H. B. Richards, Jr.

REPORT NO. 2892

INTERIM REPORT

ON

AROCLOR IN GASES

Job No. 171-1089 June 17, 1953

H. B. Richards, Jr

**RESEARCH DEPARTMENT**
**Phosphate Division**

2892 - AROCLOR IN GASES

MONS 058945

MONSANTO

Report No. 2892

INTERIM REPORT ON
AROCLOR IN GASES

Job No. 171-1089
File No.

Research Department - Phosphate Division
Anniston, Alabama.

Work Started: 5-8-53
Work Completed: 6-16-53
Report Submitted: 6-17-53

Prepared By:
H. B. Richards, Jr.

Chemists:
A. M. Ellenburg
H. B. Richards, Jr.

18 copies were made of this report and distributed as follows:

| | |
|---|---|
| No. 1 | Research File |
| No. 2 | R. L. Jenkins - St. Louis |
| No. 3 - | J. L. Christian-T. K. Smith - St. Louis |
| No. 4 | H. F. Weaver - St. Louis |
| No. 5 | C. A. Hochwalt - St. Louis |
| No. 6 | N. N. T. Samaras - Dayton |
| No. 7 | E. E. Hardy |
| No. 8 | A. M. Ellenburg |
| No. 9 | H. B. Richards, Jr. |
| No. 10 | P. G. Benignus - St. Louis |
| No. 11 | R. E. Kelly - St. Louis |
| No. 12 | P. G. Benignus - St. Louis |
| No. 13 | P. G. Benignus - St. Louis |
| No. 14 | P. G. Benignus - St. Louis |
| No. 15 | P. G. Benignus - St. Louis |
| No. 16 | P. G. Benignus - St. Louis |
| No. 17 | |
| No. 18 | |



MONS 058946

This is Copy No. 9

This report and the information contained herein is the property of
MONSANTO CHEMICAL COMPANY

C O N F I D E N T I A L

This report and the information contained herein is the property of the Monsanto Chemical Company, and should be considered confidential. It should be retained by the recipient, and not copied or loaned to others.

## TABLE OF CONTENTS


| | | Page No. |
|---|---|---|
| I. | Introduction | 1 |
| II. | Summary | 1 |
| III. | References | 2 |
| IV. | Experimental Work | 2 |
| | A. Experimental Data | 2 |
| | B. Negative Results | 3 |
| | C. Precision and Accuracy | 3 |
| V. | Discussion | 3 |
| VI. | Conclusions | 5 |
| VII. | Recommendations | 5 |
| | Appendix | 7 |
| | Sampling Positions | 7 |
| | Operating Procedure for Willson Product's, Incorporated, Chlorinated Hydrocarbon Sampling Apparatus | 8 |
| | Data Sheet - Aroclor Vapor Detection | 12 |
| | Diagrammatic Sketch | 13 |


MONS 058948

## I. INTRODUCTION:

Dow Chemical Company is interested in using Aroclor as a plasticizer in styrene latex paint systems. Research at the Plastics Division's Springfield laboratories has indicated that use of such paints in enclosed areas under certain conditions results in Aroclor vapor concentrations above the accepted safe maximum for continuous exposure. For this reason Dow is dubious about the use of Aroclor for this application.

The Sales Department, therefore, requested that experiments be carried out in the Aroclor plant at Anniston to determine the Aroclor vapor concentration to which the operating personnel are normally exposed. This data can then be submitted as evidence that exposure to this concentration has had no apparent toxic effects upon the operators.

This work was undertaken to determine the usual Aroclor vapor concentrations in the plant.

## II. SUMMARY:

The chlorine content of the air in the Aroclor plant has been determined at several positions and under various conditions. Willson Product's, Incorporated, apparatus for determination of chlorinated hydrocarbons was employed for these tests. (See Appendix). The Aroclor vapor concentration was found to vary widely depending upon several factors including location of sampling apparatus, operations being carried out, directions of drafts through the still room, and temperature and boiling point of the Aroclor under question. The actual Aroclor vapor concentrations varied from about 0.35 mg. per cu. meter to about 5.0 mg. per cu. meter under the most severe conditions. No definite average concentration has been established.

It was found, however, that the Aroclor vapor concentration in the air at the sample points is seldom below the 0.5 to 1.0 mg. per cu. meter level, which is the maximum tolerable concentrations (according to Elkins, see References), and often is as high as 3 to 5 mg. per cu. meter. These higher concentrations are extremely irritating to the eyes, nose, and throat.

