MONSANTO COMPANY

Organic Chemicals Division

Standard Manufacturing Process For

AROCLORS
Department 246

****

Supersedes: Process description for the manufacture of Aroclors, Dated: December 17, 1962.

Prepared by: L. G. Cole
L. G. Cole, P.T.S. Engineer

Approved by: R. W. Bucknell 7/15/64
R. Bucknell, Research

Approved by: E. E. Martin
E. E. Martin, Prod. Supervisor

D. B. Hosmer 8/11/64
D. B. Hosmer, Org. Prod. Mgr.

P. E. Heisler
P.E. Heisler, Gen. Prod. Spt.

Issued: 7-20-64

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TRAN 009192

MONSANTO COMPANY
Monsanto, Illinois

SAFETY REVIEW COMMITTEE

3-25-65

March 10, 1965

Messrs:

P. E. Heisler - WGK
H. C. Carder - WGK
Process Holders

R. W. Buckheit - Org. Res.
H. L. Hubbard - Org. Res.

Tentative Amendment No. "A"

Title:

Tentative Amendment No. "A" to the Standard Manufacturing Process for Aroclor (Dept. 246, WGK) dated 7/20/64.

Objective:

Alter present plant distillation system and operations for a plant test. Plant test will indicate equipment needs and ability to produce improved quality (stable) Aroclor.

Present Practice:

Two Aroclor Distillation Systems are run in parallel. The two systems are continuously fed crude Aroclor from the #2 Blow Tank. The distillation is a straight take-over operation. When a run of one type (1242, 1248, etc.) is completed (80,000-500,000#) a final boil down is conducted in No. 2 still and the bottoms are dropped.

The boil down material is combined with the previously distilled material and processed to finished product. The bottoms are drawn off and sold as Montar or discarded Following the boil down and bottom's drop the stills are ready for the next product run.

Proposed Procedure:

Run the two stills in series. Continuously feed the No. 1 still with crude Aroclor and use this system to pre-heat the entire feed and to distill off a low-boiler fraction (up to 10% of feed). Continously feed the No. 2 still from No. 1 still pot. Collect the intermediate fraction in No. 2 receiver and process as in normal operation.

At the end of the run (4-5 days) boil down and drop bottoms. Do not combine the boil down (high-boilers) with the intermediate fraction. The low boilers from No. 1 receiver and the high boilers from the boil-down will be isolated in a storage tank, if possible.

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TRAN 009193

If they pass non-electrical Aroclor specifications, they can be used as such. If the total amount has to be discarded because no storage is available, or because they are out of specification, the cost would be $3,000 based on total product costs.

Specific operating conditions for the stills will have to be determined in the field by cut and try methods.

Justification:

Foreign competition appears to be capable of producing Aroclor which is more stable than that presently made by Monsanto. An improvement of product stability is necessary to protect our market position.

Laboratory data* indicates that the distillation operation has a significant effect on product stability. These data indicate that product stability can be improved by:

1. Removing an unstable low-boil fraction
2. Preventing entrainment
3. Preventing contamination by high-boilers or boil down

This test will evaluate our ability to control the plant distillation in the three areas mentioned above, with existing equipment. Failure of the test will indicate that more drastic revisions to the existing equipment will be needed to approximate laboratory conditions.

Comments:

The production rate will be limited by maximum vapor and heat loads that can be sustained in the entrainment and condenser systems on No. 2 still. In the past 55,000#/day have been attained in these systems. The upper limit is not presently known.

Duration:

The test duration will be 4-5 days. If desired operation conditions cannot be obtained during this interval the test will be cancelled or revised.

Prepared by:

D. R. Middleton

J. J. Luecken

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*WGK PR&D Reports J-62, 2/15/65 and J-78, 3/8/65

TRAN 009194

Approvals:

P. E. Heisler

R. W. Buckniell

D. E. Harris

H. L. Hubbard

J. A. Mullendore

vmd

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TRAN 009195

MONSANTO COMPANY
Monsanto, Illinois

July 12, 1965

Messrs:

P. E. Heisler - WGK
H. C. Carder - WGK
Process Holders

R. W. Bucknell - Org. Res.
H. L. Hubbard - Org. Res.

Tentative Amendment No. "B"

TITLE:

Tentative Amendment No. "B" to the Standard Manufacturing Process for Aroclor (Dept. 246, WGK) dated 7/20/64.

OBJECTIVE:

Run two plant tests using revaporized Cl_2 and dilute (25 mole %) Cl_2, as feed stock for Aroclor 1242 production.

PRESENT PRACTICE:

The Dept. 246 Chlorinators are batch charged with biphenyl (BiØ). The BiØ is then chlorinated by continuously feeding "Snift" gas to the chlorinator mass until the desired specific gravity is reached. The "Snift" Gas is a mixture of Cl_2 (from DeNora & Hooker Cells) H_2, N_2, O_2, CO_2 and trace amounts of organic impurities. The Cl_2 concentration is in the range of 75 - 95 mole % and varies with operations in the Cl_2 departments.

PROPOSED PRACTICE (Two Plant Tests, 1242 Aroclor)

1. A plant chlorination test will be run using revaporized Cl_2 from Dept. 232 as the Cl_2 feed stock. Due to limited capacity of the revaporizing facilities in Dept. 232, we will probably be able to run only two chlorinators at a time, making a total of 5 - 6 chlorinator batches and processing through the remainder of the system as normal. Necessary samples and measurements will be taken to determine effect of concentrated and impurity free Cl_2 on Aroclor stability. This material will be treated as normal production as it passes the routine plant controls.

2. A plant chlorination test will be run using revaporized Cl_2 diluted to 25 mole % with dry air as Cl_2 feed stock. This test will be limited to 2 chlorinators due to dry air capacity, making a total of 5 - 6 chlorinator batches and processing through the remainder of the system as normal. Necessary samples and measurements will be taken to determine effect of dilute and impurity free Cl_2 on Aroclor stability. This material will be segregated from normal electrical grade 1242 Aroclor. It will be used for non-electrical 1242 if it passes specification.

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TRAN 009196

Tentative Amendment No. "B".

JUSTIFICATION:

Foreign competition appears to be capable of producing Aroclor which is more stable than that presently made by Monsanto. An improvement of product stability is necessary to protect our present U.S. market position and for possible expansion of foreign sales. These tests will provide information as to the effect of contaminants in chlorine, and the possibility of local overchlorination due to concentration effects.

COMMENTS:

For the revaporized Cl_2 test the production rate will be limited to about 32,000#/day for a duration of 1 - 1 1/2 days. For the dilute Cl_2 test the rate will be limited to about 11,000#/day for a duration of 3 days.

SAFETY:

No increase in safety hazards is forseen in these two test runs.

Prepared by:

D. R. Middleton
D. R. Middleton

APPROVALS:

P. E. Heisler 7/15/65
P. E. Heisler

R. W. Bucknell
R. W. Bucknell

D. E. Harris 7-16-65
D. E. Harris

H. L. Hubbard
H. L. Hubbard

J. A. Mullendore 7/19/65
J. A. Mullendore

SAFETY REVIEW COMMITTE

7-20-65

7-20-65

7-23-65

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TRAN 009197

MONSANTO COMPANY
Monsanto, Illinois

September 1, 1965

Messrs:
P. E. Heisler - WGK
H. C. Carder - WGK
Process Holders

R. W. Bucknell - Org. Res.
H. L. Hubbard - Org. Res.

Tentative Amendment No. C

TITLE:

Tentative Amendment No. C to the Standard Manufacturing Process (Dept. 246, WGK) dated 7/20/64.

OBJECTIVE:

Run plant test using chlorinator without catalyst basket.

PRESENT PRACTICE:

The Dept. 246 batch chlorinators (3' diam. x 16' high) are batch charged with biphenyl, which is chlorinated with snift gas. At the present, each chlorinator has a catalyst bed. The catalyst bed is 2'3" in diam. and 8' high and consists of 1 1/2" pipe nipples, 2" long.

PROPOSED PROCESS (1242 and 1260 Aroclor)

Remove the catalyst bed from one chlorinator and run three to five 1242 and three to five 1260 batches in that chlorinator following standard operating procedures, except without the catalyst bed. The test material will be kept separate from other production and will be used only if it is equivalent to normal production aroclor, according to routine analyses.

During the test batches the chlorinator off-gas will be sampled and analyzed for chlorine, to check chlorine utilization of the chlorinators without the bed.

The purpose of the catalyst bed is to provide iron, which is chlorinated to ferric chloride, the reaction catalyst. It is standard operating procedure to charge 0.05% by weight ferric chloride to each batch. Ferric chloride will, of course, be added to the test batches.

JUSTIFICATION:

During operation the catalyst becomes plugged with tars and ferric chloride and it is probable that only a small portion of the iron of the bed is available for utilization. Also, the plugged bed hinders chlorinator circulation and probably leads to hot spots in the chlorinator. There is a problem of cross contamination from batch to batch with the bed, which results in an excessive amount of overchlorinated products.

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JUSTIFICATION: (Cont'd.)

During 1956 there were severe problems with aroclor stability. One of the problems was a lack of a consistent analytical method for checking stability. Previous to that time the catalyst bed was relied upon to supply ferric chloride and ferric chloride, per se, was not added. One of the results of the stability problem was the addition of ferric chloride to each chlorinator batch, to assure that sufficient catalyst was available. Since that time analytical methods have improved and any unstable aroclor produced would be detected immediately.

The removal of the catalyst bed, then, improves chlorinator operation by increased circulation, elimination of hot spots, and prevention of contamination. The addition of ferric chloride provides sufficient catalyst. Any unstable aroclor produced would be detected immediately by the present routine analyses.

SUPPORTING DATA:

It is reported in St. Louis Research Report Nos. 1640 and 2072 that a minimum level of 0.03% $FeCl_3$ is necessary to produce stable aroclor. No mention is made of the need for iron, and none was used in the lab chlorinators.

SAFETY:

No increase in safety hazards is anticipated.

QUALITY:

Work is in progress to improve aroclor quality (stability). It is anticipated that the removal of the basket will not harm quality but, if anything, will improve it due to improved circulation, elimination of hot spots in the chlorinators, and elimination of cross-contamination from batch to batch.

DURATION OF TEST

Three to five 1242 and three to five 1260 batches will be made without the catalyst bed. If this material is equivalent to normal production material, according to routine analyses, the chlorinator without the catalyst bed will be used for normal operations, and this amendment incorporated as a process revision. If the test material is not equivalent to normal production the bed will be replaced.

COMMENTS:

This plant test would normally involve some loss of production. The present aroclor stock position is such that it is anticipated that it will be necessary to run only three of the five chlorinators during September. Also, some repairs to be made during September will require removal of the catalyst bed from the No. 3 chlorinator. September, then, is an ideal time to run this test.

Prepared by: W. G. Kramper
W. G. Kramper

APPROVALS:

P. E. Heisler	9/1/65 Date	R. W. Bucknell	9/3/6 Date
D. E. Harris	9-1-65 Date	H. L. Hubbard	9/3/6 Date
J. A. Mullendore	9-7-65 Date		

SAFETY REVIEW COMMITTEE

H. L. Hubbard 9-3-65
Oliver DeGarmo 9-3-65
C. R. Roos 9-7-65

emc

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TRAN 009200

MONSANTO COMPANY
Monsanto, Illinois

SAFETY REVIEW COMMITTEE

CWR 10-26-65

~~CRF~~ 10-29-65

CAC 10-29-65

October 20, 1965

Messrs:

P. E. Heisler - WGK
H. C. Carder - WGK
Process Holders

R. W. Bucknell - Org. Res.
H. L. Hubbard - Org. Res.

Tentative Amendment No. "D"

Title:

Tentative Amendment No. "D" to the Standard Manufacturing Process for Aroclor (Dept. 246, WGK) dated 7/20/64.

Objective:

Evaluate potassium carbonate as a replacement for lime in the Aroclor distillation system.

Present Practice:

Aroclor is distilled in two parallel systems, continuously fed from the No. 2 blow tank. At the start of a run (1242, 1248, etc.) 200 lbs. of lime (calcium hydroxide) is added to each still pot. At the end of a run (250,000-500,000 lbs.) bottoms are dropped and the cycle is repeated.

Proposed Procedure:

Segregate the two distillation systems at the start of a 1242 run. To one system, add the normal amount of lime to the still pot and proceed normally throughout the run. To the second system, substitute 200 pounds of anhydrous potassium carbonate for the lime. Distill away from the potassium carbonate for a minimum of two days.

The product distilled from the potassium carbonate will be analyzed by routine tests before it is combined with normal production material. If the product deviates from normal in any adverse way, it will be isolated and will not be sold as electrical grade.

This material will not be sold as electrical grade.

JAH

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TRAN 009201

Justification:

The presence of a base during distillation serves two known purposes: It neutralizes free acid, and it reacts with the $FeCl_3$ present. It is also thought that the base can react with some unstable Aroclors, converting them to a more stable form. Recent WGK PR&D laboratory data indicates that distillation from K_2CO_3 increases the stability of the high boiling fractions of Aroclor 1242 (low boil and mid-fractions are essentially unaffected). If this proves to be the case, it would indicate that using K_2CO_3 and making a simple low boil cut may be a practical way of making a stable Aroclor.

Safety:

No increase in safety hazard is anticipated. No unusual effect was seen in laboratory distillations using K_2CO_3.

Comments:

No production loss will be involved since WGK Dept. 246 is presently running at only 75% of demonstrated capacity.

Prepared by:

J. J. Luecken

APPROVALS:

P. E. Heisler — 10/27/65 Date

D. E. Harris — 10-27-65 Date

R. W. Bucknell — 10/26/65 Date

J. A. Mullendore — 11/1/65 Date

Please have this mat'l sold as non-electrical till accelerated tests by customer reveal it is satisfactory

COMPANY CONFIDENTIAL

TRAN 009202

MONSANTO COMPANY
Monsanto, Illinois

December 3, 1965

Messrs:

P. E. Heisler - WGK
H. C. Carder - WGK
Process Holders

cc.

R. W. Bucknell - Org. Res.
H. L. Hubbard -Org. Res.

Tentative Amendment No. "E"

TITLE

Tentative Amendment No. "E" to the Standard Manufacturing Process for Aroclor (Dept. 246, WGK) dated 7/20/64.

OBJECTIVE

Produce more stable Aroclor 1242 by chlorinating without a catalyst basket in the chlorinator and processing as normal.

Produce more stable Aroclor 1242 by chlorinating without a catalyst basket in the chlorinator and processing it through the still system with potassium hydroxide added in place of the normally used lime (calcium hydroxide).

Provide sufficient product, produced as above, for testing by customers.

PRESENT PRACTICE

Biphenyl (Biϕ) is chlorinated in the chlorinators which contain catalyst baskets. Previously the basket furnished $FeCl_3$ catalyst for the reaction. Presently (since 1957) sufficient amount of catalyst, needed to produce stable Aroclor, is added to each chlorinator when batch charged.

At the beginning of a product (1242, 1240, etc.) run 200 pounds of lime is added to each still. The purpose of the lime is to tie up $FeCl_3$ and neutralize HCl in the crude.

PROPOSED PROCEDURE

Produce 8 - 9 batches of 1142 in No. 5 chlorinator with the catalyst basket removed. This has been done previously as per Tentative Amendment No. "C". Process half of this crude material through the remainder of the system as normal, and drum it off from the finished product tank. Process the other half through No. 1 still system, but substitute potassium hydroxide (0.06% of crude charge) for the lime in the still. Drum this material off from the finished product tank, thus producing approximately 1,000 gallons of each type of test material to be used as samples for evaluation by electrical grade customers. Any excess test material will

PROPOSED PROCEDURE (Cont'd.)

be sold as non-electrical grade 1242 providing it passes all specifications.

JUSTIFICATION

From previous plant tests, the Aroclor produced in a chlorinator without the catalyst basket was equivalent or better than normal material. By removing the baskets, hold-up and cross-contamination are reduced.

Results of PR & D Laboratory studies indicate more stable Aroclor (i.e. 0.15 ppm Cl by thermal chemical chlorides) can be made by addition of KOH to the still pot and stripping off the first 1.2% of the low boilers. Plant equipment will not permit this type of fractionation, but an improvement over normal production is expected.

SAFETY

No increase in safety hazzards is anticipated. No unusual effects were seen in the laboratory distillation using KOH. Normal precautions in handling KOH will be followed.

Prepared by: D. R. Middleton

APPROVALS:

D. R. Middleton	12/3/65 Date	D. E. Harris	12-6-65 Date
P. E. Heisler	12/6/65 Date	R. W. Bucknell	12/6/65 Date
J. A. Mullendore	Date	H. L. Hubbard	12/6/65 Date

SAFETY REVIEW COMMITTEE

ADG 12/6/65

12/6/65

CMR 12/6/65

Approved with following provisos:

1) Have Aroclor 1242 examined for trace quantities of phenolics.
2) Mat'l produced by this process amendment is not to be sold as electrical grade except as test mat'l at direction of Organic Marketing.

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TRAN 009204

Monsanto, Illinois

May 10, 1965

AMENDMENT DISPOSITION

Tentative Amendment No."A" to the Standard Manufacturing Process for Aroclor(Dept.246, WGK) dated 7/20/64. Tentative Amendment No."A" is dated 3/10/65.

TO: Messrs:

P. E. Heisler - WGK	R. W. Bucknell - Org. Res.
H. C. Carder - WGK	H. L. Hubbard - Org. Res.
D. E. Harris - WGK	J. A. Mullendore - Gen. Off.
J. J. Luecken - WGK	Process Holders - c/o P. J. Prader - WGK

This memo is to serve as a disposition of the subject tentative process amendment.

The purpose of the amendment was to alter the present plant distillation system and operations for the duration of a plant test. The purpose of the plant test was to indicate equipment needs and ability to produce improved quality (stable) Aroclor. No improvement in stability was realized and the need for fractionation was demonstrated.* The distillation system was returned to normal operation as specified in the Standard Manufacturing Process.

The subject amendment should be recorded in the Standard Manufacturing Process, but not incorporated as a process revision.

D. R. Middleton

D. R. Middleton
Technical Services Dept.

vmd

*WGK TSD Report - Aroclor: Improve Electrical Grade Quality, 91370:3198, Report No.1, dated 4/14/65.

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8. Extra
9. Extra B. E. Heisler
10. Extra

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TRAN 009206

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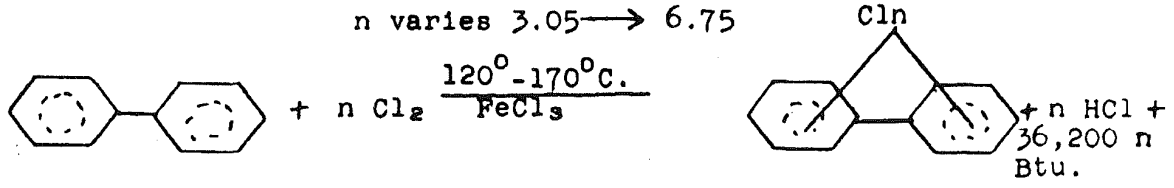
AROCLOR

SECTION I

SYNOPSIS OF PROCESS

Aroclor is a trade name used to designate chlorination products of biphenyl, biphenyl high boilers, or mixtures of the two. Liquid Aroclors are produced by chlorinating biphenyl to 21, 32, 42, 48, 54, 60, and 62% chlorine content. Chlorination above 63% yields a solid product at normal temperatures. Liquid Aroclors are identifie by four digit numbers: The last two digit numbers represent the chlorine content (percentage by weight), and the first two numbers represent the Aroclor condition (crude or distilled). Crude Aroclor start with the prefix 11 whereas distilled Aroclors start with the prefix 12. For example, Aroclor 1242 is a distilled chlorinated biphenyl containing 42% chlorine.

The first process step in the manufacture of Aroclors is a chlorination reaction. Biphenyl (Ø-Ø) and chlorine (Cl_2) gas in the presence of a Ferric Chloride ($FeCl_3$) catalyst are reacted to form a chlorinated aromatic compound. Hydrogen chloride (HCl) gas is liberated during this reaction and piped to the muriatic acid department. The exact chemistry of biphenyl chlorination is unknown. Many isomers are formed. A schematic representation of biphenyl chlorination is as follows:



BIPHENYL M.W. = 154 | CHLORINE M.W. = 71 | AROCLOR M.W.=(257.1-395.6) | HYDROGEN CHLORIDE M.W. = 36.5

AROCLOR

SECTION I

SYNOPSIS OF PROCESS

The second process step is the aeration and distillation of the crude Aroclor. Dry air is blown through the crude Aroclor for a period of two hours or more. Aeration removes most of the free hydrogen chloride. Distillation of crude Aroclors is done under vacuum automatically controlled with the controller pre-set between 30 - 50 mm Hg. abs. to obtain the best performance. Distillation of crude Aroclor separates residue, lime, ferric chloride, and tars from the finished product.

The third process step includes blending, filtration, and storage of Aroclors. Approximately 0.1 - 0.2% by weight of Attapulgus earth is added to the distilled Aroclor. The mixture is agitated and filtered to the finished product tank. The purpose of the Attapulgus earth is to absorb moisture and chloride ion to improve the electrical properties of the Aroclor. During the filtration of distilled Aroclor, 2 - 16 oz. samples of the finished product are taken to the laboratory for control analyses. If the control analyses pass specifications, the batch is transferred to a storage tank.

This process description will describe the production of Aroclors 1242, 1248, 1254, 1260, 1254 xylene mix, and 1262.

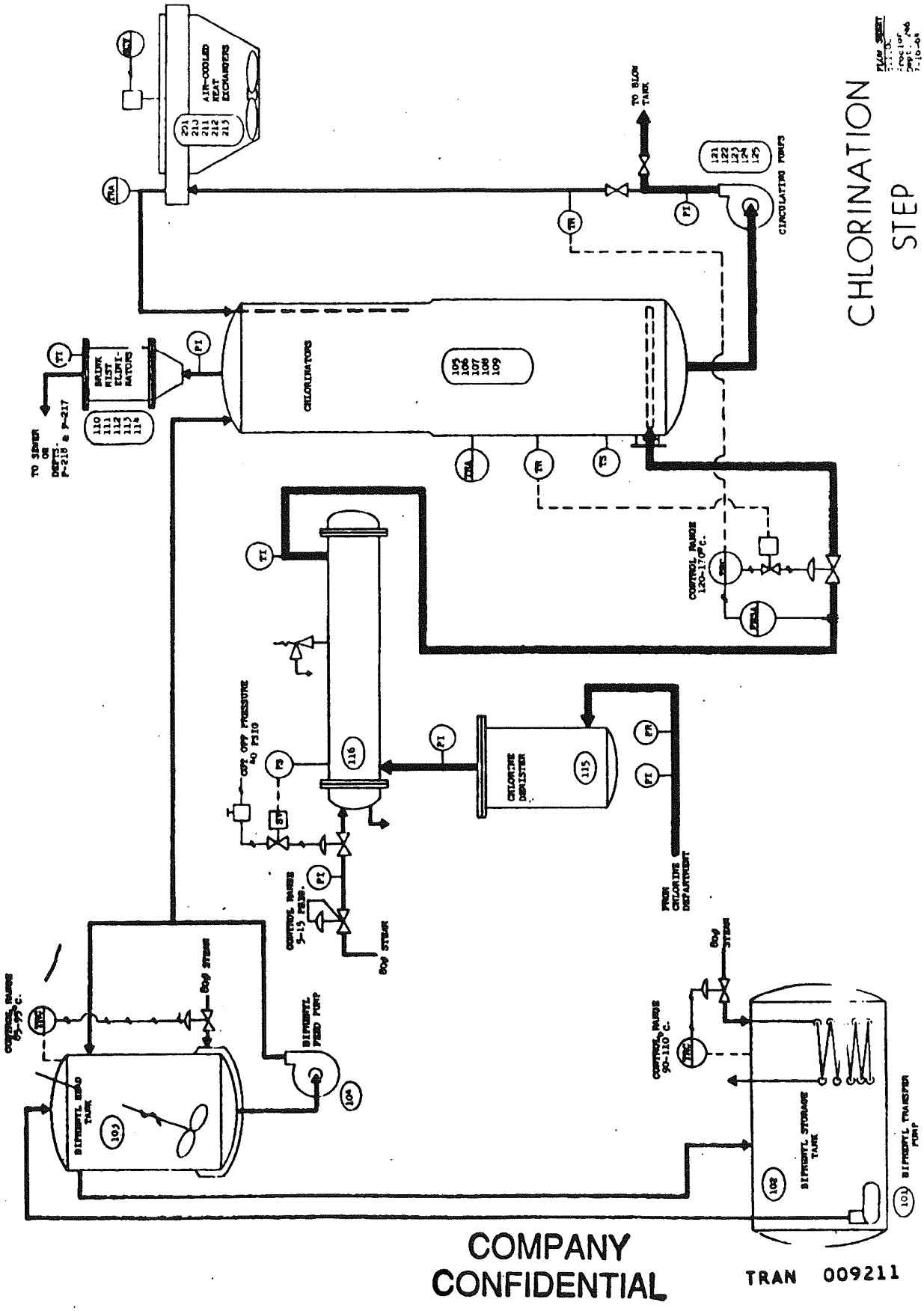
AROCLOR

SECTION II

FLOW SHEETS

This section contains the following flow sheets.

1. Complete process flow sheet.
2. Chlorination Reaction Step
3. Aeration and Distillation
4. Blending, Filtration and Storage.



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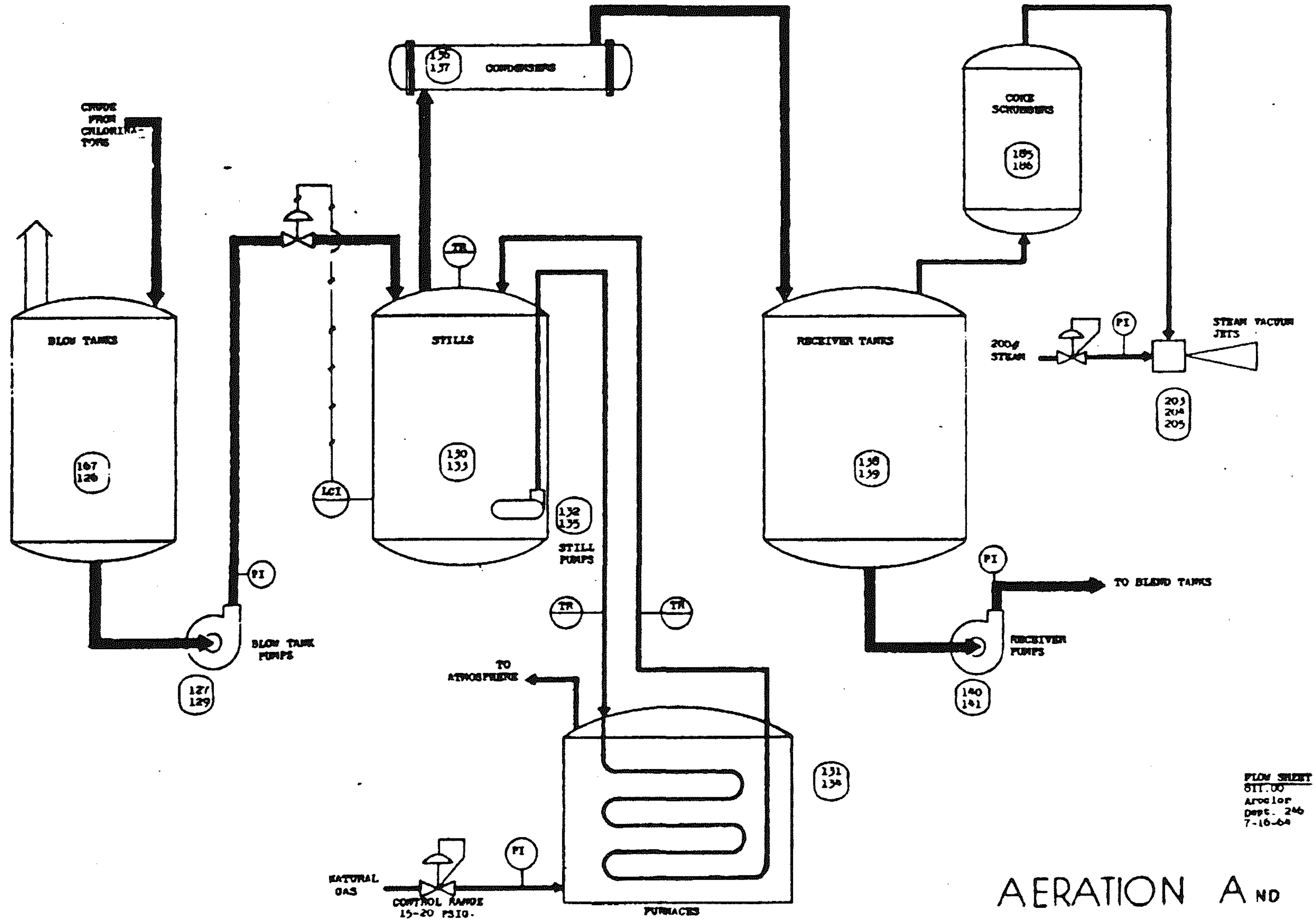
TRAN 009211



AERATION AND DISTILLATION

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TRAN 009212

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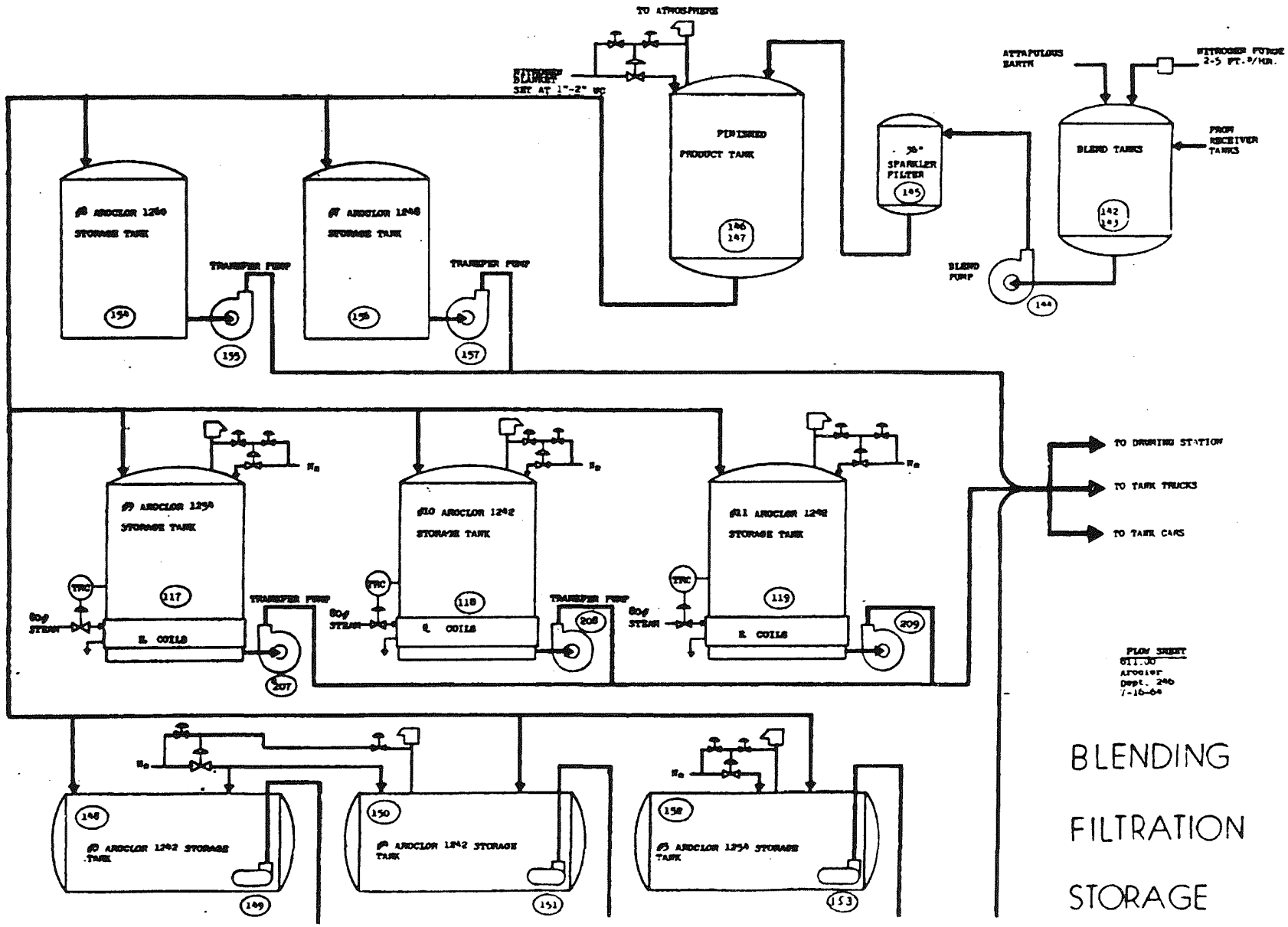

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TRAN 009213

AROCLOR

SECTION III

PROCESS IN DETAIL

A. Nomenclature and Batch Data

Aroclor is a trade name used to designate chlorination products of biphenyl, biphenyl high boilers, or a mixture of the two. The physical properties vary from light free flowing liquids to crystalline and non-crystalline solids, depending upon the degree of chlorination and the composition of the raw materials. Chlorinated biphenyl yields a liquid product of increasing viscosity up to and including 63% chlorine. Chlorination above 63% yields a solid product at normal temperatures.

