| NM | Rio Grande | | | | | | |
| | Elephant Butte Res | Channel catfish | | 0.35 | 0.52 | 0.92 | N.D. |
| | | Largemouth bass | | 0.65 | 0.30 | 1.54 | N.D. |
| NY | Hudson R. | | | | | | |
| | Poughkeepsie | Largemouth bass | 4.82 | 9.37 | 34.5 | 13.0 | 3.2 |
| | St. Lawrence R. | | | | | | |
| | Massena | Yellow perch | | 1.45 | 2.12 | 3.15 | 1.1 |
| | L. Ontario | | | | | | |
| | Port Ontario | Yellow perch | | 2.48 | 7.34 | 6.2 | 5.2 |
| NC | Roanoke R. | | | | | | |
| | Roanoke Rapids | Largemouth bass | 0.10 | 0.89 | 0.37 | 1.40 | N.D. |
| | | Carp | | | | 0.65 | N.D. |
| | | Channel catfish | | | | | N.D. |
| | Cape Fear R. | | | | | | |
| | Elizabethtown | Largemouth bass | | 3.33 | 0.81 | 3.90 | N.D. |

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Table 2.1-6 (cont.)

| State | Waterway/ Station Location | Species | 1969[a] | 1970[a] | 1971[a] | 1972[a] | 1973[b] |
|---|---|---|---|---|---|---|---|
| ND | Missouri R. | | | | | | |
| | Garrison Dam | Carp | 0.10 | 0.08 | | N.D. | N.D. |
| OH | Ohio R. | | | | | | |
| | Marietta | Carp | | 4.82 | 5.20 | 2.5 | 11.0 |
| | | Channel catfish | | 11.85 | 14.5 | 9.75 | 24.0 |
| | | Largemouth bass | 8.07 | | 22.65 | | |
| | Ohio R. | | | | | | |
| | Cincinnati | Carp | | 24.5 | 25.8 | 19.0 | 25.0 |
| | | Channel catfish | | | 27.3 | 30.0 | 21.5 |
| OK | Verdigris R. | | | | | | |
| | Oologah | Carp | | 0.61 | 0.8 | ** | N.D. |
| | | Largemouth bass | | 0.40 | 0.09 | ** | N.D. |
| | Canadian R. | | | | | | |
| | Eufaula | Carp | | 0.81 | 0.31 | | N.D. |
| | | Largemouth bass | | 0.14 | | | N.D. |
| | | Channel catfish | | | 0.36 | | |
| | White R. | | | | | | |
| | DeValls Bluff | Carp | | 1.77 | 0.73 | 1.5 | N.D. |
| | | Channel catfish | | 1.82 | 2.32 | | N.D. |
| | Red R. | | | | | | |
| | Lake Texoma | Carp | | 0.25 | 0.26 | N.D. | N.D. |
| | | Largemouth bass | | 0.21 | 0.13 | N.D. | N.D. |
| | Arkansas R. | | | | | | |
| | Keystone Res. | Carp | 0.24 | 0.45 | 0.29 | 0.5 | N.D. |
| | | Largemouth bass | 0.66 | 1.25 | | ** | N.D. |
| | | Channel catfish | | | 1.28 | | |
| OR | Willamette R. | | | | | | |
| | Oregon City | Carp | | 1.25 | | | |
| | | Channel catfish | | | | 0.44 | |
| | Columbia R. | | | | | | |
| | Bonneville | Carp | | | 0.19 | <0.1 | N.D. |
| | Rogue R. | | | | | | |
| | Gold Ray Dam | Carp | | 2.60 | | 1.4 | 5.4 |
| | | Largemouth bass | | 0.87 | | | |
| PA | L. Erie | | | | | | |
| | Erie | Yellow perch | | 2.40 | 1.11 | 1.65 | 0.75 |
| | Allegheny R. | | | | | | |
| | Natrona | Carp | | 4.59 | 5.52 | 4.0 | 1.75 |
| SC | Pee Dee R. | | | | | | |
| | Dongola | Largemouth bass | | 0.62 | | 3.70 | 0.5 |
| | Cooper R. | | | | | | |
| | Summerton | Carp | | 1.04 | 0.35 | N.D. | 1.5 |
| | | Largemouth bass | <0.10 | 0.45 | 0.18 | 3.20 | 3.3 |

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Table 2.1-6 (cont.)

| State | Waterway/ Station Location | Species | 1969[a] | 1970[a] | 1971[a] | 1972[a] | 1973[b] |
|---|---|---|---|---|---|---|---|
| SD | James R. | | | | | | |
| | Olivet | Carp | | 0.20 | 0.65 | N.D. | N.D. |
| | | Channel catfish | | | 0.20 | 1.20 | <0.10 |
| TN | Cumberland R. | | | | | | |
| | Clarksville | Carp | 0.89 | 1.67 | 0.69 | 16.0 | 4.3 |
| | | Largemouth bass | 3.15 | 2.92 | 1.19 | 5.0 | 5.8 |
| | Tennessee R. | | | | | | |
| | Savannah | Carp | | 1.46 | 0.33 | 4.65 | 1.5 |
| | | Channel catfish | | 4.32 | 3.18 | | 9.8 |
| | | Largemouth bass | | 1.20 | 0.63 | 11.0 | 3.1 |
| | Mississippi R. | | | | | | |
| | Memphis | Carp | | 3.26 | 1.22 | 10.0 | 1.5 |
| | | Channel catfish | | | | 5.4 | |
| TX | Pecos R. | | | | | | |
| | Red Bluff Lake | Channel catfish | | 1.07 | 0.19 | 0.60 | N.D. |
| | | Largemouth bass | | 0.06 | | | |
| | Brazos R. | | | | | | |
| | Richmond | Channel catfish | | 1.17 | | 0.5 | |
| | Colorado R. | | | | | | |
| | Wharton | Channel catfish | | 0.32 | 0.38 | 1.1 | N.D. |
| | | Carp | | | | | N.D. |
| | Nueces R. | | | | | | |
| | Mathis | Channel catfish | | 0.03 | | N.D. | |
| | | Largemouth bass | | 0.05 | | | N.D. |
| | Rio Grande | | | | | | |
| | Brownsville | Channel catfish | | 0.40 | 3.62 | 7.70 | 3.46 |
| UT | Utah Lake | | | | | | |
| | Provo | Carp | 0.29 | 0.18 | 0.10 | ** | 0.26 |
| | Green R. | | | | | | |
| | Vernal | Carp | 0.83 | 0.09 | 0.6 | ** | N.D. |
| | | Channel catfish | | 0.10 | 0.22 | ** | N.D. |
| VT | L. Champlain | | | | | | |
| | Burlington | Yellow perch | | 0.78 | 0.74 | 1.20 | 1.21 |
| VA | James R. | | | | | | |
| | Richmond | Channel catfish | | 0.79 | 0.44 | | 1.5 |
| | | Largemouth | | 0.34 | 0.33 | | 1.5 |
| WA | Snake R. | | | | | | |
| | Ice Harbor | Channel catfish | | 1.00 | 0.62 | 1.3 | 0.5 |
| | | Carp | | | 0.19 | | |
| | Yakima R. | | | | | | |
| | Granger | Carp | | 1.24 | 0.22 | 1.70 | N.D. |
| | | Largemouth bass | | 0.63 | | | N.D. |
| | Columbua R. | | | | | | |
| | Pasco | Carp | | 0.17 | 0.19 | 1.4 | N.D. |

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STLCOPCB4056739

Table 2.1-6 (cont.)

| State | Waterway/ Station Location | Species | 1969 | 1970 | 1971 | 1972 | 1973 |
|---|---|---|---|---|---|---|---|
| WV | Kanawha R. Winfield | Carp | 0.31 | 1.25 | 0.61 | 12.0 | 3.8 |
| WI | L. Michigan Sheboygan | Yellow perch | | 7.42 | 11.45 | 9.3 | 7.85 |
| | Wisconsin R. Woodman | Carp | | 1.15 | 1.44 | | 3.67 |
| | | Channel catfish | | 0.17 | 1.11 | | |

** - PCB-like compound present
N.D. - Not Detectable

a. estimated PCB levels
b. total of Aroclors 1242, 1254 and 1260

SOURCES:
1969 Data - Henderson, C., A. Inglis and W.L. Johnson, Pesticides Monitoring Journal, 5, 1-11 (1971).

1970-1973 Data - National Fish and Wildlife Monitoring Program, Results of Freshwater Fish Monitoring 1970-1973, U.S. Fish and Wildlife Service, U.S. Department of Interior, Washington, DC (unpublished).

DSW 442205

STLCOPCB4056740

Table 2.1-7
Summary of PCB Residues Detected in Fish from 1969-1973
National Pesticide Monitoring Program

| | | Number of Composites | | | | |
|---|---|---|---|---|---|---|
| | | With Residues | | With Residues Above .5 ppm | | |
| Year | Total | No. | % | No. | % | Range (ppm) |
| 1969 | 147 | 147 | 100 | 89 | 61 | 0.10-14.8 |
| 1970 | 393 | 390 | 99 | 239 | 61 | 0.03-24.8 |
| 1971 | 587 | 581 | 99 | 284 | 48 | 0.02-41.0 |
| 1972 | 401 | 311 | 78 | 215 | 54 | <0.05-30.0 |
| 1973 | 400 | 202 | 51 | 160 | 40 | <0.01-25.0 |

SOURCES:

1969 - Henderson, C., A. Inglis and W.L. Johnson, Pesticides Monitoring Journal, 5, 1-11 (1971).

1970-1973 Data - National Fish and Wildlife Monitoring Program, Results of Freshwater Fish Monitoring 1970-1973, U.S. Fish and Wildlife Service, U.S. Department of Interior, Washington, DC (unpublished).

DSW 442206

### 2.1.6 Birds

Two of the three elements of the National Fish and Wildlife Monitoring Program mentioned in the previous section are: mallards and black ducks; starlings.

PCB's have been found in all of the starling samples taken in 1970, 1972 and 1974. The level of residues appears to be declining over this period with national arithmetic means of 0.65 ppm, 0.43 ppm and 0.12 ppm for the three years respectively[9].

Results of sampling of mallards in 1970 and 1972[9] are shown by flyway on Figure 2.1-3. Residues are highest in the Atlantic flyways, with average concentrations more than double that of any other flyway and more than 10 times greater in some cases. Samples of black ducks were also taken in the Atlantic flyways in 1969 and 1972 and the mean PCB concentration was constant at 1.36 ppm.

In the 1969 mallard study[4] not only did mallards from the Atlantic flyway show the greatest average PCB concentration, but with the exception of Maryland all of the states in the Atlantic flyway had averages exceeding 0.5 ppm with the highest residues from New Hampshire southward through Delaware. In the Mississippi flyway, residue levels were highest in states bordering the Great Lakes, generally diminishing as sampling moved southward.

DSW 442207

STLCOPCB4056742

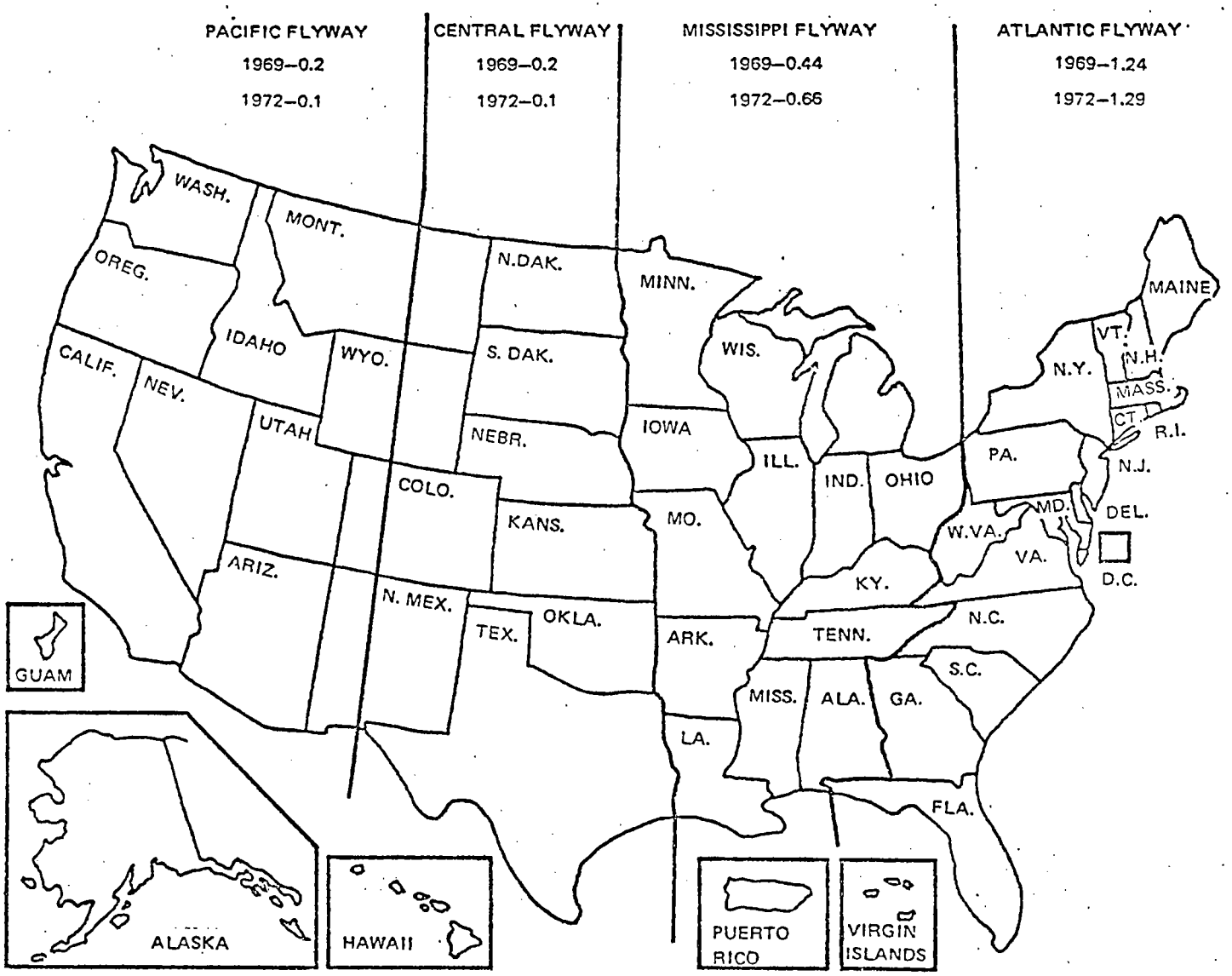


FIGURE 2.1-3 PCB's IN MALLARDS (AVERAGES, WINGS, PPM, WET WEIGHT BASIS)

DSW 442208



STLCOPCB4056743

REFERENCES, Section 2.1


1. Carey, Ann, 1975, EPA National Soil Monitoring Program, unpublished.

2. Crump-Wiesner, J.S., H.R. Feltz and M.L. Yates, J. Research USGS, 1, 603-607 (1972).

3. Haile, C.L., G.D. Veith, G.F. Lee and W.C. Boyle, Chlorinated Hydrocarbons in the Lake Ontario Ecosystem (IFYGL 1975), unpublished EPA report, EPA-660/3-75-022.

4. Heath, R.G. and S.A. Hill, Pesticides Monitoring Journal, 7, 153-163 (March 1974).

5. Henderson, C., A. Inglis and W.L. Johnson, Pesticides Monitoring Journal, 5, 1-11 (1971).

6. Martin, W.E. and P.R. Nickerson, Pesticides Monitoring Journal, 6, 33-40 (June 1972).

7. National Fish and Wildlife Monitoring Program, Results of Freshwater Fish Monitoring 1970-1973, U.S. Fish and Wildlife Service, U.S. Department of the Interior, Washington, DC (unpublished).

8. PCB Data Base, October 1972 to (partial) 1975, U.S. Geological Survey, Quality of Water Branch, Reston, VA.

9. Walker, Charles R., The Occurence of PCB's in the National Fish and Wildlife Monitoring Program, presented at the National Conference on Polychlorinated Biphenyls, Chicago, Illinois, November 19-21, 1975.


DSW 442209

STLCOPCB4056744

## 2.2 Data from Localized Monitoring Efforts - Lakes

Figure 2.2-1 is provided in order to display the relationship of the different lakes in the Great Lakes region as discussed in 2.2.1 - 2.2.5.

### 2.2.1 Lake Ontario

Lake Ontario is one of the lesser studied Great Lakes for PCB's. A thorough study of chlorinated hydrocarbons in the Lake Ontario ecosystem was performed in 1972 by Haile, Veith, Lee and Boyle.[6] Samples of various media were taken from 19 different locations in Lake Ontario during the summer of 1972, as indicated in Figure 2.2-2, and significant concentrations of PCBs were reported in all media. Findings for water, sediment and net plankton are summarized in Table 2.2-1. Other than the south shore areas off Oswego (77 ppt) and the north of the Niagara River (97 ppt), the PCB content of the Lake Ontario water appears relatively uniform in the range of 35 to 56 ppt, with an average of 45 ppt. PCB concentrations in sediments around the south shore areas off the mouths of the Welland Canal and Niagara River and off Oswego averaged more than twice the concentrations found at the four other sites (means of 184 ppb vs. 72 ppb). This led the authors to conclude that the Niagara and Oswego Rivers may be important sources of PCB associated with settleable particulates. Plankton samples were not taken at the south shore sites; lake wide levels averaged 7.2 ppm.

Fish samples selected in the same study found mean PCB concentrations on a whole fish basis in smelt (2.65 ppm) similar to those reported in Lake Michigan smelt. Mean PCB levels in alewives (2.35 ppm) were lower than values reported for Lake Michigan alewives (4.6 ppm). Bottom feeding slimy sculpin, which are less migratory than the latter two species, exhibited greater station to station variability in PCB levels, with a lake wide average of 4.63 ppm. Average concentrations in Cladophora were 515 ppb and for benthic fauna were 471 ppb. Samples were not taken consistently across media at stations and the results suffer accordingly, but the authors do draw one of the few estimates of accumulation factors for chlorinated hydrocarbons. They estimate relative concentrations as 1; 2500; 10,000; 150,000; and 300,000 for water, sediment, benthos, net plankton and fish, respectively.

Kaiser[10] shows PCB levels in two 1973 fish samples from northern Lake Ontario as 5.99 ppm (total PCB, fat, northern longnose gar) and 2.38 ppm (total postanal fins, northern pike), magnitudes considered comparable to those of other fishes from Lake Ontario.

DSW 442210

STLCOPCB4056745

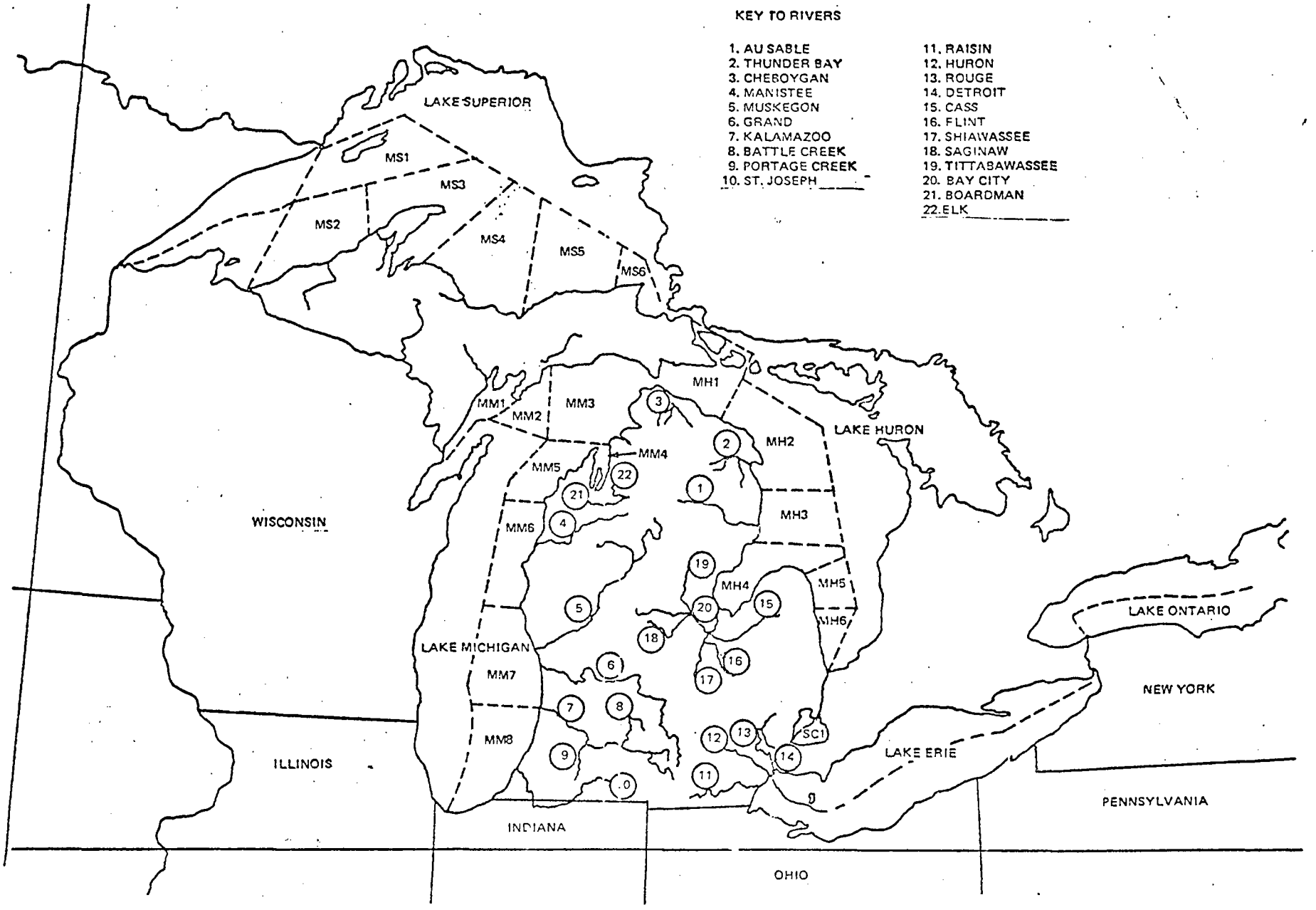


FIGURE 2.2-1 THE GREAT LAKES (AND RIVERS IN MICHIGAN)



DSW 442211
STLCOPCB4056746

Table 2.2-1

PCB Concentrations, Lake Ontario Ecosystem
Summer 1972

| Sample Location (map reference) | Water (ppt) | Sediment (ppb dry) | Net Plankton (ppm dry) |
|---|---|---|---|
| 1 | 49 | | 3.4 |
| 8 | 35 | | |
| 10 | | | 10.6 |
| 12 | | 245 | |
| 13 | 97 | 155 | |
| 30 | 44 | 80 | |
| 36 | 45 | 43 | 7.6 |
| 45 | | | 3.6 |
| 46 | | 79 | |
| 60 | 40 | 84 | |
| 75 | 56 | | 11.8 |
| 90 | 77 | | |
| 91 | | 158 | |
| 96 | | | 6.0 |

SOURCE: Haile, C.L., G.D. Veith, G.F. Lee and W.C. Boyle, Chlorinated Hydrocarbons in the Lake Ontario Ecosystem (IFYGL), EPA Report. EPA 660/3-75-022 (1975).

DSW 442212

STLCOPCB4056747

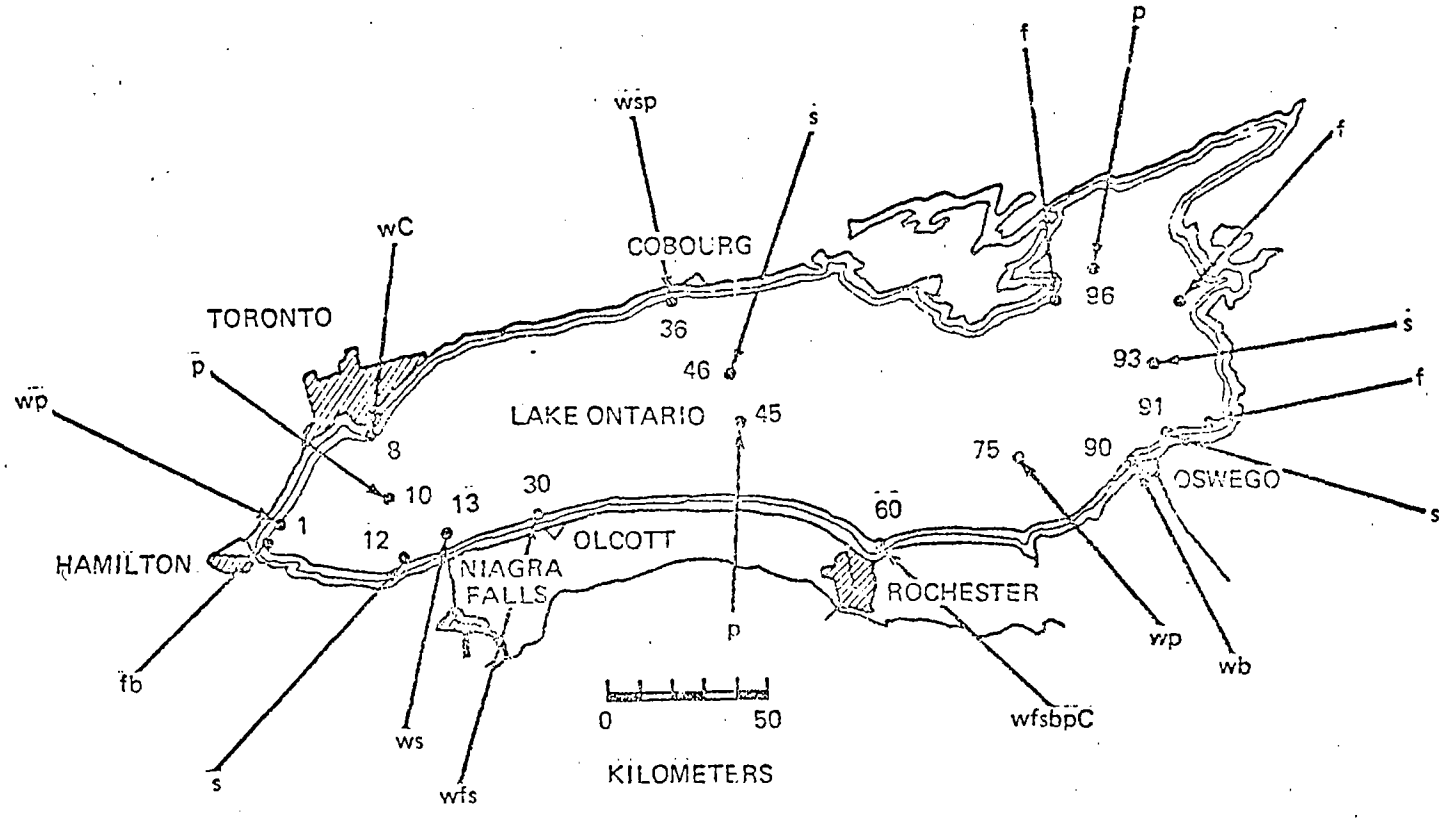


FIGURE 2.2-2 LAKE ONTARIO SAMPLING SITES FOR CHLORINATED HYDROCARBON ANALYSIS. NOTATIONS ARE: f-FISH, w-WATER, s-SEDIMENT, p-NET PLANKTON, C-CLADOPHORA, b-BENTHOS. STATION NUMBERS ARE IFYGL STATION IDENTIFIERS.