On the basis of these facts it is difficult to conceive that concentrations in the range of 1 to 5 mg. per cu. meter reported by the Plastics Division as a result of painting with an Aroclor-containing paint could be attained under normal conditions with this type paint. It should be further noted that nearly half the tests in the plant showed less than 1.0 mg. Aroclor per cu. meter, and about two thirds of the tests showed less than 2.0 mg. Aroclor per cu. meter, and only about 5.0 mg. per cu. meter under the most severe conditions. It is recommended that this laboratory secure a sample of the paint under question and make tests with it to determine the resulting Aroclor vapor concentration in the air.

MONS 058949

Sampling of the air in the plant will also be continued until more complete data are obtained on all of the Aroclors.

## III. REFERENCES:

Jacobs, M. B., "The Analytical Chemistry of Industrial Poisons, Hazards, and Solvents," second edition, Interscience, New York City, 1949.

Millhiser, F. R., "Determination of Halowax in Air," Report from Dept. of Physiology, Harvard School of Public Health, Boston, Mass., Sept., 1936.

Monsanto Chemical Company, Plastics Division, Confidential Report on Aroclor Vapor in Air From Paints, Dec., 1952, (no report number assigned).

Elkins, Hervey B., "The Chemistry of Industrial Toxicology," John Wiley & Sons, New York, 1950, page 149.

## IV. EXPERIMENTAL WORK:

The apparatus and operating procedure are described in the Appendix to this report. A description of the various sampling positions together with a sketch of the Aroclor plant floor plan may also be found in the Appendix.

### A. Experimental Data:

TABLE I
AROCLOR VAPOR CONCENTRATION IN AIR
AROCLOR 1260

| Test No. | Position No. | Concentration, mg./cu.m. Chlorine | Aroclor | Remarks |
|---|---|---|---|---|
| 11 | 5 | 0.32 | 0.53 | Still in operation. |
| 13 | 4 | 0.55 | 0.92 | Still open. |
| 14 | 5 | 0.52 | 0.87 | Still open. |
| 15 | 6-S | 1.5 | 2.5 | Filtering at 125°C. |
| 16 | 6-N | 1.2 | 2.0 | Filtering at 125°C. |
| 18 | 5 | 0.22 | 0.36 | Still in operation. |
| 19 | 4 | 0.91 | 1.5 | Still open. |
| 20 | 4 | 0.75 | 1.2 | Still charged and started. |
| 21 | 4 | 0.53 | 0.88 | Still in operation. |
| 28 | 8 | 2.8 | 4.6 | Drumming 1260 at 150°C. |

TABLE II
AROCLOR VAPOR CONCENTRATION IN AIR
AROCLOR 1242 AND 1254

| Test No. | Position No. | Concentration, Mg./cu.m. Chlorine | Aroclor | Remarks |
|---|---|---|---|---|
| 10 | 5 | 0.14 | 0.33 | Still open. |
| 29 | 4 | 1.5 | 3.6 | Still operating. |
| 30 | 5 | 1.5 | 3.6 | Still operating. |
| 31 | 6-S | 2.2 | 5.3 | Press not operating and cold. 1242 in No. 2 B.T. at 110°C. |
| 25 | 5 | 0.41 | 0.76 | Still operating. |
| 27 | 5 | 0.50 | 0.92 | Still operating. |

Note: All tests on 1242 except 25 and 27 which were 1254.

TABLE III
AROCLOR VAPOR CONCENTRATION IN AIR
MISCELLANEOUS

| Test No. | Position No. | Concentration, mg./cu.m. Chlorine | Aroclor | Remarks |
|---|---|---|---|---|
| 17 | 9 | 0.21 | - | Atmosphere blank, north of building. |
| 23 | 9 | 0.32 | - | Atmosphere blank, north of building. |
| 22 | 7 | 1.1 | 2.2 | At operators' desk. |
| 24 | 10 | 0.68 | 1.4 | At steam recorder, north end of room. |
| 12 | Reagent blank | | 0.006 mg. | $Cl^-$ in washings. |
| 26 | Reagent blank | | 0.007 mg. | $Cl^-$ in washings. |

B. Negative Results:

Tests numbers 1 through 9 were discarded. These runs were used for familiarization and establishing a satisfactory analytical procedure.

C. Precision and Accuracy:

The method used in these determinations has been claimed to have over-all accuracy of within 3% to 5% (see Millhiser, under References).