A numerical system of nomenclature, consisting of four digits, has been developed for identifying the various Aroclors. The first digit denotes the aromatic raw material used in the chlorination step. The figure 1--- indicates 100% technical grade biphenyl. The second digit denotes whether or not the product is distilled. The figure -1-- indicates undistilled product, and the figure -2-- indicates a distilled product. The last two digits of the nomenclature system denote the approximate percentage by weight of chlorine contained in the finished product. For example, Aroclor 1242 is a distilled chlorinated biphenyl containing 42% chlorine.

Manufacture of all liquid Aroclors is essentially the same. Batch data are listed below:

Type Aroclor	1242	1248	1254	1260	1262
Biphenyl Charge	4000#	4000#	4000#	4000#	4000#
Chlorination Time	10 - 12 hr.	10-12 hr.	14-17 hr.	16-20 hr.	16-22 hr.
Specific Gravity of Crude	1.349-58 at 65°C	1.408-18 at 65°C	1.498-508 at 65°C	1.558-69 at 90°C	1.580-90 at 90°C
Weight of Crude Batch	6670#	7580#	8450#	9600#	10,600#
Weight of Distilled Batch	6330#	7200#	8040#	9100#	9850#
Tons of 100% by-product HCl per Batch	1.24	1.43	2.27	2.47	2.70
Theoretical Molecular Weight	257.7	292.6	326.6	369.5	395.6

SECTION III

PROCESS IN DETAIL

B. Chlorination Reaction Step

Chlorination of biphenyl is the only process step where a chemical reaction takes place. All other Aroclor process operations are mechanical. The starting raw materials for Aroclor production are biphenyl and chlorine gas.

Biphenyl is received in 8,000 and 10,000 gallon tank cars from Anniston, Alabama. The biphenyl in the tank cars is a solid mass because the crystallizing point of biphenyl is 68.7°C. Steam must be applied to the tank car coils to melt the biphenyl. It is necessary to melt a vent hole through the solid mass of biphenyl by insertion of a hairpin steam coil through the tank car dome before applying steam to the tank car coils. The vent hole avoids a pressure build-up in the bottom of the tank car and possible damage to the car. When the biphenyl is completely melted, it is sampled for crystallizing point and moisture content and unloaded through the tank car standpipe by air pressure to the 25,000 gallon storage tank. Dry air is used to unload the biphenyl cars to keep the biphenyl free from moisture. The flash point of biphenyl is 112°C.

Chlorine gas is received in a 4 inch pipeline from the chlorine department. In order to facilitate operation of the chlorine liquefaction system, "snift" gas with a purity of 75-95% (the remainder being air) is transferred from the chlorine department. The normal pressure of the chlorine gas in Department 246 is 20-25 psig.

Biphenyl (4000#) is charged into each chlorinator from the measuring tank. The biphenyl charge in the measuring tank can be regulated by valves at different overflow levels. The four overflow levels on the measuring tank permit biphenyl charges of 1800, 2800, 3600, and 4000 pounds.

The measuring tank is equipped with an agitator and circulating pump. Two pounds of ferric chloride (0.05% of charge) are charged into the measuring tank for each batch. The charge from the measuring tank is pumped through the circulating line to the chlorinators.

Chlorination is carried out in five chlorinators. Each chlorinator is three feet in diameter by sixteen feet high, and constructed of steel. Each chlorinator has a catalyst bed which is 2' 3" in diameter by 8 feet high. The catalyst bed consists of 1 1/2 inch diameter by 2 inches long pieces of pipe which are similar in nature to raschig rings.

The biphenyl charge is heated to 120°C. or higher before chlorination is started. After charging the chlorinator, circulation of the charge is started before the chlorine feed is begun to maintain an even distribution of the ferric chloride catalyst.

PROCESS IN DETAIL

B. Chlorine gas from the chlorine department passes through a Brink mist eliminator and evaporator before entering the chlorinator. The mist eliminator removes most of the impurities, and the vaporator insures that all of the chlorine is gaseous.

The purified chlorine gas is admitted to the bottom of the chlorinator through a distributor plate (sparger) and passes through the catalyst bed. A chlorinator temperature less than 170°C. should be maintained during the chlorination reaction to avoid sublimation and subsequent condensation of biphenyl in the off-gas system. Each chlorinator is equipped with a Brink mist eliminator. The purpose of the off-gas mist eliminators is to trap entrained particles of Aroclor and biphenyl.

The chlorination temperature in the chlorinators is controlled by automatic chlorine gas flow regulation to hold the temperature within ± 5°C. The chlorination temperature must be at least 120°C. at the beginning of the batch and no more than 170°C. to finish off a batch. The normal batch temperature is 150°C. The louvers of the air-cooled heat exchanger located in the external circulating line of the chlorinator are positioned such that the batch temperature will remain between 120°C. and 170°C. The exact batch temperature will depend on the chlorine flow rate which will fluctuate to maintain a batch temperature of 150°C. The louver adjustment is manually controlled by a hand valve located in the control room. The temperature of the batch is recorded at four different points: (1) in the center of the chlorinator, (2) just above the chlorine sparger in the chlorinator, (3) at the discharge of the chlorinator pump, and (4) at the discharge of the air-cooled heat exchanger. Point 1 is alarmed for high temperatures, and point 4 is alarmed for low temperatures. As a safety device, a high temperature sensing element is positioned at point 2 to shut off the chlorine gas flow if the reaction temperature exceeds 190°C.

The batches are continuously circulated at an average flow rate of 200-220 GPM from the bottom of the chlorinator, up through the air-cooled heat exchanger, and back into the top of the chlorinator over the catalyst bed. Chlorine feed up to a maximum of 1500 pounds per hour is fed into each chlorinator through a flow recorder-integrator which is alarmed. The zero return integrator measures the total amount of chlorine gas flow per batch at any given time and will shut off the gas flow when the desired pre-set pounds of chlorine has entered the reactor. The average chlorine feed rate is 1000 pounds per hour.

Progress of the chlorination reaction is checked periodically as needed after a pre-set amount of chlorine gas as measured by the recorder-integrator passes into the chlorinator.

The degree of chlorination is measured by determining the specific gravity of a sample taken from the circulating line. More frequent gravity checks are made when approaching the end of chlorination.

AROCLOR

SECTION III

PROCESS IN DETAIL

C. Aeration and Distillation

When chlorination is complete, the crude Aroclor is pumped into number two blow tank (Capacity 2000 gallons). The crude Aroclor is aerated in the #2 blow tank for two hours or more with dry air. Aeration of crude Aroclor removes most of the free hydrogen chloride.

Crude aerated Aroclor is transferred from the #2 blow tank to the #1 blow tank. The #1 blow tank is used as a crude Aroclor feed tank to the stills. Crude aerated Aroclor is transferred from the #1 blow tank to vacuum stills through an automatic control valve which maintains a constant level in the stills. Under normal conditions the automatic feed to the stills is shut off after distilling about 75,000 pounds of Aroclor. (This is equivalent to filling 7 still receivers). The still is then boiled down until a temperature difference between the still coil inlet and outlet approaches 40°C. At this point distillation is discontinued and all but a small heel of the residue is drawn off to drums and discarded or sold as Montar. The still is immediately recharged with crude Aroclor and 200 pounds of lime is added directly to the still pot. Hydrated lime is received in 50 pound bags. The lime neutralizes any residual HCl in the still liquor and prevents sublimation of ferric chloride during the distillation period. Distillation of Aroclors is done under vacuum automatically controlled. The best performance is obtained at a steady vacuum which can be pre-set by a controller between 30-50 mm Hg. Abs.

Natural gas is used to heat the coil of the Aroclor still furnaces. The pressure of the gas burner (eclipse, st. 108.5, 2", #568, 600,00(BTU/hr.) is adjusted as needed for production requirements. The normal gas pressure is 2-3 psig.

D. Blending, Filtration, and Storage

When the still receiver is filled, the distilled Aroclor is pumped tc the blend tank (2000 gallon capacity). After two fillings of the receiver tank have been pumped to the blend tank, approximately 40 pounds of attapulgus earth is added to the distilled 1242 Aroclor. All other Aroclors are earth-treated with 20 pounds of Attapulgus earth. Regular Attapulgus earth is received in 50 pound bags. The mixture is agitated and filtered to the finished product tank (2000 gallon capacity) through a 36 inch stainless steel Sparkler Filter. The Attapulgus earth is roasted at 250°C. for a minimum of four hour in a Grieve-Hendry drying oven before addition to the blend tank. The purpose of earth heat treatment is to remove any moisture in the earth and activate it. The Attapulgus earth absorbs water and ionic impurities. This improves the electrical-quality properties o the Aroclor.

AROCLOR

SECTION III

PROCESS IN DETAIL

D. Blending, Filtration, and Storage (Cont'd.)

The filter press is cleaned after about 5-7 batches or as needed. During the filtration, 2-16 oz. samples are taken to the laboratory for control analyses. If the control analyses pass specifications, the batch is transferred from the product tank to a storage tank. After several batches have accumulated in the storage tank, the contents of the tank are mixed, and composite samples are taken for lot analyses.

Three underground (15,000 gallon) tanks and five above-surface (each 20,000 gallons) are available for storage of the finished products.

The blend tanks, finished product tanks, and Aroclor 1242 and 1254 storage tanks are blanketed with nitrogen. The pressure of the nitrogen gas is 10 psig. Nitrogen blanketing maintains the electrical properties of the Aroclors.

The Aroclors from the storage tanks are drummed, pumped to tank cars, pumped to tank trucks, or transferred to Department A-246 or B-246 mixing tanks for the production of Pyranols, Interteens, or Pydraul A-200.

Batches of Aroclor 1254-mix are mixed in the #1 blend tank. This operation consists of a mix of 10% xylene and 90% Aroclor 1254. Xylene is received in 55 gallon drums. The flash point of xylene is 85°F. Mixing, sampling and drumming of 1254-mix is accomplished directly from the blend tanks. After the blending operation, the blend tank must be cleaned. The bottom outlet of the tank is opened and the tank is cleaned out with live steam and then blown with air.

E. By-product Hydrogen Chloride

The by-product hydrogen from the chlorinators is collected in a common pipeline header and flows to the central HCl absorption unit to manufacture Muriatic Acid in Department F-218. If Department F-218 is unable to handle the off-gas, it may be sewered at Department 246 by passing through a Haveg S-K drowning jet. The removal of HCl from the off-gas concentrates the original quantity of hydrogen and air to a point well within the explosive limit. Therefore, it is essential to either dilute this gas going up the vent stack or increase its velocity past the flame propogation rate (15 ft./sec.). This is accomplished by introducing a sufficient quantity of steam into the vent stack.

AROCLOR

SECTION IV

COMMENTS ON PROCESS

CHLORINATION STEP

A. Raw Material Yields

Biphenyl and chlorine are reacted to form a chlorinated biphenyl called Aroclor. The yields on biphenyl and chlorine vary with the type of Aroclors produced. Each particular type of Aroclor has its own standard yield factors. Yields are not reported for the individual type on Aroclor each month. An average yield is reported monthly and compared with standard and theoretical yields which are calculated according to the quantities of the various Aroclors produced during the month.

Standard and theoretical conversion factors used in computing Chlorine and biphenyl yields are listed below.

STANDARD CONVERSION FACTORS

AROCLOR	CHLORINE #/# Product	BIPHENYL #/# Product
1242	.9032	0.6180
1248	1.0323	0.5580
1254	1.6130	0.4978
1260	1.2903	0.4368
1262	1.3333	0.4163
1232	0.6882	0.7216
1254 Xylene	1.0452	0.4480

THEORETICAL CONVERSION FACTORS

AROCLOR	CHLORINE #/# Product	BIPHENYL #/# Product
1132 - 1232	0.6400	0.6891
1142 - 1242	0.8400	0.5919
1148 - 1248	0.9600	0.5357
1154 - 1254	1.0800	0.4754
1160 - 1260	1.2000	0.4147
1162 - 1262	1.2400	0.3976
1254 - 10% Xylene	0.9720	0.4279

AROCLOR

SECTION IV

COMMENTS ON PROCESS

CHLORINATION STEP

B. Capacity

The monthly production capacity of Department 246 is 1,700,000 pounds (2,400,000 pounds is expected by August 1, 1964) of Aroclors on a 7 day per week basis. The capacity of the chlorinators is a function of the following variables.

1. Batch Cooling Rate - Chlorination of biphenyl is an exothermic reaction which produces 510 BTUS per pound of chlorine gas undergoing a reaction with biphenyl. Biphenyl can be chlorinated as fast as the exothermic heat can be removed from the batch and maintain a batch temperature of 150°C.

2. Chlorine Flow Rate - the reaction time decreases as the Chlorine flow rate increases. The chlorine flow rate is approximately 1000 pounds per hour per chlorinator. A maximum chlorine flow rate of 1500 pounds per hour per chlorinator can be attained if desired. The concentration of chlorine in the "snift" gas is another factor controlling the rate of chlorination.

3. Catalyst - The chlorination rate increases when ferric chloride catalyst is added to the charge. The best results are obtained when the biphenyl charge contains .05% ferric chloride catalyst.

C. Quality

Some of the factors which affect Aroclor quality are as follows:

1. Temperature - According to research experimental results, the chlorinator temperature must be greater than 120°C. at the beginning of the chlorination reaction to produce stable Aroclors.

2. Catalyst - Good contact is necessary to produce stable Aroclors. It is suspected that agitation and circulation of the reactants improve the effectiveness of the catalyst. The catalyst is also responsible for the chlorine positioning on the biphenyl molecule. Ferric chloride catalyst may be responsible for producing the desired end product. Results of research work concerning catalyst and isomeric distribution are given in Appendix N.

AROCLOR

SECTION IV

COMMENTS ON PROCESS

CHLORINATION STEP

C. Quality (Cont'd.)

3. Raw Material Purity - The purity of raw materials can affect the quality of Aroclors both directly and indirectly. In a direct manner, impurities which are ionic lessen the resistivity of Aroclors. Distillation of crude Aroclor separates most of the ionic impurities; however, minute impurities can be carried over to the receiver tanks. Attapulgus earth can remove the remaining impurities in most instances. If any ionic impurities remain after the earth treatment, the resistivity of the Aroclors will be low because such impurities will conduct electricity even in minute concentrations.

   In an indirect sense, impurities such as sulfates in the chlorine gas, will poison the ferric chloride catalyst and thus unstable Aroclors will be produced. The chemistry and mechanism of the catalyst poisoning are not known for certain.

AERATION AND DISTILLATION

Steam is not applied to the coils of the blow tanks when aerating Aroclors 1142 and 1148. This prevents the loss of Aroclor vapors. Eighty psig steam is applied to the coils when aerating other Aroclors. High moisture may be removed effectively by blowing the crude Aroclor with dry air.

Vacuum trouble on the stills is usually caused by flashing of product, air leaks, plugged vacuum lines, or improper functioning of the vacuum jets.

Flashing can usually be stopped by operating the still at a slower rate or increasing the flow of cooling water to the vapor condenser.

Vacuum trouble can be traced systematically from the jets and usually isolated.

High color and entrainment will result from overheating (around 25°C. above normal distillation temperature) Aroclor, faulty operation of the distillation step, or boiling down the still too far. (Tars will carry over). The "tail - end" still fraction (tars) is a possible source of unstable Aroclors.

AROCLOR

SECTION IV

COMMENTS ON PROCESS

BLENDING AND FILTRATION

Attapulgus Earth is added in the blend tanks to reduce moisture and inorganic chlorides as well as improve electrical properties. If batches do not meet specification (See Appendix B), redistillation may be necessary.

The Attapulgus Earth is roasted for 4 hours at 250°C. before addition to the blend tanks.

AROCLOR

APPENDIX A

EQUIPMENT LIST

This section contains an equipment list with each piece of equipment listed by Item Numbers in a consecutive numerical sequence. Miscellaneous items of Dept. 246 such as Instruments have not been assigned Item Numbers. Equipment without Item Numbers is not included in this equipment list. All equipment of Dept. 246 will have Item Numbers assigned sometime in the future. This equipment list should be expanded as additional Item Numbers are assigned.

Item No.	Equipment Name	Equipment Number	Description
101	Biphenyl Transfer Pump	19-0582 66-3930	Taber vertical submerged cent. pump, size C-3, 2 1/2" inlet, 2" outlet. Connection bronze except shaft which is monel. Motor is 3 HP, 1800 RPM.
102	Biphenyl Storage Tank	21-2210	Tank purchased from Rogers and Wrigler. Capacity is 25,000 gallons. 10' 6" DIA x 40' 6" long. 3/8" plate shell. Design pressure is 50 psi.
103	Biphenyl Head Tank	21-0767 16-7225	Tank made by Graver. Dwg. C-799. Steel tank 4' 6" ID x 5' 6" str. side, dished heads, shell 3/8", top head 3/8", and bottom head 3/4" with 1/2" jacket over it and ending 9" up on tank side. Welded throughout. Test of tank is 60# and jacket is 105# hydro. pressure. Mixer is Mixco Model N33G75, gear driven propeller. Motor is 440/3/60 TEFC, 1725 RPM.
104	Biphenyl Feed	66-7224	Durco Horiz. Cent. pump. 2" inlet, 2" outlet. Cap. 100 GPM Motor is 7 1/2 HP, 1760 RPM
105	Chlorinator #1	21-3261	Tank made by Nooter. Dwg. E-880 3' ID x 16' long with plg. head. Shell 3/8" and head 7/16" thick, 3/16" jacket over lower half of tank.
106	Chlorinator #2	21-3245	Same as Item No. 105.

APPENDIX A EQUIPMENT LIST (Cont'd.)

Item No.	Equipment Name	Equipment Number	Description
107	Chlorinator #3	21-3251	Tank made by Leader Iron Works. Otherwise, same as Item No. 105.
108	Chlorinator #4	21-1283	Same as Item No. 107.
109	Chlorinator #5	21-1432	Same as Item No. 107
110	#1 Mist Eliminator	15-0581	Tank made of carbon steel. Element made of carbon steel. Design pressure is 50 psig. and design temperature is 300°F.
111	#2 Mist Eliminator	15-0582	Same as Item No. 110.
112	#3 Mist Eliminator	15-0583	Same as Item No. 110.
113	#4 Mist Eliminator	15-0584	Same as Item No. 110.
114	#5 Mist Eliminator	15-0586	Same as Item No. 110.
115	Chlorine Mist Eliminator	21-4042	Tank made by Alpha. Carbon steel construction. Coded tank. Element 316 stainless steel. 15" Dia, glass fiber inverted type. Design pressure is 50 psig and design temperature is 300°F.
116	Chlorine Vaporizer	38-5487	Chlorine vaporizer made by Armstrong Company. 8 5/8" OD x 11' long. Carbon steel construction. Chlorine side designed for 250 psig. at 400°F. Steam side designed for 100 psig at 400°F.
120	Knockout		Steel vertical 60 gal. tank.
121	Chlorinator #1 Pump	19-4305 66-8109	Durco Mark II horiz. cent. pump. Inlet is 3" and outlet is 2", ductile iron, with Durametallic seal and Manzel lubricator. Rate is 200 GPM at 25' static head Sp. Gr. of 1.5. Motor is 10 HP, 1800 RPM.

Dept. 246 - Process Description

AROCLOR

APPENDIX A EQUIPMENT LIST (Cont'd.)

Item No.	Equipment Name	Equipment Number	Description
122	Chlorinator #2 Pump	19-4306 66-8110	Same as Item No. 121.
123	Chlorinator #3 Pump	19-4307 66-8111	Same as Item No. 121.
124	Chlorinator #4 Pump	19-4308 66-8112	Same as Item No. 121.
125	Chlorinator #5 Pump	69-3892 66-6509	Same as Item No.121.
126	Blow Tank #2	21-2086	Tank made by Graver. Dwg. E-863. 7' Dia x 7' str. sides, dished heads 1/2", Shell 3/8", 5 turn coil of 2" pipe supported on brackets welded.
127	Blow Tank #2 Pump	66-2956 69-0577	Taber horiz. cent. pump. Type L-2. 2½" x 2". Semi-steel with monel shaft and water jacketed stuffing box. At 20' static head, rate is 80 GPM, 1.5 Sp. Gr. at 500°F. Motor is 3 HP, 1800 RPM.
128	Air Dryer	14-0104	Anders Lykens Corp. Air dehydrator. Two code welded tanks filled with 55 lbs activated alumina. Dwg. #6456.
129	Blow Tank #1 Pump	19-0629 66-9080	Same as Item No. 127.
130	Still #1	20-0043	Vacuum still purchased from Graver. Dwg. C-809. Size 6' Dia. x 5'6" lg. on str. side, ⅜" shell, dished head 5/8". 60# hydro. pressure test.
131	Furnace #1	27-0045	Steel heater furnace. Steel shell 3/16 x 3'9" Dia. x 4' 10½" lg. lined with insulating fire brick. One coil 2" xH pipe, 12 turns formed into a 2' Dia coil with spare blocks and legs. Dwg. E-886.
132	Still #1 Pump	19-0594 66-4891	Taber vert. sub. cent. pump. type L-2. Casing, yoke, and impeller made of steel. 2" inlet and 2" outlet. Length 7' 9". Capacity is 75 GPM., static hea 15', Sp. Gr. 1.8 at 700°F. Motor is 5 HP., 1750 RPM.

Dept. 246 - Process Description

AROCLOR

APPENDIX A EQUIPMENT LIST (Cont'd.)

Item No.	Equipment Name	Equipment Number	Description
133	Still #2	20-0062	Vacuum still purchased from Nooter. Dwg. 6944. 6' ID x 11' 10" str. shell, internal pipes, standard dished heads. Glass wool insulation 3" with 1/2" finished coat.
134	Furnace #2	20-0066	Same as Item No. 131.
135	Still #2 Pump	66-1759 69-1277	Taber vertical sub. cent. pump. Type CL-4, 2 1/2 X 2", size 384. Pump is dynamo steel. Capacity is 75 GPM at 25' static head, Sp. Gr. 1.8. Motor is 7 1/2 HP, 1750 RPM.
136	Condenser #1	38-0770	Heat exchanger made by Nooter. Dwg. B-651. 12" DIA 5' long having nineteen 2" O.D. 11 ga. monel tubes, monel tube sheets, monel reducer, and carbon steel jacket and back up rings on flanges.
137	Condenser #2	38-1378	Same as Item No. 136.
138	Receiver Tank #1	21-0771	Vacuum receiver tank made by Nooter. Dwg. C-795. Size is 5' 6" DIA x 5' 6" str. side, 3/8" shell, 1/2" bottom and removable head. 2" IP, size xHy monel coil with 2" inlet and 1" outlet. 3 turns, 5' DIA along side and 3 turns spiral on bottom. 60# hydro. pressure test on tank and 300# on coil.
139	Receiver Tank #2	21-1377	Tank made by Nooter. Dwg. C-795. Same as Item No. 138.
140	Receiver Pump #1	66-9067 69-0565	Blackmer pump. Type PA-50L, bronze rotary pump, monel shaft, C.I. base. Capacity is 50 GPM, 1.65 Sp. Gr., 350 to 500 °F. Motor is 2 HP, 1740 RPM.
141	Receiver Pump #2	66-5670 69-1258	Same as Item No. 140.

Dept. 246 - Process Description

AROCLOR

APPENDIX A EQUIPMENT LIST (Cont'd.)

Item No.	Equipment Name	Equipment Number	Description
142	Blend Tank #1	21-0779	Tank made by Graver. Dwg. E-862. Welded steel tank, 7' Dia. x 7' high, dished heads ½", shell 3/8". All surfaces sprayed with .005" zinc then .003 tin. 2" xHy pipe coil and supports. Case bronze stirrer and bronze shaft. Test of tank is 60# and coil is 300# hydro. pressure.
143	Blend Tank #2	21-1399 66-0217	Same as Item No. 142.
144	Blend Tank Pump	19-1757 66-3718	Taber Horiz. Centrifugal pump. 304 s.s. 2" x 1½" capacity 60 GPM, 100' head. Motor is 10.0 HP, 1800 RPM.
145	36" Sparkler Filter	15-0238	Filter made by Sparkler Mfg. Co., 33-D-12 horizontal plate filter. Type 304 s.s. Jacket tested for pressure of 30 psi.
146	Finished Product Tank #1	21-0780	Filtrate receiver tank. Dwg. E-862. Same as Item No. 142.
147	Finished Product Tank #2.	21-1400	Tank made by Nooter. Otherwise, same as Item No. 142.
148	Storage Tank #3	21-0768	Tank made by Graver. Dwg. C-609. Horizontal steel, 10' Dia. x 26' long on str. side. dished heads, shell ½", head 9/16". Test of tank is 60# and coil is 300# hydro. pressure. All coils, supports, inside surface sprayed with .005" zinc and .003" tin.
149	Storage Transfer Pump #3	19-0585 66-0853	Taber Vert. Sub. pump. Dwg. A-387. Type C-3, 2" x 2", C.I. body, length 11'6". Cap. 50 GPM, 60' static head, Sp. Gr. 1.18 at 170°F. Motor is 3 HP, 1800 RPM.
150	Storage Tank #4	21-0769	Same as Item No. 148.
151	Storage Transfer Pump #4	19-0584 66-1501	Taber Vert. Sub. Pump. Type L-2. 2½" 2". Length 11'6". Cap 50 GPM at 40' static head. Motor is 3 HP, 1800 RPM

AROCLOR

APPENDIX A EQUIPMENT LIST (Cont'd.)

Item No.	Equipment Name	Equipment Number	Description
152	Storage Tank #5	21-1310	Tank made by Leader Iron Works. Dwg. C-609. 10' OD x 26' Long on str. she Same as Item No. 148 for other characteristics.
153	Storage Transfer Pump #5	19-0929 66-0856	Same as Item No. 151, except length i 4'7".
154	Storage Tank #8	21-3526	Alpha tank 12'6" Dia. x 22' high. 20,000 gallon storage capacity. Aluminum constructed Dwg. TS-D-3011.
155	Storage Transfer Pump #8	19-3172 66-2651	Durco pump, model WH2 Alloy constr. 2 x 1½", 8" impeller. Cap. 160 GPM at 55' head. Motor is 7½ HP, 1740 RPM.
156	Storage Tank #7	21-2404	Slpha tank. 13' O.D. x 20' high. Vertical tank, constructed of 3/8" mi steel. Capacity is 20,000 gallons.
157	Storage Transfer Pump #7	19-2077 66-1691	Pump made by Blackmer. Monel shaft, 2½" x 2½". Cap. 90 GPM, 15' head. Motor is 3 HP, 1750 RPM.
158	Scales	24-0246 24-0187	Made by Toledo Scale Co. 800# capacit; dial type scale.
167	Blow Tank #1	21-0750	Tank made by graver. Dwg. E-863. 7' Dia. x 7' str. side, dished heads ½", shell 3/8". 5 turn coil of 2" xHY pipe
169	Surge Tank	22-0751	Cyclone collector made by Graver. Dwg. B-695. 48" Dia. x 27" on str. side, 3' 6" long and tangential inlet near top of side. 3/16" steel throughout of welded construction.
170	City Water Pump #1	69-1083 66-3365	Taber Horiz. pump, Model CB5, 3" x 2½ 9" impeller. Cap. 180 GPM, 50' head. Motor is 7½ HP, 1800 RPM.
171	City Water Pump #2	69-2078 66-1796	Same as Item No. 170
180	Exhaust Blower	11-0265	Made by American Blower Co. Type 450E Capacity is 6408 SCFM at 1310 RPM. Dwg E-10699. Motor is 15 HP.

Dept. 246 - Process Description

AROCLOR

APPENDIX A EQUIPMENT LIST (Cont'd.)

Item No.	Equipment Name	Equipment Number	Description
185	Coke Scrubber #1	21-0756	Scrubber liquor tank made by Graver. Dwg. C-800. 4'6" Dia. x 5'6" on Str. Side. Coil 3 turns of 1½" xHY pipe.
186	Coke Scrubber #2	21-1396	Same as Item No. 185.
200	Cyclone Separator	21-1413	Separator made by Heintz Steel. 3' Id 6' high tangential separator with integral vapor pipe complete.
201	Air-cooled Heat Exchanger #5	38-5328	Air-cooled heat exchanger made by Disler. Cooling capacity is 1,200,000 Btu/hr. Steel construction except for aluminum fins. Fan motor is 2 HP, 1150 RPM.
203	Steam Vacuum Jet #1	35-3523	#2 ½ Worthington 3-stage vacuum jet.
204	Steam Vacuum Jet #2	35-1686	Same as Item No. 203.
205	Steam Vacuum Jet #3	35-3533	3-stage porcelain Kubati vacuum eject with 10" ID porcelain condenser. Jet has a capacity of 10#/hr. air at standard conditions. Jet designed for 150# steam and 2 mm Hg absolute.
206	Off-gas Drowning Jet	35-4756	Made by Schutte-Koertig. 8" Haveg fum scrubber. Complete with standard nozzle.
207	Drying Oven	14-0138	Grieve Hendry drying oven, 440 V., 3 phase, 60 cycle, manual reset temp. controller range 0-400°C.
210	Air-cooled Heat Exchanger #1	38-5564 66-8113	Same as Item No. 201.
211	Air-cooled Heat Exchanger #2	38-5565 66-8114	Same as Item No. 201.
212	Air-cooled Heat Exchanger #3	38-5566 66-8115	Same as Item No. 201.
213	Air-cooled Heat Exchanger #4	38-5567 66-8116	Same as Item No. 201.

AROCLOR

APPENDIX A EQUIPMENT LIST (Cont'd.)