DSW 442213



STLCOPCB4056748

### 2.2.2 Lake Erie

Several studies of PCB concentrations in fish samples from Lake Erie are summarized in Table 2.2-2. Levels are generally lower than those reported from Lake Michigan and Lake Superior, but are inconclusive other than demonstrating the presence of PCB's in the lake water. Water measurements in tributaries to Lake Erie[3] including the Rouge river, which is tributary to the Detroit River are in Table 2.2-3, the Raisin and Rouge Rivers show relatively high levels of concentration when contrasted to the concentration levels in fish in the preceding table.

DSW 442214

STLCOPCB4056749

Table 2.2-2

Mean PCB Levels in Fish, Lake Erie
(ppm, whole fish)

| Species | 1970[a] | 1972[b] | 1973[c] |
|---|---|---|---|
| Carp | 2.0 | | 9.3 |
| Catfish | 4.4 | | |
| Drum | 1.1 | | 0.9 |
| Yellow Perch | 0.8 | 0.25 | Trace |
| Salmon | 2.1 | | |
| Walleye | | | 0.5 |
| White Bass | 2.1 | 1.02 | 2.5 |
| Smallmouth Bass | | 0.71 | |

SOURCES: [a] Carr, R.L., C.E. Finsterwalder and M.J. Schibi, Pesticides Monitoring Journal, 6, 23-26 (1972).

[b] Kelso, J.R.M. and R. Frank, Transactions American Fisheries Society, 103, 577-581 (1974).

[c] 1973 Great Lakes Environmental Contaminant Survey - Data Summary and Analysis, Bureau of Consumer Protection, Michigan (1973).

Table 2.2-3

PCB Concentrations in Michigan Tributaries
to Lake Erie in 1971-72 and June 1973 in
ppb as Aroclor 1254

| River | Mean PCB Concentration | Range (1971-72) | 1973 |
|---|---|---|---|
| Raisin | 0.210 | <0.068-0.500 | <0.010 |
| Huron | 0.012 | <0.010-0.039 | <0.010 |
| Rouge | 0.470 | 0.058-1.600 | 0.460* |
| Detroit | 0.020 | <0.010-0.053 | <0.010 |

* Aroclor 1242

SOURCE: Hesse, J.L., Status Report on Polychlorobiphenyls in Michigan Waters, Michigan Water Resources Commission, June 1973.

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### 2.2.3 Lake Superior

The results of several available fish studies are presented in Table 2.2-4 for different species of fish. Lake trout are in the highest trophic level within the lake and biological accumulation should result in this species possessing some of the highest concentrations of PCB's.

The study by Veith and Glass[19], summarized in the table, drew samples from three areas in the western portion of the lake. There was variability in the levels of PCB's in fish caught in different areas, but no conclusions are drawn in the study. Samples from the Apostle Island region (Wisconsin) had higher mean concentrations for all species than those from the other two regions (Minnesota). Parejko and Johnston[14] note that the biphenyls containing lower percent concentrations of chlorine predominated in the sample. The latter study involved tests for correlation between factors of age, sex, geographical location and concentration level; surprisingly, no significant correlations were discovered.

The geographic distribution of lake trout samples from the 1972-1974 Great Lakes Environmental Contaminant Survey[5] is detailed in Table 2.2-5. As regards recent screening of fish against the FDA guideline, Kleinert[12] reports that of 64 fish samples collected in the nearshore waters during 1974, none exceeded the 5 ppm guideline and only two exceeded a level of 1 ppm.

Table 2.2-4

Mean PCB Levels in Fish, Lake Superior
(ppm, whole fish)

| Species | 1971[c] | 1972[a] | 1973 | | 1974[e] |
|---|---|---|---|---|---|
| Burbot | | 0.7 | 1.4[a] | | |
| Chubs | | 0.9 | 1.6[b] | | |
| Herring | | 2.0 | 1.8[b] | | |
| Lake Trout | 7.08 | 0.8 | 1.8[a] | 2.64[d] | 1.55 |
| Long-Nose Sucker | | | 0.9[a] | | |
| Smelt | | 0.3 | 0.4[a] | | |
| Whitefish | | | 0.3[b] | | |

SOURCES:

[a] Veith, G.D. and G.E. Glass, PCBs and DDT in Fish from Western Lake Superior, U.S. EPA National Water Quality Lab., Duluth, Minnesota (1974).

[b] 1973 Great Lakes Environmental Contaminant Survey - Data Summary and Analysis, Bureau of Consumer Protection, Michigan (1973).

[c] Parejko, R. and R. Johnston, Uptake of Toxic Water Pollutants, (PCB) by Lake Trout. Project Completion Report, U.S. Dept. of the Interior, Office of Water Resources Research, Contract 14-01-0001-3522 (1973).

[d] Willford, W.A., Contaminants in Upper Great Lakes Fishes, Presented at Great Lakes Fishery Commission, Upper Great Lakes Committee Meetings, Milwaukee, Wisconsin, March 1975.

[e] Hesse, J.L., PCB Situation in Great Lake Fish, Report to Michigan Water Resources Commission, April 17, 1975.

Table 2.2-5
Mean PCB Levels in Lake Trout
from Lake Superior (ppm)

| Lean Variety | | <17" | 17-20" | 20-25" | >25" |
|---|---|---|---|---|---|
| MS 1** | 1972 | --- | --- | --- | --- |
| | 1973 | 2.4 (4)* | 2.9 (1) | 5.6 (3) | 4.8 (4) |
| | 1974 | --- | --- | --- | --- |
| MS 2 | 1972 | --- | --- | --- | --- |
| | 1973 | 0.5 (3) | 1.8 (3) | 3.4 (3) | 5.2 (2) |
| | 1974 | --- | --- | 1.2 (3) | 5.2 (1) |
| MS 3 | 1972 | --- | --- | 2.2 (6) | 2.7 (3) |
| | 1973 | 1.6 (12) | 1.9 (7) | 4.5 (8) | 4.8 (11) |
| | 1974 | 0.6 (3) | 0.1 (2) | 0.4 (9) | 2.0 (12) |
| MS 4 | 1972 | --- | --- | 4 6 (3) | 5.7 (8) |
| | 1973 | --- | 1.0 (6) | 2.0 (6) | 4.7 (9) |
| | 1974 | 0.5 (2) | 0.5 (2) | 0.7 (4) | 1.4 (3) |
| MS 5 | 1972 | --- | --- | 3.3 (6) | 2.1 (3) |
| | 1973 | --- | 1.2 (3) | 1.2 (3) | 1.9 (3) |
| | 1974 | --- | 1.8 (2) | 1.4 (4) | 1.5 (6) |
| MS 6 | 1972 | --- | --- | 1.4 (3) | --- |
| | 1973 | 0.9 (3) | 1.0 (3) | 1.5 (3) | 1.3 (3) |
| | 1974 | 2.2 (8) | 0.4 (2) | 2.8 (7) | 2.6 (5) |
| **Fat or Siscowet Variety** | | | | | |
| MS 1 | 1974 | 0.5 (3) | 3.6 (2) | 1.9 (4) | 3.8 (3) |
| MS 2 | 1974 | 2.5 (5) | 6.2 (10) | 11.3 (6) | 3.3 (2) |
| MS 3 | 1974 | 4.4 (6) | 12.6 (2) | 7.4 (7) | 6.8 (7) |
| MS 4 | 1974 | 12.7 (2) | 5.4 (8) | --- | 6.1 (6) |

*Concentrations in parts per million (ppm) in fillet; wet weight. Number of samples in parentheses ( ).

**Refers to geographic area in Figure 2.2-1.

SOURCE: Hesse, J.L., Contaminants in Great Lakes Fish, Staff Report, Michigan Water Resources Commission, Department of Natural Resources, (1975).

### 2.2.4 Lake Michigan

Lake Michigan is the most heavily studied of the Great Lakes. It has been established that the lake contains the highest concentrations of agricultural pesticides due, in part, to the large useage in the watershed relative to the flushing period for the lake and to the relatively low biomass density. There were seizures of Lake Michigan fish by the FDA during 1975. Samples from a shipment of Lake Michigan Chinook and Coho Salmon in May 1975 were found to exceed the 5 ppm guideline.[2] PCB levels in these fish ranged from 7.6-10.9 ppm. Hesse[7] reports a February 1975 seizure of large, surplus salmon exceeding the FDA guideline. In May 1975[2] a seizure of chubs resulted in analysis which showed that concentrations did not exceed the guideline. Such activities, however, have dramatized the hazards to both the lake and its fishing industry. In June, 1975, the Secretary of the State of Wisconsin Department of Natural Resources, based on evidence indicating that most large trout and salmon contain PCB's at levels exceeding the 5 ppm tolerance level, concluded that most fish over 24 inches in length appear to have excessive levels.

To provide a broad historical perspective, data from several studies of Lake Michigan fish are assembled in Table 2.2-6. The question of trend in the levels of fish contamination has been addressed by both Hesse[8] and Willford[21], referring specifically to the data of Table 2.2-7. Both conclude that the situation has generally remained static since 1972. Statistical analyses show no significant differences in the levels of the three species over the three year period 1972-1974. Data from the Great Lakes Environmental Contaminant Survey for this period for lake trout is detailed, by sampling area, in Table 2.2-8. The sample sizes are generally small and, while not allowing for rigorous statistical analysis, document the presence of a widespread PCB problem in lake trout of larger sizes and an intensification of the problem in southern Lake Michigan. The general conclusions that larger fish such as brown, lake and rainbow trout and chinook and coho salmon contain PCB residues at levels exceeding the FDA guideline, that concentrations increase with the percentage of fat and the size of the fish, and that levels found in the southern portion of the lake exceed those in the northern portion are supported by various studies[2].

The results of some earlier (1971-72) fish sampling undertaken by the Illinois EPA[3] found PCB levels in the edible portion of five species (yellow perch, chub, carp, coho salmon and alewife) generally below the 5 ppm tolerance limit. This is in apparent contradiction to the later studies discussed in the preceding paragraph - especially since the Illinois samples came from the southern portion of the lake. Data from this study is included in Table 2.2-6. There are, of course, many variables which impact on the interpretation of data from fish sampling lipid content, fish size and age, season of capture, location, etc. Thus, mean readings may not be truly representative although this statistic is commonly used to provide broad summarization of an abundance of data.

Measurements taken on Lake Michigan open waters and sediment tend to show results which are consistent with reported sediment data from other sections of the country (see section 2.1.3), and somewhat higher readings for concentrations in whole water. The Illinois EPA has found tributary sediments with higher concentrations than those from open waters (1971): averages of 23.06 ppb as Aroclor 1242 and 14.66 ppb Aroclor 1254 for the former contrasted with 95.77 ppb Aroclor 1242 and 32.27 ppb Aroclor 1254 for the latter[4]. Whole water concentrations in tributaries analyzed as Aroclor 1242 or 1254 ranged from 0.1 to 4.0 ppb during the period 1971-1974[2]. PCB concentrations measured by the Illinois State Board of Health in tributaries to Lake Michigan during 1973-1974 ranged from 0.01 to 0.09 ppb.

The Milwaukee River, a Wisconsin tributary to Lake Michigan was sampled in August 1969 for PCB's[20]; concentrations of Aroclors 1260 and 1242 were in the ranges trace to 0.26 ppb and trace to 2.07 ppb, respectively. The high Aroclor 1242 reading was validated by a repeat measurement (of 2.80 ppb in February 1970) and attributed to combined sewer outfalls and contaminated industrial cooling waters. Estimates of PCB concentrations in sewage treatment plant effluents in March, 1970, ranged from 0.04 ppb to 0.25 ppb, but the effluent from a chemical plant had a concentration of 2.50 ppb. This led the authors to conclude that PCB's were discharged to natural waters through municipal and industrial wastes and that PCB's in such large ecosystems as Lake Michigan have resulted in part, through water transport from metropolitan areas. This certainly is true; unfortunately no follow-up studies were performed to estimate the effect of both controls and increased attention to the PCB problem.

With the exception of a contamination problem in the Kalamazoo River, most PCB measurements in Lake Michigan tributaries within the state of Michigan are at levels in whole water of less than 0.1 ppb. Data showing levels identified in 1971-1972 are in Table 2.2-9. The Kalamazoo River was the subject of studies in both 1971 and 1972[8]. Concentration levels were higher downstream from Battle Creek, and some sources of contamination were identified.

Fifty four fish samples were collected from 15 stream sections on the Kalamazoo River in July 1971[4]. Measurable concentrations were found in nearly all fish samples tested with concentrations ranging from less than 0.01 to 109.9 ppm in edible portions of fish on a wet weight basis. Those fish from the north and south branches and the main stream of the river down to Battle Creek had low concentrations ranging from 0.01 to 0.33 ppm. Downstream from the Battle Creek wastewater treatment plant the levels in fish increased ranging from 0.82 to 18.75 ppm and remained high downstream with levels below Kalamazoo ranging from 1.35 to 109.9 ppm[4].

Settleable solids were only sampled at eight stations in 1971 with levels identified ranging from 0.01 to 0.422 ppm[4]. The levels in the mainstream were 10 to 20 times higher than those in the north and south branches and gradually increased downstream. The sample from the Battle Creek River had the highest concentration in the watershed indicating that the tributary contributes significantly

to the total problems in the mainstream.

Since the Kalamazoo River is the most polluted input to Lake Michigan further sampling to identify possible sources of PCB loss to the environment was conducted in the vicinity of the City of Kalamazoo in 1972[15]. PCB concentrations from the discharge of several industries and a wastewater treatment plant were below the limit of detectability. However, Portage Creek, which receives effluents from several industries including two paper mills, had 0.47 ppb of Aroclor 1242. Settleable solids that were collected showed concentrations ranging from 0.23 to 2.63 ppm at eight of the ten stations. The two stations that did not have significant concentrations were upstream from the paper mill ponds. Sediment core samples taken from the Bryant paper mill ponds had concentrations up to 368.7 ppm as deep as six to eight inches.[5]

Further data collected in the spring of 1973 on settleable solids are presented in Table 2.2-10 demonstrating considerable sensitivity of measurements to sampling intervals. The levels detected in 1975 were also generally higher for the Kalamazoo River than were detected in 1971.

Table 2.2-6
Mean PCB Levels in Lake Michigan Fish
(ppm, whole fish)

| Species | 1971[b] | 1972[d] | 1973[f] | 1974[e] |
|---|---|---|---|---|
| Alewife | 2.84[a], 4.6 | 2.4 | | |
| Brown Trout | 7.3 | | | |
| Carp | 2.04[a], 4.2 | 3.9 | | |
| Chub | 2.85[a], 6.0 | 7.0, 2.83[a] | 4.48 | |
| Chinook Salmon | 11.4 | 12.4 | 6.4 | |
| Coho Salmon | 1.68[a], 11.5 | 11.2, 10.93[e] | 4.9, 12.17[e] | 10.45 |
| Lake Trout | 13.53[c], 15.5 | 7.4, 12.86[e] | 18.93[e] | 22.91 |
| Perch | 5.8 | 0.4 | | |
| Rainbow Trout | 9.3 | | | |
| Red Sucker | 3.0 | | | |
| Smelt | 2.7 | | 1.6 | |
| White Sucker | 3.9 | | | |
| Whitefish | 3.0 | 0.7 | 0.9 | |
| Menominee | | 1.1 | 1.0 | |
| Suckers | | 1.0 | 0.45 | |
| Steelhead | | 6.0 | | |
| Bloater Chubs | | 5.66[e] | 5.24[e] | 5.57 |
| Yellow Perch | 0.22[a] | 0.3[a] | 0.4 | |

SOURCES:

[a]U.S. EPA, Pesticide Monitoring Programs: Lake Michigan and Tributaries in Illinois, EPA 600/3-74-002.

[b]Veith, G.D., Chlorinated Hydrocarbons in Fish from Lake Michigan, University of Wisconsin, Madison, Wisconsin, unpublished report on EPA Project 16020 PBE, (1973).

[c]U.S. EPA, An Evaluation of DDT and Dieldrin in Lake Michigan, EPA-R3-72-003, (1972).

[d]Hesse, J.L., Status Report on Polychlorobiphenyls in Michigan Waters, Michigan Water Resources Commission, (June 1973).

[e]Bremer, K.E., State of Concerns of the Lake Michigan Toxic Substances Committee Related to Polychlorinated Biphenyls (draft) U.S.EPA, (1975).

[f]1973 Great Lakes Environmental Contaminant Survey-Data Summary and Analysis, Bureau of Consumer Protection, Michigan, (1973).

Table 2.2-7
Concentrations of PCBs in fall collections of Lake Michigan Bloaters and Lake Trout off Saugatuck, Michigan, and Coho Salmon from between Ludington and Frankfort, Michigan

| Species and Year | Number of Fish | Average Length (mm) | Total PCBs[b] (ppm) |
|---|---|---|---|
| Bloaters | | | |
| 1972 | 120[c] | 255 | 5.66 (0.95) |
| 1973 | 160[c] | 250 | 5.24 (0.37) |
| 1974 | 110[c] | 257 | 5.57 (0.31) |
| Coho salmon | | | |
| 1972 | 10 | 693 | 10.93 (2.12) |
| 1973 | 29 | 620 | 12.17 (0.77) |
| 1974 | 30 | 665 | 10.45 (0.92) |
| Lake trout | | | |
| 1972 | 9 | 648 | 12.86 (4.75) |
| 1973 | 30 | 602 | 18.93 (2.08) |
| 1974 | 30 | 616 | 22.91 (3.73) |

[a]Analysis performed by Great Lakes Fishery Laboratory.

[b]Concentrations in whole fish, wet weight with 95% confidence interval in parentheses.

[c]Composite samples, 10 fish per sample.

SOURCE: Bremer, K.E., State of Concerns of the Lake Michigan Toxic Substances Committee Related to Polychlorinated Biphenyls (draft) U.S. EPA, (1975).

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Table 2.2-8
Mean PCB Levels in Lake Trout
from Lake Michigan (ppm)

| | | <17" | 17-20" | 20-25" | >25" |
|---|---|---|---|---|---|
| MM 1** | 1972 | ---- | ---- | ---- | ---- |
| | 1973 | 2.2 (1)* | 3.6 (2) | ---- | ---- |
| | 1974 | 0.7 (1) | 1.6 (2) | ---- | ---- |
| MM 2 | 1972 | ---- | ---- | ---- | ---- |
| | 1973 | ---- | ---- | ---- | ---- |
| | 1974 | ---- | ---- | ---- | ---- |
| MM 3 | 1972 | ---- | ---- | ---- | 11.1 (3) |
| | 1973 | 2.6 (3) | 2.4 (3) | ---- | 10.6 (3) |
| | 1974 | ---- | ---- | ---- | ---- |
| MM 4 | 1972 | ---- | ---- | ---- | 6.5 (3) |
| | 1973 | 2.6 (2) | 1.8 (1) | ---- | 8.5 (3) |
| | 1974 | 1.0 (3) | 3.1 (3) | ---- | ---- |
| MM 5 | 1972 | ---- | ---- | ---- | ---- |
| | 1973 | ---- | ---- | 5.8 (1) | 7.3 (2) |
| | 1974 | ---- | ---- | 7.5 (6) | 9.6 (6) |
| MM 6 | 1972 | 2.4 (1) | ---- | ---- | 4.1 (1) |
| | 1973 | ---- | 6.4 (1) | 7.1 (2) | 11.0 (3) |
| | 1974 | 1.1 (9) | 2.5 (16) | 5.6 (11) | 9.6 (18) |
| MM 7 | 1972 | 2.7 (2) | ---- | 6.8 (1) | 7.3 (3) |
| | 1973 | ---- | ---- | ---- | 11.2 (3) |
| | 1974 | 2.4 (9) | ---- | 8.9 (8) | 11.9 (2) |
| MM 8 | 1972 | ---- | 5.8 (2) | 6.4 (1) | 12.4 (3) |
| | 1973 | 5.1 (6) | 8.2 (3) | 10.1 (4) | 12.6 (4) |
| | 1974 | ---- | ---- | ---- | ---- |

*Concentrations in parts per million (ppm) in fillet; wet weight.
Number of samples in parentheses ( ).

**Refer to geographic area in Figure 2.2-1.

SOURCE: Hesse, J.L., Contaminants in Great Lakes Fish, Staff Report, Michigan Water Resources Commission, Dept. of Natural Resources (1975).

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Table 2.2-9
Mean PCB Concentrations in Michigan Tributaries to the Lake Michigan Basin, 1971-72 and 1973
(ppb as Aroclor 1254)

| River | 1972-72 Average | 1972-72 Range | 1973 |
|---|---|---|---|
| St. Joseph | 0.013 | <0.010-0.039 | <0.010 |
| Kalamazoo | 0.065 | 0.019-0.097 | 0.040 |
| Grand | 0.041 | 0.011-0.080 | 0.033 |
| Muskegon | 0.010 | <0.010-0.037 | <0.010 |
| Manistee | 0.014 | <0.010-0.039 | 0.037 |
| Boardman | 0.017 | <0.010-0.044 | 0.018 |
| Elk | 0.012 | <0.010-0.039 | <0.010 |

SOURCE: Hesse, J.L., Status Report on Polychlorobiphenyls in Michigan Waters, Michigan Water Resources Commission, (June 1973).

Table 2.2-10

Concentrations of PCB's (polychlorinated biphenyls) in the settleable solids collected from the mouths of the Grand, Kalamazoo and St. Joseph Rivers; Spring 1973, for comparison of variable sampling periods. Concentrations in ppm on an oven-dry basis.

| | Sample | Sample Dates | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| iver | Type[a] | 3/21 | 3/23 | 3/30 | 4/2 | 4/4 | 4/6 | 4/9 | 4/11 | 4/13 | 4/20 | 4/27 | 4/30 | 5/2 | 5/4 | 5/11 | Means |
| rand | 3X | 3.24 | | | 1.6* | 0.95 | 1.0 | <0.1 | 0.93 | 1.58 | | | 0.83 | 3.5 | 0.53 | | 1.43 |
| | Weekly | | 1.25 | 0.94 | | | 1.1 | | | 1.0 | 0.55 | 0.74 | | | 0.80 | 0.77 | 0.89 |
| | Biweekly | | | 0.85 | | | | | | 0.73 | | 0.50 | | | | 0.60 | 0.67 |
| | Monthly | | | | | | | | | 1.41 | | | | | | 0.50 | 0.96 |
| | | | | | | | | | | | | | | | | Mean = | 0.99 |
| alamazoo | 3X | 6.7 | 27.5 | | 2.08 | <0.1 | 2.52 | 1.33 | 3.20 | <0.1 | | | 3.11 | 3.50 | 3.75 | | 4.72 |
| | Weekly | | 6.83 | 3.0 | | | 3.54 | | | 3.77 | 3.09 | 2.98 | | | 2.88 | 4.87 | 3.87 |
| | Biweekly | | | 3.77 | | | | | | 2.54 | | 2.64 | | | | 2.50 | 2.86 |
| | Monthly | | | | | | | | | 2.11 | | | | | | 3.14 | 2.63 |
| | | | | | | | | | | | | | | | | Mean = | 3.52 |
| t. Joseph | 3X | | | | | | | | | | | | 0.63 | 0.82 | | | 0.73 |
| | Weekly | | | | | | | | 2.13 | 0.68 | | 0.95 | | 0.83 | 1.21 | | 1.16 |
| | Biweekly | | | | | | | | | 0.85 | | 0.75 | | | 0.95 | | 1.24 |
| | Monthly | | | | | | | | | | | 0.67 | | | 0.83 | | 0.75 |
| | | | | | | | | | | | | | | | | Mean = | 0.97 |

[a]3X = Sample collected Mon, Wed. and Friday

*Concentration based upon a 1:1 ratio of Aroclor 1242 and 1251.

All other concentrations calculated as Aroclor 1242.

SOURCE: Monitoring for Polychlorinated Biphenyls in the Aquatic Environment, Michigan Water Resources Commission, (May 1

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### 2.2.5 Lake Huron

Levels of PCB's in fish samples from Lake Huron are detailed in Table 2.2-11 from areas as indicated in Figure 2.2-1. The Saginaw Bay area, designated as MH-4 on the map, has been the object of detailed analysis, and significant concentrations have been detected. Water measurements in tributaries to Lake Huron, including the Saginaw Bay area, are in Table 2.2-12. Concentrations in fish taken from the Saginaw River in 1971 were as high as 165 ppm as shown in Table 2.2-13. The waste water treatment plant on the Saginaw River is the Bay City facility. During 1971, this plant had an average effluent concentration of 120 ppb with a high of 340 ppb.

After control measures were initiated by some industrial sources in October 1972, there was a sharp drop in PCB levels at the mouth of the river. Levels measured in 1972 ranged from <0.020 to 0.640 ppb and in 1973 from <0.100 to 0.200 ppb. This is one of the noteworthy examples of controls effecting a marked change in PCB contamination[8].

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STLCOPCB4056762

Table 2.2-11
Mean PCB Levels, Whole Fish
In Lake Huron (ppm)

| Species | 1973 |
|---|---|
| Brown Trout | 3.6 (MH-2)* |
| Catfish | 4.9 (MH-4) |
| Menominee | 0.4 (MH-1) |
| Yellow Perch | 0.2 (MH-1) |
| Salmon | 8.4 (MH-1,3) |
| Walleye | 1.1 (MH-1) |
| Smelt | 0.6 (MH-3) |
| Whitefish | 0.5 (MH-1) |

*Refer to geographic area in Figure 2.2-1

SOURCE: 1973 Great Lakes Environmental Contaminant Survey - Data Summary and Analysis, Bureau of Consumer Protection, Michigan (1973).

DSW 442228

Table 2.2-12
Mean PCB Concentrations in Michigan Tributaries
to Lake Huron in 1971-72 and 1973
(ppb as Aroclor 1254)

| River | 1971-72 Average | 1971-72 Range | 1973 |
|---|---|---|---|
| Saginaw | 1.100 | 0.450-2.900 | 0.210[b] |
| Cass[a] | 0.014 | <0.010-0.048 | <0.010 |
| Flint[a] | 0.078 | 0.010-0.150 | <0.010 |
| Shiawassee[a] | 0.029 | <0.010-0.073 | <0.010 |
| Tittabawassee[a] | 0.140 | <0.022-0.230 | <0.010 |
| Au Sable | <0.010 | <0.010-0.010 | 0.013 |
| Thunder Bay | 0.023 | <0.010-0.037 | <0.010 |
| Cheboygan | 0.032 | <0.010-0.053 | <0.010 |

[a]Tributaries to Saginaw River

[b]Aroclor 1242

SOURCE: Hesse, J.L., Status Report on Polychlorobiphenyls in Michigan Waters, Michigan Water Resources Commission, (June 1973).