V. DISCUSSION

In Table I the most severe concentrations were encountered during three different operations on Aroclor 1260, charging the still, filtering, and drawing out the hot Aroclor into drums. These three operations constitute the greatest exposure to which the operator is normally subjected, plus the

exposure at the desk where the concentration was fairly high as seen in Table III. The drumming operation is the most severe of these since the concentration is highest and the time to which the operator is exposed to this concentration is usually in the order of 3 to 6 hours as compared to about 30 minutes for any of the other operations. The Aroclor vapor concentrations during the distillation operation varies from about 0.5 to 1 mg. per cu. m.

The Aroclor vapor concentrations were calculated by assuming 60% chlorine in the vapors. Actually the chlorine content of the vapors is probably lower than 60% since the lower boiling (and therefore lower chlorinated) components of the Aroclor are vaporized more readily than are the higher chlorinated components. This assumption then makes the values for the Aroclor vapor concentrations minimum values, since a lower chlorine content would give higher values for the chlorine containing material. This same fact applies to Table II.

In Table II the effect of the degree of chlorination (and therefore of boiling point) is indicated by the high concentrations found during 1242 operations. The concentration in test No. 10 was low, but the still had been shut down for about 7 hours when this test was made. It is noteworthy that the high concentration found in test No. 31 was during the earth treatment of a batch of Aroclor 1242, but not during a filtration. The intake to the sampling apparatus was about 8 ft. from the closed hatch of the tank in which the Aroclor was being treated at 110°C. There was a gentle draft through the room in the direction from the operating equipment toward the sampling apparatus. The Aroclor vapor concentration under these conditions was extremely high. Also, the concentrations in tests 29 and 30 were quite high in comparison to that found under the same conditions for 1260. These tests were made on the upwind side of the Aroclor treating tank. However, tests 25 and 27 on Aroclor 1254 under very similar conditions showed much lower vapor concentrations. Further tests are required to determine whether the high vapor concentration encountered during these tests on 1242 are usual, or whether the chlorine absorbed in the apparatus might have been from another source.

Table III gives some miscellaneous tests and blank determinations. Tests 22 and 24 show presence of considerable concentrations of roclor at points in the room relatively remote from any of the operating equipment. The operators desk is located at the head of an open stairway and quite possibly is exposed to much chlorine bearing material blown up the stairway by the draft through the building. The Aroclor vapor concentration on these two tests was estimated by assuming 50% chlorine in the vapors.

Blank determinations were made on the reagents and on the atmosphere outside the Aroclor plant. These values are tabulated in Table III.

MONS 058952

From these data it may be seen that the Aroclor vapor concentration in the plant varies from about 0.5 to 1 mg. per cu. meter at the minimum up to about 5 mg. per cu. meter under the most severe conditions. No average concentration or average daily exposure of the operator have been developed from the data so far.

Springfield has reported Aroclor concentrations from about 1 to 5 mg. per cu. meter from paints containing Aroclor. It hardly seems reasonable that concentrations within this range could be reached under the relatively mild conditions encountered, when the concentrations found in the plant are ordinarily within this range even under extreme conditions. It is therefore recommended that a sample of the paint in question be secured and tests made in a room painted with it.

It should be pointed out that although the Aroclor vapor concentration in the plant is seldom below the 0.5 to 1 mg./cu. meter level which is the maximum allowable concentration according to Elkins (see References), the exposure to which the operator is subjected varies greatly. This exposure depends upon the amount of time actually spent in the Aroclor plant, the operation being performed by the operator, and the Aroclor vapor concentration present at that particular time. All of these factors depend themselves upon several other variable conditions, making the establishing of an average exposure extremely difficult if not impossible. No apparent ill effects have been noted from this exposure over a period of several years. However, the highest concentrations were almost unbearably irritating to the nose, throat, and eyes. Elkins has made these same observations in studies in plants using Aroclor.

## VI. CONCLUSIONS:

1. The Aroclor vapor concentration in the plant is almost never below the 0.5 to 1 mg. per cu. meter level, and often reaches about 5 mg. per cu. meter in some locations.

2. The concentrations reported by Springfield of 1 to 5 mg. per cu. meter from paint containing Aroclor hardly seem reasonable considering the concentrations found in the plant.

3. No average daily exposure may be developed from these data.

## VII. RECOMMENDATIONS:

1. It is recommended that sampling of the air in the Aroclor plant be continued until more complete data are obtained.

MONS 058953

2. It is recommended that a sample of the Aroclor-containing paint in question be secured, and that a room be painted with it. Tests may then be made to determine the Aroclor vapor concentration in the room resulting from use of this paint.