Item No.	Equipment Name	Equipment Number	Description
None	Chlorine Pressure Recorder	29-1547	Made by Taylor Instrument Co. Pressure Recorder with 2 pens. Cat. No. X176JF235. Range 0-100
None	#5 Chlorinator Flow Recorder	29-2019	Made by Taylor Instrument Co. Flow Recorder - Controller. Cat. No. 137RF135. 12" chart, 0 to 10 Sq. root chart.
None	Water Meter	29-2486	Made by Worthington Corporatio 3" model IH turbine type water meter.
None	#1 Still Temperature Recorder	29-3885	Made by Leeds & Northrup Co. Temperature Recorder. Range 0 - 400°C.
None	#1 Still Absolute Pressure Controller	29-1170	Made by Taylor Instrument Co. Absolute pressure Recorder - Controller.
None	200# Steam Flow Recorder	29-0835	Made by Bailey Meter Company. Flow Recorder.
None	#2 Still Absolute Pressure Controller	29-3353	Made by Taylor Instrument Co. Absolute Pressure Recorder - Controller.
None	#2 Still Temperature Recorder	29-0244	Made by Leeds & Northrup Co. 6 point Temperature Recorder.
None	#2 Still Level Controller	29-1463	Made by Taylor Instrument Co. Liquid Level Recorder - Controller.
None	Chlorinator Temperature Recorder	29-0288	Made by Leeds & Northrup Co. 12 point Temperature Recorder
None	#1 Blow Tank Temperature Recorder	29-2916	Made by Taylor Instrument Co. Temperature Recorder Controll Adjusts 200# steam to #1 Blow Tank Cat. #86 RM43185-12.

AROCLOR

APPENDIX A

EQUIPMENT LIST (Cont'd.)

Item No.	Equipment Name	Equipment Number	Description
None	80# Steam Flow Recorder	29-5452	Made by Foxboro Company. Type T37, recording flow meter with integrator and indicator. Meter body 316 S.S. Integrator for 80#, 400°F. Steam.
None	200# Steam Flow Recorder	29-5453	Made by Foxboro Company. Type T37 Recording Flow meter with integrator and indicator. Meter body 316 S.S. Integrato for 200#, 510°F. Steam.

AROCLOR

APPENDIX B

SPECIFICATIONS

The folliwing is a list of the raw materials used for the manufacture of Aroclors. Specification sheets are included w..ere they exist.

Material Code	Raw Material
82601	Biphenyl
33500	Ferric Chloride
38800	Lime
19400	Attapulgus Earth
81059	Chlorine
43099	Nitrogen

The following is a list of the finished products manufactured in department 246. Specification sheets are included where they exist.

Product Code	Product
	MCS 295
	Aroclor 1254-10% Xylene
	Aroclor 1232
81101 (Electrical & Non-Electrical)	Aroclor 1242
81102 (Electrical & Non-Electrical)	Aroclor 1248
81103 (Electrical & Non-Electrical)	Aroclor 1254
81105 (Electrical & Non-Electrical)	Aroclor 1260
81107	Aroclor 1262
81101-81102 (Mix)	1242 - 1248 Mix
82868	Montars 1,2,3 and 4.

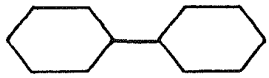
MONSANTO CHEMICAL COMPANY
ORGANIC CHEMICALS DIVISION
W.G.KRUMMRICH PLANT
RAW MATERIAL
SPECIFICATION

MATERIAL CODE: 82601
USING DEPTS.: 246
SUPPLIER: ANNISTON PLANT

Issued 6/9/61
W.G.Krummrich Plant
By A.O.Marti

MATERIAL: DIPHENYL (BIPHENYL)

CHEMICAL FORMULA



MOL WT. 154.20

SUPERSEDES SPECS OF: 4/6/51

SAMPLE FOR ANALYSIS: 2 x 16 oz. W.M.Bottles

UNRESTRICTED INFORMATION

Routine Tests

Property	Specification	Method Number
Appearance and Color	Light Yellow Cryst. Solid	10,252
Crystallizing Point	68.7°C, min.	10,298

GENERAL INFORMATION

Distillation Range:

First Drop to	2.5°C, max.	10,299
Dry Point	Must include 255°C within Range	

TRAN 009233

IN 88 (REV. 12/88)

MONSANTO CHEMICAL COMPANY
ORGANIC CHEMICALS DIVISION
W. G. Krummrich Plant
FINISHED PRODUCT SPECIFICATION

PRODUCT CODE	DEPT. OR JOB
81059	232

USE: Internal

SALES CODE:

Issued DEC 23 1963
W. G. Krummrich Plant
By M. D. Daly

PRODUCT (Trade Name): Chlorine (Snift Gas) — TYPE:

PRODUCT (Chemical Name): — TYPE:

RAW MATERIAL

Date Approved DEC 23 1963

For Dept. ~~233, 236, 237, 246~~

CHEMICAL FORMULA

Mixture

MOL WT.

SUPERSEDES SPECS OF	SAMPLE FOR ANALYSIS
New	100 c.c. Gas Burette

UNCLASSIFIED INFORMATION

General Tests (made only on request)

Property	Typical Analyses	Method Number
Chlorine (Cl_2)	86% By Volume	- - -
Oxygen (O_2)	3% " "	- - -
Carbon Dioxide (CO_2)	1.5% " "	- - -
Carbon Monoxide (CO)	0.1% " "	- - -
Hydrogen (H_2)	1.0% " "	- - -
Inert Gases (By difference)	8.4% " "	- - -
Moisture (H_2O) @ Std. Conditions	2.4×10^{-5} lbs./ft.^{3} (Average)	

Direct pipeline transfers to using Depts.

233, 236, 237, 246

This specification is for internal use at WGK Plant only.

COMPANY CONFIDENTIAL

TRAN 009234

IN 94 (REV. 12/59)

MONSANTO CHEMICAL COMPANY
ORGANIC CHEMICALS DIVISION
W. G. Krummrich Plant
RAW MATERIAL SPECIFICATION

MATERIAL CODE: 38800
USING DEPTS.: 222, 246
SUPPLIER:

Issued 6/20/63
W. G. Krummrich Plant
By M. D. Dealy

MATERIAL: Lime, Hydrated
CHEMICAL FORMULA: $Ca(OH)_2$
MOL WT.

SUPERSEDES SPECS OF: 6/5/57
SAMPLE FOR ANALYSIS: 1 x 16 oz. W. M. Bottle

UNCLASSIFIED INFORMATION

General Tests (made only on request)

Property	Specification	Method Number
Appearance	Fine white or slightly gray powder, free from lumps or gritty material	10,188
Assay ($Ca(OH)_2$)	92.00%, min.	10,191
Carbonates as ($CaCO_3$)	3.00%, max.	10,193
Magnesium	0.50%, max.	10,192
Sulfates (as SO_3)	0.30%, max.	10,189

COMPANY CONFIDENTIAL

TRAN 009235

IN 88 (REV. 10/58)

W. G. Krummrich Plant
MONSANTO CHEMICAL COMPANY
ORGANIC CHEMICALS DIVISION

RAW MATERIAL SPECIFICATION

MATERIAL CODE: 33500
USING DEPTS.: 233
SUPPLIER:

Issued 11/15/62
W. G. Krummrich Plant
By J. A. Hlavaty

MATERIAL: Ferric Chloride Anhydride

CHEMICAL FORMULA: $FeCl_3$

MOL WT. 162.21

SUPERSEDES SPECS OF: 2/26/57

SAMPLE FOR ANALYSIS: 1 x 8 oz. W. M. Bottle

UNRESTRICTED INFORMATION

General Tests (made only on request)

Property	Specification	J.F.Q. Method No.
Appearance	Black powder or granules	16-A
Assay	97.0%, min.	22-570
Sulfates	0.05%, max.	120-570
Ferrous Salts	Trace, max.	S-570-1
Solubility:		112-B
10:10 of Water	Complete to slightly turbid, max.	
10:10 of Formula 30 alcohol	Complete to slightly turbid, max.	

COMPANY CONFIDENTIAL

TRAN 009236

IN 88 (REV. 12/58)

W. G. Krummrich Plant

MONSANTO CHEMICAL COMPANY
ORGANIC CHEMICALS DIVISION

RAW MATERIAL SPECIFICATION

MATERIAL CODE: 29400

USING DEPTS.: 246

SUPPLIER: Barada and Page, Inc.

Issued 11/15/62
W. G. Krummrich
Plant
By D.C. Armstrong

MATERIAL: Attapulgus Earth 200/UP LVM

CHEMICAL FORMULA:

Clay

MOL WT.:

SUPERSEDES SPECS OF: 5/7/59

SAMPLE FOR ANALYSIS: 2 x 16 oz. W. M. Bottles

UNRESTRICTED INFORMATION

Routine Tests

Property	Specification	Method Number
Volatile Matter (at 950°C)	6 - 8%	- - -
Mesh Test:		
Through USS 325	90%, min.	- - -

This material is not accepted without the supplier's analysis of the above properties.

COMPANY CONFIDENTIAL

TRAN 009237

JN 80 (REV. 12/58)

MONSANTO CHEMICAL COMPANY
ORGANIC CHEMICALS DIVISION
W. G. Krummrich Plant
FINISHED PRODUCT SPECIFICATION

PRODUCT CODE: 81115
DEPT. OR JOB: 246
USE: Internal J.F.Q.
SALES CODE:

Issued APR 7 1964
W. G. Krummrich Plant
By W. D. Daly

PRODUCT (Trade Name): Aroclor 1232
TYPE: (MCS - 236)
PRODUCT (Chemical Name): 32% Chlorinated Biphenyl
TYPE:
CHEMICAL FORMULA:
MOL WT.

SUPERSEDES SPECS OF: New
SAMPLE FOR ANALYSIS: 2 x 16 oz. W. M. Bottles

Routine Tests	Specification	Method No.
Appearance	Clear Liquid	
Sp. Gr. @25/15.5°C	1.266 - 1.276	10,114
Acid Number	0.014 mg. KOH/grm. max.	10,087
Color, APHA	100, max.	10,084
H_2O	35 ppm., max.	10,620
General Tests		
Chlorine	31.5 - 32.5%	

This specification is for internal use only.

COMPANY CONFIDENTIAL

TRAN 009238

IN 84 (REV. 12/80)

MONSANTO CHEMICAL COMPANY
ORGANIC CHEMICALS DIVISION
ANNISTON AND KRUMMRICH
FINISHED PRODUCT
SPECIFICATION

PRODUCT CODE	DEPT. OR JOB
	27 - Anniston 246 - WGK
USE: SALES	
SALES CODE: 1040-130-04/11/16-03/09	

Issued 1/24/62
W.G.Krummrich Plant
by E.O. Martin

PRODUCT (Trade Name): AROCLOR 1142 — TYPE: CRUDE COMMERCIAL
PRODUCT (Chemical Name) — TYPE

CHEMICAL FORMULA

MIXTURE

MOL WT. - - -

SUPERSEDES SPECS OF	SAMPLE FOR ANALYSIS
3/28/58	1 Qt. Bottle Anniston;2x16 oz. W.M.Bottle WGK

UNRESTRICTED INFORMATION

Routine Tests

Property	Specification	Method Number	
		Anniston	WGK
Appearance and Color	Brown to black oily liquid	- - - -	10,084
Specific Gravity 25°/15.5°C	1.384 - 1.394	14-49-54	10,114
Acid Number (mg. KOH/g.)	0.7, max.	14-46-54	11,532

RESTRICTED INFORMATION

Acid Number of the crude, which is stored in non-lacquered metal containers shall be 0.2mg. KOH/g. max.

COMPANY
CONFIDENTIAL

TRAN 009239

IN 84 (REV. 12/66)

MONSANTO CHEMICAL COMPANY
ORGANIC CHEMICALS DIVISION
KRUMMRICH and ANNISTON
FINISHED PRODUCT
SPECIFICATION

PRODUCT CODE	DEPT. OR JOB
01101 WGK 82612 ANN.	246 WGK 27L ANN.
USE: Sales	
SALES CODE: 1040-240-04/11/16-03/09	

Issued 4/13/62
W.G.Krummrich Plant
By R.O.Marti

PRODUCT (Trade Name): AROCLOR 1242 — TYPE: ELECTRICAL GRADE (PYRANOL 1499)

PRODUCT (Chemical Name) — TYPE

CHEMICAL FORMULA

Mixture

MOL WT. ---

SUPERSEDES SPECS OF: 4/17/61

SAMPLE FOR ANALYSIS: 3 x 5 pt. Amber Bottles

UNRESTRICTED INFORMATION

Routine Tests

Property	Specification	Method Number WGK	Method Number ANNISTON
Color (APHA)	50, max.	10,084	14-44-54
Condition	Clear	10,084	G-1
Sp. Gr. @ 25/15.5°C	1.381-1.392	10,114	14-49-54
Acidity (mg. KOH/g.)	0.010, max.	10,087	14-42-54
Moisture (H_2O)	35 ppm., max.	10,620	14-53-54
Refractive Index @ 25°C	1.6240-1.6260	10,125	14-34-54
Inorganic (Free) Chlorides	0.05 ppm., max.	T-2092	014
Pour Point	-14°C or Lower	10,115	14-47-54
Dielectric Constant (1000 cycles @ 100°C)	4.70-4.90	11,608	14-36-54
Resistivity (500 VDC @ 100°C 0.1" GAP) As OHM-CM x 10^9	500, min.	11,607	14-35-57
Hydrolysis Stability Test (As Chlorides)	1.0 ppm., max.	T-2087	010
Monsanto Stability Test (As Chlorides)	0.4 ppm., max.	11,503	14-61-57
Distillation Range (ASTM D-20, Corrected)		10,117	14-31-54
10% Distilled by wt.	325°C, min.		
90% Distilled by wt.	360°C, max.		

GENERAL TESTS (Made only on request)

Sulfates	None	12,169	---
Dielectric Strength @ 25°C	35 KV, min.	11,605	043
Flash Point (°F)	338-392	10,123	14-28-54
Fire Point	None	10,123	14-28-54
Viscosity @ 100°F (SUS)	82-92	10,086	14-4-52
Corrosion Test (6 hrs @ 210°C with bright aluminum foil)		10,126	14-55-57
Change in wt. of AL (%)	0.0		

(Over)

TRAN 009240

IN 94 (REV. 12/58)

A.C. Color (APHA)	60, max.	10,084	14-44-54
A.C. Condition	Clear	10,084	G-1
A.C. Acidity (mg. KOH/g.)	0.010, max.	10,087	14-42-54
A.C. Inorganic(Free)Chlorides	0.05 ppm., max.	T-2092	014

GENERAL INFORMATION

Specific Heat @ 25°C	0.30
Coefficient of Expansion (25-65°C)	0.00068 cc/°C
Fixed Chlorine	42.5-43.5%

SPECIAL CUSTOMER REQUIREMENT

General Electric

Hydrolysis Stability Test (As Chlorides)	0.5 ppm., max.	T-2087	010
Thermal Chemical Chlorides	0.75 ppm., max.	12,722	

MONSANTO CHEMICAL COMPANY
ORGANIC CHEMICALS DIVISION
Krummrich and Anniston
FINISHED PRODUCT SPECIFICATION

PRODUCT CODE	DEPT. OR JOB
81102 - 82641	WGK 246-Ann.27

USE: Sales

SALES CODE: 1040-260-04/11/16-03/09

Issued JUL 15 1964
W. G. Krummrich Plant
By M D Daly

PRODUCT (Trade Name): Aroclor 1248 — TYPE: Non-Electrical Grade

PRODUCT (Chemical Name) — TYPE

CHEMICAL FORMULA

Mixture

MOL WT.

SUPERSEDES SPECS OF: 5-4-61

SAMPLE FOR ANALYSIS: 3 x 16 oz. W. M. Bottles

UNRESTRICTED INFORMATION

Routine Tests	Specification	WGK Method No.	Anniston Method No.
Appearance	Colorless to light yellow-green liquid	10084	G-1
Condition	Clear	10084	G-1
Color, APHA	100 max.	10084	046
Sp. Gr. @65/15.5°C	1.405 - 1.415	10114	052
Acidity (mg. KOH/g.)	0.010, max.	10087	050
Moisture (H_2O) (ppm.)	50, max.	10620	047
Viscosity @130°F (SUS)	73 - 80	10086	049
General Tests			
Flash Point (°F)	370, min.	10123	14-28-54

COMPANY CONFIDENTIAL

TRAN 009242

MONSANTO CHEMICAL COMPANY
ORGANIC CHEMICALS DIVISION

W.G.K. and Anniston
FINISHED PRODUCT
SPECIFICATION

PRODUCT CODE: 81102
DEPT: 246 WGK
27 Ann.

USE: Sales

SALES CODE: 1040-260-04/11/16-03/09

PRODUCT (Trade Name): Aroclor 1248 Electrical Grade (Pyranol 1498)
TYPE:

PRODUCT (Chemical Name):
TYPE:

CHEMICAL FORMULA

Mixture

MOL WT.

SUPERSEDES SPECS OF: 2-12-60

SAMPLE FOR ANALYSIS: 3 x 5 pt. Amber Bottles

Issued 1/10/64
W. G. Krummrich Plant
By M. D. Dsch

Corrected 2-16-64

UNRESTRICTED INFORMATION

Routine Tests	Specification	Method No's WGK	Method No's Anniston
Color, APHA	50, max.	10,084	14-44-5
Condition	Clear	10,084	G-1
Sp. Gr. @65/15.5°C	1.405 - 1.415	10,114	14-49-5
Acidity (mg. KOH/gm.)	0.010, max.	10,087	14-42-5
Moisture	35 ppm., max.	10,620	14-53-5
Refractive Index @25°C	1.6285 - 1.6305	10,125	14-34-5
Inorganics (Free) Chlorides	0.05 ppm., max.	T-2092	014
Pour Point	0°C, max.	10,115	14-27-5
Dielectric Constant (1000 cycles @100°C)	4.5 - 4.7	11,608	14-36-5
Resistivity (500 VDC @100°C 0.1" GAP) as OHM-CM x 10^9	500, min.	11,607	14-35-5
Hydrolysis Stability Test (as Chlorides)	1.0 ppm., max.	T-2087	010
Monsanto Stability Test (as Chlorides)	0.5 ppm., max.	11,503	14-61-5
Distillation Range (ASTM D-20, Corrected)		10,117	14-31-54
10% Distilled by Wt.	345°C, min.		
90% Distilled by Wt.	385°C, max.		

General Tests (made only on request)

Sulfates	None	12,169	- - -
Dielectric Strength @25°C	35 KV, min.	11,605	043
Fire Point	None to boiling point	10,123	14-28-54
Viscosity @54.4°C (SUS)	73 - 80	10,086	14-4-52
Corrosion Test (6 hrs. @210°C with bright aluminum foil)		10,126	14-55-57
Change in wt. of Al (%)	0.0		

COMPANY CONFIDENTIAL

(over)

TRAN 009243

MM 84 (REV. 12/60)

A. C. Color, APHA	60, max.	10,084 14-44-54
A. C. Condition	Clear	10,084 G-1
A. C. Acidity (mg. KOH/g.)	0.010, max.	10,087 14-42-54
A. C. Inorganic (Free) Chlorides	0.05 ppm., max.	10,118 010

GENERAL INFORMATION

Specific Heat @25°C	0.27
Fixed Chlorine	47.5 - 48.5%

MONSANTO CHEMICAL COMPANY
ORGANIC CHEMICALS DIVISION
Krummrich and Anniston
FINISHED PRODUCT
SPECIFICATION

PRODUCT CODE	DEPT. OR JOB
81103 - 82613	WGK-246-Ann.27

USE: Sales

SALES CODE: 1040-280-04/11/16-03/09

Issued JUL 15 1964
W. G. Krummrich Plant
By W D Daly

PRODUCT (Trade Name): Aroclor 1254
TYPE: Non-Electrical Grade

PRODUCT (Chemical Name):
TYPE:

CHEMICAL FORMULA

Mixture

MOL WT.

SUPERSEDES SPECS OF: 5-4-61

SAMPLE FOR ANALYSIS: 3 x 16 oz. W. M. Bottles

UNRESTRICTED INFORMATION

Routine Tests	Specification	WGK Method No.	Anniston Method No.
Color, APHA	100, max.	10084	046
Sp. Gr. @65/15.5°C	1.495 - 1.505	10114	052
Acidity (mg. KOH/g.)	0.010, max.	10087	050
Moisture (H_2O) (ppm.)	50, max.	10620	047
General Tests			
Flash Point	None	10123	14-28-54
Viscosity @210°F (SUS)	44-48	10086	049

COMPANY
CONFIDENTIAL

TRAN 009245

MONSANTO CHEMICAL COMPANY
ORGANIC CHEMICALS DIVISION
KRUMMRICH and ANNISTON
FINISHED PRODUCT
SPECIFICATION

PRODUCT CODE: 81103 WGK, 82613 ANN. | SPEC. NO. 246 WGK, 27 ANN.

USE: Sales

SALES CODE: 1040-280-04/11/16-03/09

Issued 4/13/62
W. G. Krummrich Plant
By E. O. Martin

PRODUCT (Trade Name): AROCLOR 1254 ELECTRICAL GRADE (PYRANOL 1476) | TYPE

PRODUCT (Chemical Name) | TYPE

CHEMICAL FORMULA

Mixture

MOL WT. ---

SUPERSEDES SPEC OF: 10/10/61

SAMPLE FOR ANALYSIS: 3 x 5 pt. Amber Bottles

UNRESTRICTED INFORMATION

Routine Tests

Property	Specification	Method Number WGK	Method Number ANNISTON
Color, APHA	50, max.	10,084	14-44-54
Condition	Clear	10,084	G-1
Sp. Gr. @ 65/15.5°C	1.495-1.505	10,114	14-49-54
Acidity (mg. KOH/gm.)	0.010, max.	10,087	14-42-54
Moisture (H_2O)	35 ppm, max.	10,620	14-53-54
Refractive Index @ 25°C	1.6370-1.6390	10,125	14-34-54
Inorganic (Free) Chlorides	0.05 ppm., max.	T-2092	014
Pour Point	7-12°C	10,115	14-27-54
Dielectric Constant (1000 cycles @ 100°C)	4.15-4.35	11,608	14-36-54
Resistivity (500 VDC @ 100°C 0.1" GAP) as OHM-CM x 10^9	500, min.	11,607	14-35-57
Hydrolysis Stability Test (As Chlorides)	1.0 ppm., max.	T-2087	010
Monsanto Stability Test (As Chlorides)	0.5 ppm., max.	11,503	14-61-57
Distillation Range (ASTM D-20, Corrected)		10,117	14-31-54
10% Distilled by Wt.	366-378°C		
50% Distilled by Wt.	371-383°C		
90% Distilled by Wt.	379-394°C		

GENERAL TESTS (Made only on request)

Sulfates	None	12,169	---
Dielectric Strength @ 25°C	35 KV, min.	11,605	043
Flash Point	None	10,123	14-28-54
Fire Point	None	10,123	14-28-54
Viscosity @ 210°F (SUS)	44-48	10,086	14-4-52
Corrosion Test (6 hrs @ 210°C with bright aluminum foil)		10,126	14-55-57
Change in wt. of Al (%)	0.0		

TRAN 009246

(Over)

IN 84 (REV. 10/58)

COMPANY
CONFIDENTIAL

A.C. Color, APHA	60, max.	10,084	14-44-54
A.C. Condition	Clear	10,084	G-1
A.C. Acidity (mg. KOH/g.)	0.010, max.	10,087	14-42-54
A.C. Inorganic (Free) Chlorides	0.05 ppm., max.	10,118	010

EXTERNAL SPECIFICATION

Cornell - Dubilier

Resistivity (500 VDC @ 100°C 0.1" GAP as OHM-CM x 10^9)	1500, min.	11,607	14-35-54

GENERAL INFORMATION

Specific Heat @ 25°C	0.27
Coefficient of Expansion (25-65°C)	0.00066 cc/°C
Fixed Chlorine	54.5-55.5%

MONSANTO CHEMICAL COMPANY
ORGANIC CHEMICALS DIVISION
ANNISTON AND KRUMMRICH

FINISHED PRODUCT SPECIFICATION

PRODUCT CODE	DEPT. OR JOB
82614-Ann. 81105-WGK	27-Anniston 246-WGK

USE: SALES

SALES CODE: 1040-170-04/11/16-03/09

Issued 1/24/62
W.G.Krummrich Plant
By R. O. Martin

PRODUCT (Trade Name): AROCLOR 1160 — TYPE: CRUDE COMMERCIAL

PRODUCT (Chemical Name) — TYPE:

CHEMICAL FORMULA

MIXTURE

MOL WT. - - -

SUPERSEDES SPECS OF: 3/28/58

SAMPLE FOR ANALYSIS: 1 pt. can Anniston; 2 x 16 oz. W.M. Bottles WGK

UNRESTRICTED INFORMATION

Routine Tests

Property	Specification	Method Number	
		Anniston	WGK
Appearance and Color	Brown to black viscous sticky mass	--------	10,084
Specific Gravity 90°/15.5°C	1.558 - 1.569	14-49-54	10,114
Acid Number (mg. KOH/g.)	0.7, max.	14-46-54	11,532

RESTRICTED INFORMATION

Acid Number of the crude, which is stored in non-lacquered metal containers shall be 0.2 mg. KOH/g., max.

COMPANY CONFIDENTIAL

TRAN 009248

IN 84 (REV. 12/58)

MONSANTO CHEMICAL COMPANY
ORGANIC CHEMICALS DIVISION
Krummrich and Anniston
FINISHED PRODUCT SPECIFICATION

PRODUCT CODE: 81105 - 82614
DEPT. OR JOB: WGK 246 Ann.27
USE: Sales
SALES CODE: 1040-290-04/11/16-03/09

Issued JUL 15 1964
W. G. Krummrich Plant
By M D Daly

PRODUCT (Trade Name): Aroclor 1260
TYPE: Non-Electric Grade
PRODUCT (Chemical Name):
TYPE:

CHEMICAL FORMULA

Mixture

MOL WT.

SUPERSEDES SPECS OF: 5-4-61
SAMPLE FOR ANALYSIS: 3 x 16 oz. W. M. Bottles

UNRESTRICTED INFORMATION

Routine Tests	Specification	WGK Method No.	Anniston No.
Condition	Clear	10084	G-1
Color, APHA	150, max.	10084	046
Sp. Gr. @90/15.5°C	1.555 - 1.566	10114	052
Acidity (mg. KOH/g.)	0.014, max.	10087	050
Moisture (H_2O) (ppm.)	50, max.	10620	047
Viscosity @210°F (SUS)	72-78	10086	049
General Tests			
Flash Point	None	10123	14-28-5
Fire Point	None	10123	14-28-5

COMPANY CONFIDENTIAL

TRAN 009249

IN 84 (REV. 12/59)

MONSANTO CHEMICAL COMPANY
ORGANIC CHEMICALS DIVISION
Anniston and Krummrich Plants
FINISHED PRODUCT
SPECIFICATION

PRODUCT CODE: 82814 - Ann. 81105 - WGK
DEPT. OR JOB: 27 - Ann. 246 - WGK
USE: Sales
SALES CODE: 1040-290-04/11/16/-03/09

Issued 2/7/62
W.G.Krummrich Plant
By E. O. Martin

PRODUCT (Trade Name): AROCLOR 1260
TYPE: ELECTRICAL GRADE
PRODUCT (Chemical Name)
TYPE: (PYRANOL 1482)
CHEMICAL FORMULA: Mixture
MOL WT. ---

SUPERSEDES SPECS OF: 3/28/58
SAMPLE FOR ANALYSIS: 3 x 5 pt. Amber Bottles

UNRESTRICTED INFORMATION

Routine Tests

Property	Specification	Method No. WGK	Method No. Anniston
Color (APHA)	150, max.	10,084	14-44-54
Condition	Clear	10,084	--------
Specific Gravity @ 90/15.5°C	1.555-1.566	10,114	14-49-54
Acidity (mg KOH/g.)	0.014, max.	10,087	14-42-54
Moisture (H_2O) (ppm.)	35, max.	10,620	14-53-54
Viscosity @ 210°F (SUS)	72-78	10,086	14- 4-52
Refractive Index @ 25°C	1.6455-1.6470	10,125	14-34-54
Inorganic (Free) Chlorides	No detectable amt.	10,118	14-48-57
Pour Point (°C)	25-34	10,115	14-47-54
Distillation Range (ASTM D-20, Corrected)		10,117	14-31-54
10% Distilled by wt.	385-398°C		
50% Distilled by wt.	390-404°C		
90% Distilled by wt.	400-420°C		
Corrosion Test (6 hrs. @ 210°C with bright aluminum foil)		10,126	14-55-57
Change in weight of Al (%)	0.0		
A.C. Color (APHA)	150, max.	10,084	14-44-54
A.C. Condition	Clear	10,084	--------
A.C. Acidity (mg.KOH/g.)	0.014, max.	10,087	14-42-54
A.C. Inorganic (Free) Chlorides	No detectable amt.	10,118	14-48-57

(Over)

COMPANY CONFIDENTIAL

TRAN 009250

IN 84 (REV. 12/58)

UNRESTRICTED INFORMATION (cont'd)

Property	Specification	Method Number WGK	Method Number Anniston
General Tests (made only on request)			
Flash Point	None	10,123	14-28-54
Fire Point	None	10,123	14-28-54
Fixed Chlorine (%)	59.5-60.5	10,088	14-13-54
Dielectric Strength @ 50°C	30 K.V., min.	11,605	--------
Resistivity (500 VDC @ 100°C 0.1" gap as ohm-cm. x 10^9)	500, min.	11,607	14-35-57
Dielectric Constant 1000 cycles, 100°C	3.6-3.8	11,608	14-36-45
RESTRICTED INFORMATION			
Monsanto Stability Test (As Chlorides in ppm.)	0.7, max.	11,503	14-61-57
GENERAL INFORMATION			
Evaporation Loss after 6 hrs. @ 100°C (%)	0.2, max.	10,116	14-32-54
Stability test - after 30 days at 100°C in glass sealed in air	No liberation of chlorine or chlorides	------	--------

COMPANY
CONFIDENTIAL

TRAN 009251

MONSANTO CHEMICAL COMPANY
ORGANIC CHEMICALS DIVISION
ANNISTON AND KRUMMRICH
FINISHED PRODUCT
SPECIFICATION

PRODUCT CODE: 82615-Ann. 81107-WGK
DEPT. OR JOB: 27-Anniston 246-WGK
USE: SALES
SALES CODE: 1040-170-04/11/16-03/09

Issued 1/24/62
W.G.Krummrich Plant
by E.O. Martin

PRODUCT (Trade Name): AROCLOR 1162
TYPE: CRUDE COMMERCIAL
PRODUCT (Chemical Name):
TYPE:

CHEMICAL FORMULA

MIXTURE

MOL WT. - - -

SUPERSEDES SPECS OF: 3/28/58
SAMPLE FOR ANALYSIS: 1 pt. can, Anniston; 2 x 16 oz. W.M. Bottles WGK

UNRESTRICTED INFORMATION

Routine Tests

Property	Specification	Method Number	
		Anniston	WGK
Appearance	Viscous liquid	- - - -	10,084
Color	Brown to black	- - - -	10,084
Specific Gravity @90/15.5°C	1.577 - 1.587	14-49-54	10,114
Acid No. (mg. KOH/g.)	0.7, max.	14-46-54	11,532

RESTRICTED INFORMATION

Acid No. of the crude which is stored in non-lacquered containers shall be 0.2 mg. KOH/g., max.