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### 2.2.6 Cayuga Lake

In October 1970 lake trout were collected from Cayuga Lake in Ithaca, New York. Since these fish are marked each year when they are stocked in the lake their ages were accurately known. Table 2.2-14 shows the residues of PCB's identified along with the age, length, weight and sex of each fish. The peak heights of individual PCB isomers did not vary with the age of the fish indicating that there is no selective metabolism or storage of specific PCB isomers as the fish matures. However, the concentration of total PCB's does increase progressively with maturity. The variation in PCB concentrations among individual 11 or 12 year old fish may be due to differences among foraging, metabolic and excretary capabilities of the older fish.[1]

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STLCOPCB4056765

Table 2.2-14
Residues of PCB's in Cayuga Lake Trout as a function of maturity; j, juvenile.

| Age (years) | Sex | Length (cm) | Weight (g) | PCB (ppm) |
|---|---|---|---|---|
| 1 | J | | | 0.6 |
| 1 | J | | | 1.6 |
| 1 | J | | | 0.5 |
| 1 | J | | | 1.2 |
| 2 | J | 27.7 | 181 | 2.0 |
| 2 | J | 28.7 | 226 | 1.3 |
| 2 | J | 33.5 | 407 | 2.5 |
| 3 | J | 44.5 | 815 | 2.2 |
| 3 | J | 44.5 | 725 | 2.4 |
| 3 | J | 41.1 | 770 | 1.2 |
| 4 | J | 53.8 | 1310 | 3.5 |
| 4 | J | 50.3 | 1160 | 4.1 |
| 4 | J | 55.1 | 1359 | 5.1 |
| 5 | M | 61.0 | 2030 | 5.7 |
| 6 | M | 63.5 | 2440 | 3.4 |
| 6 | M | 66.4 | 2850 | 9.7 |
| 6 | F | 68.3 | 2310 | 8.6 |
| 7 | M | 63.5 | 2260 | 4.0 |
| 7 | M | 68.9 | 3300 | 5.5 |
| 7 | | 59.7 | 1990 | 10.5 |
| 8 | F | 75.2 | 3390 | 17.5 |
| 8 | M | 71.6 | 2805 | 13.4 |
| 8 | F | 69.0 | 3300 | 4.5 |
| 9 | F | 71.2 | 3390 | 30.4 |
| 11 | M | 80.3 | 4200 | 12.4 |
| 12 | M | 71.6 | 2535 | 13.4 |
| 12 | M | 75.5 | 3120 | 26.2 |
| 12 | F | 70.6 | 3440 | 7.4 |

SOURCE: Bache, C.A., F.W. Serum, W.D. Youngs and D.J. Lisk, Science, 177, 1191-1192, (1972).

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## 2.3 Data from Localized Monitoring Efforts - Rivers

### 2.3.1 Iowa - Mississippi River

Monitoring Iowa rivers for pesticides concentrations over a period of years indicated that chlorinated hydrocarbon insecticides used in row crop agriculture were being carried into the rivers by soil erosion. Since fish are excellent biological compositors, measurement of trace elements in their tissues can give a picture of the relative pollution of a river. Therefore a study of the pesticide levels in the eggs of some fish from locations in Iowa was undertaken in the spring of 1971.[2]

Two of the sites had measurable amounts of polychlorinated biphenyls. The PCB's detected match Aroclor 1254. The concentrations identified in the roe removed from the fish from these sites on the Mississippi were as follows:

| Site | Species | Date Collected | Length of Fish | PCB Concentration in 15 grams of roe (ppm) |
|---|---|---|---|---|
| Near Northern border | Channel Catfish | 06-04-71 | 23.4 | 1.5 |
| | Largemouth bass | 05-20-71 | 16.4 | 3.2 |
| | Walleye | 04-16-71 | 27.5 | 4.2 |
| Near Southern border | Channel Catfish | 04-16-71 | 24.0 | 0.9 |
| | Largemouth bass | 04-15-71 | 17.5 | 2.9 |
| | Walleye | 04-13-71 | 24.3 | 5.5 |

The levels of PCB's found in the same species from the two locations are approximately the same indicating that the major source of these industrial chemicals is upstream from both of these sites.

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### 2.3.2 New York - Hudson River

The Hudson River in New York State provides an interesting ecosystem in which to study PCB's, primarily because it is the receiving water for effluents from two plants of the General Electric Co., at Hudson Falls and Fort Edward. These plants use PCB's in the production of transformers and capacitors. Summaries of extensive sampling during 1975 of the Hudson River are presented in Figures 2.3-1 and 2.3-2. The GE plants appear to be the major contributors to the PCB residue levels in the river. Although trace levels of PCB's are evident above the GE plant outfall location, levels in water and sediment at Station 1 located at the outfall of the Fort Edward plant were as high as any levels measured in the country. In the immediate area downstream from this outfall, PCB concentrations in water exceed the equilibrium solubility level by more than a factor of 10. Major effects on the levels in sediment are noted more than 35 miles downstream from the outfalls. The data indicate elevated concentrations in aquatic life far from the outfalls: fish samples approximately 40 and 66 miles downstream from the outfalls showed PCB levels in excess of 5 ppm while the same species showed only traces of PCB's directly upstream from the outfalls. Since sediment samples above the plants also show some concentration there does appear to be some PCB source upstream of the plants.

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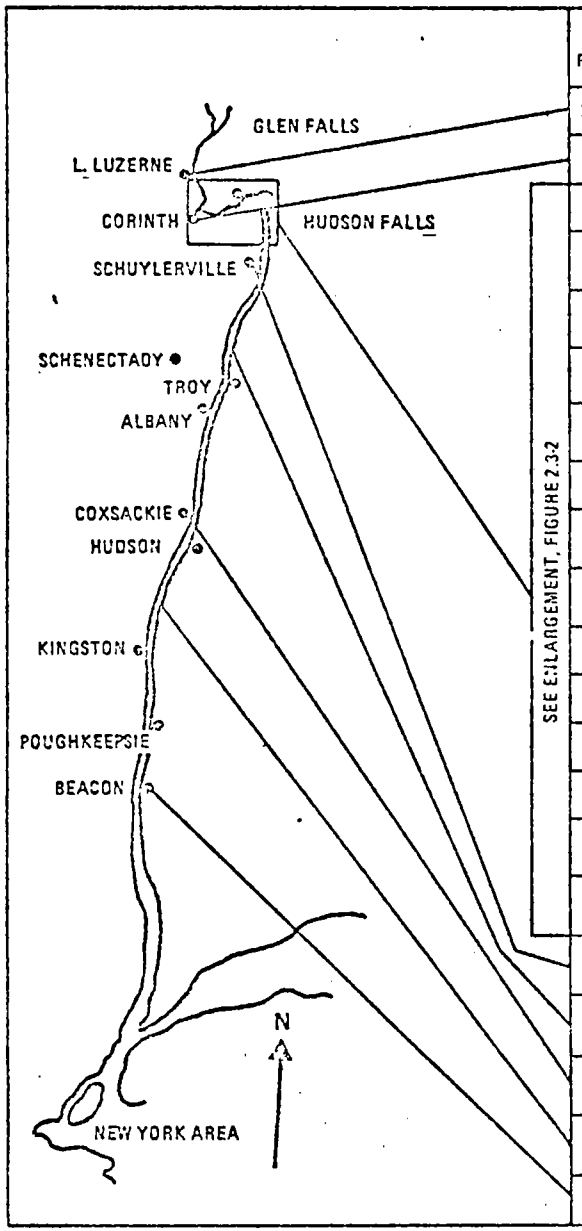


| MILE POINT | DESCRIPTION | ESTIMATED PCB'S: WATER (PPB) | SEDIMENT (PPM-DRY) | SMALL MOUTH* BASS (PPM) | WALLEYE* (PPM) | WHITE* SUCKER (PPM) | YELLOW* PERCH (PPM) | SNAILS (PPM) | WHITE* PERCH (PPM) |
|---|---|---|---|---|---|---|---|---|---|
| 223.6 | AT L. LUZERNE | | 0 | | | | | | |
| 218.8 | ABOVE CORINTH | <0.5 | 2.4 | TRACE | | TRACE | TRACE | | |
| 214.0 | BELOW CORINTH | | 1.9 | | | | | | |
| 209.9 | ABOVE SHERMAN ISLAND DAM | | 4.8 C | | | | | | |
| 205.7 | ABOVE GLEN FALLS LANDFILL | | 0.83 | TRACE | TRACE | TRACE | TRACE | | |
| 204.8 | BELOW GLEN FALLS LANDFILL | | 16.8 | | | | | | |
| 198.9 | AT PORTLAND CEMENT CO. | | <0.38 | | | | | | |
| | STATION 0 | <1. | 6.9 | | | | 17.0 | 1.9 | |
| 197.3 | ABOVE BAKER FALLS DAM | | 4.8 | | | | | | |
| 196.2 | BELOW BAKER FALLS DAM | | 114. C | | | | | | |
| | STATION 1 | 2800 | 6700 | | | | | 45 | |
| | STATION 2 | 2.2 | 540.0 | | | | | | |
| | STATION 3 | 3.1 | 2980.0 | | | | | | |
| | STATION 4 | <1 | 6.6 | | | | | 27. | |
| 194.2 | AT FT. EDWARD | | 147.9 | | | | | | |
| 188.4 | ABOVE THOMPSON ISLAND DAM | | 3707.2 C | 122.9** | 32.4** | 41.8 | | | |
| 183.5 | ABOVE SCHUYLERVILLE | | 78.5 | | | | | | |
| 157.6 | ABOVE WATERFORD | | 19 | 46.3 | 32.4 | 37.6 | | | |
| 124.9 | NEAR COXSACKIE | <0.5 | | 13.76** | | | 4.18 | | 19.7 |
| | ABOVE KINGSTON | | | | | | 5.28 | | 7.72 |
| 60.8 | NEAR BEACON | <0.. | | | | | | | |

SEE ENLARGEMENT, FIGURE 2.3-2

C - MAXIMUM VALUE IN A CORE SAMPLE
* - VALUES ARE WEIGHTED AVERAGES OF SAMPLES OF FISH FROM 3 SIZE GROUPS (EXCEPT AS NOTED) TAKEN AT VARIOUS TIMES IN 1975
** ONLY ONE FISH SAMPLED

SOURCES:
STATIONS 0-4: NADEAU, R.J. AND R.P. DAVIS, INVESTIGATION OF POLYCHLORINATED BIPHENYLS IN THE HUDSON RIVER, 1975, EPA REGION II
OTHER FISH DATA: NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, DIVISION OF FISH AND WILDLIFE, 1975, ANALYSES OF PCB's IN FISH FLESH
OTHER WATER DATA: NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, DIVISION OF PURE WATERS, PCB MONITORING IN THE UPPER HUDSON RIVER BASIN, OCTOBER 1975

FIGURE 2.3-1 MAP OF HUDSON RIVER, NEW YORK, SHOWING DEVELOPED AREAS AND SAMPLING STATIONS WITH PCB LEVELS



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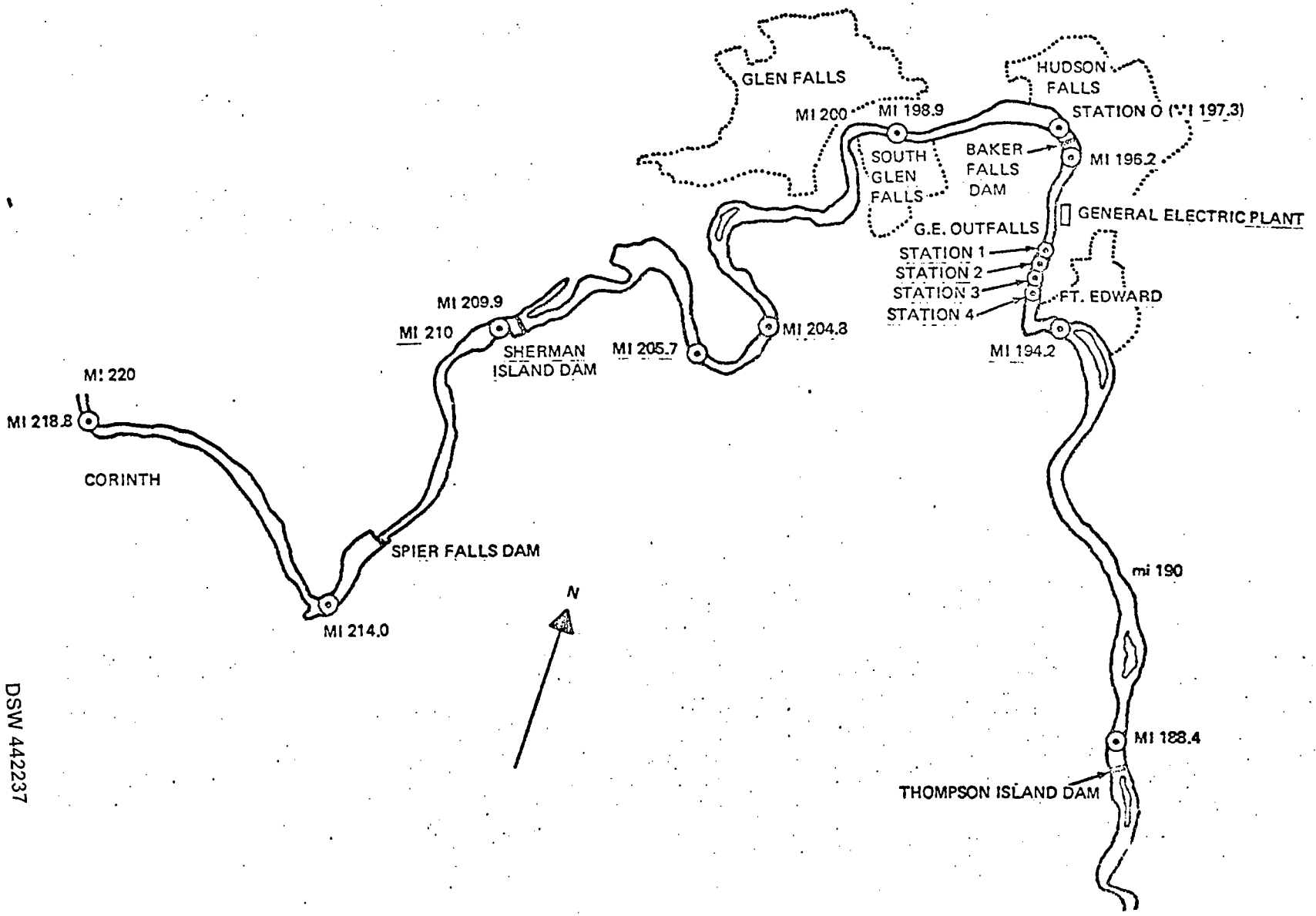


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FIGURE 2.3-2 DETAILED MAP OF A PORTION OF THE HUDSON RIVER



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### 2.3.3 Maryland - Chester River

This study was conducted in the Upper Chesapeake Bay in 1971-1972;[1] the study area is shown in Figure 2.3-3 . The Bay and its tributaries receive chlorinated hydrocarbons as a result of industrial, agricultural and waste disposal activities occurring along the shorelines of these waterways and within the total watershed.

Sediment samples were collected approximately quarterly except for the last set which was taken early in order to collect data shortly after tropical storm "Agnes". The PCB's identified were almost exclusively Aroclor 1242. The first readings, taken in November 1971 ranged from 0-21 ppb with an average of 83 ppb. By April 1972 the average had climbed to 110 ppb with a range from 0-300 ppb. By June the readings taken ranged from 0-150 ppb with the average reduced to 53 ppb. After "Agnes" in July the average had again increased to 96 ppb with readings ranging from 0-180 ppb.

The explanation given for the variations is that during the early spring, massive amounts of suspended sediment from the Susquehanna River entered the Chester River and were carried upstream in the flow of water along the river bottom. The peak sediment loads from the Susquehanna generally come at the end of February, decreasing abruptly after the end of March due to a reduced flow rate of the river. An equilibrium net transport develops in the Chester River in April. In May, fine sediments were transported slowly into the Bay. However, over the year there is a movement of sediment along the river bottom into the river from the Bay. Thus, the upper Chesapeake Bay, i.e., the Susquehanna River is the major source of suspended sediments in the lower tidal portion of the Chester River.

The average values and ranges identified in biota of the Chester River taking into account variability due to seasonal fluctuations, distributional differences resulting from sample location, and species as well as individual uptake differences were as follows:

| | Average (ppb) | Range (ppb) |
|---|---|---|
| Oysters | 55 | 16-250 |
| Soft shelled clams | 58 | 13-180 |
| Fish | 18.5 | 2-570 |
| Crabs | 20 | 0.4-51 |

Based on data collected June 6, 1972 from the nine stations along the main river course it was determined that concentrations of PCB's decreased as a function of distance up river from its mouth at Love Point in its upstream direction at the rate of 4.20 ppb/Nautical mile.

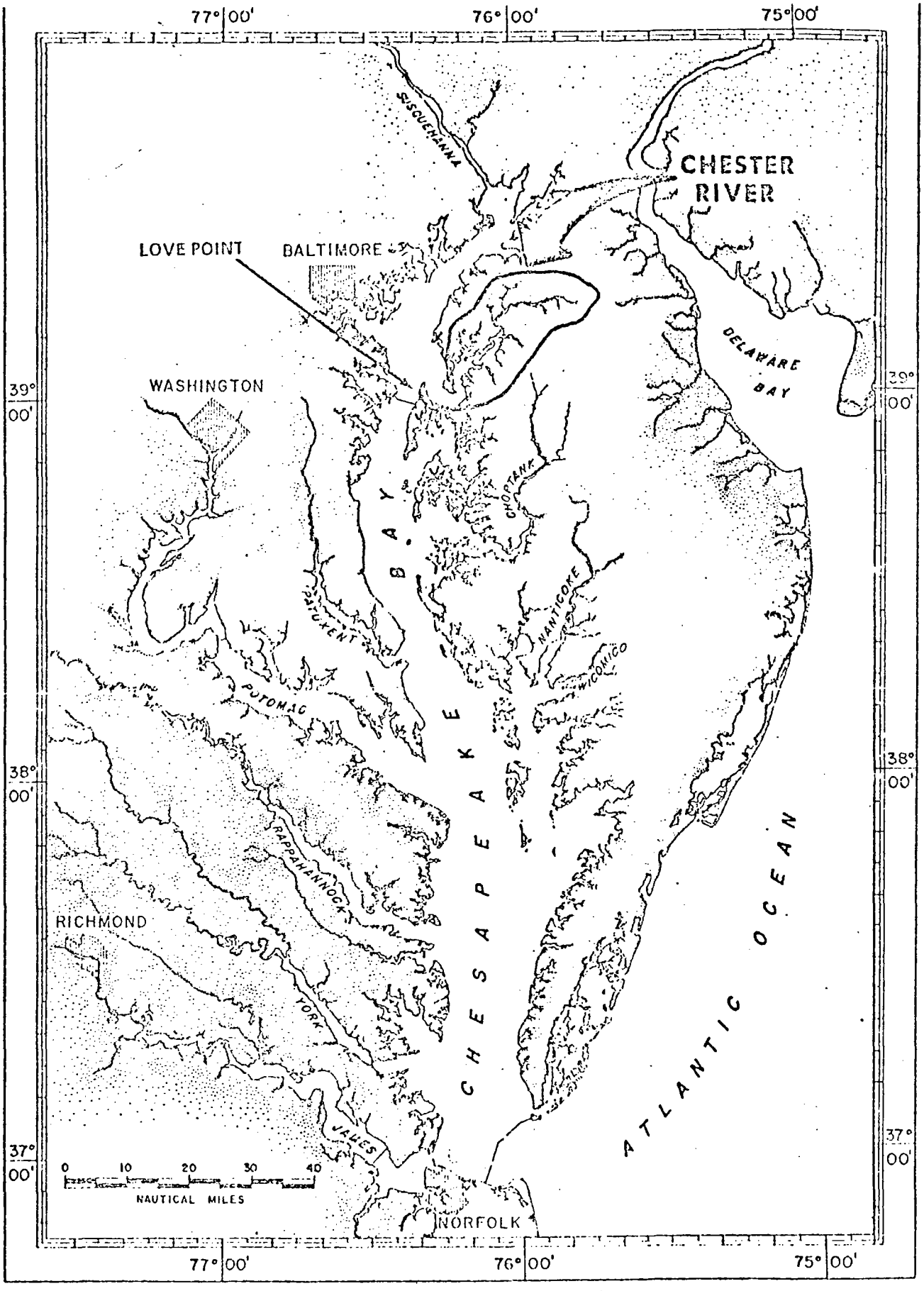


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FIGURE 2.3-3 CHART OF CHESAPEAKE BAY SHOWING MAJOR TRIBUTARIES AND LOCATION OF THE CHESTER RIVER.

### 2.3.4 Connecticut

In October 1974 the State of Connecticut intensively sampled bottom sediment in rivers and lakes thoughout the state. The results are shown in Figure 2.3-4, based on a computer mapping provided by the Connecticut District Office of the U.S. Geological Survey.[6] The data show PCB contamination to be both widespread and at high levels throughout the state, particularly around the highly developed areas of Hartford, New Haven, Stanford-Greenwich and all along the Housatonic River flowing from Massachusetts. The state had sampled mostly whole water for PCB's prior to 1974, with no appreciable residue levels discovered, but now has switched to a yearly bed material determination. The readings for the baseline period of October 1974 are to be updated yearly.

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## REFERENCES, SECTION 2.3


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## 2.4 Data from Localized Monitoring Efforts - Marine Environment

### 2.4.1 Atlantic Ocean

In addition to the many PCB studies that have been conducted within the United States, a few studies have been carried out investigating the air, water and fish off the east coast of the United States. These studies, conducted between 1971 and 1974 covering Providence, Rhode Island; Grand Banks; Vineyard Sound; Georges Bank and Bermuda show PCB's to be extensively distributed over the Atlantic Ocean. The general sampling area is shown in Figure 2.4-1.

One of the few air studies that has been published was carried out by Harvey and Steinhauer[11] in 1973. Table 2.4-1 shows the sampling locations and Aroclor 1254 concentrations identified. The highest concentrations were in Vineyard Sound which is approximately 100-150 miles from the Boston, Hartford, New York, New Jersey complex. Over 1000 miles away at Grand Banks the concentrations were 100 times less than in Vineyard Sound. Figure 2.4-2 shows the relationship of atmospheric PCB levels with distance from these industrial areas. The seaward decrease appears to be exponential.

Later studies on PCB's in surface and subsurface waters were done by Harvey[13]. Although the concentration range across the northern North Atlantic is broad, from 1-150 ppt, the average was about 35 ppt in surface waters and 10 ppt at 200 meters depth. Looking at the lower latitudes it appears that the surface waters of the Sargasso Sea have slightly lower concentrations than other parts of the North Atlantic, averaging 27 ppt. The widespread PCB distribution implicates the atmosphere as a predominant mode of transport in the Atlantic with variations due to the seaslicks, localized rainfall or discharges from ships.

During the period of February-June 1973, PCB concentrations in the marine atmosphere of the Bermuda - Sargasso Sea and Providence, Rhode Island area were measured by Bidleman and Olney[1]. It is interesting to note that most of the PCB was trapped on the polyurethane foam collection surface suggesting that PCB's are in the atmosphere mainly as vapors rather than adsorbed onto particulate matter, or that they volatilize from the trapped particles collected on the glass fiber prefilter. Table 2.4-1 gives the locations and levels identified as Aroclor 1242 or 1248.

Sargasso Sea surface water was also measured by Bidleman and Olney[1] in 1973. From Table 2.4-2 it can be seen that the concentrations were higher in the surface layer than in the subsurface samples.

Follow-up by Harvey[12], et. al., indicated that PCB concentrations in North Atlantic surface waters declined forty fold from 1972 to 1974 presumably following the cessation of certain industrial uses of those compounds. However, Longhurst and Radford dispute the decrease stating that either the analytical methods were inaccurate or Harvey's original estimate of the total amount of dissolved PCB's in the upper 200 m was incorrect. Harvey and Steinhauer have agreed[17]

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that their extrapolation may well have been improper and planned more sampling for 1975.

In 1971 a seafood monitoring program[16] was conducted on the East Coast of the United States. It is difficult to make interspecies comparisons but as can be seen in Table 2.4-3 the highest Aroclor 1260 level was in flounder from Jacksonville, Florida.

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Table 2.4-1
PCB Concentrations Over the Western North Atlantic

| Station | Sample volume ($m^3$) | $ng/m^3$ |
|---|---|---|
| Bermuda | 560 | 0.5≃ |
| | 480 | 0.4≃ |
| | 820 | 0.16≃ |
| | 500 | 0.15≃ |
| | 1070 | 0.59∝ |
| | 1320 | 0.30∝ |
| | 918 | 0.65∝ |
| | 1950 | 0.62∝ |
| | 1740 | 0.55∝ |
| | 732 | 0.52∝ |
| | 1300 | 0.61∝ |
| | 860 | 0.21∝ |
| 33°20'N, 65°14'W | 300 | 1.6∝ |
| 34°39'N, 66°15'W | 267 | 0.79∝ |
| 38°48'N, 69°14'W | 222 | 0.72∝ |
| 40°32'N, 70°20'W | 196 | 0.83∝ |
| Georges Bank | 105 | 1.4≃ |
| (41°40'N, 67°30'W) | 675 | 0.82≃ |
| | 660 | 0.58≃ |
| | 655 | 0.61≃ |
| | 640 | 0.80≃ |
| | 650 | 1.60≃ |
| Vineyard Sound | 105 | 3.9≃ |
| (41°20'N, 70°50'W) | 224 | 5.3≃ |
| Grand Banks | 780 | 0.05≃ |
| (45°16'N, 52°08'W) | 960 | 0.07≃ |
| | 840 | 0.10≃ |
| | 940 | 0.16≃ |
| | 540 | 0.05≃ |
| Providence, R.I. | 392 | 4.0∝ |
| | 1071 | 2.1∝ |
| | 744 | 5.8∝ |
| | 76 | 9.4∝ |

≃Calculated as Aroclor 1254
∝Calculated as Aroclor 1242 or 1248

SOURCE: Harvey, R.G. and W.G. Steinhauer, Atmospheric Environment, Nature, 252, 387-388 (November 29, 1974).