H. B. Richards, Jr.

H. B. Richards, Jr.

WCM
6-22-53

## SAMPLING POSITIONS

| Position Number | Description |
|---|---|
| 1. | No. 1 still, simulating position of operator's head during charging operations. 54" from floor on west side of still about 18" from charging hole. |
| 2. | No. 1 receiver, at sight glass, simulating position of operator's head. 54" from floor and 12" west of sight glass. |
| 3. | No. 1 filter press; N - northside, S -- southside. 54" from floor and 15" from edge of press when on south side or 9" from edge of press when on north side. Northside location simulates operator's head position when redressing the filter press. |
| 4. | No. 2 still, same as position 1 above. |
| 5. | No. 2 receiver, same as position 2 above. |
| 6. | No. 2 filter press, same as position 3 above. |
| 7. | At operator's desk, 54" from floor and 8" beyond front edge of desk to simulate position of operator's head when writing at desk. |
| 8. | At scales for drumming Aroclor. 54" from floor and 14" from Arcolor outlet. Opposite side of drum from operator. |
| 9. | Blank determinations as described. |
| 10. | Miscellaneous positions, as described. |

DATA SHEET - AROCLOR VAPOR DETECTION

Run No. Date: Bar. Press., mmg. Hg.:

Location of intake:

Rate of sampling, lpm.: Duration of sampling, min.:

Ambient temp. at intake, °C.: Total vol. of sample, liters:

General Remarks:

Analysis: Net wt. of washings, gm.:

$Cl^-$ conc. in washings, ppm.:

Total $Cl^-$ in sample, mg.:

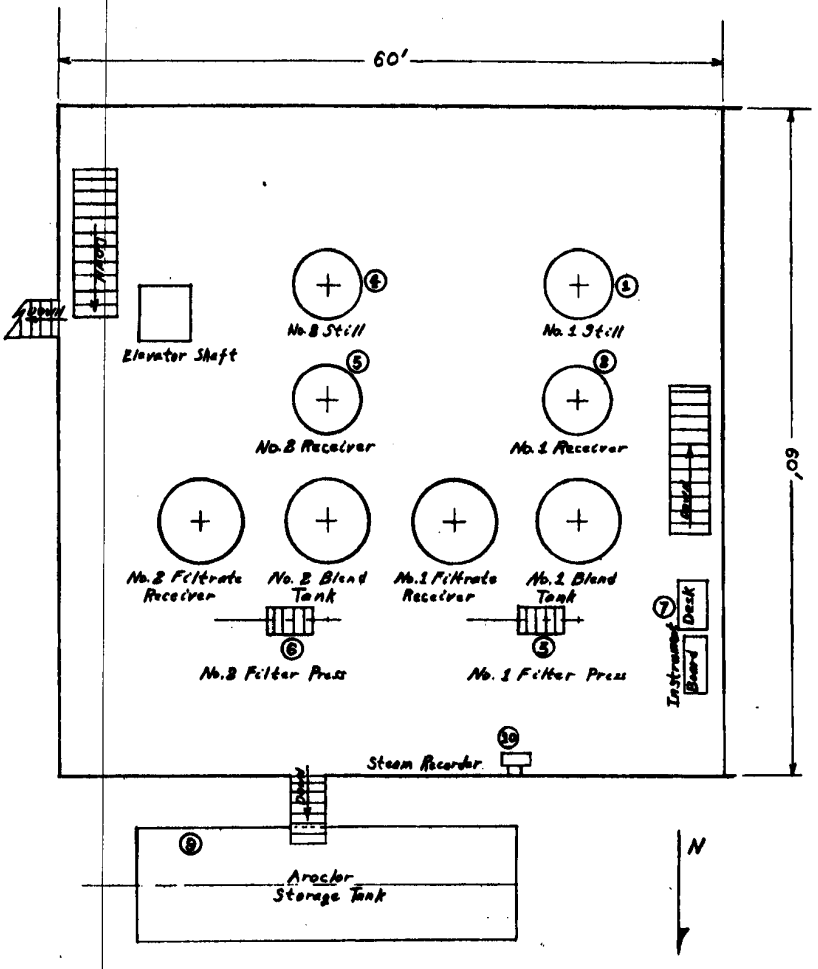
Total $Cl^-$ in blank, mg.:

Cl conc. in air, mg./cu. m.:

Arcolor conc. in air, mg./cu. m.:

MONS 058956

# Diagrammatic Sketch
## Aroclor Still Room




① Denotes Sampling Position

MONS 058957

Scale: 3/32" = 1'-0"
H.B.R. - 6-22-53