COMPANY CONFIDENTIAL

TRAN 009252

IN 84 (REV. 12/68)

MONSANTO CHEMICAL COMPANY
ORGANIC CHEMICALS DIVISION
ANNISTON AND KRUMMRICH
FINISHED PRODUCT
SPECIFICATION

PRODUCT CODE	DEPT. OR JOB
82615-Ann 81107-WGK	27 - Ann 246-WGK

USE: SALES

SALES CODE: 1040-300-04/11/16-03-09

Issued 1/24/62
W.G.Krummrich Plant
by E.O. Martin

PRODUCT (Trade Name): AROCLOR DISTILLED — TYPE: 1262

PRODUCT (Chemical Name) — TYPE:

CHEMICAL FORMULA

MIXTURE

MOL WT. - - -

SUPERSEDES SPECS OF	SAMPLE FOR ANALYSIS
3/28/58	2 x 16 oz. W. M. Bottles

UNRESTRICTED INFORMATION

Routine Tests

Property	Specification	Method Number
Appearance	Viscous liquid	10,084
Color	APHA 150, max.	10,084
Specific Gravity @ 90/15.5°C	1.572 - 1.583	10,114
Acid No. (mg. KOH/g.)	0.014, max.	10,087
Viscosity @ 210°F	86 - 100 SUS	10,086

GENERAL INFORMATION

Pour Point (ASTM)	35 - 38°C
Distilling Range	390 - 425°C
Total Chlorine	61.5 - 62.5%
Specific Gravity t coeff (85 - 130°C)	0.001/°C

COMPANY CONFIDENTIAL

TRAN 009253

IN 84 (REV. 12/58)

MONSANTO CHEMICAL COMPANY
ORGANIC CHEMICALS DIVISION
Krummrich and Anniston
FINISHED PRODUCT
SPECIFICATION

PRODUCT CODE	DEPT. OR JOB
82868	WGK 246 Ann. 27

USE: Sales

SALES CODE: *See Below

Issued JUL 15 1964
W. G. Krummrich Plant
By M D Daly

PRODUCT (Trade Name): Montars 1 and 2 — TYPE:

PRODUCT (Chemical Name): Polychlorinated Polyphenyls — TYPE:

CHEMICAL FORMULA

Mixture

MOL WT.

SUPERSEDES SPECS OF	SAMPLE FOR ANALYSIS
6-15-61	2 x 16 oz. W. M. Bottles

UNRESTRICTED INFORMATION

Routine Tests	Specification	Anniston Method No.	WGK
Appearance	Black Solid	14-17-52	11321

General Information

Physical Properties (Typical Values)	Montar 1	Montar 2
Softening Point (ASTM E-28-51T)	54-160°C	70-170°C
Acidity	Slightly Basic	Slightly Basic
Chlorine Content	36-42%	44-48%
CaO	5-15%	5-15%
Fe	0.5-1.0%	0.5-1.0%
Benzene Insoluble	- - - -	12.5%
Flash Point	500-620°F	- - - -

RESTRICTED INFORMATION

Montars 1 and 2 are the still residues from distillation of Aroclors 1242 and 1248 respectively. Composition of these Montars is not controlled, being entirely dependent on conditions required to make acceptable distilled product.

Sales Code Nos.

Montar 1 6405 - 001 - 04 - 03/09
Montar 2 6405 - 002 - 04 - 03/09

COMPANY CONFIDENTIAL

TRAN 009254

IN 84 (REV. 12/59)

MONSANTO CHEMICAL COMPANY
ORGANIC CHEMICALS DIVISION
Krummrich and Anniston
FINISHED PRODUCT SPECIFICATION

PRODUCT CODE	DEPT. OR JOB
82868	WGK 246 Ann.27

USE: Sales

SALES CODE: *See Below

Issued JUL 15 1964
W. G. Krummrich Plant
By M D Daly

PRODUCT (Trade Name): Montars 3 and 4 — TYPE:

PRODUCT (Chemical Name): Polychlorinated Polyphenyls — TYPE:

CHEMICAL FORMULA: Mixture

MOL WT.:

SUPERSEDES SPECS OF	SAMPLE FOR ANALYSIS
6-15-61	2 x 16 oz. W. M. Bottles

UNRESTRICTED INFORMATION

Routine Tests	Specification	Anniston Method No.	WGK
Appearance	Black Solid	14-17-52	11321

General Information

Physical Properties (Typical Values)	Montar 3	Montar 4
Softening Point (Method ASTM E28-51T)	86-168°C	92-206°C
Acidity	Slightly Basic	Slightly Basic
Chlorine Content	50-52%	54-56%
CaO	5-10%	5-10%
Fe	0.3-0.6%	0.5-1.0%

RESTRICTED INFORMATION

Montars 3 and 4 are the still residues from distillation of Aroclors 1254 and 1260 respectively. Composition of these Montars is not controlled, being entirely dependent on conditions required to make acceptable distilled product.

*Sales Code Nos.

Montar 3 6405 - 003 - 04 - 03/09
Montar 4 6405 - 004 - 04 - 03/09

COMPANY CONFIDENTIAL

TRAN 009255

IN 84 (REV. 12/60)

AROCLOR

APPENDIX C

PHYSICAL AND CHEMICAL DATA

AROCLOR

APPENDIX C

PHYSICAL CONSTANTS

GENERAL PHYSICAL PROPERTIES OF AROCLORS

	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	Aroclor 1262
Form	Practically colorless mobile oil	Yellow tinted mobile oil	Light yellow viscous oil	Light yellow soft sticky resin	Light yellow sticky clear resin
Color	100 Max. (APHA)	100 Max. (APHA)	150 Max. (APHA)	150 Max. (APHA)	150 Max. (APHA)
Acidity-Maximum (Mgm. KOH per Gm.)	0.015	0.015%	0.015	0.015	0.02
Average Coeffieient of Expansion.....cc/cc°C.	0.00068 (25°-64°C)	0.00070 (25°-65°C)	0.00066 (25°-65°C)	0.00067 (20°-100°C)	0.00064 (25°-65°C)
Typical Density					
Specific Gravity 25°/25°C (77°/77°F)	1.380	1.445	1.538	1.620	1.646
Pounds per Gal. -25°C (77°F)	11.50	12.04	12.82	13.50	13.72
Distillation Range-ASTM D-20(Mod) °C	325°-360°	340°-375°	365°-390°	385°-420°	400°-430°
Evaporation Loss-%-ASTM D-6Mod.					
163°C ..... 5 hrs.	3.0 to 3.6	3.0 to 4.0	1.1 to 1.3	0.5 to 0.8	0.5 to 0.6
100°C..... 6 hrs.	0.0 to 0.4	0.0 to 0.3	0.0 to 0.2	0.0 to 0.1	0.0 to 0.1
Flash Point-Cleveland Open Cup. °C	176°-180°	193°-196°	None	None	None
°F	348°-356°	379°-384°			
Fire Point-Cleve. Open Cup....°C	None*	None	None	None	None
°F					
Four Point-ASTM D-97 ..... °C	-19°	-7°	10°	31°	37°
°F	2°	19.4°	50°	88°	99°
Softening Point-ASTM E-28 °C	--	--	--	--	--
°F	--	--	--	--	--

AROCLOR

APPENDIX C

PHYSICAL CONSTANTS (Cont'd.)

GENERAL PHYSICAL PROPERTIES OR AROCLORS (Cont'd.)

		Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	Aroclor 1262
Form		Practically colorless mobile oil	Yellow tinted mobile oil	Light yellow viscous oil	Light yellow soft sticky resin	Light yellow sticky clear resin
Refractive Index-D-line 20°C		1.627-1.629	1.630-1631	1.639-1.641	1.647-1.649	1.6501-1.6517
Viscosity-Saybolt Universal Sec. (ASTM)-D-88)	210°F (98.9°C)	34-35	36-37	44-48	72-78	90-103
	130°F (54.4°C)	49-56	69-78	260-340	3200-4500	600-103 (160°F or 71°C)
	100°F (37.8°C)	80-93	185-240	1800-2500	---	----

APPENDIX C

PHYSICAL CONSTANTS (Cont'd.)

PHYSICAL AND CHEMICAL DATA

Diphenyl

Specific Gravity: 0.992 at 75°C/4°C.

The Swann Chemical Company bulletin of 1930 gave thermal data on diphenyl.

Viscosity of Diphenyl (from Anniston Files)

°F.	Centipoises
160	1.439
170	1.309
180	1.208
190	1.114
200	1.034
220	0.901
250	0.752
300	0.574
350	0.459
400	0.374
450	0.313
482	0.283

Specific Heat (from Anniston Files)

°F.	B.T.U./lb.
200	0.416
300	0.470
400	0.547
500	0.616
600	0.658
700	0.679
800	0.686
900	0.690
1000	0.696

APPENDIX C

PHYSICAL AND CHEMICAL DATA (Cont'd.)

Diphenyl (Cont'd.)

Another record gives the following values for liquid diphenyl:

°C.	Sp. Heat cals./gram
100	0.360
150	0.380
200	0.412
250	0.460
300	0.518
350	0.575
400	0.610
450	0.625

Vapour Cp = $\frac{0.460}{250°C.}$

$\frac{0.625}{450°C.}$ (D. A. Roper, Design Data for Units 4 & 5)

Density of Liquid Diphenyl (from Anniston files)

°C.	Grams./cc
75	0.9885
100	0.9695
150	0.9294
200	0.8885
250	0.8470
300	0.8010
350	0.7510
400	0.6918
450	0.6180

Heat of Vaporization:

65.4 g. cal./g. at 258.5°C.

AROCLOR

APPENDIX C

PHYSICAL AND CHEMICAL DATA (Cont'd.)

Specific Gravity of Aroclors at Various Temperatures

For	Temp. °C.	Sp. Gr.	Lbs. per Gallon (US)
1242	60	1.347	11.23
	65	1.344	11.20
	70	1.338	11.16
	75	1.335	11.13
	80	1.332	11.10
	85	1.329	11.07
	90	1.324	11.03
	95	1.319	11.00
	100	1.315	10.96
1248	60	1.413	11.78
	65	1.410	11.75
	70	1.403	11.71
	75	1.400	11.68
	80	1.397	11.65
	85	1.394	11.62
	90	1.390	11.58
	95	1.385	11.55
	100	1.381	11.51
1254 or GE 1476	60	1.505	12.55
	65	1.500	12.50
	70	1.495	12.46
	75	1.490	12.42
	80	1.485	12.38
	85	1.480	12.34
	90	1.475	12.30
	95	1.470	12.26
	100	1.465	12.21
1260 or GE 1482	60	1.584	13.21
	65	1.580	13.17
	70	1.575	13.13
	75	1.570	13.09
	80	1.565	13.05
	85	1.560	13.01
	90	1.555	12.96
	95	1.550	12.92
	100	1.545	12.88

AROCLOR

APPENDIX C

PHYSICAL AND CHEMICAL DATA (Cont'd.)

Specific Gravity of Aroclors at Various Temperatures (Cont'd)

For	Temp. °C.	Sp. Gr.	Lbs. per Gallon (US)
1262	60	1.604	13.40
	65	1.600	13.36
	70	1.597	13.32
	75	1.593	13.28
	80	1.588	13.24
	85	1.582	13.19
	90	1.577	13.15
	95	1.572	13.11
	100	1.568	13.07

Heat Capacity of Aroclors at Various Temperatures (Cal/gm°C.)

Temperature °C. / Aroclor	0	50	100	125	150	175	200	250	300
1242	.280	.300	.320	.330	.335	.340	.350	.365	.380
1248	.270	.280	.295	.305	.315	.320	.330	.340	.355
1254	.255	.265	.275	.285	.295	.300	.310	.325	.340
1260	.220	.235	.250	.260	.265	.270	.280	.290	.305

Latent Heat of Vaporization of Aroclors

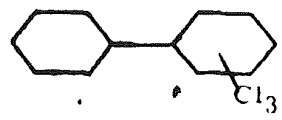
Aroclor	Temp. Range	Latent Heat of Vaporization
1242	300°-310°C.	61 Cal/gm
1248	300°-330°C.	54 Cal/gm
1254	300°-350°C.	50 Cal/gm
1260	300°-370°C.	48 Cal/gm

IN 010

Syst 479
V 580

PHYSICAL CONSTANTS DATA

SUBSTANCE: AROCLOR 1142 (Technical)

STRUCTURAL FORMULA: 

COMPILED BY: Rev. By A. M. Ellenburg

DATE: 1947 7/5/57

NAME		SOURCE & DATE
Formula $C_{12}H_7Cl_3$	Total Cl_2 41.5 - 42.5%	Specs 12-21-54
Molecular Weight		
Appearance	Brown to black oily liquid	Specs 12-21-54
Boiling Point at 760 mm		
Boiling Point at mm		
Boiling Point at mm		
Boiling Point at mm		
Crystallizing Point		
Melting Point		
Solution Point		
Specific Gravity @ 65/15.5°C	1.348-1.360	Specs 12-21-54
Specific Gravity @ 25/15.5°C	1.384-1.397	
Pounds per Gal. @ 25 °C	10.5	
Coefficient of Expansion		
Refractive Index @ n_D^{25}		
Infra Red Spectrum *(Reference)*		
Ultra Violet Spectrum *(Reference)*		
Viscosity @		
Viscosity @		
Surface Tension		
Solubility in Water		
Solubility in		
Solubility in		
Sp. Gr. Temp Coeff. (50-105°C)	0.0009/°C	Specs 12-21-54
Flash Point °F *(Method)* C. O. C.	350	Aroclor Bull. OP-115 [illegible]
Fire Point °C	None	
Heat of Combustion		
Heat of Formation		
Thermal Stability (cal./kg./min.)		
Latent Heat of Fusion		
Latent Heat of Vap.		
Specific Heat		
Critical Temperature		
Critical Pressure		
Dissociation Constant		
Other Constants		TRAN 009263
Toxicity *(Give Reference)*	Schwartz, U. S. Pub. Health Service Bull. #229 1936 "Industrial Poisons, Hazards and Solvents" by M. B. Jacobs Vol. I, P. 463-464 1941	

COMPANY CONFIDENTIAL

NOTE: *These data should not be released outside of Monsanto Chemical Company. Use additional sheets if necessary.*

DEP 246

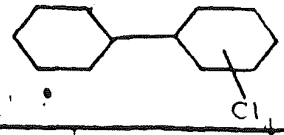
Syst 479
I 580

PHYSICAL CONSTANTS DATA

SUBSTANCE

AROCLOR 1148 (Technical)

STRUCTURAL FORMULA



COMPILED BY

Rev. by A. M. Ellenburg

DATE 1947
7/5/57

NAME		SOURCE & DATE
Formula $C_{12}H_5Cl_5$	Total Cl_2 47.5 - 48.5 %	Specs. 4/11/55
Molecular Weight		
Appearance	Viscous colorless oily liquid	Specs. 4/11/55
Boiling Point at 760 mm		
Boiling Point at mm		
Boiling Point at mm		
Boiling Point at mm		
Crystallizing Point		
Melting Point		
Solution Point		
Specific Gravity @ 65/15.5	1.410-1.420	Specs. 4/11/55
Specific Gravity @		
Pounds per Gal. @ 25 °C	12.0	
Coefficient of Expansion		
Refractive Index @ n_D		
Infra Red Spectrum (Reference)		
Ultra Violet Spectrum (Reference)		
Viscosity @		
Viscosity @		
Surface Tension		
Solubility in Water		
Solubility in		
Solubility in		
Sp. Gr. Temp. Coeff. (50-100°C)	0.0009/°C	Specs. 4/11/55
Flash Point °F (Method) C.O.C.	382	Aroclor Bulletin OP-115
Fire Point °C	None	" (1954)
Heat of Combustion		
Heat of Formation		
Thermal Stability (cal./kg./min.)		
Latent Heat of Fusion		
Latent Heat of Vap.		
Specific Heat		
Critical Temperature		
Critical Pressure		
Dissociation Constant		

Other Constants

TRAN 009264

Toxicity (Give Reference)

Schwartz, U.S. Pub. Health Service Bull. 229, 1936. "Industrial Poisons Hazards & Solvents" by M.B. Jacobs Vo. I, p. 463-434 1941

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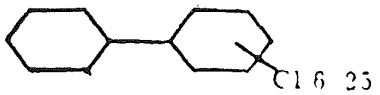
COMPANY CONFIDENTIAL

DEPT 246
IN 010

Syst 971
D,580

PHYSICAL CONSTANTS DATA

SUBSTANCE: AROCLOR 1160 (Technical)

STRUCTURAL FORMULA: 

COMPILED BY: Rev. By A. M. Ellenburg

DATE: 1947 7/5/57

NAME		SOURCE & DATE
Formula $C_{12}H_{3.75}Cl_{6.25}$	Total Cl_2 59.5-60.5%	Specs. 12-21-54
Molecular Weight		
Appearance	Brown to black sticky mass	Specs 12-21-54
Boiling Point at 760 mm		
Boiling Point at mm		
Boiling Point at mm		
Boiling Point at mm		
Crystallizing Point		
Melting Point		
Solution Point		
Specific Gravity @ 90/15.5	1.558-1.572	Specs. 12-21-54
Specific Gravity @		
Pounds per Gal. @ 25 °C	13.5	
Coefficient of Expansion		
Refractive Index @ n_D		
Infra Red Spectrum *(Reference)*		
Ultra Violet Spectrum *(Reference)*		
Viscosity @		
Viscosity @		
Surface Tension		
Solubility in Water		
Solubility in		
Solubility in		
Sp Gr. Temp. Coeff. (75-130°C)	.0.0010/°C	Specs 12-21-54
Flash Point °F *(Method)*	None	
Fire Point °C	None	
Heat of Combustion		
Heat of Formation		
Thermal Stability (cal./kg./min.)		
Latent Heat of Fusion		
Latent Heat of Vap.		
Specific Heat		
Critical Temperature		
Critical Pressure		
Dissociation Constant		
Other Constants		
		TRAN 009265
Toxicity *(Give Reference)*	Schwartz, U. S. Pub. Health Service Bull. #220, 1936. "Industrial Poisons, Hazards and Solvents" by M. B. Jacobs Vol. I, p463-464 1941	

COMPANY CONFIDENTIAL

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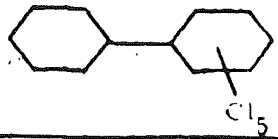
DEPT 246
IN-619

Syst 479
I, 550

PHYSICAL CONSTANTS DATA

SUBSTANCE: AROCLOR 1154 (Technical)

STRUCTURAL FORMULA: 

COMPILED BY: R. A. M. Ellenburg

DATE: 1947 7/5/57

NAME		SOURCE & DATE
Formula $C_{12}H_5Cl_5$	Total Cl_5 53.5 - 54.5%	Specs. 12-21-54
Molecular Weight		
Appearance	Brown to black oily liquid	Specs. 12-21-54
Boiling Point at 760 mm		
Boiling Point at mm		
Boiling Point at mm		
Boiling Point at mm		
Crystallizing Point		
Melting Point		
Solution Point		
Specific Gravity 65, 15.5	1.500 - 1.510	" "
Specific Gravity		
Pounds per Gal. 25 °C	12.8	
Coefficient of Expansion		
Refractive Index n_D		
Infra Red Spectrum (Reference)		
Ultra Violet Spectrum (Reference)		
Viscosity		
Viscosity		
Surface Tension		
Solubility in Water		
Solubility in		
Solubility in		
Sp. Gr. Temp. Coeff. (55-105°C)	0.00095/°C	" "
Flash Point °F (Method)	None	
Fire Point °C	None	
Heat of Combustion		
Heat of Formation		
Thermal Stability (cal./kg/min.)		
Latent Heat of Fusion		
Latent Heat of Vap.		
Specific Heat		
Critical Temperature		
Critical Pressure		
Dissociation Constant		
Other Constants		
		TRAN 009266
Toxicity (Give Reference)	Schwartz, U. S. Pub. Health Service, Bull. #225, [illegible] "Industrial Poisons, Vol. I, -463-364 1941 Hazards and Solvents by M. B. Jacobs	

COMPANY CONFIDENTIAL

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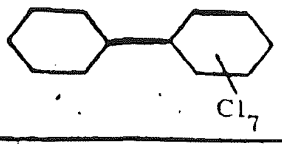
DEPT. 246

Sy 57479
I, 580

PHYSICAL CONSTANTS DATA

SUBSTANCE: AROCLOR 1162 (Technical)

STRUCTURAL FORMULA: 

COMPILED BY: Rev. By A. M. Ellenburg

DATE: 1947 7/5/47

NAME		SOURCE & DATE
Formula $C_{12}H_3Cl_7$	Total Cl_2 61.5 -62.5%	Specs. 4-11-55
Molecular Weight		
Appearance	Brown to black sticky mass	Spec 4-11-55
Boiling Point at 760 mm		
Boiling Point at ___ mm		
Boiling Point at ___ mm		
Boiling Point at ___ mm		
Crystallizing Point		
Melting Point		
Solution Point		
Specific Gravity @ 90/15.5	1.577 - 1.587	Spec 4-11-55
Specific Gravity @		
Pounds per Gal. @ 25 °C	13.7	
Coefficient of Expansion		
Refractive Index @ $n_D^{\ }$		
Infra Red Spectrum *(Reference)*		
Ultra Violet Spectrum *(Reference)*		
Viscosity @		
Viscosity @		
Surface Tension		
Solubility in Water		
Solubility in		
Solubility in		
Sp. Gr. TempCoeff. (85-120°C)	0.0010/°C	Spec 4-11-55
Flash Point °F *(Method)*	None	
Fire Point °C	None	
Heat of Combustion		
Heat of Formation		
Thermal Stability (cal./kg/min.)		
Latent Heat of Fusion		
Latent Heat of Vap.		
Specific Heat		
Critical Temperature		
Critical Pressure		
Dissociation Constant		
Other Constants		TRAN 009267
Toxicity *(Give Reference)*	Schwartz, U.S. Pub. Health Service Bull. #229, 1936 "Industrial Poisons Hazards and Solvents" by M. B. Jacobs Vol. I, p-463-464, 1941	

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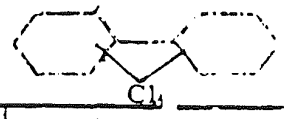
Syst 4
X, 580

PHYSICAL CONSTANTS DATA

SUBSTANCE: AROCLOR 1242

STRUCTURAL FORMULA



COMPILED BY: A. M. Ellerburg

DATE: 4-25-57

Dept 346

NAME		SOURCE & DATE
Formula	$C_{12}H_7Cl_3$	
Molecular Weight	≈257 Avg.	
Appearance	Colorless Mobile O...	Monsanto Bull. OP 1... 9
Boiling Point at 760 mm Range	325 - 360 C.	"
Boiling Point at 3 mm	155-195 C.	
Boiling Point at mm		
Boiling Point at mm		
Crystallizing Point	Non-crystallizing	
Melting Point		
Solution Point		
Specific Gravity 25/25 C.	1.380	
Specific Gravity 25/15.5 C.	1.381 - 1.392	Spec. Data 2-14-55
Pounds per Gal. @ 25 °C	11.50	M. B. OP-1.5
Coefficient of Expansion 25-65 C.	0.00065 cc/cc/°C.	"
Refractive Index 25 C. n_D	1.6245 - 1.6265	Spec. Data 2-14-55
Infra Red Spectrum (Reference)		
Ultra Violet Spectrum (Reference)		
Viscosity @ 210 F.	34.35 SUS	M. B. OP-1.5
Viscosity @ 100 F.	82.92 SUS	"
Surface Tension Dynes/cm @ 20 °C.	45.3	J. Coll. Sci. 1... 10...
Solubility in Water	Insoluble	M. B. OP-1.5
Solubility in 95% Alcohol @ 29 °C.	23.3 g./100 cc	"
Solubility in Pyridine @ 30 °C.	32.5 g./100 cc	"
Flash Point °C (Method) c.o.c.	180 C.	"
Fire Point °C c.o.c.	None	"
Heat of Combustion		
Heat of Formation		
Thermal Stability (cal./kg./min.)		
Latent Heat of Fusion		
Latent Heat of Vap. cal/gm.	61	Calculated
Specific Heat @ 25 C.	0.293	M. B. OP-1.5
Critical Temperature		
Critical Pressure		
Dissociation Constant		
Specific Heat @ 300°C.	0.380	"
Other Constants: Pour Point	-14 C. or lower	"
Thermal Conductivity, cal/cm/°C/sec.	24.0 @ 28 C.	To be published
Dielectric Constant 100 °C. 60 cy.	4.7 - 4.9	M. B. OP-1.5
		TRAN 009268
Toxicity (Give Reference)	Contact Medical Dept.	M. B. OP-115

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COMPANY CONFIDENTIAL

Dept 246

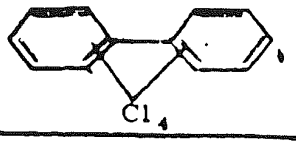
IN 610

Sys 57-9
B590

PHYSICAL CONSTANTS DATA

SUBSTANCE: AROCLOR 1248

STRUCTURAL FORMULA



COMPILED BY: A. M. Ellenburg

DATE: 4-25-57

Dept 246

NAME		SOURCE & DATE
Formula	$C_{12}H_6Cl_4$	
Molecular Weight	292 (Avg.)	
Appearance	Yellow Tinted Mob. Oil	Monsanto Bull. OP-115(19
Boiling Point at 760 mm Range	345-385°C.	"
Boiling Point at 3 mm "	165-210°C.	"
Boiling Point at mm		
Boiling Point at mm		
Crystallizing Point	Non-crystallizing	"
Melting Point		
Solution Point		
Specific Gravity @ 25/25°C.	1.445	"
Specific Gravity @ 65/15.5°C.	1.405-1.415	Specifications 9/9/54
Pounds per Gal. @ 25 °C	12.04	M.B. OP-115
Coefficient of Expansion 25-65°C.	0.00070 cc/cc/°C.	"
Refractive Index @ 25°C n D	1.6285-1.6305	Specification 9/9/54
Infra Red Spectrum (Reference)		
Ultra Violet Spectrum (Reference)		
Viscosity @ 130°F.	73-80 SUS	M.B. OP-115
Viscosity @		
Surface Tension Dynes/cm @20°C.	44.2	J. Coll. Sci. 7, 166. (1952
Solubility in Water	Insoluble	M.B. OP-115
Solubility in 3A Alcohol @ 25°C.	15 g./100 cc	"
Solubility in Pyridine @ 29°C.	111.4g./100 cc	"
Flash Point °F (Method) C.O.C.	196°C.	"
Fire Point °C C.O.C.	None	"
Heat of Combustion		
Heat of Formation		
Thermal Stability (cal./kg. min.)		
Latent Heat of Fusion		
Latent Heat of Vap. cal/gm.	54	Calculated
Specific Heat @ 25°C.	0.277	M.B. OP-115
Critical Temperature		
Critical Pressure		
Dissociation Constant		
Specific Heat @ 300°C.	0.356	"
Other Constants: Pour Point	0°C. or lower	"
Other Constants: Thermal Conductivity, cal/cm/°C/sec.	23.6 @ 28°C.	To be published
Other Constants: Dielectric Constant, 100°C., 60 cy.	4.5-4.7	M.B. OP-115
		TRAN 009269
Toxicity (Give Reference)	Contact Medical Dept.	M.B. OP-115

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COMPANY CONFIDENTIAL

DEPT 296

SYST 479
V 580

PHYSICAL CONSTANTS DATA

SUBSTANCE: AROCLOR 1254

STRUCTURAL FORMULA

COMPILED BY: A. M. Elerberg

DATE: 4-25 4[illegible]

NAME		SOURCE & DATE
Formula	$C_{12}H_5Cl_5$	
Molecular Weight	326 (Avg.)	
Appearance	Pale Yellow viscous oil	Monsanto Bul. OP 11[illegible]/19[illegible]
Boiling Point at 760 mm Range	365-[illegible]40 °C	"
Boiling Point at 3 mm "	180-[illegible]200 °C	"
Boiling Point at mm		
Boiling Point at mm		
Crystallizing Point	Non-crystalline	"
Melting Point		
Solution Point		
Specific Gravity @ 25/25 °C.	1.538	"
Specific Gravity @ 65/15.5 °C.	1.495-1.50[illegible]	Specifications 2.14.[illegible]
Pounds per Gal. @ 25 °C	12.82	MB OP 11[illegible]
Coefficient of Expansion [illegible] 65 °C.	0.00066 [illegible] °C.	
Refractive Index @ 25 °C n D	1.6370-1.6390	Specifications 2.14.[illegible]
Infra Red Spectrum (Reference)		
Ultra Violet Spectrum (Reference)		
Viscosity @ 210 °F	44-48 SUS	MB OP 11[illegible]
Viscosity @		
Surface Tension Dynes/cm	50.3 @ 25 °C 42.0 @ 100 °C	"
Solubility in Water	Insoluble	"
Solubility in 3A Alcohol @ 2[illegible] °C	10 g./100 cc	"
Solubility in Pyridine @ 31 °C.	114 g./100 cc	"
Flash Point °F (Method) c.o.c.	None	"
Fire Point °C c.o.c.	None	"
Heat of Combustion		
Heat of Formation		
Thermal Stability (cal./kg./min.)		
Latent Heat of Fusion		
Latent Heat of Vap. cal/gm.	50	Calculated
Specific Heat @ 25 °C.	0.261	MB OP 11[illegible]
Critical Temperature		
Critical Pressure		
Dissociation Constant		
Specific Heat @ 300 °C.	0.336	"
Other Constants: Pour Point	12 °C.	"
Thermal Conductivity, Cal/cm/°C/Sec.	22.9 @ 28 °C	To be published
Dielectric Constant, 100 °C, 60 cy.	4.15-4.3[illegible]	MB-OP-11[illegible]
Toxicity (Give Reference)	Consult Medical Dept.	MB OP 11[illegible]

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TRAN 009270

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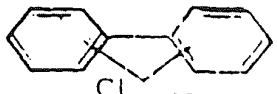
DEPT 296
IN 610

SYST 479
E, 580

PHYSICAL CONSTANTS DATA

SUBSTANCE: AROCLOR 1260

STRUCTURAL FORMULA: 

FURNISHED BY: A. M. Hornberg — DATE: 4-23-[illegible]

NAME		SOURCE & DATE
Formula	$C_{12}H_{5-n}Cl_{n+2}$	
Molecular Weight	361 (Avg.)	
Appearance	Lt. Yel. soft sticky resin	Monsanto Bul. OP-115.12
Boiling Point at 760 mm Range	385-420°C	
Boiling Point at 5 mm "	235-245°C	
Boiling Point at mm		
Boiling Point at mm		
Crystallizing Point	Non-Crystallizing	
Melting Point		
Solution Point		
Specific Gravity 25.5°C	1.520	
Specific Gravity 60, 15.5°C	1.53-1.56	Specification [illegible]
Pounds per Gal. °C	13.20	MB OP-115
Coefficient of Expansion 20-100°C	0.0006 cc/cc/°C	
Refractive Index [illegible]	1.632-1.640	Specification [illegible]
Infra Red Spectrum (Reference)		
Ultra Violet Spectrum (Reference)		
Viscosity [illegible]°F	72 SUS	MB OP-115
Viscosity "		
Surface Tension		
Solubility in Water	Insoluble	
Solubility in		
Solubility in		
Flash Point °F (Method) C.O.C.	None	"
Fire Point °C C.O.C.	None	"
Heat of Combustion		
Heat of Formation		
Thermal Stability (cal. kg/min.)		
Latent Heat of Fusion		
Latent Heat of Vap. cal/gm	48	Calculated
Specific Heat @ [illegible]°C	0.32	MB OP-115
Critical Temperature		
Critical Pressure		
Dissociation Constant		
Specific Heat @ 300°C.	0.303	"
Other Constants: Pour Point:	25-34°C.	"
Dielectric Constant, 100°C 60 cy.	3.8-3.8	"
		TRAN 009271
Toxicity (Give Reference)	Contact Medical Dept.	MB OP-115

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Dept 246
Bldg 810

Sy ST479
580

PHYSICAL CONSTANTS DATA

SUBSTANCE	STRUCTURAL FORMULA
AROCLOR 1260 - 10% Toluol Mix	Mixture by Weight 90% - Aroclor 1260 10% - Toluol

COMPILED BY	DATE
A M Ellenburg	7/3/57

NAME		SOURCE & DATE
Formula		
Molecular Weight		
Appearance	Syrupy liquid	Specs. 4/11/55
Boiling Point at 760 mm		
Boiling Point at mm		
Boiling Point at mm		
Boiling Point at mm		
Crystallizing Point		
Melting Point		
Solution Point		
Specific Gravity @ 40/15.5°C	1.475-1.495	"
Specific Gravity @		
Pounds per Gal. @ 25 °C	12.5	"
Coefficient of Expansion		
Refractive Index @ n_D^{25}		
Infra Red Spectrum *(Reference)*		
Ultra Violet Spectrum *(Reference)*		
Viscosity @ 100°F	50.2 cs. (232 SUS)	WGK Lab 3/8/56
Viscosity @ 210°F	3.5 cs. (38 SUS)	"
Surface Tension		
Solubility in Water		
Solubility in		
Solubility in		
Flash Point °F *(Method)* Tag open cup	105	WGK Lab 12/5/46
Fire Point °F " " "	110	"
Heat of Combustion		
Heat of Formation		
Thermal Stability (cal./kg./min.)		
Latent Heat of Fusion		
Latent Heat of Vap.		
Specific Heat		
Critical Temperature		
Critical Pressure		
Dissociation Constant		
Other Constants		
Toxicity *(Give Reference)*		

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TRAN 009272

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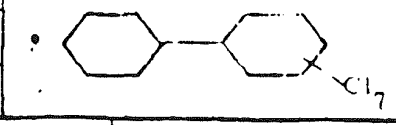
DEPT 246
IN 610

PHYSICAL CONSTANTS DATA

Syst 499
#5 580

SUBSTANCE: AROCLOR 1262

STRUCTURAL FORMULA: 

COMPILED BY: A. M. Ellenburg

DATE: 7/3/57

NAME		SOURCE & DATE
Formula	$C_{12}H_3Cl_7$	
Molecular Weight	395	
Appearance	Light yell. sticky Resin	Monsanto Bulletin OP-115
Boiling Point at 760 mm	390-425°C	" (195
Boiling Point at mm		
Boiling Point at mm		
Boiling Point at mm		
Crystallizing Point		
Melting Point		
Solution Point		
Specific Gravity at 90/15.5°C	1.577-1.587	Specs. 4/11/55
Specific Gravity at 25/25°C	1.646	MB OP-115
Pounds per Gal. at 25 °C	13.72	"
Coefficient of Expansion 25-65°C	0.00064 cc/cc/°C	"
Refractive Index at 25°C n_D	1.648-1.650	"
Infra Red Spectrum (Reference)		
Ultra Violet Spectrum (Reference)		
Viscosity at 210°F	86-100 SUS	Specs. 4/11/55
Viscosity at		
Surface Tension		
Solubility in Water		
Solubility in		
Solubility in		
Flash Point °F (Method)	None	MB OP-115
Fire Point °C	None	"
Heat of Combustion		
Heat of Formation		
Thermal Stability (cal./kg./min.)		
Latent Heat of Fusion		
Latent Heat of Vap.		
Specific Heat		
Critical Temperature		
Critical Pressure		
Dissociation Constant		
Pour Point	35-38°C	
Other Constants		TRAN 009273
Toxicity (Give Reference)	Contact Med. Dept.	MB OP-115

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AROCLOR

APPENDIX D

UTILITIES

The utility calculations are based on design calculations for a 28.8 million pounds per year production rate.