Table 2.4-2
PCB's Measured in Sargasso Sea Area, 1973

| Location | Sample* | ppt** |
|---|---|---|
| 29°56'N, 64°40'W | SM | 11.2 |
| | SS | 3.6 |
| 30°45'N, 66°55'W | SM | 4.9 |
| | SS | <0.9 |
| 30°34'N, 66°59'W | SM | 8.3 |
| | SS | 1.0 |
| 28°53'N, 65°07'W | SM | 42.6 , 19.3 |
| | SS | <0.9 , <0.9 |
| 29°56'N, 63°00'W | SM | 3.8 |
| | SS | <0.9 |
| 30°00'N, 64°30'W | SM | 5.6 |
| | SS | 1.6 |
| 31°34'N, 63°49'W | SM | 5.0 |
| | SS | 1.8 |
| 31°38'N, 63°57'W | SM | 8.4 |
| | SS | 0.9 |

*SM - sample is surface microlayer
SS - sample is subsurface water

**PCB calculated as Aroclor 1260

SOURCE: Bidleman, T.F., and C.E. Olney, Science, 184, 516-518 (Feb. 8, 1974).

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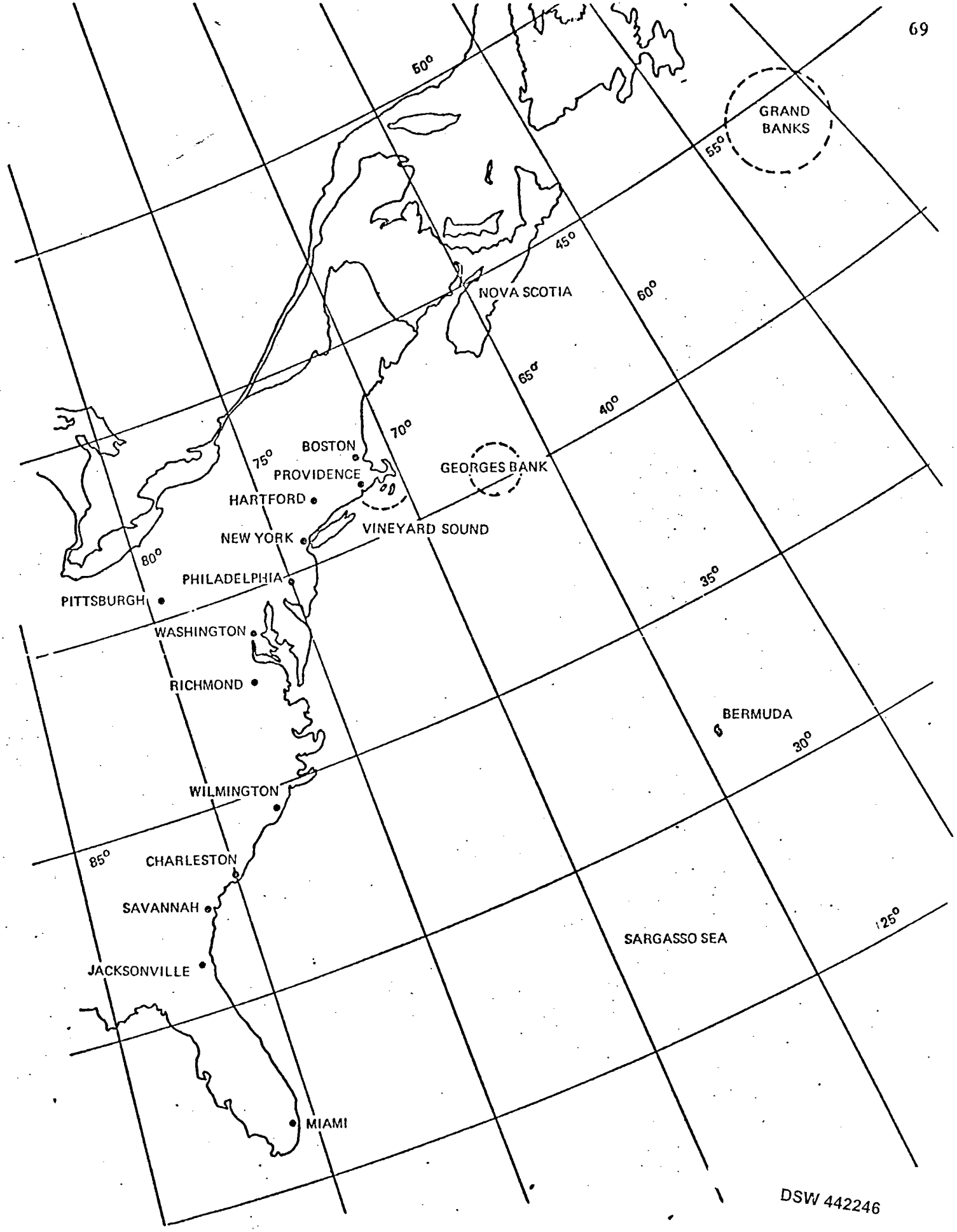
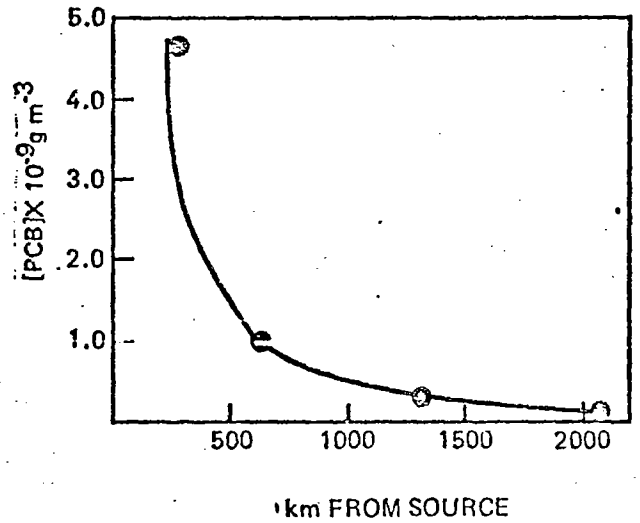



FIGURE 2.4-1 ATLANTIC OCEAN SAMPLING SITES




SOURCE: HARVEY, G.R. AND W.G. STEINHAUER, ATMOSPHERIC ENVIRONMENT, 8, 777–782, (1974).

FIGURE 2.4-2 RELATIONSHIP OF ATMOSPHERIC PCB LEVELS WITH DISTANCE FROM INDUSTRIAL AREAS

DSW 442247

Table 2.4-3
PCB Residues in Seafood

| Species | Sample Quantity | Aroclor 1260 (ppm) |
|---|---|---|
| | JACKSONVILLE, FLA. | |
| Blue crabs | 15 | 0.08 |
| Shrimp | 1 kg | 0.60 |
| Flounder | 3 | 0.65 |
| Weak fish | 5 | 0.44 |
| Drum | 5 | 0.17 |
| | SAVANNAH, GA. | |
| Blue crabs | 16 | ---- |
| Shrimp | 0.5 kg | ---- |
| Pilot shrimp | 0.5 kg | ---- |
| Oysters | 15 | ---- |
| Razorback clams | 28 | ---- |
| Squid | 5 | ---- |
| Flounder | 4 | ---- |
| | CHARLESTON, S.C. | |
| Blue crabs | 10 | ---- |
| Shrimp | 1 kg | 0.02 |
| Oysters | >15 | ---- |
| Squid | >15 | ---- |
| Croaker | 1 | ---- |
| | MOREHEAD CITY, N.C. | |
| Blue crabs | 15 | ---- |
| Shrimp | 1 kg | ---- |
| Oysters | 24 | 0.02 |
| Clams | 20 | ---- |
| Scallops | 12 | ---- |
| Flounder | 3 | ---- |
| Spanish mackerel | 2 | ---- |
| Weak fish | 2 | ---- |
| Blue fish | 2 | ---- |
| Fish meal | 0.5 kg | 0.11 |
| | CHESAPEAKE BAY | |
| Blue crabs | 25 | 0.02 |
| Weak fish | 3 | 0.49 |
| Striped sea bass | 3 | 0.02 |
| Spot | 5 | 0.10 |
| Herring | 10 | ---- |
| | DELAWARE BAY | |
| Blue crabs | 15 | 0.13 |
| Flounder | 2 | 0.07 |
| Weak fish | 5 | 0.23 |
| Striped bass | 2 | 0.07 |
| Mullet | 5 | 0.21 |
| Croaker | 1 | 0.50 |

SOURCE: Markin, G.P., J.C. Hawthorne, J.L. Collins and J.H. Ford

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## 2.4.2 Bay of Fundy

As early as 1969, PCB residues were identified in harbour porpoises from the Bay of Fundy, located in the northeast section of Maine[5]. Zitko, et. al.[24], identified Aroclor 1254 in a number of different fish ranging from 0.07 ppm in the muscle of basking shark and 0.21 ppm in the muscle of sea raven to 3.55 ppm in Herring Oil and 218 ppm in the liver of white shark. The species studied and the levels measured are listed in Table 2.4-4.

Table 2.4-4
PCB and Chlorinated Hydrocarbon Pesticides in Aquatic Animals from the Bay of Fundy - Gulf of Maine Area.

| Species | Tissue | Aroclor 1254, ppm |
|---|---|---|
| Herring | whole fish | 0.34 |
| Mackerel | muscle | 0.35 |
| Plaice | muscle | 0.38 |
| White hake | muscle | 0.44 |
| Ocean perch | muscle | 0.32 |
| Cod | muscle | 0.55 |
| Sea raven | muscle | 0.21 |
| | viscera | 0.73 |
| Basking shark | muscle | 0.07 |
| | liver | 1.07 |
| White shark | muscle | 0.77 |
| | liver | 218 |
| Bluefin tuna | muscle | 1.54 |
| Herring oil | | 3.55 |
| Fishmeal | | 0.54 |
| Double-crested cormorant | eggs | 43.5 |
| | | 17.2 |
| | muscle | 3.38 |
| | liver | 2.13 |
| | subcutaneous fat | 38 |
| | abdominal fat | 52 |
| Herring gull | eggs | 12.6 |
| | | 5.54 |
| | muscle liver | 5.06 |
| | | 6.50 |
| | subcutaneous fat | 75 |

SOURCE: Zitko, V., O. Hutzinger and P.M.K. Choi, Environmental Health Perspectives, 47-50, (April 1972).



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### 2.4.3 Gulf of Mexico - Caribbean Sea

Runoff from approximately two-thirds of the United States and one-half of Mexico enters the Gulf of Mexico and is swept generally westward to be trapped in the Western Gulf for as much as 100 years. Therefore a buildup of man-made toxic chemicals is possible in the Western Gulf especially since there is a heavy concentration of chemical manufacturers in Louisiana and Texas.[7]

The earliest samples collected in this area were brown Pelicans collected in 1969 from the Atlantic and Gulf Coast of Florida and in 1970 from Florida Bay. The highest levels, 1.0-7.5 ppm came from the Atlantic Coast while those from the Gulf Coast ranged up to 4.2 ppm and those from the Keys in the Bay only had concentrations up to 2.5 ppm. The birds represented a wide range of ages and both sexes, but the immature and adult birds always had higher residues than the young.[2]

In 1971 a seafood monitoring program[18] for the insecticide mirex was set up. Three of the stations were located in the Gulf of Mexico and identified Aroclor 1260 as indicated in Table 2.4-5. Due to the different kinds of species involved a comparison of levels is difficult to prepare. However, it is clear that the levels in samples from Mobile Bay, Alabama ranging from 0.01 to 0.40 ppm were higher than those from the Mississippi Sound where the highest level was only 0.20 ppm.

Fish and other marine organisms were collected in the Gulf of Mexico and the Caribbean Sea in May and October 1971 as shown in Figure 2.4-3. While PCB's were detected in nearly all the samples analyzed the levels were generally low. The samples from coastal waters generally had higher levels than samples from open waters. This same observation holds true for sea plankton. Of the six samples containing PCB's above 100 ppb wet weight four of them were near Coastal areas.[9]

Groupers were also collected[8] since they tend to spend their post larval life in one locality and should therefore yield data more representative of a particular area. Figure 2.4-3 shows the sampling locations. The levels are generally low although the highest levels do come from the western Gulf. Note also that at Anton Lizardo the levels in the groupers increase with increasing size as can be expected since the fat content of the fish increases with increasing size and age of the specimen. Table 2.4-6 presents some of the levels identified in 1971.

Giam et. al.[6] again took measurements from stations in the Gulf of Mexico in 1973-1974 as indicated in Figure 2.4-3 and Table 2.4-7. The concentrations in biota are lower than they were in the 1971 survey with an average according to Giam of about 20 ppb reduced from 60 ppb. It must be noted, however, that these stations were all close to the southern coast of the U.S. with no samples collected in the Western Gulf.

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Table 2.4-6
Biota and Plankton from the Gulf of Mexico - 1971

| Station | Biota | Weight (lbs.) | Standard Length (mm) | PCB's (ppb) |
|---|---|---|---|---|
| 1 | Flounder∞ | | | 32 |
| 2 | Flounder∞ | | | 36 |
| 3 | Flounder∞ | | | 59 |
| 4 | Flounder∞ | | | 34 |
| | Plankton† | | | 678 |
| 5 | Crustacean∞ | | | 151 |
| | Crustacean∞ | | | 22 |
| 6 | Shrimp∞ | | | 167 |
| 7 | Rock Shrimp∞ | | | 6 |
| | Squid∞ | | | 40 |
| 8 | King Mackerel muscle∞ | | | 34 |
| | Plankton† | | | <3 |
| | Tuna muscle∞ | | | 58 |
| 9 | Tuna muscle∞ | | | 36 |
| 10 | Plankton† | | | 100 |
| 11 | Plankton† | | | 30 |
| 12 | Plankton† | | | <3 |
| 13 | Plankton† | | | 1055 |
| 14 | Plankton† | | | 44 |
| 15 | Plankton† | | | 42 |
| 16 | Plankton† | | | 191 |
| 27 | GrouperΩ | 3.1 | 398 | 110 |
| | | 2.9 | 378 | 32 |
| | | 1.9 | 306 | 14 |
| | | 1.9 | 287 | 14 |
| | | 0.7 | 222 | 12 |
| 28 | GrouperΩ | 4.9 | 414 | 33 |
| | | 4.8 | 416 | 12 |
| | | 2.8 | 338 | 10 |
| 29 | GrouperΩ | 10.0 | 514 | 7 |
| | | 3.7 | 403 | 7 |
| | | 2.9 | 354 | 6 |
| 30 | GrouperΩ | 6.0 | 495 | 5 |
| | | 4.8 | 459 | 3 |
| | | 1.6 | 315 | 3 |
| | | 3.0 | 385 | 14 |
| | | 2.4 | 339 | 6 |
| 31 | GrouperΩ | 3.3 | 352 | 81 |
| 32 | GrouperΩ | 18.0 | 681 | 220 |

∞Giam, C.S., A.R. Hanks, R.L. Richardson, W.M. Sackett and M.K. Wong, Pesticides Monitoring Journal, 6, 139-143, (Dec. 1972).

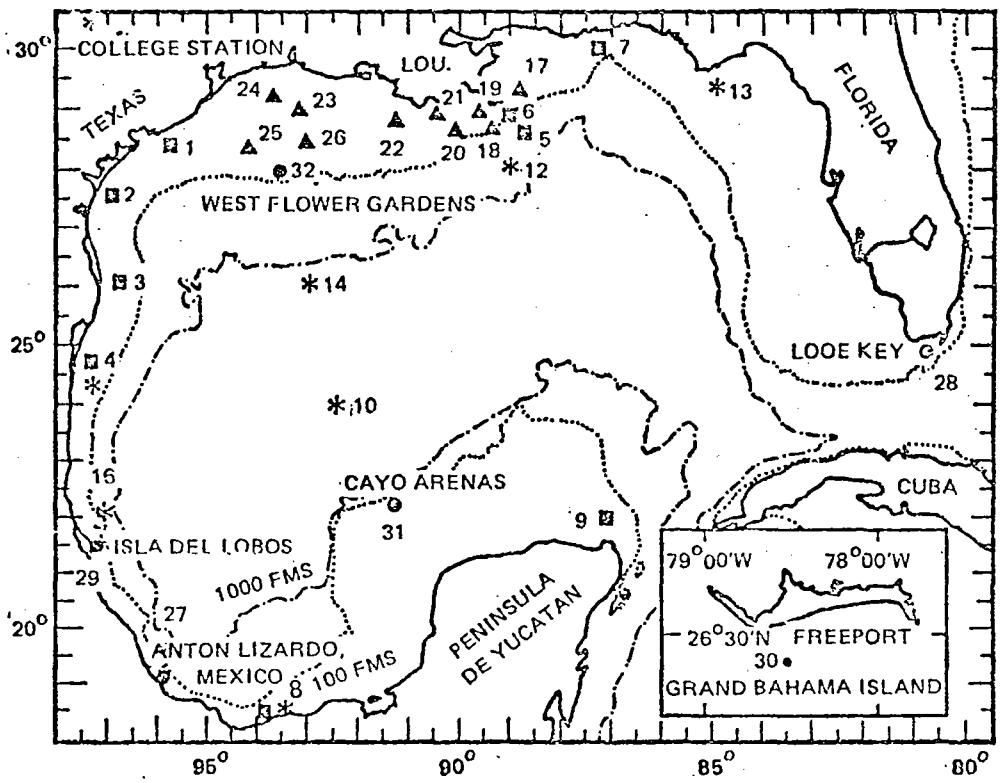
†Giam, C.S., M.K. Wong, A.R. Hanks, W.M. Sackett and R.L. Richardson, Bulletin of Environmental Contamination and Toxicology, 9, 376-382, (1973).

ΩGiam, C.S., R.L. Richardson, D. Taylor and M.K. Wong, Bulletin of Environmental Contamination and Toxicology, 11, 189-192, (1974).

Table 2.4-5
PCB Residues in Seafood

| Species | Sample Quantity | Aroclor 1260 (ppm) |
|---|---|---|
| | MISSISSIPPI SOUND | |
| Crabs | 15 | 0.07 |
| Shrimp | 1 kg | ---- |
| Squid | 1 kg | 0.03 |
| Flounder | 3 | 0.03 |
| Speckled sea trout | 3 | 0.20 |
| Spanish mackerel | 3 | 0.06 |
| Weak fish | 5 | 0.12 |
| Atlantic whiting | 5 | 0.10 |
| Fish oil | 1 liter | 0.02 |
| Fish meal | 1 kg | 0.02 |
| Ground fish (unprocessed) | 1 kg | 0.04 |
| | MOBILE BAY, ALA. | |
| Blue crabs | 15 | 0.12 |
| Shrimp | 1.3 kg | 0.01 |
| Oysters | 20+ | 0.03 |
| Squid | 10 | 0.04 |
| Flounder | 3 | 0.11 |
| Speckled sea trout | 1 | 0.40 |
| Spanish mackerel | 2 | 0.18 |
| Weak fish | 5 | 0.37 |
| Atlantic whiting | 5 | 0.11 |
| Croaker | 3 | 0.33 |
| Red snapper | 2 | 0.14 |
| Mullet | 5 | 0.11 |
| Anchovy | >20 | 0.08 |
| Shad | >10 | 0.09 |
| | TAMPA BAY, FLA. | |
| Crabs | 10 | 0.03 |
| Weak fish | 5 | 0.83 |
| Mullet | 5 | 0.31 |

SOURCE: Markin, G.P., J.C. Hawthorne, J.L. Collins, and J.H. Ford, Pesticides Monitoring Journal, 7, 139-143, (March 1974).




■ BIOTA 1971

● GROUPERS 1971

▲ BIOTA, WATER, SEDIMENT, 1973–1974

✱ PLANKTON 1971

FIGURE 2.4-3 GULF OF MEXICO SAMPLING SITES

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Table 2.4-7
Concentrations of PCBs in Selected Samples
from the Gulf of Mexico, 1973-74

| Station | Biota (ppb) | Water (ppt) | Sediment (ppb) |
|---|---|---|---|
| 7 | 20 | 4.1 | <0.2 |
| 18 | 11 | 2.1 | 35.0 |
| 19 | 22 | 1.7 | 33.0 |
| 20 | 23 | --- | <0.2 |
| 21 | 37 | 1.7 | <0.2 |
| 22 | 14 | 2.1 | ---- |
| 23 | 6 | 2.4 | ---- |
| 24 | 11 | 1.3 | ---- |
| 25 | 94 | 0.8 | <0.2 |
| 26 | 68 | 2.7 | ---- |

SOURCE: Giam, C.S., J.S. Chan, J.P. Kakareka and G.S. Neff, Trace Analyses of Phthalates and Chlorinated Hydrocarbons in Gulf of Mexico Samples.

### 2.4.4 California

According to Hom and Risebrough[14] PCBs have become a significant component of the marine food webs of southern California. They have been associated with a high incidence of premature births among sea lions and eggshell thinning with consequent reproductive failure in fish-eating birds.

One study collected different levels of sediment from the Santa Barbara Basin.[14] The dated and analyzed sediments indicated that the deposition of PCB's began about 1945 probably as a result of the rapid increase in PCB use as electrical insulating fluids and paint additives during World War II. Through 1967 there was no indication of a leveling off in the rate of PCB deposition. Levels in the 1940-1945 layer were 31 ppb increasing to 49 ppb in the 1947-1952 layer, 66 ppb in the 1955-1960 layer and 103 ppb in the 1962-1967 layer.[14]

Risebrough[23] has suggested that the observation of PCB's in the sea indicate that they are dispersed by wind currents. Table 2.4-8 shows the distribution of PCB residues in several collections of marine fish collected from the Coastal waters of southern California in late 1965 and early 1966 and in marine birds collected in late 1966. Note that the levels in the birds 0.08-109 ppm were higher than those in fish, N.D.-1.2 ppm. Petrels and shearwaters breed on remote islands spending their entire lives at sea. They do not dive for fish but feed primarily upon organisms obtained at or near the surface where aerial fallout could be expected to retain temporally the water-insoluble chlorinated hydrocarbons components. Two Peregrine Falcons showed PCB levels ranging from 1.5 ppm, net weight, in the brain of an immature bird to 1,980 ppm lipid weight in the carcass of an adult bird.

Analyses of Western gull eggs[22] show that eggs from San Francisco Bay, with levels from 24-950 ppm contained more PCB's than eggs from the Farallon Islands 27 miles west of the Golden Gate Bridge with levels from 12-1010 ppm. These were both higher than eggs from Baja California where the levels were 1.2-471 ppm.

Concern over reproductive failure of the Double Crested Cormorant led to a study in 1969 of Cormorant eggs from three locations in southern California. The levels identified ranged from 12-1,100 ppm in the yolk lipids.[10] A similar concern also led to a study of Brown Pelicans on Anacapa Island in May 1969. Fat samples from six adult birds and one immature bird ranged from 77 to 366 mg/gm.[15]

Early data collected by Munson[19] in 1970 from San Diego and Orange Counties showed levels in aquatic biota ranging from <2.0 to 8.8 ppm lipid weight (N.D. - 1.0 wet weight) in San Diego and 0.62 - 38 ppm lipid weight (0.008 to 1.4 wet weight) from Orange County. However, the difference in residue levels may be due to a different type of uptake mechanism since the samples from Orange County were invertebrates while those from San Diego were fish.



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In addition to the studies of Double Crested Cormorants and Brown Pelicans, Faber et. al.[4] studied Common Egrets and Great Blue Herons. The PCB levels ranged up to 15 ppm in the brain and 93 ppm in the livers of adult egrets from the Audubon Canyon Ranch. Fish which the birds might feed on from Bolinas Lagoon showed levels from 0.072-0.079 ppm.

In order to assess the potential contamination from chlorinated hydrocarbons the U.S. Geological Survey initiated a study in February 1972 of the San Francisco Bay. Bottom material was collected from 26 streams that discharge into San Francisco Bay. The results of the analyses are given in Figure 2.4-4 illustrating the widespread distribution of PCB's in the San Francisco Bay area. The readings from Steven Creek of 180 ppb and from Alamitos Creek, of 610 ppb were higher than anticipated since neither area had any apparent industrial or commercial development. Despite the extreme range up to 1400 ppb there was no significant difference between the average residue of streams discharging into the Bay south of San Francisco and those discharging into the Bay north of San Francisco.[16]

Studies of Waste Water Treatment Plants in the Southern California area will be presented in Section 2.5.3.4.

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Table 2.4-8
Polychlorinated Biphenyl (PCB) Residues
in Marine Fish and Marine Birds, 1965-1966

| Species<br>Locality, | PCB |
|---|---|
| Northern Anchovy | |
| Terminal Island | 1.0 |
| Shiner Perch | |
| San Francisco Bay | 0.4-1.2 |
| English Sole | |
| San Francisco Bay | 0.05-0.11 |
| Monterey | 0.04 |
| Jack Mackerel | |
| Channel Islands | 0.02 |
| Hake | |
| Puget Sound | 0.16 |
| Channel Islands | 0.12 |
| Bluefin Tuna | |
| Body muscle | 0.04 |
| Liver | 0.04 |
| Yellowfin Tuna | |
| Liver | 0.04 |
| Skipjack Tuna | |
| Liver | 0.1 |
| Cassin's Auklet | 0.16 |
| Ancient Murrelet | 0.15 |
| Fulmar | 0.08 |
| Fulmar | 0.34 |
| Red Phalarope | 0.10 |
| Rhinoceros Auklet | 0.36 |
| Slender-billed Shearwater | 2.1 |
| Sooty Shearwater | 1.2 |
| Sooty Shearwater | 0.9 |
| Peregrine Falcon | |
| Breast muscle, second year | |
| Female, migrant from Artic | 22 |
| Breast muscle, immature | |
| California | 10.5 |
| Breast muscle, adult | |
| female, California | 109 |

SOURCE: Risebrough, R.W., Chlorinated Hydrocarbons in Marine Ecosystems.