The breakdown of utility usage by individual equipment is only on estimate. The estimates of utility usage are average values in most instances as it is difficult to measure the operating time and load for a particular piece of equipment with great accuracy.

The total usage of each utility was taken from the cost sheets. Estimates of individual operating time and percentage of the total load were made to calculate the distribution of utilities as given in the following pages of this section.

AROCLOR

APPENDIX D UTILITIES (Cont'd.)

1. Power Consumption

A. Electricity - 440 V., 3 phase, 60 cycle

Item No.	Equipment Motor	Motor HP	Peak Load KW	Monthly Usage KWH
101	Biphenyl transfer pump	3.00	2.6	80
103	Biphenyl head tank pump	.75	0.7	240
104	Biphenyl feed pump	7.50	6.6	1980
121	#5 Chlorinator pump	10.00	8.8	3040
122	#4 Chlorinator pump	10.00	8.8	3040
123	#3 Chlorinator pump	10.00	8.8	3040
124	#2 Chlorinator pump	10.00	8.8	3040
125	#1 Chlorinator pump	10.00	8.8	3040
127	#2 Blow tank pump	5.00	4.4	200
129	#1 Blow tank pump	5.00	4.4	1580
132	#1 Still pump	5.00	4.4	1580
135	#2 Still pump	7.50	6.6	2340
140	#1 Receiver pump	2.00	1.7	20
141	#2 Receiver pump	2.00	1.7	20
144	Blend tank pump	3.00	2.6	200
149	#3 Storage transfer pump	3.00	2.6	160
151	#4 Storage transfer pump	3.00	2.6	240
153	#5 Storage transfer pump	3.00	2.6	200
155	#8 Storage transfer pump	3.00	2.6	80
157	#7 Storage transfer pump	3.00	2.6	80
170	#1 City water pump	7.50	6.6	2340
171	#2 City water pump	7.50	6.6	0
180	Exhaust blower	15.00	13.0	0
	Miscellaneous		0.9	3.0
	Totals	135.75	119.8	26,860

AROCLOR

APPENDIX D UTILITIES (Cont'd.)

1. Power Consumption (Cont'd.)

B. Electricity - 110 V., one phase, 60 cycle

Equipment	Peak Load KW	Monthly Usage KWH
Lighting	15	3600
Instrumentation	2	1440
Miscellaneous	3	2150
Totals	20	7190

2. Natural Gas

Item No.	Using Equipment	Normal Use SCFH	Peak Use SCFH	Monthly Usage MSCF
131	#1 Furnace	1200	2400	430
132	#2 Furnace	1200	2400	430
	Totals	2400	4800	860

3. Compressed (plant) Air

Item No.	Using Equipment	Normal Use SCFM	Peak Use SCFM	Monthly Usage MSCF
127	#2 Blow tank	60	200	2590
148	#3 Storage tank	60	200	90
150	#4 Storage tank	60	200	90
152	#5 Storage tank	60	200	90
154	#8 Storage tank	60	200	90
156	#7 Storage tank	60	200	90
	Miscellaneous	10	200	330
	Totals	370	1400	3460

AROCLOR

APPENDIX D UTILITIES (Cont'd.)

4. Nitrogen

Item No.	Using Equipment	Normal Use SCFH	Peak Use SCFH	Monthly Usage SCF
142	#1 Blend Tank	3	4	2140
143	#2 Blend Tank	3	4	2140
146	#1 Product Tank	3	4	2140
147	#2 Product Tank	3	4	2140
148	#3 Storage Tank	3	4	2140
150	#4 Storage Tank	3	4	2140
152	#5 Storage Tank	3	4	2140
	Totals	21	28	14,980

5. Purchased Water

Item No.	Using Equipment	Normal Use GPM	Peak Use GPM	Monthly Usage M. Gal.
130	#1 Still	3	5	150
131	#2 Still	3	5	150
203	#1 Vacuum Jet	20	20	870
204	#2 Vacuum Jet	18	20	770
205	#3 Vacuum Jet	15	20	650
206	S-K Drowning Jet	25	30	120
	Miscellaneous	2	10	100
	Totals	86	110	2810

6. High Pressure Steam
200 PSIG at 388°F.

Item No.	Using Equipment	Normal Use Lb./hr.	Peak Use Lb./hr.	Monthly Usage M. Lb.
167	#1 Blow Tank	210	310	150
203	#1 Vacuum Jet	450	670	320
204	#2 Vacuum Jet	400	615	290
205	#3 Vacuum Jet	325	500	240
	Totals	1385	2095	1000

7. Low Pressure Steam
80 PSIG at 325°F.

Item No.	Using Equipment	Normal Use Lb./hr.	Peak Use Lb./hr.	Monthly Usage M. Lb.
102	Biphenyl Storage Tank	700	900	500
138	#1 Receiver Tank	700	900	500
139	#2 Receiver Tank	700	900	500
142	#1 Blend Tank	200	300	150
143	#2 Blend Tank	200	300	150
146	#1 Finished Product Tank	200	300	150
	Totals	2700	3600	1950

AROCLOR

APPENDIX D UTILITIES (Cont'd.)

7. Low Pressure Steam (Cont'd.)

Item No.	Using Equipment	Normal Use Lb./hr.	Peak Use Lb./hr.	Monthly Usage M. Lbs.
147	#2 Finished Product Tank	200	300	150
148	#3 Storage Tank	700	900	500
150	#4 Storage Tank	700	900	500
152	#5 Storage Tank	700	900	500
154	#8 Storage Tank	700	900	500
156	#7 Storage Tank	700	900	500
	Miscellaneous	1400	2800	1000
	Totals	7800	10,500	5600

Dept. 246 - Process Description

AROCLOR

APPENDIX E PERSONNEL

Departments 246, A-246, B-246 and C-246 are closely related. Operating personnel may work in all of the departments in a given day. For this reason, the description of operating classifications and assignments for departments 246, A-246, B-246 and C-246 is given as though all four of the departments are just one department.

Operating Classifications

Job	Number of Men	
	7 day/week Schedule	10 & 4 Schedule
Premium Operator	4	3
Standard Operator	4	3
Repairman	1	1
Packer	2	2
Porter	½	½
Swingman	1	0
Total	12½	9½

The swingman works two shifts per week (Saturday and Sunday) as a relief foreman, two shifts as a repairman, and one shift operating the premium job. There is an open shift on the standard operator job that is covered by overtime. The premium operator and standard operator cover three shifts each day. The repairman works the day shift, and with the swingman, there is 7 days per week repairman coverage. Packers work the day and middle shift 5 days per week. The porter works half time in department 246 and half time in department 243. The premium operator has lead responsibility for his shift.

The work force works all three departments Aroclor, Pyranol and Pydraul as one coordinated operation. The assignment of time is 70% to Aroclors, 15% to Pyranol and 15% to Pydraul.

Operating Assignments:

Premium Operator: Has overall responsibility and operates 5 chlorinators 2 stills and covers the necessary absences of the standard operator.

Standard Operator: Operates 2 blend tanks filter, 2 finished product tanks, storage tanks, makes Pyranol and Pydraul mixes, loads trailer, and tank cars, charges chlorinators and transfers receivers and also belongs to the Fire Brigade.

Repairman: Unloads cars and trailers of Biphenyl, Trichlorobenzene and Tetra-Trichlorobenzene and finished product, makes weekly safety inspections and department minor repair work.

Packer: Fills, stencils and labels 5 gallon, 30 and 55 gallon drums and clean-up assignments when not drumming.

Porter: Cleans office, control room, repair room, wash room and smoking shelter.

Swingman: Works one day per week as premium operator, two days as repairman and two days as relief foreman. As relief foreman takes overall supervision and day shift on weekends including arranging for maintenance, night sheets and line-up of work.

Dept. 246 - Process Description

AROCLOR

APPENDIX F PACKAGING & SHIPPING

Aroclor, Pyranol & Pydraul are filled about half in drums and half in tank cars or tank trucks.

A substantial amount (about 40%) of Aroclor is used to make Pyranol and Pydraul.

Sales are largely directly to the customer. The remainder is in bulk shipments to the J. F. Queeny Plant.

All electrical grade tank truck shipments are made in the customers trucks which are stainless steel. Non-electrical Aroclors are shipped in leased trucks and may be iron although other materials of construction are suitable Pydraul is shipped in steel tank trucks.

Electrical grade Aroclor and Pyranols are shipped in lined tank cars either 4,000 or 8,000 gallons in capacity. The lining is either tin, zinc or aluminum spray because iron contamination is detrimental to the electrical properties. Electrical grade cars are either owned by Monsanto or on a long term lease. Non-Electrical grade Aroclor is shipped in steel cars.

All electrical grade lots and bulk shipments of non-electrical material are sampled from the final container. That is all tank cars and tank trucks are sampled and analyzed after loading. All electrical grade drums are sampled from one of the drums.

Tank cars and tank trucks are inspected to be sure they are free of dirt and water or other foreign material before loading. Heels are drained before loading some materials. Car washing when necessary is done by the repair track. Tank cars are sealed with a numbered aluminum seal

Lacquer lined drums are used for Aroclor and Pyranol and plain steel drums are used for Pydrauls.

A summary of products, weights and containers current use is as follows:

Product	Weights and Containers 5 Gal.	30 Gal.	55 Gal.	TT	TC
1232	-	-	600#	-	-
1242	60	-	600#	Yes	Yes
1248	60	-	600#	Yes	Yes
1254	60	-	600#	Yes	Yes
1254 Xylene	-	-	600#	-	-
1260	60	-	600#	Yes	Yes
1262	60	-	600#	-	-
MCS295	-	-	645#	-	-
Pyranol 1488	-	-	675#	-	-
Pyranol 1481	-	-	675#	-	-

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TRAN 009281

PACKAGING & SHIPPING (Cont'd.)

Product	Weights and Containers 5 Gal.	30 Gal.	55 Gal.	TT	TC
Pyranol A-13B3B	65	360#	675#	-	4000 Gal.
Inerteen PPO	65	360#	674#	-	4000 Gal. & 8000 Gal.
Pydraul A-200	59	-	645#	Yes	-
Pydraul 280	-	-	625#	-	-

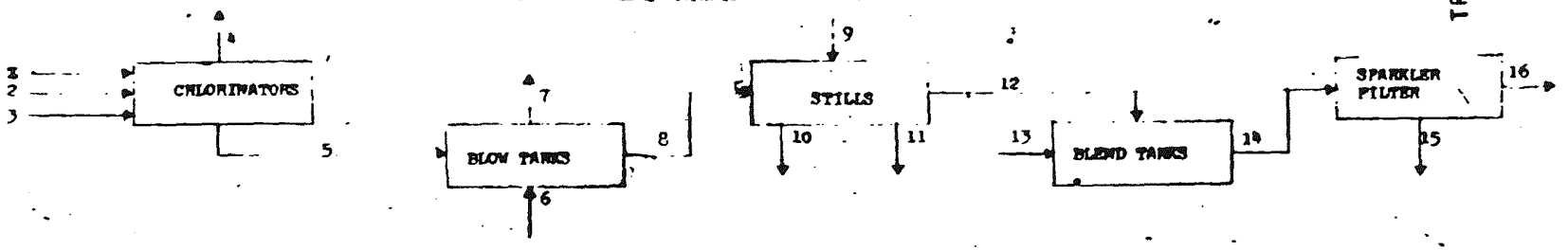
AROCLOR

APPENDIX G MATERIAL BALANCE

The material balance on Dept. 246 was made with a minimum of field measurements. Most of the estimates on the following page check fairly close with actual raw material usages that can be readily measured. The exact composition of some of the intermediate process streams is uncertain.

AROCLOR MATERIAL BALANCE

LBS. MATERIAL PER 100 LBS. AROCLOR



AROCLOR 1242

PROCESS STREAM / RAW MATERIAL	M.W.	1 BIPHENYL	2 CHLORINE	3 FERRIC CHLORIDE	4 OFF-GAS HCL	5 CRUDE AROCLOR	6 AIR	7 AIR-HCL MIXTURE	8 AERATED AROCLOR	9 LIME	10 STILL BOTTOMS	11 VACUUM JET	12 DISTILLED AROCLOR	13 ATTAPULGUS EARTH	14 BLENDED AROCLOR	15 FILTER CAKE	16 FINISHED PRODUCT	TOTAL USAGE
BIPHENYL	154	63			.50	106			62		35		59		59	1	58	63
CHLORINE	71		918		45	873		95	465		28	05	435		422	15	42	918
FERRIC CHLORIDE	162			03		03			03		03							03
ATTAPULGUS EARTH	68													15	15	15		15
AIR	29						3	3										3
LIME	74									50	50							50
TOTALS		63	918	03	45	1082	3	395	1088	50	683	05	1065	15	1086	1615	100	1698

AROCLOR 1254

PROCESS STREAM / RAW MATERIAL	M.W.	1 BIPHENYL	2 CHLORINE	3 FERRIC CHLORIDE	4 OFF-GAS HCL	5 CRUDE AROCLOR	6 AIR	7 AIR-HCL MIXTURE	8 AERATED AROCLOR	9 LIME	10 STILL BOTTOMS	11 VACUUM JET	12 DISTILLED AROCLOR	13 ATTAPULGUS EARTH	14 BLENDED AROCLOR	15 FILTER CAKE	16 FINISHED PRODUCT	TOTAL USAGE
BIPHENYL	154	498			50	493			493		28		465		465	5	36	498
CHLORINE	71		1175		587	628		95	6185		68	05	55		55	1	58	1175
FERRIC CHLORIDE	162			03		03			03		03							03
ATTAPULGUS EARTH	68													15	15	15		15
AIR	29						3	3										3
LIME	74									5	5							5
TOTALS		498	1175	03	552	1124	3	387	1118	5	1013	05	145	15	1115	16	100	1698

AROCLOR 1248

PROCESS STREAM / RAW MATERIAL	1 BIPHENYL	2 CHLORINE	3 FERRIC CHLORIDE	4 OFF-GAS HCL	5 CRUDE AROCLOR	6 AIR	7 AIR-HCL MIXTURE	8 AERATED AROCLOR	9 LIME	10 STILL BOTTOMS	11 VACUUM JET	12 DISTILLED AROCLOR	13 ATTAPULGUS EARTH	14 BLENDED AROCLOR	15 FILTER CAKE	16 FINISHED PRODUCT	TOTAL USAGE
BIPHENYL	56			50	56			56		3		53		53	1	52	56
CHLORINE	5	132		50	50		95	541		255	05	496		495	1.5	48	132
FERRIC CHLORIDE			03		03			03		03							03
ATTAPULGUS EARTH													15	15	15		15
AIR						3	3										3
LIME									5	5							5
TOTALS	56	132	03	100	109	3	395	1015	5	05	05	549	15	1015	155	100	1698

LGC 5-1-64

AROCLOR

APPENDIX G

SUMMARY OF MATERIAL BALANCE RESULTS

AROCLOR 1242

Raw Material & Cost ($/lb.)	Usages - Lbs./100 lbs. product Theory	Material Balance	Material Balance Usages lbs/100 lbs.
Biphenyl (.0662)	58	63	58 Finished Prod. 1 Filter Cake 3.5 Still Bottoms .5 Off-Gas HCl 63.0
Chlorine (.0217)	84	91.8	42 Finished Prod. 1.5 Filter Cake .05 Vacuum Jet 2.8 Still Bottoms .95 Air-HCl Mixture 44.50 Off-Gas HCl 91.80
*Ferric Chloride (.129)	0.03	.03	.03
*Attapulgus Earth (.0302)	15	.15	.15
*Air (.00055)	3	3	3.0
*Lime (.0100)	0.5	0.5	0.5

AROCLOR 1248

Biphenyl (.0662)	52	56.5	52 Finish Product 1 Filter Cake 3 Still Bottoms .5 Off-Gas HCl 56.5
Chlorine (.0217)	96	103.2	48 Finished Prod. 1.5 Filter Cake .05 Vacuum Jet 2.55 Still Bottoms .95 Air-HCl Mixture 50.15 Off-Gas HCl 103.20

*These raw materials are the same for production of all Aroclors.

AROCLOR

APPENDIX G SUMMARY OF MATERIAL BALANCE RESULTS (Cont'd.)

AROCLOR 1254

Raw Material & Cost ($/lb.)	Usages - Lbs./100 lbs. product Theory	Material Balance	Material Balance Usages Lbs./100 lbs.
Biphenyl (.0662)	46	49.8	46 Finished Product 0.5 Filter Cake 2.8 Still Bottoms 0.5 Off-Gas HCl 49.8
Chlorine (.0217)	108	117.5	54 Finished Product 1 Filter Cake 0.05 Vacuum Jet 6.8 Still Bottoms 0.95 Air-HCl Mixture 54.7 Off-Gas HCl 117.50

AROCLOR 1260

Biphenyl (.0662)	40	43.4	40 Finished Product 0.9 Filter Cake 2.0 Still Bottoms 0.5 Off-Gas HCl 43.4
Chlorine (.0217)	120	128.8	60 Finished Product 0.5 Filter Cake 0.05 Vacuum Jet 4.8 Still Bottoms 0.95 Air-HCl Mixture 62.50 Off-Gas HCl 128.80

AROCLOR

APPENDIX H ATMOSPHERIC DISCHARGE - WASTE DISPOSAL

Discharge to Atmosphere	Lbs. per C Lbs. of Aroclor Produced	Total Lbs./Yr. based on Prod. Rate 28.6 Mlbs/Yr.
1. HCl fumes from blow tanks	0.01	2,000
2. HCl fumes from other tanks vented to atmosphere	0.01	2,000
3. Chlorine gas from chlorinator vented to blow tank	Unknown	Unknown
4. Aroclor & Biphenyl vapors of tanks vented to atmosphere	Unknown	Unknown
Discharge to Sewers		
1. HCl from chlorinators	2.5*	500,000*
2. Cl_2 from chlorinators	2.0*	30,000*
Discharge to Waste Disposal		
1. Montar	0.0176*	5,000*
2. Aroclor	0.33*	95,000*

*Estimated

AROCLOR

APPENDIX I

PROCESS CONTROL

Sampling Point	Frequency	Reason for Sample	****Normal Range	Method Number
Chlorinators	2-3 times per batch	Specific Gravity	.011	
Blend Tanks	3 times each day	Color (APHA)	50-150 Max.	10,084
		Sp.Gr. at 25/15.5°C.	.011	10,114
		Acidity (mg. KOH/g.)	.014 Max.	10,087
		*Moisture (H_2O) (PPM)	35 PPM Max.	10,620
		*Refractive Index at 25°C.	.0020	10,125
		*Inorganic (free)Chlorides	.05PPM Max.	T-2092
		*Dielectric Constant	.20	11,608
		*Resistivity (500 VDC at 100°C. 0.1" GAP as ohm-cm X 10^9	500,Min.	11,607
		*Hydrolysis Stability Test (as Chlorides)	1.0 PPM Max.	T-2087
		*Monsanto Stability Test (As Chlorides)	0.5 PPM Max.	11,503
		**Sulfates	None	12,169
		**Dielectric Strength at 25°C.	35 KV Min.	11,605
		**Viscosity at 100°F.(SuS)	10	10,086
		***Thermal Chemical Chlorides	0.75 PPM Max.	12,722
Storage Tank Composite	Every 1-2 days	Same as blend tanks		
Tank Cars & Trailers	Every Load	Same as blend tanks		

*Tests made on electrical grade Aroclors only.
**Tests made on request only.
***Special customer test.
****Maximum range for all Aroclors including electrical and non-electrical grades.

AROCLOR

APPENDIX J SAFETY & TOXICITY DATA

Safety Equipment

The following is a list of safety equipment (personal and departmental) required in department 246.

1. Fire extinguishers:
   A. Dry Chemical (3) - Southwest corner Bldg. CR - Main Floor.
   - West wall at top of stairs of Second Floor.
   -
   B. Carbon Dioxide Snow - Southwest corner of Bldg. CR, ground level.
2. Chlorine Gas Masks (4) - Southwest corner, second floor
   - Control room, second floor
   - East side, outside control room
   - Wall, Southwest corner of sprinkler house, main floor.
3. Scott Air Masks - West of Lean-To
4. Safety Showers (2) - Southeast corner of Bldg. CR, ground level.
   - Southeast corner of Bldg. CR, 2nd Floor.
5. Davis Vapotester
6. Eye Baths
7. Sprinkler System

Safety Precautions

The folliwing are safety precautions followed in the operation of department 246.

1. Safety Equipment of Employee
   Each employee has the following safety equipment: (1) Hard hat (2) Safety glasses (3) Goggles (4) Rubber and canvas gloves (5) Rubber overshoes. Special equipment may be issued as necessary for performing a particular job in a safe manner.

AROCLOR

APPENDIX J SAFETY & TOXICITY DATA (Cont'd.)

Safety Precautions (Cont'd.)

2. Sampling of Crude Aroclor
The samples of Aroclor taken during the chlorination reaction are hot (170°C.). Precaution must be taken to avoid skin contact of samples and inhalation of Hydrogen Chloride, Chlorine and Aroclor vapors.
3. Fires
Fires may result from the ignition of leaking gas, Xylene, Diphenyl, rags, paper, wood, etc. Automatic fire extinguishers and sprinklers have been installed to combat fires.
4. Explosions
Explosions may be caused from accumulated pockets of natural gas or a rapid burning of Diphenyl in a closed container such as a Chlorinator. Chlorinators are equipped with a 10" diameter pressure relief line with a rupture disc made to burst at 22 psi in case Diphenyl within the Chlorinator ignites.
5. Toxicity
Toxicity does not present a serious problem. However, a complete daily change of clean clothes is supplied to each person and time is allotted at the end of each shift to take a bath. Instructions are also issued to avoid actual skin contact with Biphenyl and Aroclor as much as possible and to wash hands and face before eating.
6. Miscellaneous
There are many accidents that can occur that may be classified as health and safety hazards. These accidents may result from such things as broken process lines, acid leaks, steam leaks, etc.

The worst inherent hazards are as follows:

1. Free Chlorine from ruptured line or major leak.
2. HCl Gas from ruptured line or major leak.
3. Dropping bottoms from stills.
4. Hot Aroclor & Diphenyl.

Safety Record

The last lost-time injury in Dept. 246 was January 28, 1948. The frequency of minor injuries is low, around one per month.

Toxicity: This material is a liquid under normal conditions and has a medium toxicity range for liquid ingestion and high toxicity for vapor inhalation. The maximum allowable concentration (M.A.C.) is 1 mg/cubic meter.

Fire Hazard: There is no fire hazard under normal conditions. Aroclor mixes (Xylene, Toluene, Butyl Acetate, etc.) may burn and explose at high temperatures when exposed to flames.

Other Hazards: This material can cause dermatitis, systemic poisoning from the fumes, and yellow atrophy of the liver. There are skin, mucous membranes and eye hazards encountered in handling this material.

Treatment and Antidotes: Call a physician and remove patient from fumes.

Storage and Handling: Protect the skin, lungs, and eyes by wearing approved protective clothing, respirator, and goggles. People who handle this material at elevated temperatures should have medical supervision, and the air should be sampled to insure compliance with M.A.C. There are no special storage restrictions under normal conditions except store in a ventilated area.

Shipping: There are no special shipping restrictions.

FERRIC CHLORIDE ($FeCl_3$)

Toxicity: This material is a solid under normal conditions and is non-toxic or has a rating as low.

Fire Hazard: There is no fire hazard under normal conditions, but it will emit toxic fumes at high temperatures.

Other Hazards: Some people are allergic to this material and may develop skin rash, and there is an eye hazard.

Treatment and Antidotes: Call a physician.

Storage and Handling: Protect the skin with approved protective clothing, avoid the breathing of $FeCl_3$ dust, wear approved respirator with adequate cartridge, and protect the eyes with approved goggles. There are no storage regulations.

Shipping: There are no shipping restrictions.

DIPHENYL ($C_6H_5C_6H_5$)

Toxicity: This material is a solid at normal conditions and is medium toxic. The M.A.C. of vapor is 2 mg/cubic meter of air. If ingested, the lethal dose is 2.4 g/Kg of body weight. The fumes are not dangerously deadly, but they are poisonous over a prolonged time.

Fire Hazard: Diphenyl is very flammable and will burn when exposed to heat or flame or oxidizing materials.

Other Hazards: Diphenyl is not too corrosive to skin, but it will affect the eyes.

DIPHENYL ($C_6H_5C_6H_5$) (Cont'd.)

Treatment and Antidotes: Wash eyes with water and get the patient to fresh air. Try to get patient to vomit, and call a physician.

Storage and Handling: This material can be stored in steel containers away from fire hazards and oxidizing agents. Wear suitable clothes and approved goggles when handling diphenyl.

Shipping: Ship in cars or other suitable containers with a red warning label of flammability.

XYLENE ($C_6H_4(CH_3)_2$

Toxicity: This material is a liquid under normal conditions and is very toxic in liquid or gaseous form, but it is less toxic than toluene. The M.A.C. is 200 ppm.

Fire Hazard: This material is very flammable and the limiting explosive concentration is 1-5.3% by volume in air. It will also react with oxidizing agents.

Other Hazards: This material will cause necrosis if enough is inhaled, and is hazardous to eyes, mucous membranes, and the skin.

Treatment and Antidotes: Get patient to fresh air, and call a physician. If injested, get patient to vomit. Wash eyes and skin with water.

Storage and Handling: This material should be stored in a cool well-ventilated area away from fire hazards or strong oxidizing agents. The material for storage can be steel cars or tanks. Wear approved protective clothing, respirator, and goggles.

Shipping: Ship in containers of steel or appropriate material with a red label.

TRICHLOROBENZENE:

Toxicity: This material is a solid at room temperature and the vapors are quite toxic. The solid is poison if ingested. The M.A.C. is 50 ppm.

Fire Hazard: This solid is flammable but is listed only as a moderate fire hazard. Will burn at 420°C. or above.

Other Hazards: This material will affect the liver, eyes, and mucous membranes.

Treatment and Antidotes: Wash eyes with water, and get patient to fresh air. Call a physician.

AROCLOR

APPENDIX J SAFETY & TOXICITY DATA (Cont'd.)

TRICHLOROBENZENE (Cont'd.)

Storage and Handling: Store this material in cool, well-ventilated area away from hazards and oxidizing agents. Wear protective clothing, chemical safe goggles and approved respirator.

Shipping: Ship in steel containers like cars on tanks with red label.

TETRA-TRI-CHLOROBENZENE

Toxicity: This material is a solid at normal temperatures and is medium toxic. The M.A.C. of vapor is 50-75 ppm.

Fire Hazard: This material is not a very great fire hazard, but it will burn at high temperatures and will decompose and emit chlorine.

Other Hazards: This material will affect the eyes, skin, and mucous membranes.

Treatment and Handling: Wash eyes and skin with water and get patient to fresh air. Call a physician.

Storage and Handling: Store this material in a cool place away from fire hazards and strong oxidizing agents. This material can be stored in steel cars, tanks, or etc. Wear protective clothing, approved respirator, and chemical safe goggles when handling this material.

Shipping: Ship this material in containers marked with a red label.

LIME $Ca(OH)_2$

Toxicity: Lime is not dangerously toxic, and it is regarded as more of a nuisance. This material is a solid or slurry.

Fire Hazard: This material is not flammable.

Other Hazards: Lime is very hazardous to the eyes. It will burn the skin also, and the dust will affect the mucous membranes.