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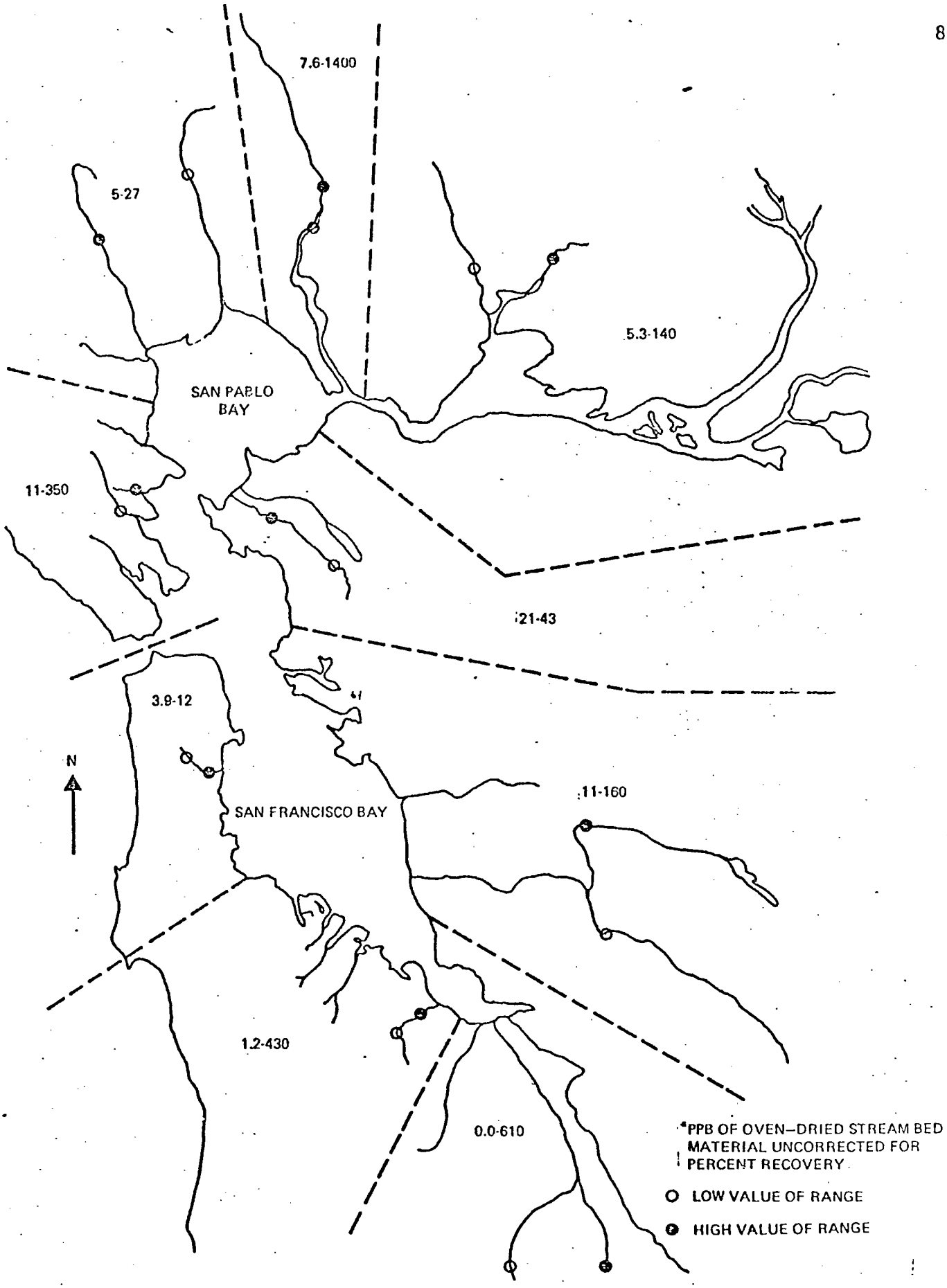


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FIGURE 2.4.4 PCB'S IN SAN FRANCISCO BAY AREA STREAM BEDS

### 2.4.5 Escambia Bay, Florida

The first detection of Aroclor 1254 residues in Escambia Bay was in oysters in April 1969.[3] Later sampling also showed residues in water, sediment, fish, blue crabs and shrimp as indicated in Table 2.4-9. One source was apparently an industrial outfall which had had accidental leakage of a heat exchange fluid. Fish, shrimp and crabs contained higher concentrations than oysters but are also more mobile and therefore not as useful as monitors for a particular area.

Figure 2.4-5 identifies the sampling locations (stations 1-7). Less than 0.1 ppb occurred in the water at station 2 but it was not detected in lower bay water. Leaching from sediments is presumably the cause of the continued presence of Aroclor 1254 in the river water. Sediment samples taken near the outfall reached 486 ppm in August 1969.[3]

Pink shrimp collected at the same time from the bay were found to contain whole body residues of Aroclor 1254 as high as 14 ppm.[20] Residues in seven composite samples of at least five shrimp ranged from 0.6 to 120.0 ppm. Fiddler crabs collected in April 1970 from the lower Escambia River and Upper Escambia Bay had individual whole body residues of 0.45 to 1.5 ppm.

The largest accumulations were found in the sediments with the maximum residue of 61 ppm observed in the River at the outfall from the industry. The maximum in the Bay of 30 ppm was found near the mouth of the river. Although Aroclor was not detected in sediments collected above the plant, soil samples from the bank near the mouth of the river downstream from the source 6.5 km had 1.4 to 1.7 ppm. Subsequent samplings from three stations in the bay showed little change in the chemical even after nine months. Table 2.4-9 shows the levels identified for these sediment collections as stations 8-20.[20]

The amount of PCB in sediment samples appeared to decrease after the initial February 1970 survey.[21] The decrease is especially noticeable in December 1970 and October 1971. In general, the residues identified in 1971 were about one-tenth the 1970 values. Cores taken in a 1972 survey generally indicated less PCB than in 1971. Table 2.4-9 identifies the readings taken for these three years as stations 21-23.

Later surveys of biota from the estuary showed levels to remain relatively high. Table 2.4-10 compares residues in the same species or those occupying similar trophic levels captured on the same day in Escambia and East Bays; the East Bay site being about 35 kilometers from the original source of the material. Although sand seatrout and Atlantic cutlassfish could be expected to have the highest residues since they are predators the highest levels were actually found in silversides whose diet consists mainly of plankton. Note also that the concentrations in species from Escambia Bay were 5 to 10 times greater than those found in East Bay but that Aroclor 1254 was found even in species captured distant from the original source of PCB.[21]

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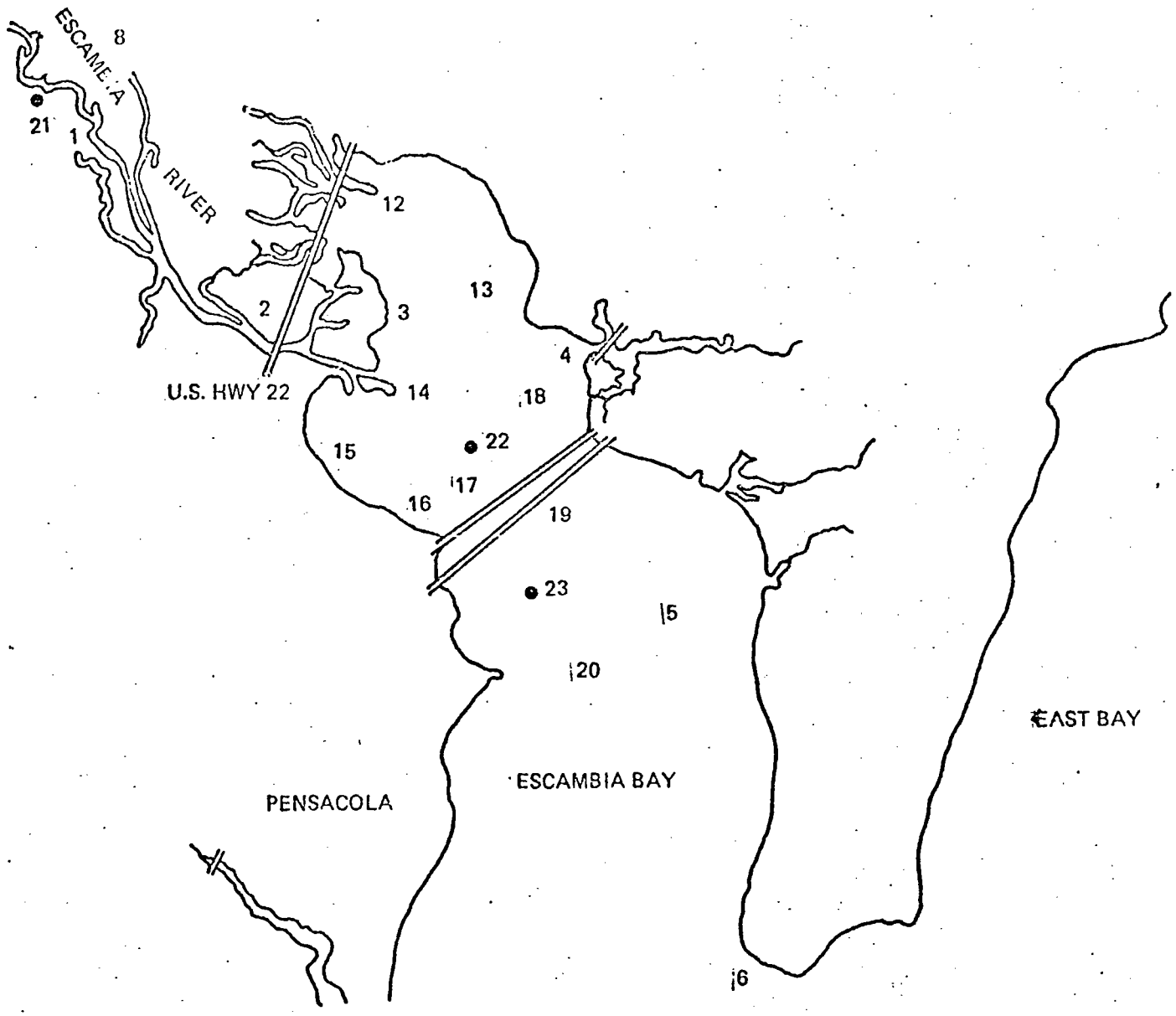


FIGURE 2.4-5 ESCAMBIA BAY SAMPLING STATIONS

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Table 2.4-9
Residues of Aroclor 1254 in Samples from Escambia Bay and River

| Location | Sample | Residues of Aroclor 1254 (ppm) 1969 | 1970 | 1971 | 1972 |
|---|---|---|---|---|---|
| 3 | Speckled trout | 20.0 | | | |
| 3 | Flounder liver | 184.0 | | | |
| 4 | Menhaden | 5.7 | | | |
| 4 | Menhaden | 11.0 | | | |
| 4 | Menhaden | 12.0 | | | |
| 4 | Flounder liver | 76.0 | | | |
| 4 | Flounder muscle | 4.5 | | | |
| 4 | Flounder gills | 19.0 | | | |
| 4 | Croaker | 12.0 | | | |
| 4 | Pinfish | 10.0 | | | |
| 3 | Shrimp | 2.5 | | | |
| 3 | Blue crab | 7.0 | | | |
| 3 | Blue crab | 6.3 | | | |
| 4 | Shrimp | 1.5 | | | |
| 4 | Blue crab | 1.0 | | | |
| 1 | Sediment | 486 | | | |
| 2 | Sediment | <.03 | | | |
| 6 | Sediment | 1.7 | | | |
| 8 | Sediment | | N.D. | | |
| 9 | Sediment | | 61.0 | | |
| 10 | Sediment | | 5.7 | | |
| 11 | Sediment | | 4.1 | | |
| 12 | Sediment | | 1.9 | | |
| 13 | Sediment | | 1.8 | | |
| 14 | Sediment | | 30.0 | | |
| 15 | Sediment | | 4.2 | | |
| 16 | Sediment | | 3.3 | | |
| 17 | Sediment | | 4.9 | | |
| 18 | Sediment | | 0.6 | | |
| 19 | Sediment | | 2.5 | | |
| 20 | Sediment | | 1.4 | | |
| 21 | Sediment 0-2 in. | | 78.0 | 8.1 | 0.97 |
| | Sediment 2-4 in. | | 30.0 | 0.12 | 5.8 |
| | Sediment 4-6 in. | | 6.1 | N.D. | ---- |
| | Sediment 6-8 in. | | 0.4 | N.D. | ---- |
| 22 | Sediment 0-2 in. | | 10.0 | 0.91 | 0.14 |
| | Sediment 2-4 in. | | 11.0 | N.D. | N.D. |
| | Sediment 4-6 in. | | 15.0 | N.D. | N.D. |
| | Sediment 6-8 in. | | 20.0 | N.D. | ---- |
| | Sediment 8-10 in. | | 18.0 | N.D. | ---- |
| | Sediment 10-12 in. | | 1.2 | N.D. | ---- |
| 23 | Sediment 0-2 in. | | 0.19 | 0.19 | ---- |
| | Sediment 2-4 in. | | 0.08 | N.D. | ---- |
| | Sediment 4-6 in. | | 0.02 | N.D. | ---- |
| | Sediment 6-8 in. | | N.D. | N.D. | ---- |

SOURCE: Nimmo, D.R., D.J. Hansen, J.A. Couch, N.R. Cooley, P.R. Parrish and J.I. Lowe, Toxicity of Aroclor 1254 and its Physiological Activity in Several Estuarine Organisms, (unpublished).

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Table 2.4-10
Comparison of Concentrations of Aroclor 1254 Found in Species Collected in Escambia and East Bays

| Species | Escambia Bay (ppm) | East Bay (ppm) |
|---|---|---|
| Spartina | N.D. | N.D. |
| Zostera | N.D. | N.D. |
| Olive Nerite | 0.49 | N.D. |
| Rangia | N.D. | N.D. |
| Penaeid Shrimp | 0.98 | Trace |
| Blue Crabs | 6.90 | 0.46 |
| Bay Anchovy | 3.00 | 0.68 |
| Catfish | 3.80 | 0.58 |
| Tidewater Silversides | 10.00 | 0.95 |
| Silver Perch | 4.50 | 0.48 |
| Sand Seatrout | 1.50 | ---- |
| Spotted Seatrout | ---- | 0.12 |
| Spot | 1.80 | Trace |
| Atlantic Croaker | 1.60 | Trace |
| Hogchoker | 1.30 | N.D. |
| Atlantic Cutlassfish | 2.90 | 0.72 |

SOURCE: Nimmo, D.R., D.J. Hansen, J.A. Couch, N.R. Cooley, P.R. Parrish and J.I. Lowe, Toxicity of Aroclor 1254 and its Physiological Activity in Several Estuarine Organisms, (unpublished).

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DSW 442264

STLCOPCB4056799

## 2.5 Data from Localized Monitoring Efforts - Industrial Plants, Products, Sewage Treatment Facilities and Landfills

### 2.5.1 Industrial Plants

#### 2.5.1.1 Monsanto, Co., Sauget, Illinois

The only PCB production facility in the United States is the Monsanto plant at Sauget, Illinois which has produced PCB mixtures ranging from 20 to 68 percent chlorine. Polychlorinated terphenyls have been produced at this facility, but production was suspended in 1971.

Soil contamination studies[7] were initiated in February 1976. The sampling locations around the Monsanto facility are identified in Figure 2.5-1. The levels of Aroclor 1242, Aroclor 1260 and decachlorobiphenyl found at these sampling sites are listed in Table 2.5-1. The distribution of all PCBs analyzed appears to be higher near the plant site and generally decreasing with distance from the site. There is some evidence that higher concentrations are present in the soils located to the southeast which corresponds with the predominant wind direction in this area.

A typical chromatogram of a soil sample obtained near the plant is shown in Figure 2.5-2 along with the reference chromatograms of Aroclor 1242 and 1260 run under the same instrument conditions. Using these reference spectra, this sample contains 11 ppm Aroclor 1242, 9.3 ppm Aroclor 1260 and 1.0 ppm decachlorobiphenyl.

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Table 2.5-1
PCB Levels in Soils, ppm, Monsanto

| Sample Station | Aroclor 1260 | Aroclor 1242 | Decachlorobiphenyl | Total PCB |
|---|---|---|---|---|
| 1 | 0.05 | <0.01 | 0.097 | 0.147 |
| 2 | 0.12 | <0.01 | 0.61 | 0.73 |
| 3 | 1.4 | <0.01 | 0.90 | 2.3 |
| 4 | 0.31 | 0.68 | 0.38 | 1.37 |
| 5 | 0.20 | <0.01 | 0.27 | 0.47 |
| 6 | 1.3 | 0.82 | 1.6 | 3.72 |
| 7 | 2.9 | 3.0 | 1.3 | 7.2 |
| 8 | 9.6 | 6.1 | 2.4 | 18.1 |
| 9 | 0.65 | <0.01 | 0.12 | 7.7 |
| 10 | 0.28 | 0.45 | 0.081 | 0.811 |
| 11 | 0.10 | <0.01 | 0.049 | 0.145 |
| 12 | 0.26 | <0.01 | 0.081 | 0.341 |
| 13 | 9.6 | 10.0 | 1.1 | 20.7 |
| 14 | 0.03 | <0.01 | 0.40 | 0.43 |
| 15 | 0.39 | 0.46 | 0.12 | 0.97 |

SOURCE: Unpublished Report, Contract 68-01-2978, USEPA, Office of Toxic Substances; July 1975

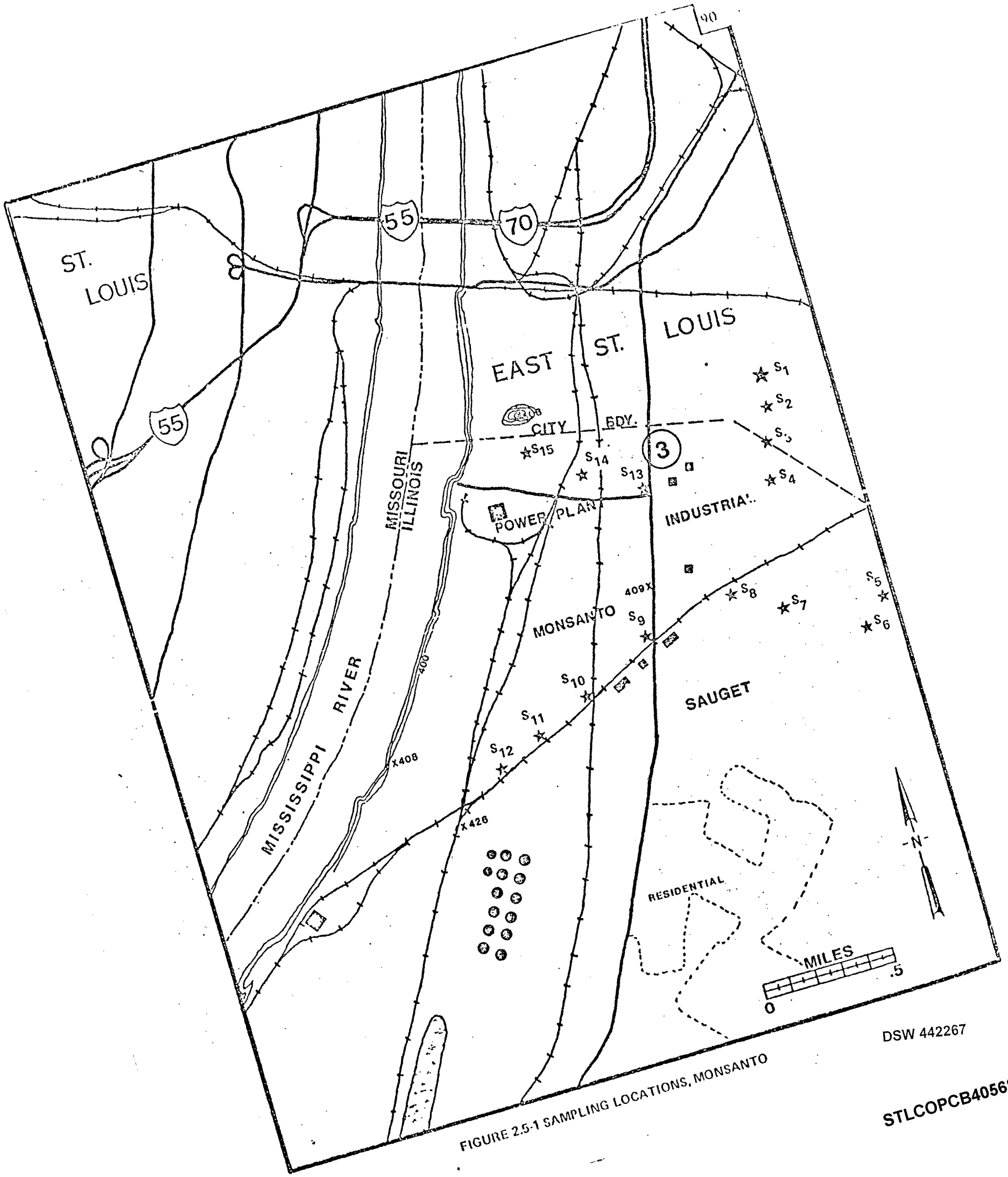


FIGURE 2.5-1 SAMPLING LOCATIONS, MONSANTO

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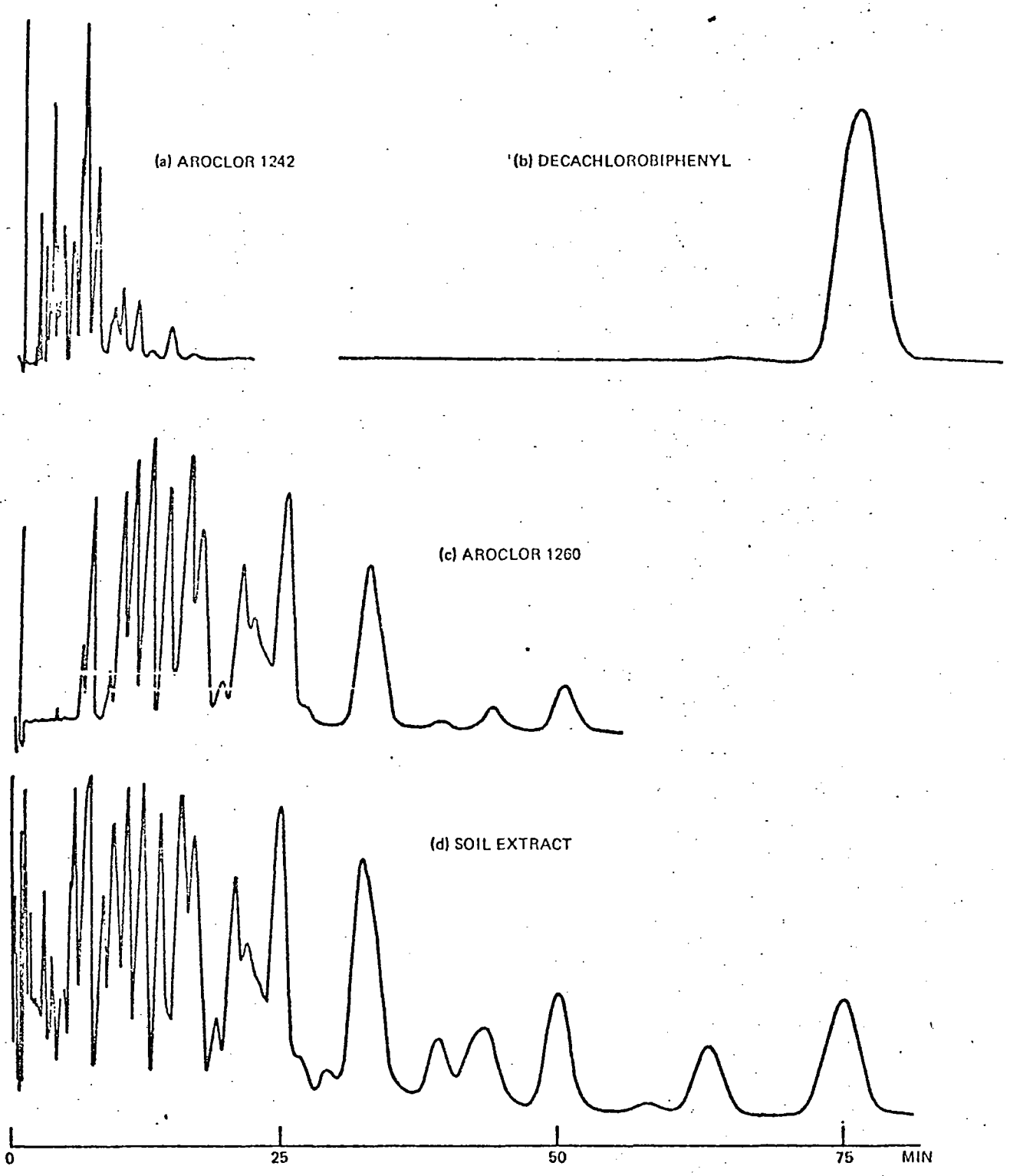


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FIGURE 2.5-2 TYPICAL CHROMATOGRAMS OF STANDARD AROCLORS, DECACHLOROBIPHENYL AND A SOIL SAMPLE TAKEN IN THE VICINITY OF MONSANTO CO., SAUGET, ILLINOIS

2.5.1.2 Yates Manufacturing Co., Chicago, Illinois

The Yates Manufacturing Co. is an investment casting wax manufacturer. Prior to 1972, Aroclors 5460, 6090 and 5442, mixtures that contain both PCBs and polychlorinated terphenyls, were used. Subsequent to 1972, this company has been purchasing decachlorobiphenyl from foreign sources.

Soil contamination studies[7] were initiated in February 1976. The sampling locations around the Yates facility used to study soil contamination are identified in Figure 2.5-3. The concentration levels of Aroclor 1242, Aroclor 1260 and decachlorobiphenyl found at these sampling sites are listed in Table 2.5-2.

Table 2.5-2
PCB Levels in Soils, ppm, Yates Manufacturing

| Sample Location | Aroclor 1260 | Decachlorobiphenyl | Total PCB |
|---|---|---|---|
| 1 | 0.22 | < 0.001 | 0.22 |
| 2 | 0.24 | 0.053 | 0.293 |
| 3 | 0.81 | 0.033 | 0.113 |
| 4 | 0.34 | 0.19 | 0.53 |
| 5 | 0.51 | 0.58 | 1.09 |
| 6 | 0.40 | 1.2 | 1.6 |
| 7 | 0.26 | 0.51 | 0.77 |
| 8 | 1.5 | 0.75 | 2.25 |
| 9 | 0.57 | 0.040 | 0.61 |
| 10 | 0.67 | 0.020 | 0.69 |
| 11 | 1.6 | 3.6 | 5.2 |
| 12 | 0.29 | 0.001 | 0.291 |
| 13 | 0.56 | 0.034 | 0.594 |
| 14 | 1.8 | < 0.001 | 1.8 |

SOURCE: Unpublished Report, Contract 68-01-2978, USEPA, Office of Toxic Substances; July 1975

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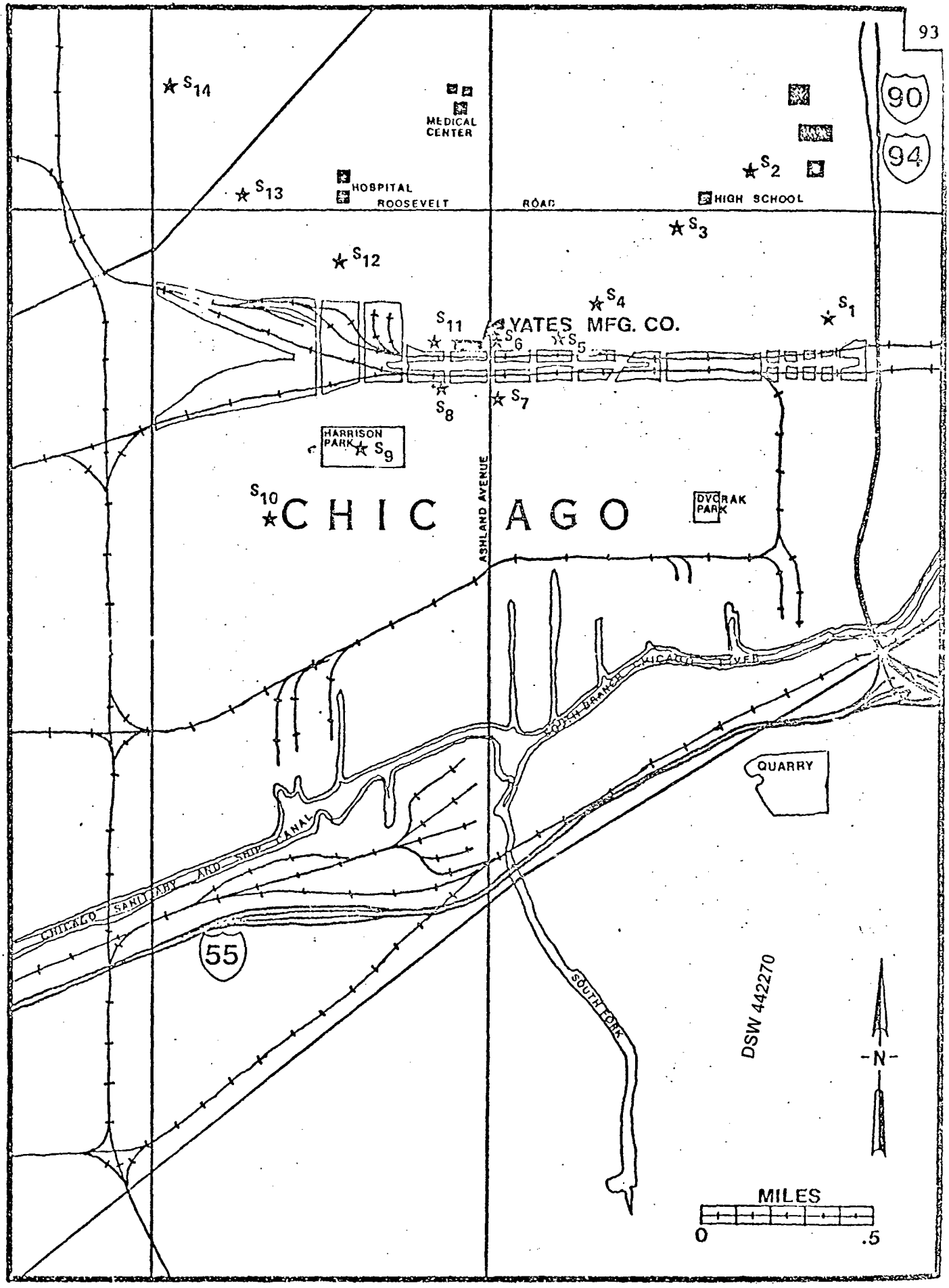



FIGURE 2 SAMPLING LOCATIONS, YATES MANUFACTURING

2.5.1.3 Valcast Corp., Troy, Michigan

Valcast Corp. is an investment casting facility located in a small industrial park in suburban Detroit, Michigan. PCBs are a constituent of the wax mold compound used to fashion intricate shapes which are to be cast.