Treatment and Antidotes: Flood eyes and skin with large quantities of water. If lime is ingested, get patient to vomit and call physician.

Storage and Handling: Lime can be stored in steel containers, and people should wear protective clothing, respirators, and rubber or chemical safe goggles when handling lime.

Shipping: There are no special restrictions for shipping, but the containers should have a white label, a caustic warning.

ATTAPULGUS EARTH:

Toxicity: This earth is not toxic in general.

Fire Hazard; There is no fire hazard.

Other Hazards: Attapulgus earth can create a dust hazard similar to other dusts that contain silica.

Treatment and Antidotes: Consult a physician.

Storage and Handling: Attapulsug earth presents no special storage problem and should be handled by persons wearing an approved respirator.

Shipping: There are no special restrictions on shipping.

HYDROGEN CHLORIDE (HCl)

Toxicity: This material is a gas under normal conditions and is very toxic. The M.A.C. is 5-10 ppm and a concentration of 1500-2000 ppm would be fatal to humans in a few minutes.

Fire Hazard: There is no fire hazard under normal conditions, but wet gas reacts with some metals to form hazardous hydrogen.

Other Hazards: This material is hazardous to teeth, skin, eyes, and mucous membranes.

Treatment and Antidotes: Wash profusely with water, if injested, eat chalk, magnesium hydroxide, egg whites, and milk, and also administer oxygen. Call a physician.

Storage and Handling: This material should be stored in a cool, well ventilated area away from oxidizing agents. This material can be stored in rubber lined, glass, or tantalum vessels. People handling this material should wear suitable clothing like rubber aprons, shoes, and gloves. Also rubber goggles or chemical safe grades and approved pack or canister gas masks.

Shipping: Shipping containers must have a white warning label and a non-flammable label. Ship in appropriate containers such as rail car or carboy.

CHLORINE (Cl_2)

Toxicity: This material is a gas under normal conditions and is very toxic. The M.A.C. is .35 to 2 ppm. A concentration of 1000 ppm would be rapidly fatal. Least concentration with detectable odor is 3.5 ppm

CHLORINE (Cl_2) (Cont'd.)

Fire Hazard: There is no fire hazard under normal conditions, but there is an explosion hazard if chlorine is mixed with a strong reducing agent such as hydrogen or hydrocarbons at high temperature.

Other Hazards: This material causes eye, skin, and mucous membrane irritation.

Treatment and Antidotes: The patiant should be given oxygen immediately and treated for shock. Call a physician.

Storage and Handling: This material should be stored in a ventilated and cool place away from fire hazards. When handling, wear a gas mask or approved respirator, clothing and rubber or chemical safe goggles. In strong chlorine concentrations, wear canister gas masks, Scott air pack, or oxygen breathing apparatus.

Shipping: The shipping containers must have a green gas label and a non-flammable label on. Ship in steel cars or cylinders.

APPENDIX K BACK GROUND INFORMATION

The manufacture of Aroclors was developed quite by chance. The Indian Refining Company, in the latter part of 1926, approached the Swann Chemical Company located in Anniston, Alabama, regarding the production of Biphenyl which the Indian Refining Company wanted to use as a heat transfer medium. The Swann Chemical Company agreed to produce Biphenyl, but first a process had to be developed.

Two years later, in 1928, a pilot plant for producing Biphenyl became operative. However, in the meantime, the Indian Refining Company dropped all interest in Biphenyl. Since a process had been developed for manufacturing Biphenyl, the Swann Chemical Company started looking for other outlets for this material. The simplest outlet was in the form of Chlorinated Biphenyls which were produced in the laboratory in 1929.

The Chlorinated Biphenyls produced exhibited good electrical properties. This was reported to the General Electric Company who immediately became interested in the product which ultimately developed into large scale consumption in electrical transformers and capacitors.

The trade name "Aroclors" was adopted for the Chlorinated Biphenyl products. The properties of Aroclors vary from mobile oily liquids to fine white crystals and hard transparent resins. The excellent electrical properties, fire resistance and inertness of the Aroclors make them useful for many applications.

Plant equipment was installed to produce Aroclors at a rate of 3000 pounds per day or 1 million pounds per year. In the following years, this production rate was insufficient to meet the increased sales requirements.

The Swann Chemical Company was purchased by the Monsanto Company in 1935. This purchase gave Monsanto access to the patent rights for the production of Aroclors.

Production Capacity needed to be expanded, and since Monsanto had a Chlorine Plant at Plant"B" (now called the W. G. Krummrich Plant), the Aroclor production was transferred from the Anniston Plant to the Monsanto, Illinois Plant, where operations at an increased productive capacity started in September, 1936.

By 1940, the Krummrich Plant production capacity was inadequate, and in 1941, a similar production unit was installed in the Anniston Plant.

Monsunto Company
Monsanto, Illinois

SAFETY REVIEW COMMITTEE

Accepted by Production

WBJ

Original signed by:

CWR 2-19-64

ODG 2-20-64

HBP 2-10-61

January 17, 1964

Messrs:

P. E. Heisler - WGK
E. E. Martin - WGK
R. W. Bucknell - Org. Res.

K. L. McHugh - Org. Res.
Process Holders

TENTATIVE AMENDMENT NO. "A"

TITLE:

Aroclor Standard Manufacturing Process of Dec 17, 1962
811.01 - 811 07

OBJECTIVE:

Increase amount of Ferric Chloride Catalyst added to the Biphenyl in Dept. 246, Aroclor.

PRESENT PRACTICE:

Presently 1 lb. of ferric chloride is added to the biphenyl charge tank to 4000 lbs. of biphenyl. It is suggested that this amount be increased to 2 lbs. of ferric chloride per 4000 lbs. charge of biphenyl added to the charge tank. It has been shown in the St. Louis Research Reports Nos. 1640 and 2072 that a minimum level of $FeCl_3$ catalyst is 0.03% to produce stable Aroclors.

Aroclors manufactured at the W G. Krummrich plant do not meet specs. by as comfortable a margin as Anniston's Aroclors do. If we are to retain our customers for electrical-grade Aroclors at W.G.K., the quality must be improved. Safety will not be affected in any way. This will be a permanent procedure change.

W. B. Johnson

COMPANY CONFIDENTIAL

TRAN 009297

Tentative Amendment No. "A" (Cont'd.)

APPROVAL: DATE:

Original signed by:

P. E. Heisler — 2/11/64
P. E. Heisler - WGK Date

E. E. Martin — 2/11/64
E. E. Martin - WGK Date

D. B. Hosmer — 2/14/64
D. B. Hosmer - G. O. Date

R. W. Bucknell — 2/19/64
R. W. Bucknell - J. F. Q. Date

DISTRIBUTION LIST:

1. H. L. Minckler/R. S. Wobus - Gen. Offices
2. R. E. Soden - WGK
3. T. W. Dalton - WGK
4. J. R. Kellogg - WGK
5-6. St. Louis Research
7. Vital Records Center
8. WGK Standards Department
9. WGK Technical Services
10. Vault Copy
11. England
12. England
13-14. Anniston - R. G Moody
15-16. Extra

May 9, 1963

TENTATIVE AMENDMENT NO. A

PROCESS DESCRIPTION FOR THE MANUFACTURE OF AROCLOR IN DEPT. 246 OF DECEMBER 17, 1962 - W. G. KRUMMRICH PLANT, MONSANTO, ILLINOIS

SUB-TITLE: Preparation of Aroclor 1232 by the direct chlorination process common to Aroclor 1242, 1248, 1254, 1260 and 1262.

PRESENT PROCESS: Aroclors are the reaction products formed by the chlorination of diphenyl in the presence of iron chloride catalyst. The crude Aroclor, produced in the chlorinator, is air blown, distilled over calcium oxide treated with Attapulgus earth, filtered, and transferred to storage

PROPOSED CHANGE: Amend the existing manufacturing process to include the production of Aroclor 1232, which contains high percentages of dichlorobiphenyl, to be used in the large scale preparation of MCS 177, a 700°-800°F. heat transfer fluid.

Aroclor 1232 is prepared by the direct chlorination of diphenyl to a specific gravity of 1.232 to 1.236 at 65°/15.5°C. in the presence of iron chloride catalyst. The crude Aroclor 1232 is air blown, and distilled over calcium oxide prior to transfer of the product into storage containers at 50° to 80°C. Insoluble isomers, present in this special Aroclor 1232, slowly separates out of solution upon prolonged standing at room temperatures and are very difficult to redissolve. Since this product is a starting material for the MCS 177 process, the Attapulgus treatment and final filtration are optional but not necessary.

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TRAN 009299

This special Aroclor 1232 cannot be back-blended if the finished product is off on its prescribed chlorine specifications The incorporation of excess monochlorobiphenyls into the product will increase the volatility of the MCS 177 and the addition of trichlorobiphenyls will drastically raise the pour point of the finished heat transfer fluid. Abnormal compositions of this Aroclor 1232 are readily detectable by gas-liquid chromatographic analyses.

Approval is requested to demonstrate this change as a source of the necessary starting material for Monsanto's candidate, in the lucrative field of high temperature heat transfer applications.

ORIGINAL SIGNED BY:

Written by J. D. Sullivan
J. D. Sullivan

Date 5/9/63

Approved By:
Original Signed by:

W. R. Richard W. R. Richard

P. E. Heisler P. E. Heisler

E. E. Martin E. E. Martin

Safety Review Committee:

1. R. S. Wobus
2. C. Barbre
3. T H. Becker
4. J. Soffranko
5. St. L. Res. Lib.
6. St. L. Res. Lib.
7. Plant B
8. England
9. P. G Marsh
10. Plant B
11. Plant B
12. Plant B
13. H. L. Hubbard
14. J. Mitoray

January 23, 1951

TENTATIVE AMENDMENT
AROCLOR PROCESS

Dept. 246, Plant B

This amendment provides for the addition of anhydrous $FeCl_3$, 0.3% by weight of biphenyl, to the chlorinator as fortifying catalyst for the production of Aroclor 1160

This change in process operation is a result of a complaint submitted because of the presence of green color in Aroclor 1260. Research work has indicated a trend toward improved color when anhydrous $FeCl_3$ is used either alone or in combination with plant steel catalyst. To cite an example, using 5% by weight plant steel catalyst, an untreated Aroclor 1260 was prepared in the laboratory having a color of 56% Transmission (Fisher Electrophotometer, filter 425B), whereas from a batch in which the same catalyst plus 0 3% by weight anhydrous $FeCl_3$ was employed, an Aroclor 1260 of 72% Transmission was obtained. Extensive analyses of the Aroclor 1260, which was prepared using plant steel in conjunction with 0.3% by weight anhydrous $FeCl_3$, did not indicate any abnormalities or deviations from usual quality material. A complete summary of the Research work is presented in a memorandum to Dr. R. M. Hitchens, January 24, 1951.

It is proposed to condut a plant demonstration which will comprise the production of three to four chlorination batches of Aroclor 1160 using 0.3% by weight of the biphenyl charge as anhydrous $FeCl_3$. Depending on the outcome of this plant trial, that is, if a color improvement is observed and a normal quality product is retained, a run of longer duration will be planned to study further the effect of anhydrous $FeCl_3$ catalyst on the color of Aroclor 1260. This may include variations in the amount of $FeCl_3$ charged to the chlorinator.

Original Signed by: J. P. Mitoray
J P Mitoray

In
January 24 1951

COMPANY CONFIDENTIAL

APPROVED:

Original Signed by:

H. L. Hubbard	1/25/51	O. J. Weinkauff	1/25/51
H L. Hubbard	Date	O. J. Weinkauff	Date
T. W. Dalton	1/25/51	C. Barbre	6/25/51
T. W Dalton	Date	C. Barbre	Date
D. B. Hosmer	1/26/51	Paul G. Marsh	1/26/51
D. B. Hosmer	Date	P. G. Marsh	Date

TRAN 009301

SAFETY REVIEW COMMITTEE
Original Signed by:
T.M.P. 10-8-57
R.E.H. 10-9-57
R.H.M. 10-9-57

September 27, 1957

Distribution:

Dr. O. J. Weinkauff - Research
R. S. Wobus - Roberts Bldg.
T. M. patrick - Research
A. M. Ellenburg - Research
T. W. Dalton - WGK
J R. Kellogg - WGK
Process Holders

TENTATIVE AMENDMENT NO. B

Title:

Aroclor - Standard Manufacturing Process

Objective:

This amendment covers changes in the chlorination step of the Aroclor process; in particular, it suggests that the batch of biphenyl be circulated in the chlorinator during the entire period of chlorination, and that a temperature of 130-150°C., be maintained during the whole chlorination

Previous Practice:

In the Manufacturing Process, no definite temperature is described for the start of the Chlorination. For the biphenyl measuring tank a temperature of at least 85°C., is recommended and as a "finishing temperature" a range of 120-135°C is described for Aroclor 1242 and 1248, a "finishing temperature" of 120-150°C., for Aroclor 1254, 1260 and 1262.

The circulation of each batch in the chlorinator is started after the first four (4) hours of the chlorination (approximately half of the total chlorination time of Aroclor 1242).

Proposed Amendment:

The biphenyl charge will be heated to at least 115-120°C., in the measuring tank. After charging the chlorinator, circulation will be started before the chlorine feed is begun to allow distribution of the ferric chloride catalyst.

The temperature of the chlorinator should be brought up to 130°C., in a minimum time usually 20 to 30 minutes after the chlorine introduction The chlorination of biphenyl to all liquid Aroclors should be carried out at a reaction temperature of 130-150°C.

Proposed Amendment (Cont'd.)

NOTE: In order to mechanically reduce losses due to sublimation and entrainment, it is suggested that the circulating line introducing the charge into the top of the chlorination be extended to the surface level of the biphenyl charge. This will prevent the reaction mixture from being sprayed into the exit gas stream and should eliminate some entrainment.

Justification:

Laboratory experiments and actual plant runs have indicated that catalyst concentration and reaction temperature are imperative for the production of an end product of good quality. (Final Report No. 1640, October 22, 1956 by H Merten, Progess Report No. 5; Job No 3428 Code IND FL, of August, 1957 by H Merten and A. M. Ellanburg.

Circulating each biphenyl batch from the beginning of the chlorination should facilitate the production of a more uniform material, since a better contact of the biphenyl charge with the catalyst at the start of each chlorination is made possible. The catalyst will be distributed more evenly and hot spots will be eliminated.

The production of inferior Aroclor caused by too low a chlorination temperature of deficient catalyst distribution would be avoided by changing the present Manufacturing Process according to this amendment.

In addition to the data obtained by laboratory experiments (described above) the following Table I illustrates the effect of temperature changes on the quality of the end product of actual plant runs (shown by stability chloride values). Table II indicates the improvement in the stability of different Aroclors produced by circulation of the batches during the whole chlorination period compared to runs carried out with batch circulation after the lapse of a four-hour chlorination period.

TABLE I

Batch No.	Temperature Low	High	Stability Chloride ppm./16 hrs.
319	94	116	0.80
320	110	129	0.74
321	133	145	0.49

TABLE II

Circulation	Aroclor No.	Lot No.	Stability Chloride ppm./16 hrs.
after 4 hours	1254	T-631	.85
after 4 hours	1254	T-632	.89
entire period	1254	T-635	.45
entire period	1254	T-636	.45
after 4 hours	1260	T-1044	.52
after 4 hours	1260	T-1045	.57
entire period	1260	T-1048	.39
entire period	1260	T-1049	.45

Precautions:

No increased toxicity or safety hazards will result from this process change

Extent of Demonstrations:

It is suggested that this amendment be incorporated in the standard Manufacturing Process as soon as possible.

Original Signed by: H. L. Merten
H. L. Merten
Research Department

ln

Approved:

Original Signed by:

J. R. Kellogg
J. R. Kellogg

A. M. Ellenburg
A. M. Ellenburg

T. W. Dalton
T. W Dalton

T. M. Patrick, Jr.
T. M. Patrick

Safety Review Committee
ORIGINAL SIGNED BY:
H. L. Hubbard 3/18/57

R. H. M. 3/18/57

R. E. Howard 3/18/57

March 13, 1957

Distribution:

Dr. O. J. Weinkauff - Research
R. S. Wobus - Roberts Bldg.
H. L. Hubbard - Research
A. M. Ellenburg - Research

T. W Dalton - WGK
J. R. Kellogg - WGK
Process Holders

Tentative Amendment No. A

Title:
Aroclor - Standard Manufacturing Process for Department 246,
W. G. Krummrich - Revised 3/15/55 - G. N. Schwartz.

Objective:
This amendment covers process changes in the chlorination step of the Aroclor Process, Section V Part B, concerning the Catalyst.

Present Practice:
The biphenyl charge is dropped by gravity to the #1 2, 3, 4 or 5 chlorinators. The chlorinators are constructed of steel and are 3 feet in diameter x 16 feet in height. For catalyst, they contain an 8 foot bed of coarse steel turnings which have been burned free of oil and moisture over an open gas flame prior to their introduction into the chlorinator. Additional catalyst is added to the chlorinators as required. Normally, this is not necessary more than once a year.

Proposed Amendment:
In addition to the present catalyst source, each chlorinator batch of 3600 or 4000 pounds of biphenyl will be charged with 2 pounds of anhydrous ferric chloride before the chlorination begins.

Justification:
Experience has shown that various degrees of unstable Aroclor can result at times from the present method of supplying catalyst to the chlorination step. The use of $FeCl_3$ has been investigated and found to give a very stable product when used in the suggested purportion

The complaints from General Electric Company on Aroclor 1242 regarding the instability of certa n material produced in July and August, 1956, make it mandatory that we maintain our Aroclor quality at its maximum at all times.

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TRAN 009305

Precautions:
No increased toxicity or safety hazard will result from this process change. Ferric chloride is highly hygroscopic and is acidic in nature, therefore care should be tanke to prevent contact with skin or clothing.

Extent of Demonstration:
The process change has been demonstrated at Anniston. This amendment will be a permanent change and should be incorporated in the next revision of the manufacturing process.

A. M. Ellenburg
Organic Research
Group Leader

Approved:

Original Signed by;

J. R. Kellogg
J. R. Kellogg

A. M. Ellenburg
A. M. Ellenburg

T. W. Dalton
T. W. Dalton

F. B. Zienty 3-19-57
T. M. Patrick
for T. M. Patrick

ln

Monsanto, Illinois

CC: C. M. Edelblut - Anniston
J. Clegorn - Anniston
Safety Review Committee
Original Signed by;
T.M.P. 6-12-59
R.E.H. 6-12-59
R. H. M. 6-15-59

June 8, 1959

Messrs.
T. W. Dalton
T. M. Patrick - Research
A. M. Ellenburg - Research
H. S. Scott
Process Holders

PROCESS AMENDMENT - AROCLORS
Dept. 246 - W.G.K. PLANT

Title
Modification of chlorination temperatures for Aroclor production

Purpose
To provide chlorination temperature ranges that are more compatible with plant conditions

Old Procedure
Biphenyl chlorination is performed at temperature range of 130 to 150°C.

Proposed Procedure
Initial chlorination of Biphenyl may be started at a minimum temperature of 95°C. provided that 120°C is reached within 1/2 hour. Chlorination may be continued for the next tow hours at a temperature no less than 120°C. Completion of the batch will then be controlled between 130 and 150°C.

Reason and Justification
Normal Biphenyl storage is maintained at approximately 95°C. to keep safely below the flash point. Therefore to adhere strictly to the process would require heating of the batch to 130°C. before chlorination. This results in production delays and increased Biphenyl pluggage in chlorinator off gas lines. Based on plant experience most chlorinators are recharged while still hot from the preceeding batch; this normally yeilds a starting temperature in the range of 120°C. However, occasionally delays cause charging to a cooler chlorinator where the net temperature may approach 95°C. This proposal would allow chlorination to start immediately under these conditions The batch temperature would then rise rapidly from its own heat with water being applied later to line out the temperature somewhere slightly above 120°C. A lower temperature range 120 to 130°C. is needed for the first two hours to reduce Biphenyl carry-over into the off gas lines.

This proposed process ammendment has tentative approval from Research.

J. R. Kellogg

In
Original Signed by:

T. W. Dalton
T. W. Dalton

J. R. Kellogg
J. R Kellogg

A. M. Ellenburg
A. M. Ellenburg

T. M. Patrick 6-12-59
T. M Patrick

COMPANY
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TRAN 009308

AROCLOR

APPENDIX L TIME CYCLE

The design capacity of the department is 1,700,000 (2,400,000 after August, 1964) pounds per month, or 20,400,000 pounds per year.

Figure 1 of this section illustrates the flow pattern of the Aroclor process and lists the approximate time needed to complete each process step. The time table for the Aroclor process is summorized below:

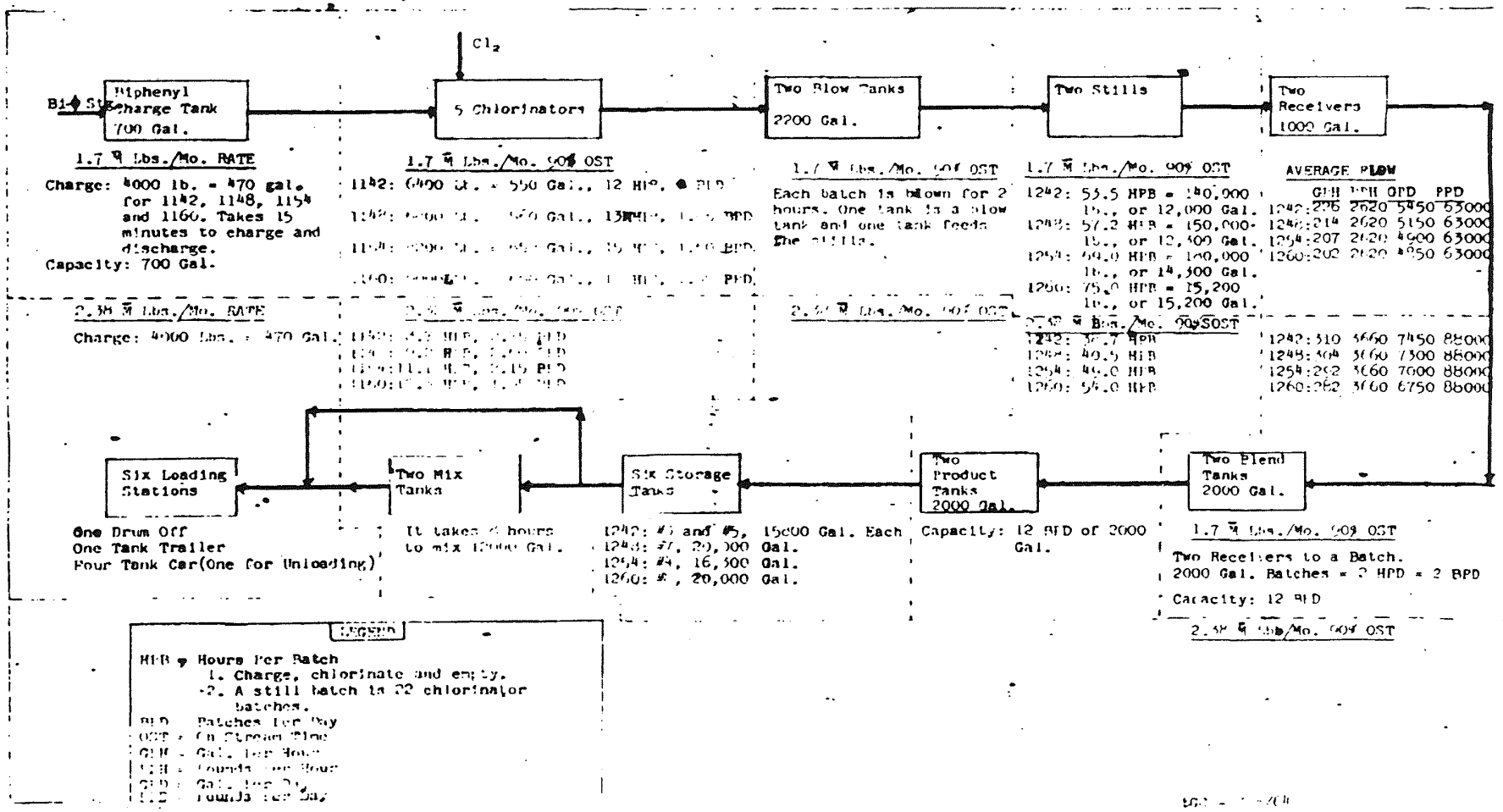
Operation		Time (hours)	Equivalent pounds of Finished Product
Charge Chlorinator		.25	
Chlorination	1242	8.70	6330
	1248	9.20	7200
	1254	11.10	8040
	1260	12.30	9100
Transfer to blow tanks		.25	
Aeration		2.00	
Distillation	1242	1.75	
	1248	1.75	
	1254	1.75	
	1260	1.75	
Blending		2.00	
Filtering		2.00	
Dropping to Storage		2.00	

The time required to make completed batches of the various Aroclors are tabulated below:

Aroclor	Batch Time (hrs.)
1242	18 95
1248	19.45
1254	21.35
1260	22.55

Process operations including filter press cleaning, sampling, etc. are independent of the batch completion time cycle because production time is not lost.

Figure 1. AROCLOR FLOW SHEET WITH BATCH SIZE AND RATES



TRAN 009310

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Dept. 246 - Process Description

AROCLOR

APPENDIX M

QUALITY CONSIDERATIONS

The Aroclor compounds are among the most versatile chemically-made materials in industry. Aroclors are useful in many ways because of their outstanding inertness.

Aroclors are used alone for particular physical jobs such as insulating, heat transfer, sealants, and expansion media; and they are used as components or extendors in elastomers, adhesives, paints, lacquers, varnishes, pigments and waxes.

Aroclors must be highly pure, with dependably minimal traces of electrolytes for use in electrical applications. Electrical grade Aroclors must pass numerous stringent specifications. The following tests determine Aroclor quality:

Hydrolysis stability	Measure of chemically unstable chlorine compounds.
Munch or Monsanto Stability Test	Measure of thermally unstable chlorine compounds at elevated temperatures.
Thermal Chemical Chloride	Developed by the General Electric Co. to measure chemically and thermally unstable chlorine compounds.
Resistivity	Measure of insulative properties.
Power Factor	Measures power loss due to current through a capacitor.
Dielectric Constant	Measures the capacitance of a standard such as air compared to the capacitances of Aroclor.
Specific Gravity, refractive index	Measures of chlorination level.

The stability and electrical properties of electrical-grade Aroclors are paramount in quality considerations. The chlorination step of the process is most critical because many properties of the final product are determined by the properties of the crude Aroclor. Conditions in the chlorinator needed for a good quality product are:

1. Chlorination Temperature - The chlorination temperature must be greater than 120°C. at the beginning of the chlorination reaction to produce stable Aroclors. Results of research tests indicate that product stability is better as the initial chlorination temperature is increased.

Department 246 - Process Description

AROCLOR

APPENDIX M

QUALITY CONSIDERATIONS

2. Ferric Chloride Concentration - Research has found that the ferric chloride concentration must be at least 0.03% to form stable products. Research recommends 0.05% ferric chloride. Lower catalyst ratios result in increased "addition" chlorination as opposed to "substitution" chlorination, indicated by higher chloride values and lower yields.

   The isomeric distribution of the final product is a function of the type and concentration of the catalyst used in the reaction.

   Homogeneous suspension of the catalyst is extremely important. Good catalyst contact can not be attained without homogeneous suspension. Since ferric chloride does not mix well with biphenyl, the dry catalyst must not be poured into the chlorinator.

3. Geometry of Reacting Vessel - The shape of the reactor affects the circulation and flow pattern of the reactants. It is suspected that the chlorine gas channels through a void space in the existing catalyst basket. This problem is presently being studied.

   The reactor must be designed such that circulation of reactants is rapid and homogeneous and local over-chlorination does not occur.

4. Cleanliness - The ferric chloride catalyst settles to the bottom of the chlorinator. Areas of the packed bed become plugged with ferric chloride and channeling of reactant flow may result.

   A steam clean-out of the chlorinator may be an expedient method to remove the ferric chloride. This method was tried in the department, and evidently was successful. Further tests by the laboratory will verify the effectiveness of a steam clean-out.

5. Sparging - The sparger controls the gas distribution under the catalyst hold-up plate and the size of gas bubbles. It is not known whether the catalyst basket or sparger or both are the critical factors in achieving the proper flow of gas through the reactor. It is believed that the sparger should distribute small bubbles give good gas distribution throughout the chlorinator. The small bubbles have a greater surface area per unit volume of gas for mass transfer, and this should increase the reaction rate.

6. Raw Material Purity - The purity of raw materials can affect the quality of Aroclors. Sulfates are particularly harmful in the chlorine gas. It is suspected that sulfates poison the ferric chloride catalyst and Sulfonate some of the biphenyl. If the ferric chloride catalyst is poisoned, the effective catalyst concentration is reduced and thus unstable aroclors will be produced. The chemistry and mechanism of catalytic poisoning are not known for certain. Sulfonated biphenyl is carried-over during distillation and is not removed by earth treating.

Dept. 246 - Process Description

AROCLOR

APPENDIX M

QUALITY CONSIDERATIONS

6. Raw Material Purity (Cont'd.)
Sulfonated biphenyl has ionic properties which lowers the resistivity of the finished product. A Brink Mist Eliminator has been installed in Dept. 246 to eliminate the chlorine impurities.

7. Earth Treatment - The factors affecting stability also influence the electrical properties of Aroclors. An absorbent will be ineffective if the Aroclor was not prepared in a manner such that a stable product was formed during the chlorination reaction.

However, research has found that absorbents are very effective for improvement of electrical properties by removing ferric chloride and tars carried-over during distillation, provided the crude Aroclor has good stability.

The absorbent used in Dept. 246 (after distillation) is Attapulgus Earth; the concentration should be 0.05% for Aroclor 1242 and 0.1% for other Aroclors. The earth must be heat treated at 250°C. for a minimum of 4 hours before addition to the Aroclor. Heat treatment reduces the moisture and activates the earth.

8. Lime Treatment - It is important that proper amount of lime (250 pounds per still run) be added to the still to prevent sublimation of ferric chloride.

9. The blend tanks, finished product tanks, and Aroclor 1242 and 1254 storage tanks are blanketed with nitrogen gas. Nitrogen blanketing maintains the electrical properties of the Aroclors by preventing corrosion of the equipment.

In summary, the chlorination step of the process is the most critical. A good quality Aroclor can not be produced if a stable compound is not formed during chlorination.

Once a stable compound is formed, other techniques such as use of lime, absorbents, and nitrogen blanketing are used to maintain and improve electrical properties.

Absorbents

Numerous absorbents have been screened in the laboratory at various contact temperatures for their effect on resistivity of plant untreated Aroclor 1242.

The most satisfactory absorbent pound for improving the resistivity of Aroclor 1242 was LVM attasorb. Table I of this section lists the laboratory results of the different absorbents used to treat Aroclor 1242.

Degradation of Aroclors

Degradation of Aroclors, which leads to loss in electrical resistivity, is one of the short comings of using Aroclor as a dielectric, especially since only a very minor degradation can cause a serious breakdown in electrical equipment.

The thermal degradation of fractionated Aroclor has been measured at 250°C. and the amount of Hydrogen Chloride liberated was measured. The results of these tests are listed in table II of this section.

Aroclor 1242 has been degraded by ultraviolent light, and the decrease in electrical resistivity with irradiation time was measured. The plot of resistivity versus time of irradiation (Figure 1 of this section) resembles a conductivity versus concentration curve for a weak electrolyte. It is possible to remove the conducting material brought about by photo-degradation, and restore the resistivity to its original value by passing the degraded material over activated alumina.