Soil contamination studies[7] were initiated in February 1976. The sampling locations around the Valcast facility are identified in Figure 2.5-4. The concentration levels of Aroclor 1260 and 1242 found at these sampling sites are listed in Table 2.5-3.

Figure 2.5-5 is a typical chromatogram of a soil sample extract taken from this location. Aroclor 1260 was present in many of the soil samples taken from the Valcast area, but decachlorobiphenyl was absent. The one observed concentration of 18 ppm of Aroclor 1242 appears to be anomalously high, however, replicate analysis yielded values of 16 ppm and 19 ppm, respectively. Aroclor 1242 was not detected in any other soil samples from this area.

A small drainage ditch that passes adjacent to the north boundary of the Valcast facility was sampled. This ditch serves to remove storm-water runoff in the vicinity and receives discharged cooling water from Valcast and other local small industies. Analysis of the Valcast cooling water at the point of discharge and of water in the drainage ditch failed to detect PCB levels greater than the detection limit of 0.1 ppb Two bottom sediment samples taken from this drainage ditch, however, had concentrations as follows:

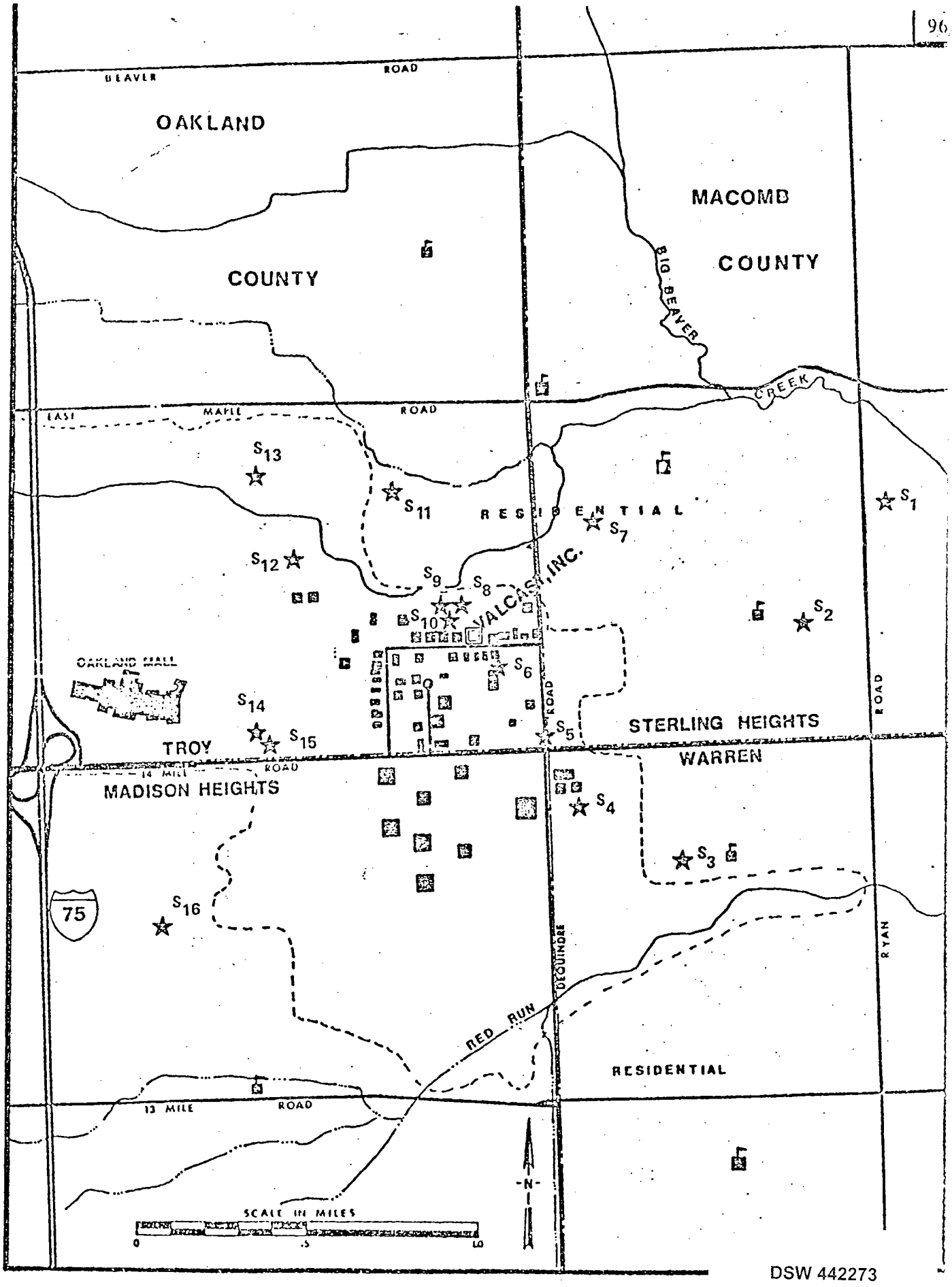
| | | |
|---|---|---|
| Aroclor 1242 | 2.3 ppm | 9.4 ppm |
| Aroclor 1260 | 6.7 ppm | 8.9 ppm |
| Decachlorobiphenyl | 0.09 ppm | 0.11 ppm. |

Table 2.5-3

PCB Levels in Soils, ppm, Valcast

| Sample Station | Aroclor 1260 | Aroclor 1242 |
|---|---|---|
| 1 | < 0.01 | |
| 2 | < 0.01 | 18.0 |
| 3 | 0.04 | |
| 4 | 0.06 | |
| 5 | 0.05 | |
| 6 | 0.04 | |
| 7 | 0.14 | |
| 8 | 0.07 | |
| 9 | < 0.01 | |
| 10 | 0.12 | |
| 11 | < 0.01 | |
| 12 | 0.12 | |
| 13 | 0.03 | |
| 14 | < 0.01 | |
| 15 | 0.03 | |
| 16 | 0.02 | |

SOURCE: Unpublished Report, Contract 68-01-2978, USEPA, Office of Toxic Substances; July 1975




DSW 442273

FIGURE 2.5-4 SAMPLING LOCATIONS, VALCAST

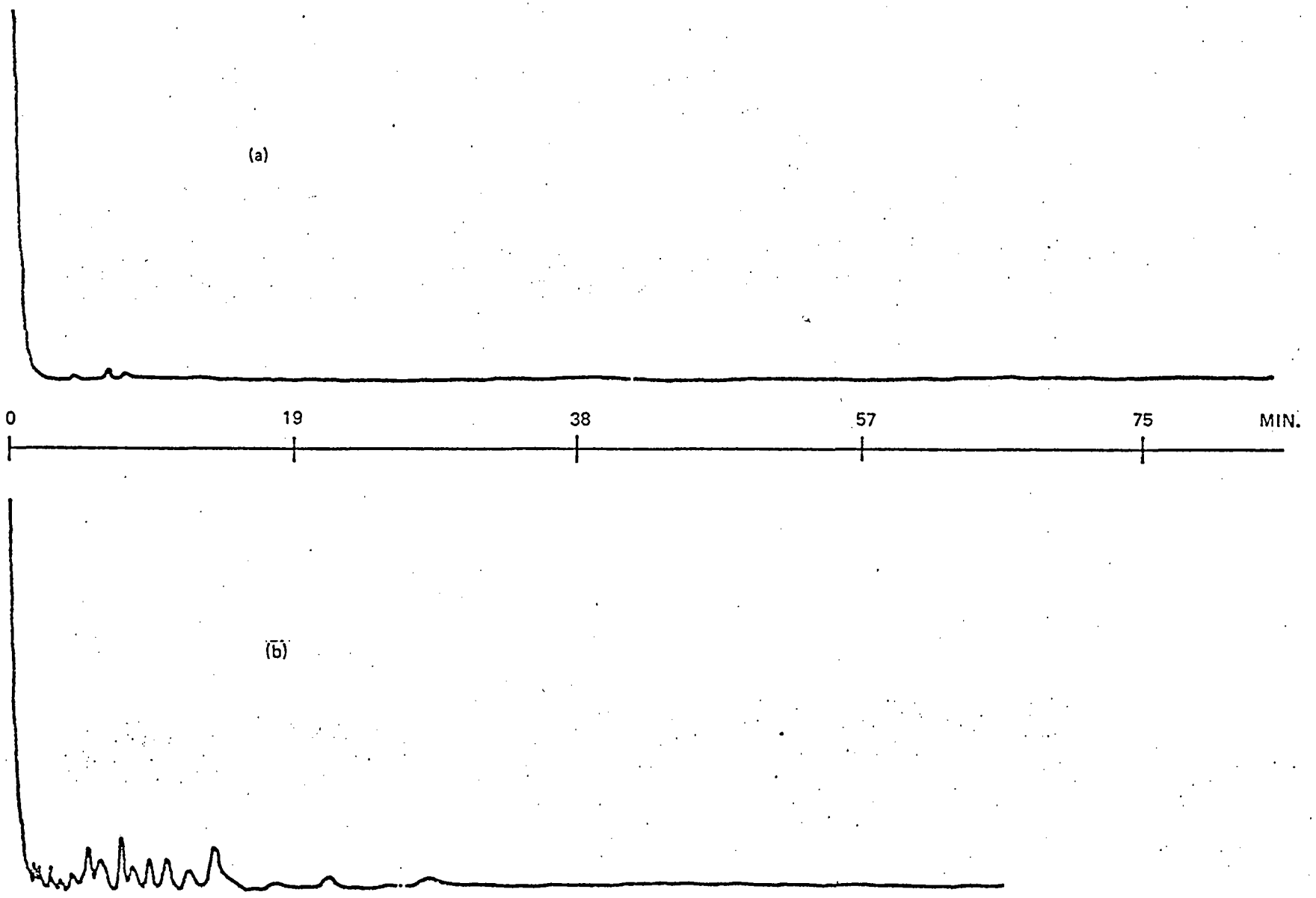



FIGURE 2.5-5 TYPICAL CHROMATOGRAMS OF SOIL SAMPLES TAKEN IN THE VICINITY OF VALCAST CORP., TROY, MICHIGAN – (a) 0.01 ppm, (b) 0.014 ppm AROCLOR 1260

DSW 442274

STLCOPCB4056809

2.5.1.4 General Electric, Hudson Falls - Ft. Edward, N.Y.

The General Electric Plants at Hudson Falls and Ft. Edward use large quantities of PCB's for filling capacitors and transformers. Both plants have chemical waste treatment facilities, but, significant PCB and oil/grease levels are discharged by the waste stream. The NPDES Permit Application lists:

| Outfall Location | Daily Average Concentration ppm | | Average Daily Loading (lbs.) | | Maximum Daily Loading (lbs.) | |
|---|---|---|---|---|---|---|
| | Oil/Grease | PCB | Oil/Grease | PCB | Oil/Grease | PCB |
| Hudson Falls | 13.7 | .5 | 239.8 | 10.0 | 250.9 | 17.6 |
| Hudson Falls | 2.1 | --- | 4.9 | ---- | 5.25 | ---- |
| Ft. Edward | 8.9 | 5.0 | 38.27 | 20.0 | 44.5 | 30.0 |

In the summer of 1974, EPA Region II initiated a sampling program in the general vicinity of the General Electric plants.[2] The five sampling stations established for this program are shown in Figure 2.5-6. Station 0 is upstream from the plants and serves as the control station; station 1 is located at the junction of the outfall stream from the Ft. Edward facility and the Hudson River, station 2 is located about 0.25 miles downstream from the outfall junction, station 3 is about 0.5 miles downstream from station 1, and station 4 is located about 0.75 miles downstream from station 1.

Samples collected included sediment, water, fish and snails; Aroclors identified included 1016, 1254, 1248 and 1242. The levels found at each sampling location are listed in Table 2.5-4.

PCB's identified as Aroclor 1016 were conclusively identified in the water samples at detectable concentrations at all sampling locations except Station 0 (control) and station 4, the furthest downstream.

At all stations the sediments contained higher concentrations of Aroclor 1016 than the water column resulting from adsorption of PCB's on suspended or already settled materials.

The biological samples collected at station 0 contained PCB's characteristic of Aroclor 1254 and Aroclor 1248. Distinctly different from the samples at station 0 were the samples collected in the vicinity of or below the General Electric discharge. Fish data from these areas suggests that Aroclor 1242, Aroclor 1016, or a mixture of these two formulations are present in the Hudson. There are no distinguishing features which can reliably determine whether the mixture is Aroclor 1016 or 1242 at this time.

DSW 442275

STLCOPCB4056810

Table 2.5-4
Environmental PCB Levels from the General Electric,
Hudson Falls - Ft. Edward N.Y. Area

| Media | Water (ppb) | Sediment (ppm) | | Fish (ppm) | |
|---|---|---|---|---|---|
| Aroclor | 1016 | 1016 | 1254 | 1248 | 1242 |
| Station | | | | | |
| 0 | <1.0 | 6.9 | 4.0 | 13.0 | |
| 1 | 2800 | 6700 | | | 45[a] |
| 2 | 2.2 | 540 | | | |
| 3 | 3.0 | 2980 | | | 350[b] |
| 4 | <1.0 | 6.6 | | | 78[c]<br>27[a] |

[a]Snails (composite)

[b]Rock Bass

[c]Shiner Minnows

SOURCE: Nadeau R.J., and R.P. Davis, Investigation of Polychlorinated Biphenyls in The Hudson River, USEPA Region II.

DSW 442276

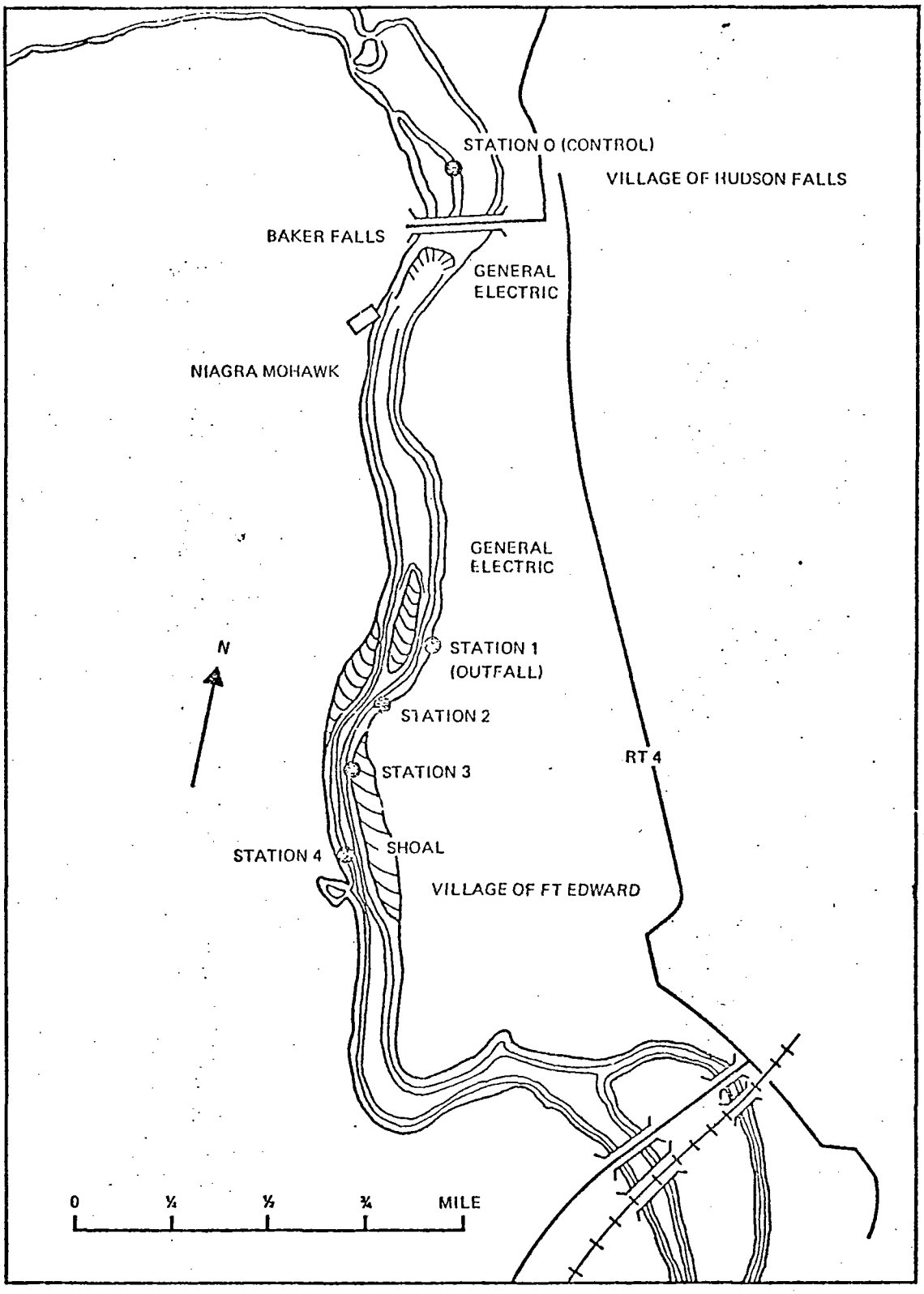



FIGURE 2.5-6 MAP OF HUDSON FALLS-FT. EDWARD, NEW YORK. NOTE LOCATION OF SAMPLING STATIONS RELATIVE TO GENERAL ELECTRIC FACILITIES.

DSW 442277

## 2.5.2 Sewage Treatment Facilities

### 2.5.2.1 Illinois

An early study[8] of discharges into Lake Michigan was conducted by the state of Illinois in 1970-1972 from locations as shown in Figure 2.5-7. Only two counties in Illinois border on the lake and all sewage treatment plant effluents and tributary stream sources enter the lake from Lake County. In most cases, sewage treatment plant effluents had higher concentrations of PCB's than the tributary streams.

PCB's were not measured in 1970; however, in 1971, 37 sediment samples were collected from tributary streams and ravines in Lake County and at stations offshore from Lake and Cook counties and analyzed for PCB's. The lake samples were collected 40 to 80 yards offshore from seven North Shore Sanitary District sewage treatment plants and at stations approximately one to three miles offshore. Aroclor 1242 in tributary sediments ranged up to 553 ppb in an unnamed channel in Waukegan and Aroclor 1254 ranged from 1.54 to 232.00 ppb in Pettibone Creek in North Chicago. Samples from open water sediments had Aroclor 1242 concentrations ranging up to 106.07 ppb. The highest level was found 40-80 yards offshore from the North Shore Sanitary District sewage treatment plant at North Chicago. Aroclor 1254 concentrations ranged from 2.48 to 46.92 ppb. Selected values are given in Table 2.5-5.

Water samples were collected in both 1971 and 1972 at the tributary streams and sewage treatment plants. Aroclor 1242 and 1254 ranged from 14.00-1810.0 ppt and 192.0-388.0 ppt in 1971 respectively and up to 653.0 ppt for Aroclor 1242 and 61.0 to 841.0 ppt for Aroclor 1254 in 1972 in tributary streams. However, in samples from sewage treatment plants Aroclor 1242 concentrations ranged from 268.0-4020.0 ppt in 1971 and up to 21.0 ppt in 1972. Aroclor 1254 concentrations ranged from 139.0-568.0 ppt in 1971 and from 97.0 to 178.0 ppt in 1972. The highest readings were from the North Shore Sanitary District at Waukegan in 1971. Table 2.5-6 presents the levels identified in water samples from Illinois Streams and Sewage Plants Tributary to Lake Michigan.

DSW 442278

STLCOPCB4056813

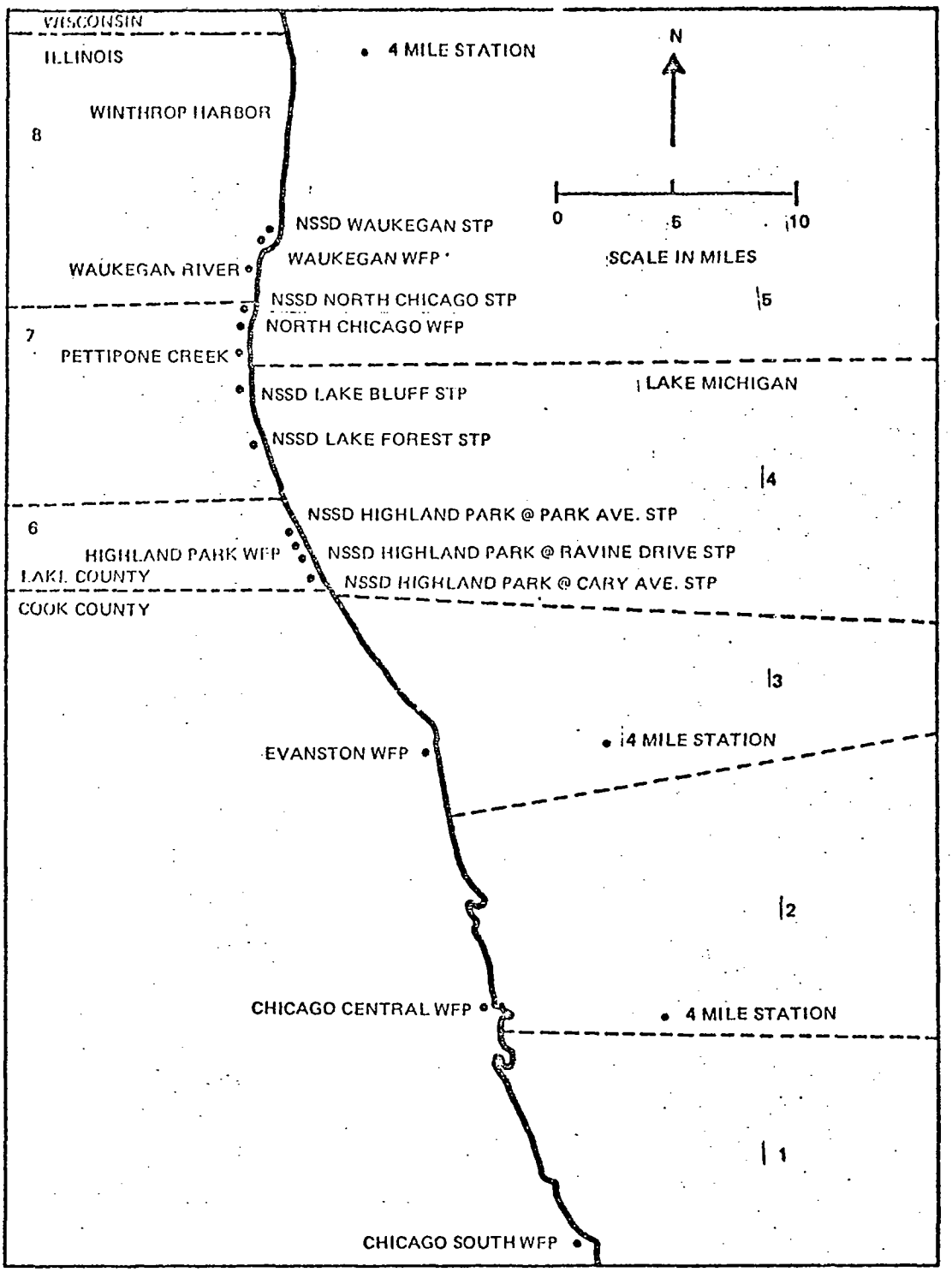



FIGURE 2.5-7 LOCATIONS OF WATER AND SEDIMENT SAMPLING STATIONS

DSW 442279

Table 2.5-5
Polychlorinated Biphenyls in Sediments from Lake Michigan
and Tributary streams in Illinois 1971
(ppb) dry weight basis

| Location | | Aroclor 1242 | Aroclor 1254 |
|---|---|---|---|
| <1 to 3 miles offshores | | | |
| Cook County | 1 | N.D.-18.55 | 2.48-17.25 |
| | 2 | 17.23-83.35 | 9.38-46.92 |
| | 3 | 3.58-13.65 | 3.15-12.42 |
| Lake County | 4 | 7.43-19.25 | 5.26-17.45 |
| | 5 | 4.98-46.11 | 8.36-34.52 |
| Highland Park | STP | 11.11 | 12.42 |
| Lake Forest | STP | 10.51 | 7.02 |
| Lake Bluff | STP | 44.36 | 14.45 |
| North Chicago | STP | 106.07 | 26.54 |
| Waukegan | STP | 17.32 | 11.97 |
| 10-50 yards upstream from Lake | | | |
| Lake County | 6 | N.D.-4.32 | 1.54-17.90 |
| | 7 | 1.31-173.40 | 2.54-232.00 |
| | 8 | 1.77-553.00 | 2.56-131.00 |

SOURCE: USEPA, Pesticide Monitoring Programs: Lake Michigan and Tributaries in Illinois, EPA 600/3-74-002

Table 2.5-6
Polychlorinated Biphenyls in Water Samples from
Illinois Streams and Sewage Plants Tributary to Lake Michigan
1971 - 1972, (ppt)

| Location | Aroclor 1242 | Aroclor 1254 |
|---|---|---|
| 1971 | | |
| Waukegan River | 1810.0 | 388.0 |
| Pettibone Creek | 140.0-187.0 | 192.0-194.0 |
| Waukegan STP | 601.0-4020.0 | 139.0-568.0 |
| North Chicago STP | 268.0-1070.0 | 153.0-260.0 |
| 1972 | | |
| Waukegan River | 57.0-120.0 | 61.0-136.0 |
| Pettibone Creek | N.D.-653.0 | 107.0-841.0 |
| Waukegan STP | N.D.-17.0 | 97.0-139.0 |
| North Chicago STP | N.D.-21.0 | 100.0-178.0 |

SOURCE: USEPA, Pesticide Monitoring Programs: Lake Michigan and Tributaries in Illinois, EPA 600/3-74-002

2.5.2.2 Michigan

Samples collected in 1971 and 1972 from municipal waste water treatment plant effluents throughout Michigan[4] indicated these plants as a major source of PCB's with an average concentration of 2.55 ppb for 60 effluents sampled. Only seven of the effluents exceeded 1 ppb but one, the Bay City treatment plant on the Saginaw River, had an average effluent concentration of 120 ppb with a high of 340 ppb.