Thermal degradation of Aroclors is minor compared to photo chemical degradation. Thermal treatment causes release of a small amount of hydrogen Chloride initially, but this evolution ceases after a short time. Such behavior is attributed to thermal degradation of impurities. If Aroclor is irrodiated, then exposed to a thermal treatment, appreciably more HCl is liberated.

TABLE I

ADSORBENT SCREENING DATA

Adsorbent	Adsorbent Pretreatment	Contact Temperature °C.	Volume Resistivity at 100°C. ohm-cm. x 10°
LVM Attapulgus Earth	None	60	3400
		80	2000
		100	2800
		120	2900
LVM Attapulgus Earth	Heated at 250°C.- 12 hours.	60	4200
		80	6400
		100	7200
		120	6100
LVM Attapulgus Earth.	Heated at 350°C.- 12 hours.	60	9300
		80	9000
		100	6300
		120	6300
LVM Attapulgus Earth.	Heated at 350°C.- 4 hours.	60	2400
		80	5600
		100	6000
		120	5700
Attasorb - LVM	None	60	9700
		80	12,100
		100	13,700
		120	17,800
Attaclay	None	80	10,200
		100	5400
		120	6000
Activated Alumina (Alcoa Grade F-3 -325 mesh)	None	60	2100
		80	2500
		100	2800
		120	3100
Voclay 325 (Western Bentonite)	None	80	5700
		100	3800
		120	9700
Panther Creek (Southern Bentonite)	None	80	6200
		100	11,300
		120	8100
Filtrol Grade 1	None	80	2600
Zeolex 7 (Zeolite)	None	80	7000
Florite 60 mesh (Activated Bauxite)	None	100	3600
Suprex L-G (Kaolin)	None	100	4500
Attasorb - LVM	Heated 350°C.- 12 hours.	100	12,200
Attasorb - RVM	None	100	6,200

TABLE I (Cont'd.)

Adsorbent	Adsorbent Pretreatment	Contact Temperature °C.	Volume Resistivit at 100°C. ohm-cm. x 10^9
Linde Molecular Sieve Type 4-A	None	60	2100
Laminar Alumina (Dayton)	None	60	900

Note: Resistivity of Aroclor before treatment = 1 x 10^9 ohm-cm.

TABLE II

THERMAL DEGRADATION OF AROCLORS AT 250°C.

Aroclor	gm. of HCl/gm x 10^6	Heating Time
1221	3.35	1 hr.
	6.73	2 hrs.
	11.07	5 hrs.
1232	3.91	1 hr.
	6.42	2 hrs.
	9.81	5 hrs.
1242	5.96	1 hr
	9.58	2 hrs.
	13.00	5 hrs.
1248	3.61	1 hr.
	5.44	2 hrs.
	8.48	5 hrs.
1254	3.43	1 hr.
	3.96	2 hrs.
	6.43	5 hrs.

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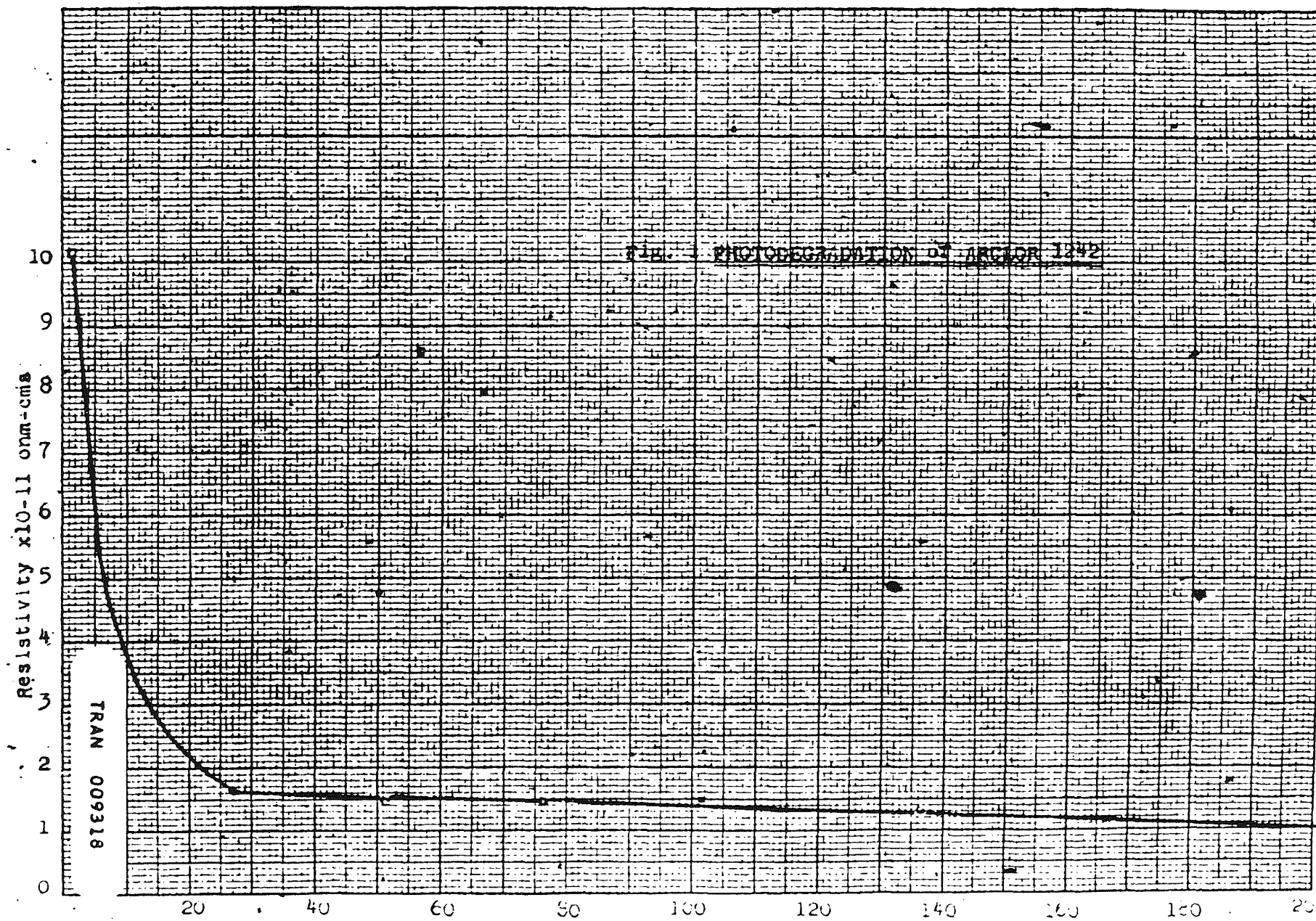
K•Σ 10 X 10 TO ½ INCH 46 1323
7 X 10 INCHES
KEUFFEL & ESSER CO.



Dept. 246 - Process Description

AROCLOR

APPENDIX N

MISCELLANEOUS

REFERENCES

1. St. Louis Report No. 2694, Job No. 171-1028, February 15, 1952.

Title: Operation of Aroclor Stills At Increased Pressure For Increased Rates

Summary: Distillation runs were made at 20 to 30 mm Hg. The rate of Distillation of 1200 series Aroclors increases with pressure.

2. St. Louis Report No. 2755, Job No. 2-02-760.01 - 3948-3 March 6, 1961.

Title: Improved Aroclor 1242 Studies

Summary: Studies were carried out to determine the effect of temperature, chlorine content, and catalyst concentration in chlorinated biphenyl mixtures. 2, 4-dichlorobiphenyl is the percursor of the high dielectric constant, trichlorinated components.

3. St. Louis Report No. 2072, Job No. 2-02-750.01-3428, May 4, 1958.

Title: Final Report on Aroclor Process Studies.

Summary: Purity of raw materials, catalyst concentration, reaction temperature and rate of chlorination were the variables studied with respect to their influence on the stability of the finished product.

4. St. Louis Report No. 2540, Job No. 171-616, December 28, 1958.

Title: The Effect of Prolonged Heat on the Electrical Properties of Aroclors.

Summary: Aroclors 1232, 1242, 1248 and 1254 were held at 130°C. The power factor was periodically measured.

5. St. Louis Report No. 2234, Job No. 171-451, June 14, 1956.

Title: Evaporation Loss of Aroclors.

Summary: The evaporation loss of Aroclors was determined at 100°C. under static conditions.

Dept. 246 - Process Description

AROCLOR

APPENDIX N

MISCELLANEOUS

REFERENCES

6. St. Louis Report No. 2790, Job No. 171-1028, July 3, 1952.

Title: Increased Production of Aroclors by More Rapid Rate of Chlorination.

Summary: Chlorination rate was increased from 400 pounds per hour to 770 pounds per hour. Aroclors produced at increased rate was within specifications.

7. St. Louis Report No. 1842, Job No. 2-02-750.01-3368 July 12, 1957.

Title: Use of Ferric Chloride as Catalyst for Production of Aroclor 1242.

Summary: The Comparison of stability chloride values revealed no difference between the product made with iron turnings as catalyst and ferric chloride as catalyst.

8. St. Louis Report No. 2096, Job No. 2-02-750.01-3202, June 6, 1958.

Title: Resistivity Improvement of Aroclor 1242.

Summary: Numerous absorbents were screened at various contact temperatures for their effect on resistivity of plant untreated Aroclor 1242. Heat activation of Attapulgus Earth was also studied.

9. E. E. Martin, OPERATING INSTRUCTIONS FOR DEPT. 246, W. G. Krummrich Plant, 1961.

10. E. E. Martin, PROCESS DESCRIPTION FOR MANUFACTURE OF AROCLORS, 1962.

11. E. Mather, PROCESS DESCRIPTION FOR MANUFACTURE OF AROCLORS, 1955.

AROCLOR

APPENDIX N MISCELLANEOUS

The following table shows the results of tests which measured the evaporation losses of the various Aroclors.

Aroclor	Evaporation Rate gms./cm²/hr./100°C.
Aroclor 1221	.00174
Aroclor 1232	.000874
Aroclor 1242	.000338
Aroclor 1248	.000152
Aroclor 1254	.000053
Aroclor 1260	.0000088
Aroclor 1262	.0000132

From the above results, the evaporation rate for Aroclor 1262 is greater than that of Aroclor 1260. This unexpected result may be explained by some difference in the conditions of which the two lots were prepared.

The reaction products in Biphenyl Chlorination differ with the type of catalyst used. Results of research investigations are listed below:

	Isomer Distribution of Aroclor 1232						
Catalyst	2 -	4 -	2,2' -	2,4 -	2,4' -	4,4'	tri
$FeCl_3$	15%	7%	15%	6%	38%	11%	9%
$SbCl_3$	11	0.7	20	3.6	38	18	9
$TiCl_4$	11	0	20	2.2	46	14	7
$SnCl_4$	24	1	16	2.3	38	18	1.3

Some of the typical operating diff culties in department 246 and possible remedies are given below:

CHLORINATORS

Trouble	Cause	Remedy
Chlorinators operating against too much back pressure.	Plugged off-gas lines	Open lines and steam them out, Dry out lines with air before resuming operation.
Chlorinator slow in picking up gravity	1. Low Chlorine pressure or low chlorine gas concentration 2. Wet Biphenyl	1. Call Chlorine Dept. for more gas 2. Check Biphenyl storage tanks for moisture.

BLOW TANKS

Blow tanks stacking off	Operating Chlorinators with vent open.	Close chlorinator vent; possibly reduce air to blow tanks

STILLS

Not enough vacuum	1. Ejectors not pulling properly 2. Coke scrubber Contains water	1. Check Ejectors 2. Drain Coke scrubber

36" SPARKLER FILTER

Foreign material in filtrate samples	Dirty filter or broken paper	Clean & re-paper press

PRODUCTION COST STANDARD

PLANT W. G. Krumbhaar | PAGE 1 OF 1

Product A60C-0053 | Dept. No. 24 | Prod. Code 811 00

Yield on Std ⊖ Theory ⊖ % Theory/Std ⊖ Capacity 1700 000 | Effective JAN 1 1964

Yield on Std ⊖ Theory ⊖ % Theory/Std ⊖ Cost Unit ⊖ | Inv. Unit Cost —

		ZERO PROD.	INVENTORY VALUE & CAP			OTHER OPERATING BRACKETS					
		BRACKET 1	BRACKET 2			BRACKET 3			BRACKET 4		
PRODUCTION-QUANTITY		NONE	1700 000			1200 000					
EXPENSED-AMOUNT	F OR V	AMOUNT	UNIT	COST	AMOUNT	UNIT	COST	AMOUNT	UNIT	COST	AMOUNT
MATERIAL COST											
STEAM	F	216		127	2163		135	1626			
ELECTRICITY	F	94		019	323		017	209			
COMPRESSED AIR	V	9		005	85		005	63			
WATER-PURCHASED	V	39		023	385		024	286			
WATER-PLANT											
FUEL-GAS	V	49		020	337		018	218			
FUEL-OIL											
REFRIGERATION											
ICE											
LABOR-MANUFACTURING	F	4996		293	4996		285	3426			
SALARIES	B	1126		066	1126		094	1126			
PAYROLL-OVERHEAD	F	727		043	727		046	547			
FACTORY SUPPLIES	F	80		047	800		047	560			
LABORATORY	V	200		093	1600		092	1100			
CLOTHING & LAUNDRY	F	100		018	300		019	230			
PROD. DEPT. CONT. EXP.											
TECHNICAL SERVICE											
MECH. EXP.	B	6249		367	6249		521	6249			
Total Direct Conversion		13864	1116		18991	1303		15640			
DEPRECIATION	B	1822		107	1822		152	1822			
FACTORY INDIRECT EXPENSE	B	3042		179	3042		254	3042			
Total Indirect Conversion		4864	286		4864	406		4864			
Total Product Cost		18728	1402		23835	1709		20504			
Cost - $			1411								

EXPENSE-QUANTITY	UNIT	UNIT PR	QUANTITY	QUANTITY	QUANTITY	QUANTITY
LABOR	HOURS	XXX	1423	1423	990	
LABOR RATE	XXX	XXX	3.50	3.50	3.46	
LABOR	MEN	XXX	7.3	7.3	5.1	
STEAM	M LBS.	.140	338	3380	2540	
ELECTRICITY	C KWH	.820	115	394	255	
COMPRESSED AIR	M CF	.048	177	1996	1320	
WATER-PURCHASED	M GAL.	.147	262	2618	1945	
WATER-PLANT	M GAL.					
FUEL-GAS	M CF	.389	127	866	560	
FUEL-OIL	GAL.					
REFRIGERATION	TON					
ICE	BLKS.					
LAB.	MAN/HRS					
LABOR STANDBY BASIS	XXX			XXXX	XXXX	XXXX

NUMBER OF UNITS			
EQUIPMENT USED:			
DEPT. NO.	5	5	5
DEPT. NO. 811 00 (24)	100 5	100 5	109 5
DEPT. NO.	5	5	5
OPERATING PERIOD:			
DAYS	XXX	30	22
SHIFTS	XXX	3	3

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10/7/65

10/7/65

TRAN 009323

A 170 REV. 12/60

PRODUCTION COST STANDARD

PLANT	W G Krummrich
PAGE	1 OF 1
PRODUCT	Aroclors
DEPT. NO.	246
PROD. CODE	811 00
% THEORY TO STD. ON 82601	95.5 %
% THEORY TO STD. ON 81059	93.0 %
CAPACITY	1 900 000
COST UNIT	
EFFECTIVE	Jan 1 1964
INV. UNIT COST	

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RAW MATERIALS: MATERIAL CODE	NAME	QUANTITY PER UNIT: THEORY	QUANTITY PER UNIT: STANDARD	PRICE PER LB.	UNIT COST
19400	Attapulgus Clay		150	03025	005
33800	Lime Hydrated		500	01090	005
33600	Ferric Chloride		030	12960	004
	Aroclor 1242 · 811 01				
82601	Biphenyl	5919	61980	06980	4326
81059	Chlorine	8400	90320	01929	1742
	Aroclor 1248 · 811 02				
82601	Biphenyl	5337	55880	06980	3900
81059	Chlorine	9600	103220	01929	1991
	Aroclor 1254 · 811 03				
82601	Biphenyl	4754	49780	06980	3475
81059	Chlorine	10800	116130	01929	2 [illegible]
	Aroclor 1260 811 05				
82601	Biphenyl	4171	43680	06980	3049
81059	Chlorine	12000	129030	01929	2489
	Aroclor 1262 811 07				
82601	Biphenyl	3976	41630	06980	2906
81059	Chlorine	12400	133330	01929	2572
	Aroclor 1232 811 15				
82601	Biphenyl	6891	72160	06980	5037
81059	Chlorine	6400	68820	01929	1328
	Aroclor 1454 (10% xylene) 811 14				
81103	Aroclor 1254	9000	90900	07138	6488
64005	Xylene	1000	10100	05740	580
RAW MATERIAL WAREHOUSING & HANDLING					007
GROSS TOTAL MATERIALS					
BY-PRODUCTS					
82851	HCl Gas Sales & Use	-		-	
Cl2 #/cwt theory = lbs Cl numbers of Aroclor Grade x 2					
O2 #/cwt theory = (100 - Cl2 theory/2) + Cl2 theory/2 x .0283					
Cl2 #/cwt actual = Cl2 theory / .93					
O2 #/cwt actual = O2 theory / .955					
HCl #/cwt theory = Cl2 theory/2 x 1.028					
TOTAL BY-PRODUCTS					
NET TOTAL MATERIALS					

PRODUCTION CONTROL DATA

CLASSIFICATION	AMOUNT	CLASSIFICATION (Contd.)	AMOUNT
COST OF SHUT-DOWN		COST OF STAND-BY	
COST OF START-UP		COST TO MOVE A MAN	
COST OF CHANGEOVER		STAND-BY LABOR - NO. OF MEN	

OTHER PRODUCTS PRODUCED IN CONJUNCTION WITH THIS PROD.

PRODUCTION CODE		CAPACITY
Bottom Dowtherm	4%	
Pyranol -	2	
Heavy -	2	
On stream	92	
2560#/hr x 720 x 96		
1695 ...		

OTHER DATA

1964 Inventory Std Units Per LB

811.01	.07491	.07581
811.02	.07314	.07415
811.03	.07138	.07451
811.05	.06961	.07085
811.07	.06901	.07029
811.15	.07788	.07858
811.14	.07075	.07178
811.09	.08451	

Cost · STD

TRAN 009324

WORK PROPOSAL

WGK PLANT TECHNICAL SERVICES

ORIGINAL TO T.S.D. JOB BOOK
CC ASST. ENG. SUPT., DESIGN
V. Brawley
J. Savage
L. Sprandel
R. Spuering

INITIATED BY: D. E. Harris — DATE: 7-28-65

COMPLETED BY: R. H. Spuering — DATE: 8-9-65

DEPT.: 246 — PRODUCT: Aroclor — JOB NO.: ~~328~~ M5044

FOLDER:

TITLE:

ELIMINATE OBNOXIOUS FUMES AT DRUMMING STATION

STATEMENT OF PROBLEM AND OBJECTIVE (Use reverse side if necessary)

There are obnoxious fumes in the drumming area where an operator must spend long periods of time. These fumes are from cleaning filters in the area, leaks from pumps, and opening drums of raw materials.

The obnoxious fumes should be eliminated to provide a suitable work area.

ESTIMATED SAVING OR OTHER BENEFITS

Elimination of the obnoxious fumes will permit operators to work in an area without irritation.

SUGGESTED APPROACH, REFERENCES, ETC

Provide a vent fan in the roof if it is determined that this will provide adequate ventilation.

PRELIMINARY EVALUATION (To be completed by Technical Service Dept.)

MANPOWER REQUIREMENTS

EVALUATION	16	MAN HOURS
CH. E. DES.		"
M.E. DES.	16	"
E.E. DES.	8	"
INSTR.		"
DRAFTING	24	"
START-UP		"
		"
		"
		"
		"
TOTAL	64	"
TOTAL	8	MAN DAYS

NO. MEN	T.S.D. COST	ESTIMATED SAVINGS OR PROFITS	NEW FIXED CAPITAL
3			

COMMENTS

TRAN 055800

ASSIGNED TO T.S.D. ASST. ENG. SUPERINTENDENT: L. W. Sprandel

APPROVALS

GENERAL SUPT.	PLANT MANAGER	TECHNICAL PRODUCTION MGR.
P. E. Heisler		

DEPOSITION EXHIBIT
P/f's 428
7-9-92 ~~89~~

H. Berger

PROGRESS REPORT — TECHNICAL SERVICES DEPT. – W. G. KRUMMRICH PLANT

JOB NO. 91341.4119 | REPORT NO. 1 | DATE 9/22/69

W.G. KRUMMRICH PLANT		RESEARCH	GENERAL OFFICE	OTHERS
•☒ E.Billen	☒ M.Goldasich	☐ G.O.	•☐ J. E. Smith	•☐ J. R. Savage
☒ E. Malone	☒ J.Shafer	•☐ J. O. Bright	•☐ B. DAHIA	•☐ W. A. KELLOGG
•☒ A. E. Leisy	☒ R.McCutchan	•☐ W.R. Richard	•☐ D. E. Cayard	•☒ J.C. Landwehr
•☒ T. W. DALTON	☒ J. Davis	☐ C. E. ANAGNOSTOPOULOS	•☐ P. W. EDWARDS	•☐ So. 2nd St.
•☒ J. W. Molloy	☒ E.Mares	•☒ B.Hodges	•☐ R. E. Howard	•☐ P.O. DeGarmo
☒ O. L. Bratsch	☒ G.Hudson	•☒ W.A.Kuhn	•☐ A. A. HEMMIGER	•☐ T.M. Patrick
☐ D. J. O'Toole	☒ F.Elliott	☐	•☒ D. B. HOSNER	•☐ J.F. Quinn
☒ D. W. Jackson	☒ R.Hamlet	☐	•☐ H. C. Carder	☒ E.S.Tucker-JF(
•☒ L. Sprandel	☒ D.Sartor	☐	•☐ H. L. SAMPLE	☐
•☒ B.R.Williams	☒ R.Spiller	☐	☒ R. Stratmeyer	☐

• TO RECEIVE DETAIL SECTION

TITLE: WATER POLLUTION: AROCLOR CONTROL

Wildlife

PERSONNEL: M. Pierle (C. F. Buckley)

PROBLEM: To determine source and quantity of Aroclor losses to the sewer.

SUMMARY

Aroclor losses are confined to Departments 238, 217, 218, 243, 245, 246, 258, 270, 273, and 275. Department 245 is now hauling 3600-4800 gallons/year of spent aroclor to the Monsanto landfill. The remaining major source of aroclor in the sewer is Department 246. From yield losses it is estimated that these losses total 40,000 #/yr. to the sewer. A project with estimated cost of $10,000 is presently being developed to minimize the Department 246 losses.

Water and mud samples are being taken to determine both the actual plant losses and the effect of W.G.K.'s outfall on the aroclor levels in the Mississippi River.

M. A. Pierle
Technical Services Dept.

jo

COMPANY CONFIDENTIAL

DEPOSITION EXHIBIT
P/f's 429
7-9-92

TRAN 058842

BACKGROUND:

The outbreak of adverse publicity toward the use of chlorinated hydrocarbon insecticides has caused the W.G.K. plant to study the losses of polychlorinated biphenyl (aroclor) from the plant. Recent studies have indicated that PCB materials act similar to the insecticides in that they are resistant to biological breakdown in the environment, and therefore, they tend to concentrate in animals such as birds or fish.

The object of this report is to summarize preliminary information on the sources and quantities of aroclor material in the W.G.K. plant effluent.

DETAILS:

A. Sources

1. Each manufacturing department was surveyed to determine whether or not aroclor could be present in its effluent. The use of aroclor is confined to Departments 238, 243, 245, 258, 270, 273, and 275.

2. Aroclor has also been detected in the catch pot systems in Department 218 and 217. This is contained in the HCl off-gas from Department 246.

3. The manufacturing department, 246, has aroclor in its effluent. This is readily visible in the department's trench sewers.

B. Quantity

1. Although aroclor is used in the above stated departments, only two departments (245, 238) have to completely change out their system on a routine basis.

   Department 245 uses 600 gallons every 1 1/2 - 2 months, and Department 238 uses about 2,000 gallons/year. Other department losses are from vapor losses due to tank breathing and leaks from pump packing.

2. The amount of aroclor in the HCl off-gas system is believed to be minor since it is infrequently found in the 217 and 218 catch pots.

3. Based on yield losses, Department 246 losses are estimated at 40,000#/yr.

B. Quantity (continued)

4. General

The following sampling program has been developed to quantify the losses from the W.G.K. plant and to determine the effects in the Mississippi River.

Liquid Samples

1. Plant outfall - one weekly composite sample.
2. One weekly composite sample representing effluent from Department 246.

Mud Samples

1. Sample from primary treatment plant sludge.
2. 0.5 miles upstream of outfall.
3. 200 feet below outfall.
4. 1.0 miles below outfall.

All of above are taken once per month.

To date, due to work priority, analytical results are not available. Samples will continue to be collected.

C. Control Measures

1. Dept. 245 - The aroclor which previously had been sewered is now being hauled to the Monsanto landfill. This amounts to a plant reduction of 3600 to 4800 gallons per year.

2. Dept. 238 - This material has and will continue to be disposed of at the landfill.

3. A project is presently being developed for Dept. 246 as part of a general paving project which should minimize aroclor losses. It involves the construction of settling chambers in trench sewers which will act as collection basins for the aroclor. The material will be removed by either a steam jet pump or a sump pump if it is needed. The estimated cost for aroclor loss control is $10,000.

CONCLUSIONS:

1. The major sources of aroclor in the plant effluent is Department 246.
2. Laboratory results are not yet available to actually quantify total plant or Department 246 losses.
3. A project to minimize Department 246 losses is being developed. Estimated cost is $10,000.

FUTURE WORK:

1. Continue supplying samples to the laboratory.
2. Improve monitoring system in Department 246.
3. Report on analytical results when obtained.

PR&D WORK PLAN

cc J. T. Bell
V. R. Haupt
J. C. Landwehr
C. L. Jessee
G. W. Miller
H. L. Williams
G. L. Arnett
J. L. Brown
W. H. Howard
E. G. Wright
J. R. Savage - G.O.
P. O. DeGarmo - Queeny
W. R. Richard - G.O.
P. B. Hodges - G.O.
J. E. Smith - G. O.

DATE: April 27, 1970

SUBJECT: Aroclor Pollution Study

DEPARTMENT: 916.07

JUSTIFICATION: Reduce polychlorinated biphenyl and terphenyl content of plant waste water.

COST:

Estimated per diem PR&D Cost	$87
Mandays	10
Total Estimated Cost	$870

EXPERIMENTAL:

1. Run adsorption isotherms with the waste water at 10°C and ambient temperatures utilizing the following absorbents:

   a. Carbon (different types)
   b. Attapulgus clay
   c. Porocel
   d. Silica
   e. Molecular sieve
   f. Aroclor 5460

   Target Completion Date 5/8/70

2. The data obtained in the above test will dictate the direction of future work. Another work plan will be issued upon completion of this work plan.

SAFETY: The waste water effluent from the Aroclor department contains mainly HCl and Aroclor (i.e., in low concentrations). HCl fumes and acid are very corrosive to the skin and mucous tissue. Repeated exposure to Aroclor can cause a condition of chlorance. Hence, any area exposed to the waste water should be washed thoroughly with copious amounts of water. If exposure is in a critical area as the eyes, consult a physician.

Ishmeal Ransaw

Ishmeal Ransaw

/bs

TRAN 059631

DEPOSITION EXHIBIT
Plf's 430
7-9-92

W. B. Papageorge - St. Louis

December 7, 1970

J. Mason
H. Bergen
F. Holzapfel
G. Bratsch KRUMMRICH
G. Jessee [illegible]
D. B. Shearn - [illegible]
P.J.A. Marsh - ANNISTON

J. R. Savage

One very important objective of our PCB environmental control program was to control the losses of PCB in our plants to achieve a maximum of 50 ppb in the waste water effluent by 1-1-71 and 10 ppb by 9-1-71.

During the month of September, Newport reported an average of 246 ppb. During November Anniston reported 1410 ppb and the Krummrich Plant reported 495 ppb.

Because of the seriousness of the PCB problem this level of performance cannot be allowed to continue. I do not recall that any of the plants have been denied a resource they requested to achieve the stated objectives.

We do not have the luxury of unlimited time to combat this problem. What do we need to reduce losses quickly?

W. B. PAPAGEORGE

ms

TRAN 061773

IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF ILLINOIS
EASTERN DIVISION

THE UNITED STATES OF AMERICA,	)	
	)	
Plaintiff,	)	
	)	
vs.	)	No. 78 C 1004
	)	
OUTBOARD MARINE CORPORATION and MONSANTO COMPANY,	)	
	)	
	)	
Defendants.	)	

The deposition of JAMES RICHARD SAVAGE, called by the Outboard Marine Corporation for examination, pursuant to notice and agreement and pursuant to the Rules of Civil Procedure for the United States District Courts pertaining to the taking of depositions, taken before Thea L. Urban, a Notary Public in and for the County of Cook, State of Illinois, and a Certified Shorthand Reporter of said State, at the offices of Kirkland & Ellis, 200 East Randolph Drive, Chicago, Illinois 60601, on the 27th day of January, A.D. 1982, commencing at 11:00 o'clock a.m.

PRESENT:

MS. ELIZABETH STEIN,
(Pollution Control Section
Land & Natural Resources Division
Department of Justice
Washington, D.C. 20530),

appeared on behalf of the
United States of America;

DEPOSITION EXHIBIT
PIFs 432
1-9-92

Q That would include the laboratory technical service?

A Yes.

Q And manufacturing?

A Yes. And the Maintenance Department.

Q Were you involved as Production Supervisor of the Aroclor Department in manufacturing forecasts determining how much should be manufactured?

A No, my job was to produce according to the schedule.

Q Who provided you with the schedule?

A I don't really know. It came from the General Office.

Q In the Aroclor Department, what steps were taken to prevent water pollution?

A In the Aroclor Department?

Q Yes.

MR. SCHINK: You are now talking about preventing Aroclors from getting into the waste water?

MS. OLIVER: Yes.

BY THE WITNESS:

A I would say the principal precaution was maintenance of equipment to prevent leaks.

BY MS. OLIVER:

Q Were there leaks in the equipment?

A Sometimes.

Q Would they occur during the normal course of using the equipment?

A Yes.

Q How were the leaked materials disposed of?

A We would use Floor-Dri compounds of some kind to adsorb the material, shovel it into drums. The drums were taken to a landfill.

Q Is that the only method that was used?

A Yes. Rags instead of Floor-Dri compound, where it was appropriate.

Yes, in general, that was the way.

Q How would any PCBs find their way out of the plant into the municipal treatment waters outside the plant?

MR. SCHINK: I object to the form of the question. He said he was not aware there were any at that time in the waste.

MS. OLIVER: He was aware since then that they had been found.

MR. SCHINK: But he didn't say he was aware since then they were in the waste at the time he was there, so there was no foundation.

BY MS. OLIVER:

Q Do you know how that could have happened, Mr. Savage?

MR. SCHINK: How what could have happened? I object to the question.

BY MS. OLIVER:

Q Do you understand what I am asking, Mr. Savage?

A Not really. You are asking me how something happened that I wasn't aware of and I don't understand.