Samples collected from 58 waste water treatment plants in 1973 averaged 0.52 ppb. The Bay City PCB discharge had been greatly reduced as a result of control measures in industries served by the waste water treatment plant.

Sewage Sludge from 57 of the 58 plants tested in 1973 showed Bay City to have the highest concentration of PCB's in the sludge being removed by the treatment process averaging 352 ppm compared to a state wide average of 15.6 ppm.

The range of values for all waste water treatment plants sampled in 1971-1973 are given in Table 2.5-7.

DSW 442282

STLCOPCB4056817

Table 2.5-7
PCB Levels from Waste Water Treatment Plants, Michigan

| City | Effluent (1971-72) (ppb) Aroclor 1254 | Effluent (1973) (ppb) Aroclor 1242 | Effluent (1973) (ppb) Aroclor 1254 | Sludge (1973) (ppb) Aroclor 1242 | Sludge (1973) (ppb) Aroclor 1254 |
|---|---|---|---|---|---|
| Adrian | 0.41-14.00 | | | | |
| Albion | 0.44 | | 0.34 | | 1.5 |
| Ann Arbor | <0.10-0.14 | | 0.25 | | 1.1 |
| Battle Creek | 0.16-0.92 | | <0.10 | | 2.8 |
| Bay City | 5.70-340.00 | 3.20 | | 352.0 | |
| Benton Harbor St. Joseph | 0.31-0.99 | | 0.20 | | 13.8 |
| Brighton | 0.38 | | | | <0.1 |
| Charlotte | 0.61 | | 0.34 | | 6.8 |
| Constantine | 0.85 | | 0.46 | | 2.1 |
| Detroit | 0.88-3.00 | 2.15 | 32.1 | | |
| Dexter | <0.10 | | 0.23 | | 3.2 |
| E. Lansing | 0.35-0.69 | | 0.18 | | 4.6 |
| Escanaba | 0.29 | | | | 5.9 |
| Essexville | 0.21-0.28 | | 0.10 | | 3.9 |
| Flint | <0.10-1.30 | | <0.10 | | 6.3 |
| Flushing | 0.52 | | | | |
| Gladstone | 0.19 | 0.44 | | | 4.1 |
| Grand Haven | <0.50 | | <0.10 | | 4.1 |
| Grand Rapids | 0.37-0.68 | 1.05 | | | 11.8 |
| Holland | 0.42-0.79 | <0.10 | | | 0.8 |
| Houghton-Hancock | <0.10 | 0.18 | | | 5.5 |
| Iron Mountain-Kingsford | 0.55-1.20 | 0.69 | | | 9.5 |
| Ironwood | 0.16 | | 0.29 | | 5.2 |
| Jackson | <0.10 | <0.10 | | | 3.0 |
| Kalamazoo | 0.19-1.30 | 1.12 | 23.3 | | |
| L'Anse | <0.10 | | 0.31 | | 4.4 |
| Lansing | 0.13-0.23 | 0.22 | | | 5.3 |
| Manistique | <0.20 | 0.63 | | | 1.5 |
| Marquette | 0.35 | 0.29 | | | 2.8 |
| Marshall | <0.10 | 0.15 | | | 3.9 |
| Menominee | 0.35 | 0.57 | | | 4.2 |
| Midland | 0.13-0.40 | <0.10 | | | 2.9 |
| Milford | <0.10 | | 2.20 | | |
| Monroe | 0.33-0.60 | <0.10 | | | 3.3 |
| Mt. Clemens | 1.40-10.00 | | 2.90 | 175.0 | |
| Mt. Pleasant | <0.10 | 0.29 | | | 6.5 |
| Muskegon | 0.28 | 0.83 | | | 12.7 |
| Muskegon Heights | 0.37 | 0.18 | | | 11.0 |
| Niles | 0.68 | 0.48 | | | 7.8 |
| Norway | 0.40 | <0.10 | | | <0.1 |

Table 2.5-7 (cont.)

| City | Effluent (1971-72) (ppb) Aroclor 1254 | Effluent (1973) (ppb) Aroclor 1242 | Effluent (1973) (ppb) Aroclor 1254 | Sludge (1973) (ppb) Aroclor 1242 | Sludge (1973) (ppb) Aroclor 1254 |
|---|---|---|---|---|---|
| Ontonagon | <0.10 | | | | |
| Owosso | <0.10 | 0.12 | | | 2.0 |
| Parchment | <0.10 | | | | |
| Pontiac (Auburn Rd) | <0.10-0.61 | | 0.60 | | |
| Pontiac (E. Blvd) | 0.15-1.30 | | 0.54 | | |
| Portage | 1.90 | | | | |
| Port Huron | 0.28-0.52 | | 1.80 | | |
| Saginaw | 0.74-3.80 | | 0.77 | | 5.0 |
| St. Ignace | <0.20 | 0.31 | | | 1.5 |
| South Haven | <0.10 | | | | |
| Swartz Creek | <0.10 | | | | |
| Three Rivers | <0.30 | <0.10 | | | 4.1 |
| Trenton | 0.14-1.10 | <0.10 | | | <0.1 |
| Warren | 0.10-0.16 | <0.10 | | | <0.1 |
| Wayne County (Wyandotte) | 0.17-0.64 | 0.40 | | 2.01 | |
| Wyoming | 0.44-0.55 | 0.22 | | | |
| Ypsilanti | 0.21-0.22 | | 0.31 | | 2.0 |
| Ypsilanti Twp #1 | <0.10-0.12 | <0.10 | | | <0.1 |
| Ypsilanti Twp #2 | 0.16-0.19 | <0.10 | | | <0.1 |
| Cadillac | | 0.53 | | | <0.1 |
| Howell | | | | | 15.0 |
| Sault Ste. Marie | | 0.73 | | | 2.4 |
| Traverse City | | <0.10 | | | 1.8 |

SOURCE: Monitoring for Polychlorinated Biphenyls in the Aquatic Environment, Michigan Water Resources Commission, May 1973

DSW 442284

STLCOPCB4056819

2.5.2.3 Wisconsin

Samples from sewage treatment facilities in Wisconsin were collected in March 1970. The PCB concentrations identified in the effluents ranged from 0.04 to 0.25 ppb and are presented in Table 2.5-8.[9]

In 1971 11 municipal sewage treatment plants in eleven southeastern Wisconsin cities were sampled as shown in Figure 2.5-8. Table 2.5-9 shows the results of this study and indicates that six of the eleven sewage plants had effluents ranging from 0.1 to 0.5 ppb of Aroclor 1254 while two sites were greater than 1.0 ppb for the same Aroclor. However Portage had 42 ppb of Aroclor 1248 in the effluent with 5.2 ppm in the digester sludge.

It is interesting to note that even though Port Washington is not as highly industrialized as Grafton the effluents from both cities contained approximately the same concentrations of PCB's ranging from 0.12 to 0.23 ppb.

Since the concentrations for Cedarburg were so high a special 24 hour study was conducted. The concentrations in raw sewage began to increase at the beginning of the working day from 0.54 ppb to a maximum of 3.1 ppb at 4:00 p.m. Table 2.5-10 presents the readings taken. The concentration in the final effluent appears to begin increasing from 0.33 ppb at midnight to a maximum of 0.77 ppb at 2 p.m. The concentration of PCB's in the effluent is approximately 30 percent of that in the influent. The concentration of PCB's in the sludges is approximately 1,000 times higher than in the fluid wastes. These data demonstrate that the time of sampling waste effluents is of importance in mass transport estimates.[1]

Table 2.5-8
Concentrations of PCBs in Outfalls into the
Milwaukee River on March 26, 1970

| Location | Aroclor | PCB Concentration (ppb) |
|---|---|---|
| West Bent STP effluent | 1254 | 0.25 |
| Fredonia STP effluent | 1254 | 0.12 |
| Tributary at Fredonia | 1260 | 0.04 |
| Saukville STP effluent | 1260 | 0.13 |
| Chemical plant effluent, Saukville | 1242 | 2.50 |
| Grafton STP effluent | 1254 | 0.04 |

SOURCE: Veith, G.D., and G.F. Lee, Water Research, 5, 1107-1115, (1971)

Table 2.5-9
PCB Concentrations in the Effluents from 11 Southeastern
Wisconsin Sewage Treatment Plants, 1971

| City | PCB Concentrations (ppb) | Estimated Mass Transport (in lb/day) |
|---|---|---|
| Beaver Dam | 0.05 | 0.0002 |
| Port Washington | 0.12-0.22 | 0.0027 |
| Grafton | 0.07-0.23 | 0.0008-0.0015 |
| Cedarburg | 0.28-1.1 | 0.0027-0.018 |
| Racine | 0.60-0.83 | 0.142 |
| Burlington | 0.08-0.14 | 0.0017 |
| Lake Geneva | 2.2-2.8 | 0.018 |
| Walworth | 0.17-0.34 | |
| Beloit | 3.89-11.75 | 0.0038-0.0052 |
| Ft. Atkinson | 1.24-2.48 | |
| Portage | 32-42 | 0.0015 |

SOURCE: Dube, D.J. Polychlorinated Biphenyls in Effluents from Sewage Treatment Plants in Southeastern Wisconsin

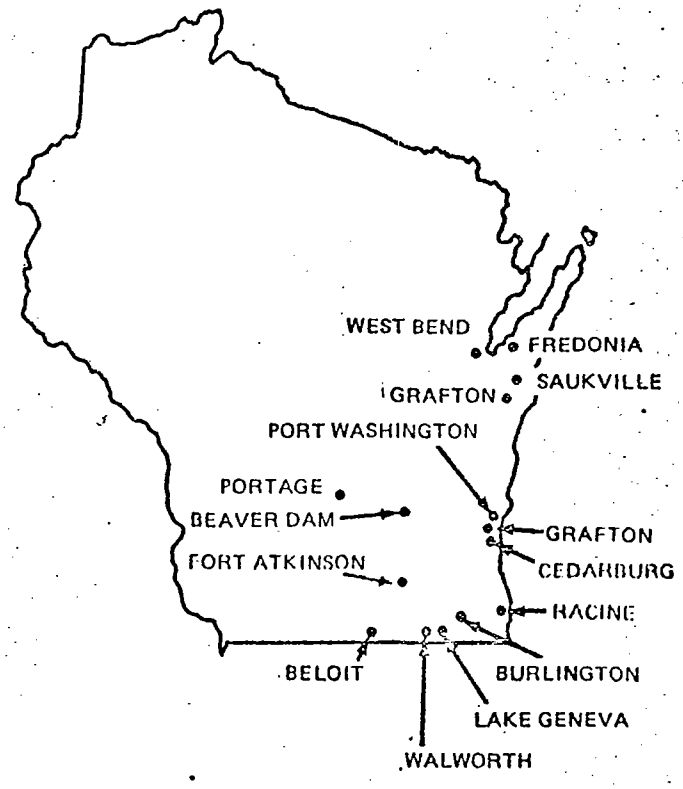



FIGURE 2.5-8 WISCONSIN CITIES WHERE MUNICIPAL SEWAGE TREATMENT PLANTS WERE SAMPLED IN 1971

DSW 442287

Table 2.5-10
A 24-hour Survey of PCB's in the Cedarburg Treatment Plant on April 15, 1971

| Time | Flow (in gal/min) | PCB Concentrations (in ppb)[1] In the Influent | In the Effluent | In the Primary Trickling Filter |
|---|---|---|---|---|
| 0:00 | 1480 | 0.30 | 0.33 | ----- |
| 1:00 | 1360 | ---- | ---- | 0.19 |
| 2:00 | 1300 | 0.20 | 0.10 | ----- |
| 4:00 | 1250 | 0.13 | 0.35 | ----- |
| 6:00 | 1200 | ---- | 0.16 | ----- |
| 8:00 | 2000 | 0.54 | 0.39 | ----- |
| 10:00 | 2100 | 0.40 | 0.50 | ----- |
| 12:00 | 1900 | 1.7 | 0.23 | 0.69 |
| 14:00 | 1900 | 1.5 | 0.77 | ----- |
| 16:00 | 1850 | 3.1 | 0.70 | ----- |
| 17:00 | 1900 | ---- | ---- | 0.25 |
| 20:00 | 1950 | 0.30 | 0.22 | ----- |
| 21:00 | 1800 | ---- | ---- | 0.14 |
| 22:00 | 1650 | 0.36 | 0.34 | ----- |

[1]The Chromatograms of the samples most closely resembled the chromatogram of Aroclor 1254.

SOURCE: Dube, D.J. Polychlorinated Biphenyls in Effluents from Sewage Treatment Plants in Southeastern Wisconsin

DSW 442288

STLCOPCB4056823

2.5.2.4 Ohio

Very little information is available from the Ohio River. The values reported are given in Table 2.5-11.

Table 2.5-11
PCB Levels from Sewage Treatment Plants, Ohio, 1971

| Collection Site | Aroclor Detected | Concentration (ppb) |
|---|---|---|
| Dayton | 1254 | 17 |
| Hamilton | 1248 | 10 |
| Middleton | ---- | N.D. |

SOURCE: Polychlorinated Biphenyls and the Environment, Interdepartmental Task Force on PCB's, May 1972

DSW 442289

STLCOPCB4056824

2.5.2.5 California

In 1970 over a billion gallons of waste water entered the sea each day from urban sewage systems in California. Since two kilograms of PCB output per day are equivalent to one ton per year, outfalls of 9 sewage treatment plants discharging waste to the sea in California were sampled in an effort to identify potential PCB sources. The samples were all taken from sewage outfalls at sites closest to the points of entry into the sea as shown in Figure 2.5-9. The highest output was reported in Los Angeles County which is one of the most industrialized areas in the state. Table 2.5-12 shows the PCB levels identified in the samples collected.[5]

The only other available data were collected in early 1975 on sludge as part of the California Compliance Monitoring Survey for Chlorinated Hydrocarbons.[6] The results obtained are listed in Table 2.5-13.

Only one plant was sampled in both studies, the Hyperion Plant in Los Angeles. The 1970 sludge samples had 78.5 and 98.1 ppb concentrations while the 1975 readings ranged from 1,000-1,400 ppb.

DSW 442290

STLCOPCB4056825

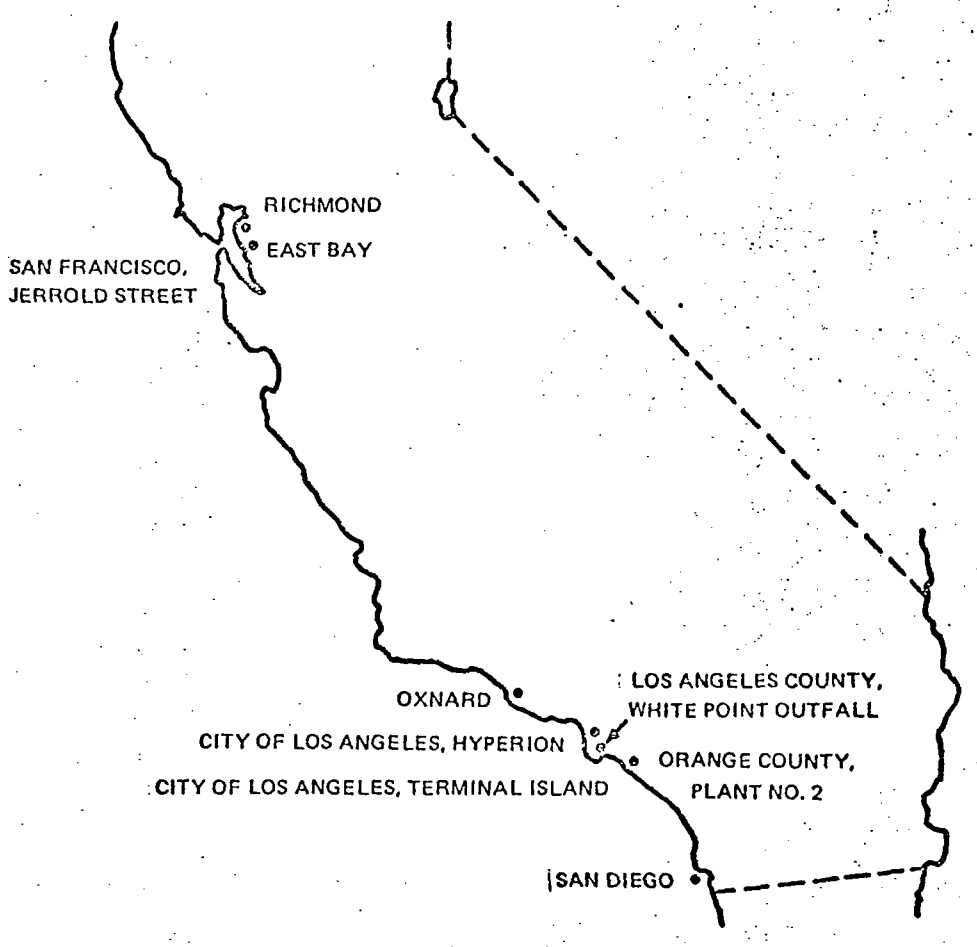



FIGURE 2.5-9 LOCATIONS OF TREATMENT PLANTS SAMPLED, CALIFORNIA

DSW 442291

Table 2.5-12
PCB Compounds in Urban Sewage Outfalls in California - 1970

| Sampling Station | Description | Flow | PCB Type | PCB ppb | PCB est. kg/day |
|---|---|---|---|---|---|
| Richmond | Serves most of Richmond including one of the most heavily industrialized regions of the Bay Area. | 21.5 | ---- | N.D | ---- |
| EBMUD East Bay Municipal Utility District | Discharges primary treated waste water and digested sludge into San Francisco Bay. | 155 | 1260 | 3.1-3.8 | 2.0 |
| San Francisco (Southeast Sewage Treatment Plant) | Serves the industrial area of San Francisco. | 31.5 | 1260 | 3.8-5.8 | 0.6 |
| Oxnard | Serves Oxnard. | 10.0 | ---- | N.D | ---- |
| Hyperion Waste Water (City of Los Angeles) Sludge | Mostly domestic sources. | 340<br>5 | 1254<br>1254 | 0.16-0.37<br>78.5-92.1 | 0.4<br>1.6 |
| White Point | Serves Long Beach, Torrance and other heavily industrialized areas of Los Angeles County. | 350 | 1242, 1254 | 76 | 100 |
| Terminal Island | Serves Wilmington and Terminal Island seas. Processes mostly industrial waste. | 9.3 | 1242 | 5.8-12.8 | 0.35 |
| Orange County (plant #2) | Serves most of Orange County. | 130 | 1242 | 0.21-0.64 | 0.18 |
| San Diego | Serves San Diego and surrounding communities. | 80 | | N.D | |

SOURCE: Schmidt, T.T., R.W. Risebrough and F. Gress, Bulletin of Environmental Contamination and Toxicology 6, 235-243, (1971)

DSW 442292



STLCOPCB4056827

Table 2.5-13
PCB Levels in Sludge, California, 1975

| Location | Description | Polychlorinated Biphenyls (ppm) Aroclor 1254 | Aroclor 1260 | Aroclor 1242 |
|---|---|---|---|---|
| Orange County Sewage Treatment Plant | Fountain Valley Digester Sludge | ---- | ---- | 38-40 |
| Hyperion Sewage Treatment Plant | Los Angeles, Digester Sludge | 1.0-1.4 | ---- | ---- |
| Fort Ord Sewage Treatment Plant | Secondary Digester Sludge | 0.2-0.4 | ---- | ---- |
| Treasure Isle Sewage Treatment Plant | Sludge | 0.4-0.6 | ---- | ---- |
| Travis Air Force Base, Sewage Treatment Plant | Digester Sludge | 0.6-0.8 | ---- | ---- |
| Mather Air Force Base | Sacramento Primary Digester Sludge | 0.4-0.6 | ---- | ---- |
| McClellan Air Force Base | Secondary Sludge | ---- | 4.5-5.5 | ---- |
| Beale Air Force Base | Primary Digester | 0.3-0.5 | | |

SOURCE: Unpublished Data, USEPA National Field Investigation Center, August 1975

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## 2.6 Data from Localized Monitoring Efforts - Cities

### 2.6.1 Jacksonville, Florida

Samples of ambient air, water, soils and bottom sediments were collected in the vicinity of Jacksonville, Florida, on September 10, October 6-7 and November 20-21, 1975, for PCB analysis.[1]

Figure 1 illustrates the sampling locations in the Jacksonville area. The outlined area on Figure 2.6-1 circumscribes a municipal sewage sludge disposal site which has been used for the past several years by the City of Jacksonville.

AIR DATA

Air samples were collected at the fire station off Fort Caroline Road using a high-volume sampler equipped with polyurethane foam as the collection medium. Measured PCB concentrations are reported in Table 2.6-1 for the 24-hour period of November 20-21, 1975. The levels measured throughout this period ranged from 4 to 9 $ng/m^3$, with the lowest levels being observed during the early morning period. Chromatograms indicated the presence of the lower substituted PCB components of Aroclors 1221 and 1016. Quantitation of the PCB levels was performed after perchlorination to decachlorobiphenyl.

WATER, BOTTOM SEDIMENT AND SLUDGE DATA

The analytical data for water, bottom sediment and sludge are summarized in Table 2.6-2 for the sampling points shown on Figure 2.6-1. PCB content of bottom sediments range from 10 to 572 ppb, surface water concentrations ranged from the analytical detection limit of 20 ppt to 285 ppt, expressed as decachlorobiphenyl. The highest sediment concentration (572 ppb) was observed near the cooling water discharge of the Jacksonville Electric Authority Southside Generating Station. This may be related to use of PCB-containing materials at the generating station. Intermediate concentrations were observed in sections of the St. John's River which is surrounded by urban and industrial development. Drainage creeks from the municipal sewage sludge landfill area had bottom sediments of lower concentration. Inspection of gas chromatographic elution patterns indicates the presence of Aroclor 1260 in these sediment samples.

A concentration level of 720 ppb was measured for fresh sludge taken from the Monterey sewage treatment plant. Two-year-old sludge, taken from the landfill area, had a concentration level of 119 ppb.

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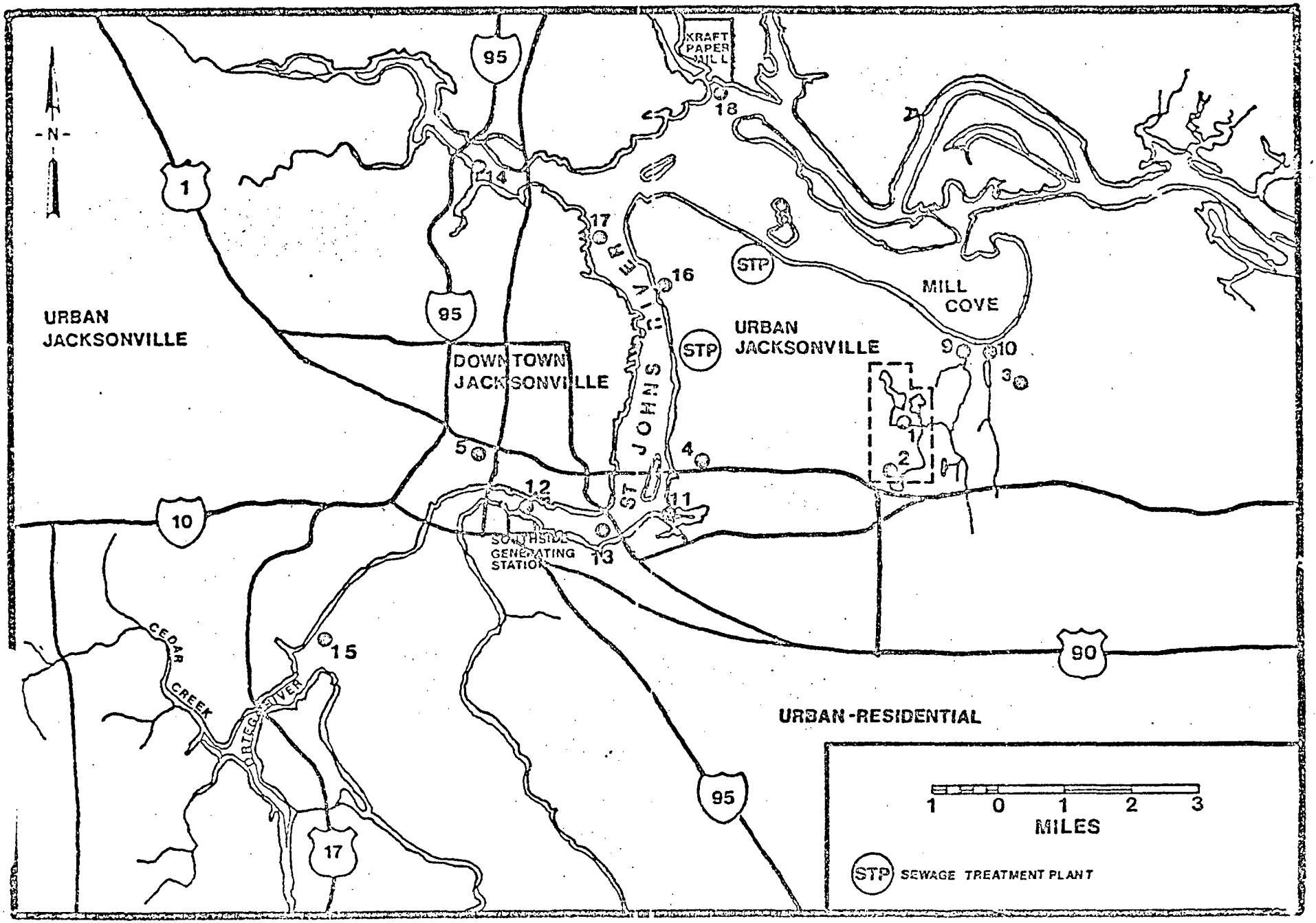


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Table 2.6-1
PCB in Ambient Air in the Vicinity of Jacksonville, Florida

| Date | Period | Concentration ($ng/m^3$)* |
|---|---|---|
| 11/20/75 | 1200-1600 | 9 |
| 11/20/75 | 1200-1800 | 8 |
| 11/20/75 | 1800-2400 | 9 |
| 11/20/75 | 2000-2400 | 7 |
| 11/21/75 | 2400-0600 | 4 |
| 11/21/75 | 0600-1200 | 6 |

* Reported as decachlorobiphenyl.

Table 2.6-2
PCB Analysis of Environmental Samples
in the Jacksonville, Florida, Area.

| Sample Site | Sample Type | Site Description | Concentration (ppb)* |
|---|---|---|---|
| 1 | Sludge | Monterey sewage treatment plant | 720 |
| 2 | Soil | SW section of sludge landfill; about two years old | 119 |
| 3 | Soil | Air collection site | 68 |
| 9 | Sediment | Unnamed Stream into Mill Cove | 10 |
| 10 | Sediment | Ginhouse Creek | 21 |
| 11 | Sediment | Arlington River Mouth | 74 |
| 11 | Water | Arlington River Mouth | 0.260 |
| 12 | Sediment | Generating Station Discharge | 572 |
| 13 | Sediment | St. John's River | 142 |
| 14 | Sediment | Trout River | 167 |
| 14 | Water | Trout River | 0.020 |
| 16 | Water | Jacksonville College Pier | 0.285 |
| 17 | Water | St. Joseph's River | 0.103 |
| 18 | Water | Broward River Mouth | 0.020 |

*Reported as decachlorobiphenyl.

SOURCE: Unpublished Report. Contract 68-01-2978, Office of Toxic Substances, EPA, December 1975.

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## 3.0 Behavior of PCB's in the Environment

In general, PCB environmental movement is dependent on stability, solubility and volatility. These properties will control their transport via air, soil, water and/or sediment depending on the partition coefficient in each phase.

General discussions on the thermal, photochemical and chemical properties of PCB's have recently been published by Hutzinger, Safe and Zitko[5]. Various transport mechanisms have received considerable attention[9,4]. Current air data indicates that the predominant movement of PCB's in the atmosphere is not attached to particulates as is the case with DDT, but rather as the free unbound molecular species.

Some of the complexities of the behavior of PCB's in the environment include the following characteristics which are discussed in subsequent sections: (a) the complexity of the composition of different Aroclor products, (b) the difficulty in definition of water solubility and adsorption properties due to the complexity of the mixtures, and (c) the variability of the volatilization process depending on the starting mixture and point of release. By coupling these areas, the focus will be on those PCB properties that influence environmental sample collection, control their distribution in environmental samples and present potential difficulties in environmental sampling.

### 3.1 Composition of Aroclor Products

PCB's have been manufactured in the United States by the Monsanto Industrial Chemicals Company, and marketed under the trademark Aroclor with a numerical designation[8]. Table 3-1 provides an overview of the major Aroclors produced with their associated chlorine content. These Aroclor products are mixtures of different isomers. A typical analysis of the currently produced products and the associated chlorobiphenyl composition is shown in Table 3-2. In addition, the number of potential isomers making up the chlorobiphenyl component are also indicated. From this chemical analysis, Aroclor 1221 can be considered primarily as a monochlorobiphenyl and is the only Aroclor with a significant biphenyl concentration; Aroclor 1016 and 1242 are primarily trichlorobiphenyls, with the 1016 having a lower penta and hexa content than the 1242 product; Aroclor 1254 is primarily a pentachlorobiphenyl product. The composition of the different isomers could be quite different for each product.

### 3.2 Water Solubility of PCB's

The water solubility of various Aroclor products and some chlorobiphenyl isomers has been measured by different investigators. A limited set of reported values are shown in Table 3-3. The solubility for all three monochlorobiphenyl isomers is listed and range from 1190-5900 ppb. The solubilities for all of the higher chlorobiphenyl isomers have not been measured and only representative compounds are listed to

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show the range of values possible and the component solubilities for Aroclor 1221; for the dichlorobiphenyls, the 2,4-, 2,2'-, 2,4'-, 4,4'-dichloro isomer is listed out of a possible 12 isomers and range in solubility from 80-1880 ppb; for the trichlorobiphenyls, only the 2,2',5-trichloro is listed out of a possible 24 isomers; for the tetrachlorobiphenyls only the 2,2',5,5'-tetrachloro is listed out of a possible 42 isomers. These values indicate that PCB's have low solubilities and the solubility decreases with the number of chlorine atoms present in the isomer, i.e., the lower isomers containing chlorine show the highest solubility. Factors that contribute to the variability of the results include adsorption to particulate matter or wall surfaces and the slow equilibration process.

Studies by Haque et. al.,[3] show that equilibration of Aroclor 1254 in water required approximately two months to reach complete equilibrium, with the major portion being achieved in a week. These studies also included various types of adsorbent surfaces ranging from sand to highly organic soil samples. The adsorption increased strongly with the organic content of the adsorbent studied. Starting with an original concentration of Aroclor 1254 at 56 ppb, the addition of 100 grams of sand or silica gel had very little effect on the final PCB concentration. However, by adding a high organic content soil, the final PCB concentration was reduced by approximately 85%.

Studies by Eichelberger[1] on the behavior of PCB's in river water over a 16 week period indicated that the levels of recovery of 10 ppb spiked Aroclor 1242 samples were 87, 76, 73, 60, 53 and 43 percent for zero time, 1, 2, 4, 8 and 16 weeks respectively. Losses were attributed to irreversible adsorption on either the walls of the sample container or the silt contained in the sample.

### 3.3 Interactions of PCB's with Soils

The behavior of PCB's in soil is a complex process dependent on a number of factors which include surface properties and composition. Soil composition can be identified by characterizing the percentage of sand, silt, clay and organic carbon. Depending on the surface properties, soils can act as an effective barrier to PCB migration in landfill sites and as an effective sink to PCB's deposited via aerial fallout. Once the PCB's are adsorbed, factors that would influence PCB movement are leaching when water is added to the soil and re-evaporation under normal atmospheric conditions.

In a series of experiments directed at understanding the leaching properties for various soils that could be encountered at different landfill sites, different types of soils were studied[10]. These experiments percolated water through a column packed with soil coated with Aroclor 1016 and monitored the effluent water. Breakthrough of the PCB's was found to be related to the clay content of the soil. Soils with the higher clay content retained the PCB's. The isomer distribution in the

effluent reflected the different water solubility and adsorption properties characteristic of the Aroclor 1016 isomers. The less chlorinated isomers were more readily leached. Results from these experiments are shown in Figure 3-1, where an Aroclor 1016 and 1221 standard solution is compared with the leached mixture. The resulting isomer distribution is significantly changed from the starting Aroclor 1016 and has a closer resemblance to the isomer pattern of Aroclor 1221. In the worst case, less than 0.05% of the total Aroclor 1016 available was leached under conditions equivalent to forty years of annual rainfall.

Adsorption and evaporation studies[3] with Aroclor 1254 on different soils show that due to the few adsorption sites in sand, sand surfaces adsorb relatively small amounts when compared to the other types of soils. Consequently the vaporization loss from a sand surface will be significantly higher than soil surfaces where it is more tightly bound. The less chlorinated isomers show a greater loss than those isomers of high chlorine content.

### 3.4 Evaporation of PCB's from Water

The transfer of PCB's from water to the air environment may be significantly faster than expected when considering that these compounds have a high molecular weight, low solubilities and low vapor pressures[6,7]. On examination, these compounds exhibit very high activity coefficients in aqueous solution resulting in high equilibrium vapor partial pressures and consequently high evaporation rates. The rates are relatively insensitive to temperature. For different Aroclor products, the evaporation process is complex depending on the chlorobiphenyl isomers present, leading to different isomer concentrations in each phase with time. The calculated half-lives for Aroclor 1242 and 1254 for a water depth of one meter are 12.1 and 10.3 hours respectively. Using the half-life values, if a monitoring station is located one hour downstream from a source of Aroclor 1242, by the time the water reaches the station, approximately one twentieth of the initial levels may have been evaporated. Where the water body is turbulent, the evaporation rate will be increased significantly.

### 3.5 Environmental Sampling Guidelines

Based on these limited studies, the following guidelines and precautions are suggested:

(1) laboratory measurements of field samples should be made as soon as possible;
(2) concentration levels of field samples measured in the laboratory will be lower than actual concentrations;
(3) concentration levels in water may be much lower in some areas depending on the type of suspended particulate matter;
(4) samples collected at plant outfalls will be non-equilibrium samples;



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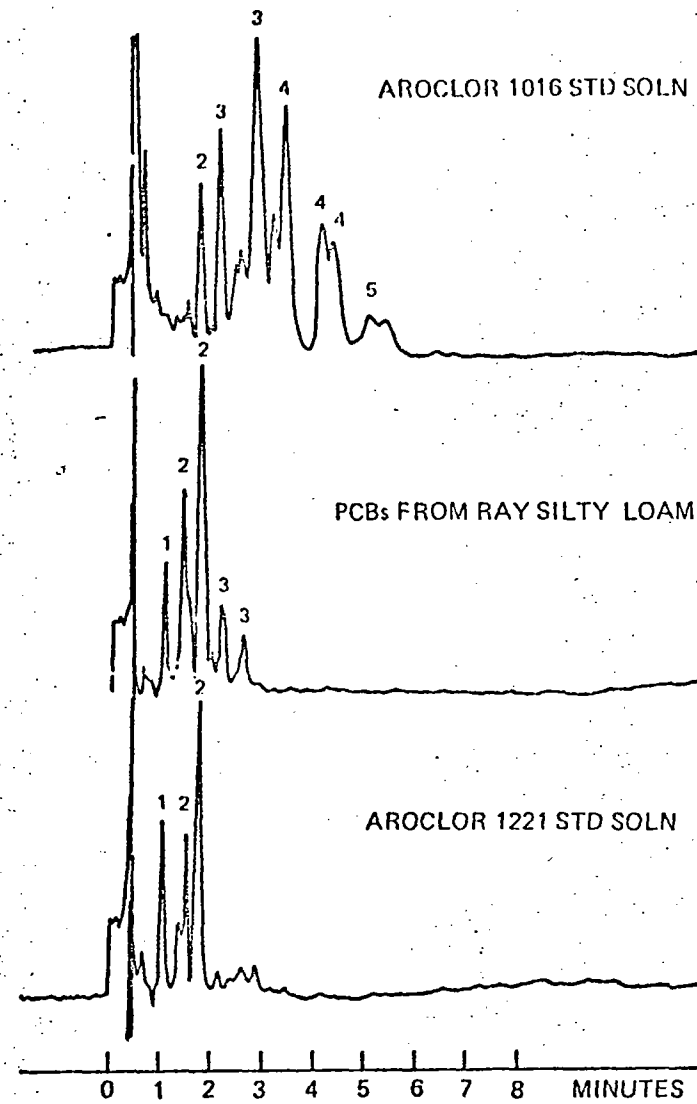


SOURCE: MIEURE, J.P., O. HICKS, R.G. KALEY AND V.W. SAEGER, "CHARACTERIZATION OF POLYCHLORINATED BIPHENYLS," NATIONAL CONFERENCE ON POLYCHLORINATED BIPHENYLS, CHICAGO, ILL., NOVEMBER 19-21, 1975

FIGURE 3-1

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(5) sampling methods should be employed which reduce the problem of irreversible adsorption on container walls;
(6) soil samples will have an enriched high chlorobiphenyl isomer concentration;
(7) leached water and air samples will have an enriched lower chlorobiphenyl isomer concentration;
(8) true identification of the specific Aroclor released into the environment becomes more difficult with time.

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Table 3-1
AROCLOR PRODUCTS
Produced by Monsanto

| Currently in Production | Discontinued | Percent Chlorine |
|---|---|---|
| 1221 | | 21 |
| | 1232 | 32 |
| 1016 | | 41 |
| 1242 | | 42 |
| | 1248 | 48 |
| 1254 | | 54 |
| | 1260 | 60 |
| | 1262 | 62 |
| | 1268 | 68 |

Table 3-2
COMPOSITION OF SOME AROCLORS

| Chlorobiphenyl Composition | Number of Isomers | Chlorobiphenyl Percent Distribution of some Aroclors | | | |
|---|---|---|---|---|---|
| | | 1221 | 1016 | 1242 | 1254 |
| $C_{12}H_{10}$ | | 11 | <0.1 | <0.1 | <0.1 |
| $C_{12}H_9Cl$ | 3 | 51 | 1 | 1 | <0.1 |
| $C_{12}H_8Cl_2$ | 12 | 32 | 20 | 16 | <0.5 |
| $C_{12}H_7Cl_3$ | 24 | 4 | 57 | 49 | 1 |
| $C_{12}H_6Cl_4$ | 42 | 2 | 21 | 25 | 21 |
| $C_{12}H_5Cl_5$ | 46 | <0.5 | 1 | 8 | 48 |
| $C_{12}H_4Cl_6$ | 42 | ND | <0.1 | 1 | 23 |
| $C_{12}H_3Cl_7$ | 24 | ND | ND | <0.1 | 6 |
| $C_{12}H_2Cl_8$ | 12 | ND | ND | ND | ND |

ND = None detected, <0.1%

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Table 3-3
SOLUBILITY OF AROCLORS AND CHLOROBIPHENYLS IN WATER

| Aroclor Products | Solubility (ppb) | Media | References |
|---|---|---|---|
| 1016 | 225-250 | distilled water | 10 |
| 1221 | 200 | distilled water | 8 |
| 1242 | 200 | distilled water | 9 |
| 1254 | 300-3000 | fresh water | 12 |
| 1254 | 300-1500 | salt water | 12 |
| 1254 | 50 | distilled water | 9 |
| 1254 | 56 | distilled water | 3 |
| 1254 | 40 | distilled water | 8 |
| Chlorobiphenyl Compounds | | | |
| 2-chlorobiphenyl* | 5900 | | 5 |
| 3-chlorobiphenyl | 3500 | | 5 |
| 4-chlorobiphenyl* | 1190 | | 5 |
| 2,4-dichlorobiphenyl | 1400 | | 5 |
| 2,4-dichlorobiphenyl | 637 | | 2 |
| 2,2'-dichlorobiphenyl* | 1500 | | 5 |
| 2,4'-dichlorobiphenyl* | 1880 | | 5 |
| 4,4'-dichlorobiphenyl* | 80 | | 5 |
| 2,2',5-trichlorobiphenyl | 248 | | 2 |
| 2,2',5,5'-tetrachlorobiphenyl | 46 | | 11 |
| 2,2',5,5'-tetrachlorobiphenyl | 26 | | 2 |

*These are the major chlorobiphenyl compounds in Aroclor 1221; the other major constituent is biphenyl which has a solubility in water of 4600 ppb.

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## 4.0 Occurrence of PCB's in Food

Some of the earliest findings of PCB's in foods occurred during the fall of 1969 in coho salmon and milk from West Virginia which was traced back to the misuse of a transformer fluid containing PCB's for defoliant spraying adjacent to dairy pasturage. In 1971 PCB's were found in poultry from North Carolina. Contaminated fish meal was implicated as the causative agent. The contamination was traced back to a leak in heat exchange equipment using PCB's. The fish meal samples examined contained from 14 to 30 ppm of PCB's. Follow-up sampling of eggs showed that 71 of 224 eggs contained residues in excess of 0.5ppm ranging from 0.6 to 4.2.ppm.[2]

The Food and Drug Administration conducts a comprehensive food surveillance program yearly to determine pesticide residues, PCB's, heavy metals and other contaminants in the dietary intake of consumers in the United States and to target emerging problems and trends. The FDA has analyzed all raw agricultural commodities sampled under the pesticide surveillance program for PCB's since 1969. PCB's have been encountered most frequently in fish, both freshwater (catfish, chub, and smelt) and saltwater (porgies, sea trout, bonita and sardines), with trace levels in shellfish. Table 4-1 presents the results of this program from July 1970 to September 1971.[2]

The total diet studies for FY 70 and FY 71 showed composite samples containing PCB residues up to 0.36 ppm. The positive readings were found in meat, fish, poultry, dairy and the grain and cereal composites. The 0.36 ppm value was found to be caused by migration of PCB's from the grayboard container and dividers to packaged shredded wheat.[2]

The FY 73 study included thirty market basket samples from representative areas of the United States consisting of the total 14-day diet of a 15-20 year old male in the region of collection including about 117 individual food items.[1]

These 117 food items are separated after any necessary preparation into twelve food group composites for analysis:

| | |
|---|---|
| I | Dairy Products |
| II | Meat, Fish and Poultry |
| III | Grain and Cereal Products |
| IV | Potatoes |
| V | Leafy Vegetables |
| VI | Legume Vegetables |
| VII | Root Vegetables |
| VIII | Garden Fruits |
| IX | Fruits |
| X | Oils, Fats and Shortening |
| XI | Sugar and Adjuncts |
| XII | Beverages (including drinking water) |

Most of the PCB levels identified in 1973 were trace amounts resulting in a daily intake of only 1 μg/day. The most frequent occurrences were in the meat-fish-poultry and grain-cereal products groups with 33% and 17% positive analyses. It has been suggested that environmental contamination may be the source in the first group and lingering recycled paper contamination in the second group.

Of 30 composites examined for each commodity group PCB residues were only determined in five of the groups as follows:

| Group | Frequency |
|---|---|
| Dairy Products | 3 |
| Meat, Fish and Poultry | 10 |
| Grain and Cereal Products | 5 |
| Potatoes | 1 |
| Oils, Fats and Shortening | 1 |

The range for all 20 positives was trace to 0.073 ppm. In fact 19 of the 20 readings were only trace amounts with the 0.073 ppm composite appearing in the Grain and Cereal Products group.[1]

Data for 1974 are not available yet. However preliminary information is that there were only 14 positive readings with 13 of them in the Meat, Fish and Poultry Group and the other one in the sugar and adjuncts group. The range of levels measured was trace to 0.05 ppm with the maximum levels in the Meat, Fish and Poultry group.[3]

Using the preceding figures it is estimated by FDA that the daily intake of PCB's from all twelve food group composites was 1.07 μg/day in 1973 and 0.388 μg/day in 1974.[3]

Table 4-1
PCB Residues in Selected Food Commodities
July 1970 - September 1971

| | Number of samples examined | Number of samples positive | Percent positive | PCB levels, ppm, Low | high | Average |
|---|---|---|---|---|---|---|
| Fish | 670 | 363 | 54 | T | 35.29 | 1.87 |
| Cheese | 1344 | 91 | 6 | T | 1.0 | .25 |
| Milk | 941 | 69 | 7 | T | 27.8 | 2.27 |
| Shell eggs | 550 | 161 | 29 | T | 3.74 | .55 |
| Fish by-products | --- | 13 | -- | T | 5.0 | 1.17 |
| Total (excluding fish by-product) | 3505 | 684 | 19 | | | 1.14 |

SOURCE: Kolbye, A.D., Jr., Environmental Health Perspectives, 85-88, April 1972.

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# 5.0 Exposure and Biological Accumulation of PCB's in Man

## 5.1 National Monitoring Programs

The National Human Monitoring Program for Pesticides is conducted by the Office of Pesticide Programs, EPA. Small samples of adipose tissue from postmortem examinations and from specimens submitted for pathological examination during therapeutic surgery are collected and analyzed for the presence of chlorinated hydrocarbon insecticides. Analysis for PCB's was begun in 1968. Summaries of the data from 1971 are reported in Table 5.1-1 and from 1972 to 1974 in Table 5.1-2.

Note that although classes are different in the two sets of results, the proportion of samples showing traces of PCB's is increasing: 50.7%, 1971; 73.99%, 1972; 75.49%, 1973; 90.93%, 1974. The increase between 1973 and 1974 is dramatic. However, the percentage of tissues which contained quantifiable (greater than 1.0 ppm) of PCBs appears to be remaining relatively constant (31.1%, 58.53%, 35.08%, 40.30%, 1971-74).

## 5.2 Localized Studies

There have been several localized studies showing the presence of PCB's in both human plasma and milk. A 1968 study in Charleston County, South Carolina[3], reported that of 612 plasma samples collected from healthy volunteers, 45% showed some PCB residue. Levels ranged to a maximum of 29 ppb with a mean plasma residue of 2.12 ppb. This study also tested for the significance of several factors on PCB levels, concluding only that residues were more frequent and higher in whites and urban residents. A follow-up study conducted in 1972[1] in the Charleston area sampled plasma and scalp hair specimens from 37 refuse burners and 54 controls. PCB residues were not detected in hair samples, but 81% of the refuse burners (compared with only 11% of the controls) had detectable PCB residues in plasma. Median levels for those with detectable amounts in plasma were 2.6 ppb for the refuse workers and 3.7 ppb for the controls, with maximums of 14.1 ppb and 20.2 respectively.

A 1971-72 study[6] of 40 human milk samples in Colorado discovered PCB residues in 20% of the samples in ranges from 40 to 100 ppb. A 1971 study of 47 lactating women in Texas[2] reported an absence of PCB residues both in milk from all subjects and in serum from 28 subjects. A minor study of blood samples from nine cachectic patients and 15 healthy nonpatients from Missouri and surrounding states[4] reported detectable PCB residues in all patients (mean 48 ppb, range 10-100 ppb) and none detectable in the nonpatients. No conclusions were drawn.

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Table 5.1-1
PCB Concentrations in Human Adipose Tissue, 1971

| Sample Size | Absent Number | Absent % | Trace to Below 1 ppm Number | Trace to Below 1 ppm % | 1-2 ppm Number | 1-2 ppm % | 2 ppm Number | 2 ppm % |
|---|---|---|---|---|---|---|---|---|
| 637 | 314 | 49.3 | 125 | 19.6 | 165 | 25.9 | 33 | 5.2 |

SOURCE: Yobs, Anne R., Environmental Health Perspectives, 1, 79-81 April 1972.

Table 5.1-2
PCB Concentrations in Human Adipose Tissue, 1972-1974

| | Sample Size | Absent Number | Absent % | Below 1 ppm Number | Below 1 ppm % | 1-3 ppm Number | 1-3 ppm % | 73 ppm Number | 73 ppm % |
|---|---|---|---|---|---|---|---|---|---|
| 1972 | 4102 | 1067 | 26.01 | 634 | 15.46 | 2079 | 50.68 | 322 | 7.85 |
| 1973 | 1277 | 313 | 24.51 | 513 | 40.17 | 378 | 29.60 | 70 | 5.48 |
| 1974 | 1047 | 95 | 9.07 | 530 | 50.62 | 371 | 35.43 | 51 | 4.87 |

SOURCE: Kutz, F.W., Project Officer, National Human Monitoring Program for Pesticides, Office of Pesticides Programs, U.S. EPA, Washington, DC.

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## 6.0 Environmental Trends

There are few data bases or environmental studies which provide an adequate basis for sound analytic determinations of national trends in environmental levels of PCB's. Such a data base would be a result of a system of studies involving consistent sampling across media, i.e., statistical samples taken at the same locations at representative time periods, analyzed according to standard protocols, taken over a period of time long enough to establish a trend. Some studies do show consistent sampling within specific media, e.g., the Great Lakes Environmental Contaminant Survey, but the literature is full of snapshot studies with neither predecessor nor successor, and baseline studies which have not been followed by any further work. Thus, whether due to funding, modification of priorities or personnel changes, long-term consistency and coordination have not been achieved. As a result, the conclusions drawn in this section represent qualitative judgements drawn from the large mass of generally uncoordinated PCB studies analyzed.

Even recognizing all the faults of the available data base, the sheer mass of data supports the conclusion that there is widespread contamination of the environment by PCB's. There are regional variations, but effects are consistent across all media (e.g., water, sediment, fish, birds), generally showing greater concentrations of PCB's in highly developed areas and in areas of industrial activity. Over the past five years of increasing recognition of and attention to the problems of PCB's, the situation has shown no improvement nationally. Conscious efforts have, however, resulted in substantial improvement in some localized instances.

PCB contamination of the nation's waterways was termed widespread by the USGS over the period 1971-1972; more recent data from the USGS up to 1975 has shown no reduction in either levels or in geographical dispersion. Although sampling stations in the USGS data base are not expected to be representative of the U.S. and the data suffers from multiple observations at some stations and spot readings at others, over the period 1971-1975 states which had reported PCB's in sediment continued to do so while six of the 23 states which had shown no contaminated samples in 1973 did report some contamination in 1974. Sediment concentrations are imperfect indicators of current contamination levels and whole water measurements would be better. However, the currently practiced analytical protocol for water measurements, which limits detectability to 0.1 ppb, leads to a preponderance of zero readings in whole water which mask the very real problem of PCB contamination in the nation's waters. In almost all cases in which samples of both whole water and bottom sediment were taken simultaneously and the sediment had a non-zero PCB level, concentration in the water was reported as zero ppb. This occurred even when the concentration in bottom sediment was as high as 4000 parts per billion! Were water measurements to be taken at the parts per trillion level as some recent studies have done, whole water readings would certainly show PCB contamination, to an extent similar to that shown by sediment readings.

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The results of the U.S. Fish and Wildlife Service's fish monitoring activities show that stations which have reported high concentrations in the past continue to do so, and that the higher concentrations are associated with river systems having significant industrial activity. Such results are consistent with those for water and sediment from the USGS water quality file. The fish data, however, shows a decline in both the proportion of composites with some PCB residues and the proportion with residues in excess of 0.5 ppm in the 1970-73 sampling program. Levels of detection are generally lower in 1973 than in previous years. While there are cautionary notes (see section 2.1.5), some improvement in PCB contamination appears evident, although mostly at those stations with prior low contamination levels.

Water is recognized as being a major sink and transport mechanism for PCB's and, therefore, residue levels in water and fish are significant. Yet other media confirm the stability and breadth of contamination over the nation. Data on human adipose tissue show a steady climb over the years 1971-74 in the percent showing traces of PCB's. Soil monitoring shows that sixty percent, i.e., 3 of 5 cities sampled each year since the National Soils Monitoring Program started have had at least one positive PCB sample. Bird monitoring conducted as part of the U.S. Bureau of Fish and Wildlife's portion of the National Pesticides Monitoring Program shows residue levels in black ducks and mallards increasing between 1969 and 1972 in the Atlantic and Mississippi flyways and slightly decreasing in the Central and Pacific Flyways. PCB residues in starlings for 1970, 1972 and 1974 appear to be decreasing, yet PCB residues have been found in <u>all</u> samples each year, underscoring the ubiquitous nature of PCB's throughout the country.

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