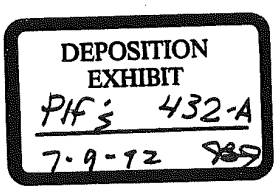
Q You are aware today, are you not, that PCBs were discharged from the Anniston Plant and found their way into streams and municipal treatment plant sewers and waters generally outside the plant?

A Yes, I later became aware of that.

Q What I am asking you is from your knowledge of the production and the operation of the Anniston Plant and the Aroclor Production Department, how did that happen?

A I think based on our later study that we began to understand that that was even very small leaks which later one would be washed down or perhaps due to rainfall could create small concentrations of PCBs in the waste water which we eventually did learn to measure

Q Let us start with the leaks. They were from



Monsanto

FROM (NAME & LOCATION): R. L. Neary (4-8156) General Offices

DATE: April 6, 1970

SUBJECT: Minutes of Meeting on Aroclor Fractionation
UUU Building - 1700 So. Second Street

REFERENCE: April 2, 1970

cc: H. S. Bergen
R. E. Howard/R. M. Kountz
W. B. Papageorge
W. R. Richard
J. R. Savage

TO : Those in Attendance:
J. L. Bernhardt
J. O. Bright
N. F. Mueller
R. H. Munch
R. L. Neary
J. E. Silver

This meeting was called to review Aroclor 1142 fractionation work by Research and develop a program of action involving Engineering.

The background was reviewed on Aroclor uses and the basis for the proposed fractionation step in the refining process to improve biodegradability. During the discussion of product composition, preliminary laboratory batch distillations and production rates, the following basis was established for the requested economic evaluation study.

1. The fractionated product will be designated as 1242-B.
2. Production rate - 30M lb/yr.
3. Continuous fractionation of 1142 taking 82% overhead.
4. The higher boiling isomers from the column bottoms will be taken as a side stream and processed to Aroclors 1254 and 1260. The residue will be processed to recover yield in the present residue recovery systems.
5. The project will be based on blocked operation at one plant. No provisions are planned for co-product manufacture of 1242 and 1242-B. The design capacity will match the existing plant 1242 unit.

The future plans are as follows for sequential actions:

1. Develop preliminary economics for fractionation by 4/13.
2. Discuss additional cost with major customers.
3. Identify data needed for design.
4. Carry out process development in Research.
5. Define project and prepare project scope.

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DEPOSITION EXHIBIT
Plfs 433
7-9-92

TRAN 007185

IM-10 REV 11 65

Future plans (cont'd):

6. Obtain project approval.

7. Execute project.

R. L. Neary

Monsanto

FROM (NAME & LOCATION): Mr. J. R. Savage - General Office

DATE: May 4, 1970

cc: Mr. W. R. Richard

SUBJECT: QUICK ACTION POSSIBILITIES ON AROCLOR POLLUTION

REFERENCE:

TO : Mr. H. S. Bergen
General Office

1. Release to the "scientific community" an estimate of worldwide PCB production, along with % in contained (sealed) applications. Explain that we do this in spite of competitive hazard, because we recognize....etc.

2. Introduce an interim HT fluid to keep customers going until more sophisticated fluids are ready. We could quickly start making Aroclor 1237. Call it Therminol BFR (Barely Fire Resistant). Should be substantially loer in 5 & 6 Cl than any other Fire Resistant Therminol. Could put NCR temporarily on same product? Also use as a blend stock in 1232 instead of 1242?

3. Announce that, in addition to replacing/eliminating the non-biodegradable PCB's from "consumable" products (plasticizers, coatings, etc.) we are setting out to "close the loop" worldwide on contained (sealed) applications by providing a reclamation and disposal service to the customer. An extension of previous Pydraul andTherminol reclamation programs which make it unnecessary to discard used or contaimated fluids.

J. R Savage

md

TRAN 005572

DEPOSITION EXHIBIT
PIF: 434
7-9-92

H. S. BERGEN - ST. LOUIS

MAY 20, 1970

AROCLOR 1232 REPLACEMENT

N. T. JOHNSON
D. A. OLSON
J. R. SAVAGE

W. R. RICHARD

We are temporarily continuing with Aroclor 1232 as now made for several accounts (Wynn Oil and Radiator Specialties).

We would like to go as soon as possible to a product as close to Aroclor 1232 as possible, but one which would not crystallize and be essentially biodegradable. I understand that we might approach this by using Aroclor 1236 and blending this with Aroclor 1221. There may be other ways to get around it also.

Would you please develop as quickly as possible our best replacement for this product so that we can plan to start making it as soon as possible. Please keep Marketing, Jim Savage and I advised. Thanks.

H. S. BERGEN

ms

Monsanto

P. G. Benignus - St. Louis General Office

June 11, 1970

CAPACITOR AROCLOR 1242

MCS 1016

TO : D. A. Olson - St. Louis

H. S. Bergen - St. Louis
R. H. Munch - J.F. Queeny
W. R. Richard - St. Louis
J. Savage - St. Louis
J. G. Bryant - St. Louis
G. R. Graham - New York
J. R. Fallon - St. Louis
N. T. Johnson - St. Louis
T. Katayama - MMK Tokyo
C. Coleman - Ruabon
P.J.A. Marsh - Brussels
R. Kountz - St. Louis
A. Koenig - St. Louis
W. Gordon - St. Louis

To improve biodegradability some experimental Aroclor 1242 with some of the higher chlorinated biphenyls removed is being prepared.

This material has already been called Aroclor 1242B. Obviously the "B" implies biodegradability. We now feel that this nomenclature is not desirable at this stage of this new and not fully explored material.

Therefore, we now elect to call this material MCS 1016. Please now use this designation, instead of Aroclor 1242B.

Thank you.

Paul G. Benignus

/dn

TRAN 008623

Monsanto

FROM (NAME & LOCATION) W. B. PAPAGEORGE - ST. LOUIS

DATE JULY 17, 1970

SUBJECT

REFERENCE

TO : H. S. BERGEN

cc D. S. CAMERON - BRUSSELS
W. S. CLARK
E. M. EMERY - JFQ
M. W. FARRAR - 2ND STREET
R. E. KELLER - 2ND STREET
R. M. KOUNTZ
J. MASON
R. H. MUNCH - 2ND STREET
D. A. OLSON
W. R. RICHARD
J. R. SAVAGE
J. E. SPRINGGATE
E. S. TUCKER - 2ND STREET
H. A. VODDEN - RUABON
E. P. WHEELER

I reviewed our biodegradation studies with R. Munch, R. Kountz, S. Tucker, E. Emery and J. Savage on Thursday, July 16, 1970.

1. Monsanto-USA Studies

River die-away studies indicated Aroclor 1221 disappears, Aroclors 1242, 1248 and 1254 were undegraded.

Semi-continuous activated sludge studies indicate that selective degradation of specific homologs does occur because peaks normally present in Aroclor 1221, 1242 and 1248 disappear.

2. Monsanto-U.K. Studies

Shake flask studies demonstrate that 2,4'-, 2,2,3- and 2,3,4'- isomers degrade readily. 2,2',4,6-, 2,2',4,4', and 4,4' do not degrade.

Ruabon laboratory also demonstrated by peak analysis that MC3-1016 and Aroclor 1130 are more degradable than Aroclor 1242.

3. Environment Samples

Investigators in both Europe and USA find isomers in wildlife that resemble those in Aroclor 1254. Predominant homologs present in Aroclor 1242 are usually not found except close to industrial plants. Since large quantities of Aroclor 1242 are produced and released to the environment, degradation must be occurring.

TRAN 037172

DEPOSITION EXHIBIT
PIFs 437
7-9-92 SBD

Evidence of degradation has been noted by Monsanto laboratory in studies of foundry plant settling ponds, milk and fish. Peaks which are present in the original Aroclor are modified or missing in the sample extract indicating degradation.

4. MCS-1016

Considerable discussion was held on what is meant by "biodegradable" when describing MCS-1016. Capacitor customers I visited had the erroneous impression that this meant the material could be introduced into the plant sewer system and would be non-detectable a very short distance downstream. For our purposes, the term "biodegradable" means that peaks which persisted through the biodegradation tests with Aroclor 1242 are significantly reduced in this distilled product. Neither Aroclor 1242 or MCS-1016 can be dumped into the environment. Users of either material must exercise control. In some instances this may require activated sludge treatment units. It is generally agreed that the relative improvement in biodegradability is an advantage which the capacitor industry will find interesting. We must establish if the less controllable hydraulic fluids applications can materially benefit from the use of MCS-1016.

5. Current Work

At Ruabon, work continues on HB-40, Aroclors and Pyralene 1500 (a competitive product). Dr. W. C. Evans, University of North Wales, Bangor is investigating some microorganisms which he believes are effective on PCB's.

E. Emery is completing his studies on HB-40 and MIPB. He will immediately start tests to determine relative per cent degradation of Aroclor 1242, Aroclor 1254, MCS-1016 and Aroclor 1230B. These tests take about 3 weeks to complete and his equipment provides for testing four products at a time. Analytical facilities are manned 7 days per week, 12 hours per day. Equipment needs are being evaluated.

The backlog of products to be tested continues to increase. The Applied Sciences Group continually reviews the list to re-establish continuing changes in priorities.

In summary, emphasis on this work has been accelerated within the past three months, the work is progressing as planned and our facilities are being utilized to the practical limit.

W. B. PAPAGEORGE

ms

TRAN 037174

A. J. Heinze - (4-8142) - General Offices - (Zone 259)

August 6, 1970

Project Scope Report

MCS-1016 Fractionator - WGK
CBA 2417

F. J. Holzapfel
R. M. Kountz
N. B. Volk

E/25

(1) [illegible]
(2) BILL YOUNG
(3) BAILEY WILLIAMS
(4) CHUCK DEVINE

Messrs.:

R. M. McCutchan (2)
R. H. Munch
J. R. Savage

Attached is the Scope Report for the subject project. In the interest of expediting final definition of this project, please review the Scope Report by August 12, 1970.

Messrs. Kountz and Volk will meet with you on August 12 (to be arranged by N. Volk) to review the overall project and discuss any comments you may have.

(5) BILL [illegible]

AJH

A. J. Heinze

vo

Attachment

MCS 1016

Fractionation of 1142. Removes all >5 Cl, most of the 4 Cl. The higher ones are found in the environment. No direct evidence of the biodegradability of any of the PCB's.

Replacement of MCS 1016 will probably be as follow Chlorinate to 29% Chlorine. Fractionate to remove ortho chloro biphenyl and biphenyl. Take a heart cut for Product. Stop heart cut when 4,4' starts over. The 4,4' & higher will go to 125° and 12+

TRAN 037811

AUG 19 1970

Monsanto

FROM (NAME & LOCATION): W. B. PAPAGEORGE - ST. LOUIS

DATE: AUGUST 18, 1970

cc: H. S. BERGEN
J. MASON
J. E. SPRINGGATE

SUBJECT: PCB ENVIRONMENTAL PROBLEM
JULY STATUS REPORT

REFERENCE:

TO:
D. S. CAMERON - BRUSSELS
W. S. CLARK
J. R. DURLAND - TOKYO
M. W. FARRAR - 2ND STREET
E. V. JOHN
R. E. KELLER - 2ND STREET
R. M. KOUNTZ
D. A. OLSON
P. S. PARK
W. R. RICHARD
J. R. SAVAGE
E. P. WHEELER

MARKETING:

Market withdrawal programs continue on schedule. Therminol food users are converting to Therminol 66 or Therminol 55, with little loss of business.

Customer letters for notification of Pydraul F9A are prepared and will be issued when manufacture is complete (estimate 2 weeks).

The withdrawal/replacement program for Aroclor plasticizers appears to be going well. Several customers have reported success in reformulating in such applications as epoxy coating/potting systems and inks. Production orders for the products being withdrawn have been very heavy, however, the producing plants and production planning have done an excellent job of keeping shipments moving in an orderly fashion.

ENGINEERING:

Aroclor Incineration

A preliminary project scope for a 10 M pound/year liquid incineration system was developed and issued for review. A safety review was held. The project scope is being modified to reflect comments received. The appropriation request data transmittal will be issued in early August.

DEPOSITION EXHIBIT
PFS 439
7-9-92 SD

TRAN 039104

ENGINEERING: (Continued)

MCS-1016 Distillation

Economic analyses to establish method and location for distilling 55 M pounds/year of MCS-1016 were completed and issued. The preliminary project scope was prepared and issued for comments. A safety review has just been held. The appropriation request data transmittal will be issued in early August.

EUROPE

There has been little new activity during July. Neither of the NERC reports has yet been published, although the new journal "Environmental Pollution" carried the paper written by the Monkswood people on the avian toxicity of PCB's. This provoked one or two reports in the popular press.

A NATO committee is sponsoring an investigation into marine pollution along the coast from Calais to the north of Holland, with special reference to PCB's. They were advised to get in touch with Bayer and Prodelec for information on the usage of PCB's in Belgium and within the whole of the EEC.

Implementation of the PCB plan for Europe is held up pending further meetings with the other PCB producers, firstly to determine their attitude towards a voluntary withdrawal from uncontrollable applications, and secondly to determine their reaction in the event of a unilateral withdrawal by Monsanto.

JAPAN

No new public developments in Japan. MMK writing revised policy for marketing of Aroclors. U.S.A. customers (3M, Thiokol) investigating Japanese sources.

MEDICAL

Two year feeding studies continue. Twelve month status report is expected in August. Fish toxicity studies are being repeated as well as some of the chicken reproduction studies. FDA has issued guidelines establishing upper limits on PCB contents in milk at 0.2 ppm and other food at 5.0 ppm.

PUBLIC RELATIONS

A news release on Monsanto's recent actions to curb the use of PCB was distributed on July 16. It was primarily a rebuttal to recent stories that PCB caused birth defects, but included a complete background of voluntary actions taken to solve the PCB problem. Copies went to all news media who have carried PCB stories in the past two years.

Use of our story by the press has been light.

RESEARCH

Aroclor 1242 Replacement for NCP

The two major problems with monoisopropyl biphenyl (MIPB) are now defined as odor and eye irritation. Both problems could be solved by changing from propylene to a higher olefin for alkylation of biphenyl. Major interest is now centered on $C_{6,8,10}$ alkyl biphenyl (ABP-11) from Ethyl Corp. α-olefin, our oxo process feedstock. Early testing by NCR was highly encouraging, however, print fade looms as a major problem. Back-up candidates include butyl, amyl, and hexyl biphenyl.

A series of six odor masks were provided NCR in an effort to improve the odor of MIPB without interfering with solvent performance.

Samples of extender and cosolvents were supplied to NCR to improve dye solubility and to give more rapid color development than NCR's current cosolvent. These materials are (1) heads fraction from alkyl benzene manufacture at Chocolate Bayou, (2) alkyl benzene (Alkylate 215), and (3) alkyl benzene high boiler (Alkylate H-230).

Plasticizer Replacements

Blends of Aroclors 5460, 5442 and 1221 were developed to approximately match the viscosities of Aroclors 1254, 1248 and 1242. Replacement recommendations were made to customers to whom viscosity is important. Specifications are being developed in cooperation with the Anniston Laboratory.

MCS-1016

Sixteen drums of the MCS-1016 have been prepared by fractionating Aroclor 1142 in a packed column equivalent to 25 trays in the Dayton Pilot Plant. The distillate was brought here and analyzed. Then the fractions were recombined to give the desired composition and treated with a Porocel column to give the desired electrical properties. The product is now ready for shipment to customers for testing in capacitors. Since all the electrical properties of MCS are indistinguishable from those of Aroclor 1242 and there are only minor differences in other properties, this fluid should be a direct substitute for Aroclor 1242 in the capacitor industry with no capacitor design change or processing changes needed.

RESEARCH: (Continued)

Industrial Fluids

Pydraul F-9A

Pydraul F-9 was reformulated as Pydraul F-9A to avoid the use of chlorinated biphenyl. The new formulation is compatible with F-9. The lubricity in V105E pump tests is superior to any fluid we have ever run.

NC Phosphate Ester

Manufacturing costs are directly proportional to reaction times in the Step I reactor. We demonstrated that foaming in the Step I lab reactor and reaction time could be reduced by concurrent addition of $POCl_3$ and nonylphenol/cumylphenol. This should bring the reactor cycle to <6 hours. The process pay-load might be further increased by employing the Schotten-Baumann Step II and III reactors.

The pilot plant is reworking 1000 pounds of plant material by acid hydrolysis and washing to reduce acidity and hydrolyzable material.

Aroclor Substitutes

Bromoaroclor 1233 (13% Br) was scaled-up in a 35 gallon run in the Pilot Plant. This fluid is being tested in hydraulic fluid applications as a more biodegradable replacement of chlorinated biphenyl.

Isomerization of chlorinated terphenyl 5032 results in a fluid with a 100°F viscosity of 2800 cs and a 210°F viscosity of 11.7. We are seeking the lowest viscosity, all liquid terphenyl for use in hydraulic fluids.

a-Methylstyrene dimer was mono and dichlorinated for evaluation as a plasticizer in place of chlorinated biphenyl.

RESEARCH: (Continued)

Biodegradation - Ruabon

Priority has been given to the development of more refined GLC analytical techniques so that more selectivity will be available for degradation studies of multicomponent PCB's such as Aroclor 1242. This has caused some delay, but work in progress includes biodegradation studies of Pyralene 1500 (a competitive product), two of the key isomers for assessing the viability of the theoretical mechanism for degradation and HB-40. We are also studying the soil culture which Professor Evans, at Bangor University, has said will grow on Aroclors 1242 or 1254 as sole carbon source.

Biodegradation Testing - St. Louis

Testing of Aroclor 1242, Aroclor 1254, MCS-1016 (Aroclor 1242B), and Aroclor 1230B in our semi-continuous activated sludge units will be started as soon as sample background problems have been resolved. Identical conditions will be employed to permit a comparison between our present Aroclor product and the proposed substitutes.

MANUFACTURING

Anniston

Current Level

Aroclor losses during July averaged 3280 ppb in the plant effluent. This is equal to 36 pounds/day of Aroclor.

Plant Effluent Suspended Aroclor Control

Aroclor sump construction continues. Revision requesting an additional $4500 has been prepared. This was necessitated by unforeseen ground water problems. Completion by 9/1/70 still appears possible.

MANUFACTURING: (Continued)

Bulk Waste Disposal

Data defining magnitude of solid material quantities will be completely collected by week of August 31. Quantities and the basic estimates from which they are derived will be discussed with Production and TSD representatives August 6.

Laboratory testing of mixtures of Montar 1 and Montar 5 were not dramatically successful in reducing pumping temperatures required - 200°C range still necessary.

Experiments with hydrocarbon dilution of chlorinated and unchlorinated Montars appear to indicate this as an extremely attractive route to effectively reduce pumping temperatures, in some cases to near ambient. Economic evaluations will be made in the next two months. If successful, this will reduce handling costs and also provide auxiliary fuel for incineration.

Sauget

PCB Levels in Sewer

Current losses are about 45 pounds/day to the river which is a concentration of 200-250 ppb.

Memo being published by M. Pierle covering the sampling program for the plant. The Aroclor Department and total plant effluent will be monitored daily. Current effort is to improve the sampling technique.

Aroclor analyzer received and laboratory is ready for routine analysis. Sampling will begin on a routine basis this week.

PCB Levels in Atmosphere

Points of loss have been determined. Report being published. Most severe losses are from Therminol units in Departments 239, 245, 248 and 255. Work begun to correct these areas.

MANUFACTURING: (Continued)

Equipment has been purchased to take vapor samples. Where vapor is flowing, losses can be measured quantitatively. Where vapor flows cannot be measured such as in breather vents, qualitative results will be obtained. Will complete this as per schedule by September 1, 1970.

Projects To Reduce Sewered PCB's From Aroclor Department

Absorber rupture disk repiping (Est. 1512) complete.

Basin for trenches (Est. 1795) complete.

Blow tank demister (Est. 2031) project approved, long delivery items on order and project package will be issued by August 7, 1970.

Provide paving curbs and catch basin in Aroclor department to prevent losses from spills, especially in the tank car loading area. Guesstimate cost is $60,000 to $80,000. Estimate will be submitted by mid-August.

PCB Rework Project (Est. 2095)

Estimate completed, $32,000 capital, $3,000 expense. Appropriation request being typed.

Incineration Liaison

Phenol department fusion reactor area firmed up as location for Aroclor incineration. Tony Rasmussen named Manufacturing Representative.

W. B. PAPAGEORGE

ms

J. R. Savage - General Office

September 25 1970

Mr. D.C. Malm JFQ Plant
Mr. W.B. Papageorge

PCB POLLUTION

Mr. A. E. Peterson
J. F. Queeny Plant

Comments on the PCB situation at JFQ:

1. Central Drumming

We are now under an edict to eliminate all PCB's from our industrial fluid (Pydraul) line by the end of the first quarter of 1971. We therefore will not be using any PCB's in Central Drumming (note that Aroclor 5442 and 5432 are not PCB's). Therefore, we cannot justify capital in CD for curbs, etc. on this basis, although housekeeping or "routine" pollution considerations might still justify some expenditure.

It is certainly true that extreme care must be exercised to avoid losses during the next few months.

2. Heat Transfer Systems

Any filling or topping off of these systems should be done with Therminol FR-1 (Aroclor 1242). We have begun converting our customers, but the word may not have reached Monsanto users who order fluid under Aroclor nomenclature. D. E. Roush (#42529) can answer any technical questions. FR-1 is no panacea, but is less of an environmental problem.

3. Aroclor 1232 in TSCl:

This service should be converted to 1221 if possible. Aroclor 1221 is relatively biodegradable, while 1232 is a blend of 1221 and 1242, which contains several per cent of very persistent isomers.

J. R. Savage

md

TRAN 036358

Monsanto

DEC 30 [illegible]

FROM (NAME & LOCATION): J. F. Queeny Plant

DATE: December 29, 1970

SUBJECT: Aroclor Loss - Status Report

REFERENCE: Report 9/21/70

TO: Messrs: P. B. Hodges
W. B. Papageorge
J. R. Savage

cc: D. H. Abresch
F. W. Copanas
* P. F. Gatens
E. C. Gruetzemacher
W. G. Knapp
D. C. Malm
* E. D. Malone
D. E. Munie
W. F. Meyer
J. F. Nemeth
* A. C. Rehkemper
C. R. Schrock
J. A. Stepp
* E. D. Take
* B. L. Tilford
* R. L. Wagner
R. L. Wiese

* Summary only.

SUMMARY

PCB type Aroclors have been used or handled in four departments and the Research Pilot Plant at JFQ. Total annual losses have already been reduced from 21,500 lbs. to 14,000 lbs. via interim and permanent measures taken at a cost of $3,000.

A program has been developed which, if fully implemented, would essentially eliminate all normal losses to the environment by 8/1/71 at a cost of approximately $35,000.

Comments on the program by 1/15/71 are solicitated.

The program is summarized in Table I. Priorities are based on probability of loss and estimated cost of correction.

TRAN 036827

DEPOSITION EXHIBIT
P/F's 4441
7-9-92 985

IN-10 REV 11-68

TABLE I

Aroclor Status and Proposals

Priority	Problem Area	Est. Loss lbs./yr.	Source of Loss	Possible Actions	Status	Est. $	Timing
1	TSCl Nash Pump	6000	Seal fluid Sep. & Demist. Drains	Drain header connected to disposal drum.	complete	500	-----
2	"WW" Bldg.	1000	Vapors, pump leaks, jacket steam outs.	Change fluid to Therminal - 66	complete	2000	-----
3	TSCl Heaters (2)	2500	Vapors, pump leaks.	a. Switch to T-66, inert system, or b. Switch to A-1242 pan pumps, cold trap vent.	Topping with A-1242. Awaiting completion of compatibility study of T-66 with TSCl.	4000 4500	Compatability results by 12/31/70. PAFE by 2/1/71.
4	Phthalyl Chloride	1000	Vapors pump leaks.	Switch to A-1242, permanent pump pan, pressurize system, vent condenser.	Topping with A-1242. Temp drip pan proj. scope ready.	1500* 500**	PAFE by 1/21/71.
5	W Bldg. Leader Unit	8000	Vapors, pump leaks, steam out of jackets.	Clean system. Switch to A-1242 cold trap vent new type pump curb area.	Unit currently down. Top with A-1242. Major pump overhaul unsuccessful.	13,000	Investigate by 3/1/71. PAFE by 4/1/71.

TRAN 036828

Priority	Problem Area	Est. Loss lbs./yr.	Source of Loss	Possible Actions	Status	Est. $	Timing
6	W Bldg. Yard unit	small	Vapors, pump leaks, steam out of jackets.	Switch to A-1242. Cold trap vent Pan pump. Install chg. pump.	Unit currently down top with A-1242. Pump in good condition.	7000	Investigate by 3/1/71. PAFE by 4/1/71.
7	CLHS	3000	Pump leaks, hose drainage, piping leaks.	PCB containing Aroclors will be eliminated from all blends by 4/1/71. J. R. Savage memo of 9/23/70. PAFE for new unloading pump submitted.		2500	PAFE #10691 submitted 12/10/70.
8	W Bldg. Centerunit	0	Not in use.	Isolate to prevent use.	down	500	6/1/71.
				Dismantle	---	2500	Defer.

* Total PAFE of $5000 expected. Justification is primarily to prevent corrosion of vessel and jacket.

** Interim measure taken.

TRAN 036829

FUTURE WORK

1. Continue to define details of changes required for the leader and south yard units servicing the "W" Building.

2. Proceed with program as outlined, or as modified to meet needs based on information received from addressees.

/jcm

I. INTRODUCTION

PCB's containing Aroclors are extremely stable and highly inert fluids and as such were considered to be a safe fluid. Recent evidence, however, indicates that PCBs have an adverse effect on the environment. Since aroclors are only slowly degradeable through natural means there is concern over their buildup in the environment. Aroclors in the 1200 series are of primary concern. The higher the number, the more resistant is the fluid to bio degradation.

To protect the environment Monsanto has established a self imposed limitation of PCB losses to the waste effluent of 10 ppb. In addition, volatile losses to the atmosphere are to be essentially eliminated.

The purpose of this report is to relate the interim and permanent steps taken to date to reduce PCB losses to the environment and to invite comments on measures proposed to obtain a further and permanent reduction in losses.

II. DETAILS

A. General

An inspection of the Aroclor using facilities at TSCl, Phthalyl Chloride, "W" Building and the Research Pilot Plant ("WW" Bldg.) was made. Technical advice and recommendations were obtained from D. E. Roush of the Fluids Group. Discussions were held with Department Supervision and alternate solutions to the elimination of PCB losses to environment were presented and a course of action chosen. A final decision in TSCl can not be made until the outcome of a compatibility study is complete.

Interim and permanent measures where immediately feasible have been taken.

B. Departments

1. Research Pilot Plant

Two portable high temperature fluid heating systems have been employed in this facility. A third unit has just been obtained. Although the units originally used Therminol 77, Aroclor 1248 was substituted many years ago and its use continued. Fluid losses have been incurred from pump leaks and steaming of vessel jackets to the sewer when changing heating or cooling medium, and vaporization.

Alternate solutions for the WW problems were:

1. Continue with Aroclor fluid. Estimated cost $6000.
   a. Switch to Aroclor 1248 because it is more biodegradeable.
   b. Provide large drain pans under pumps.
   c. Cold trap vent to prevent volatile losses.
   d. Provide for trapping of effluent steamed from vessel jackets.
2. Change to non PCB containing fluid. Estimated cost $2000.
   a. Switch to Therminol 66.
   b. Inert the systems to prevent oxidation and eliminate the fire hazard.

A meeting was held with Dr. Knapp and Mr. H. Close of the Research Pilot Plant to discuss the alternates proposed. Alternate #2 was recommended to and accepted by Research as the best overall solution. Since Therminol 66 contains no PCB, future concern over such losses from this facility will be eliminated. Dr. Knapp agreed to complete the changes required before the next startup of heating systems (12/18/70).

2. TSCl

   a. Nash Compressor - HCl system

   Aroclor 1232 is used as the sealing fluid for the Nash Compressor in the HCl system. Losses are estimated at 6,000 lbs. annually. Aroclor builds up regularly in the system's instrumentation and is drained periodically to the pump's catch pan. The drain line from the Brink's demister joins the pump pan drain. This line formerly ran directly to the sewer. The line has been altered so that the drainings are now caught in a drum. Full drums are marked "Aroclor for Incineration" and sent to WGK for storage.

   HCl from TSCl is used in the manufacture of Bisphenol A. Samples of Bisphenol A have been submitted to Research to determine whether any PCB's are present. Analytical problems have been encountered by Research. New laboratory facilities have just been completed which are expected to provide reliable results. Analysis of the BPA sample is expected by year end.

A search was conducted for a substitute fluid for the Nash Compressor, but no satisfactory material could be found. Bisphenol A manufacture is scheduled to cease at JFQ by the end of 1971. At this time it may be possible to alter the HCl system to eliminate the Nash Compressor and thereby eliminate the use of Aroclor.

b. Heating Units - Two

Two heating systems employing Aroclor 1248 are in use. Annual losses total approximately 2500 pounds from these units. The bulk of the losses are the result of pump leaks. Some atmospheric losses are incurred as no conservation measures are employed on the vents.

As an interim measure the department is using Aroclor 1242 for loss makeup. Operating instructions have been modified and personnel instructed to exert extreme care in handling of Aroclor fluids to prevent inadvertent sewering.

Alternate solutions to correct the problems with these heaters are:

1. Continue with Aroclor fluid. Estimated cost $4500.
   a. Switch fluid to Aroclor 1242.
   b. Provide large drain pans for pumps.
   c. Cold trap vents.
2. Change to non PCB containing fluid. Estimated cost $4000.
   a. Switch to Therminol-66.
   b. Inert systems with CO_2.
   c. Alter line from conservation vent and provide cold trap/flame arrester.

The alternates were discussed with the department supervisor Don Abresch and alternate #2 recommended. Mr. Abresch agreed with the recommendation providing that Therminol-66 was found to be compatible with the TSCl streams heated. A study has been requested of the TSD Process Group and results are expected by 12/31/71.

Both units are heated by 350 lbs. steam. The fluids are used at a maximum temperature of 205°C. While this temperature is above the flash and fire points of Therminol-66, inerting of the system with CO_2 should provide adequate fire protection. The auto ignition temperature of T-66 is 364°C or 120°C higher than temperature of the heating steam. Therefore instrument malfunctions cannot result in over heating of the fluid.

A PAFE for the necessary changes can be submitted by 2/1/71.

3. Phthalyl Chloride

This department has one Aroclor system used for both heating and cooling of a reactor. Heating is accomplished by the use of bayonet heater submerged in the agitated jacket. The fluid is circulated through an external heat exchanger for cooling of the reactor.

Losses are about 1000 lbs./yr. and are primarily from pump leaks. Atmospheric losses are estimated to be 69 lbs./yr.

Corrosion of the vessel has become a major problem. The corrosion is caused by the introduction of atmospheric moisture which causes the breakdown of Aroclor to form HCl at the temperatures used (300°C). The moisture is introduced by the breathing action taking place via the open vent as alternate heating and cooling cycles are employed.

Jacket maintenance costs from corrosion average $1500/yr.

Corrective action is a necessity to prevent the loss of the $15,000 reactor and consequent business interruption.

Interim actions have been taken to reduce the PCB loss and limit its effect on the environment. Aroclor 1242 is used to make up any fluid lost. A temporary drip pan at the pump packing gland has been provided. Operators have been instructed to take precautions against allowing Aroclor fluid to enter the waste effluent and operating instructions modified.

Two alternatives were developed to solve the combined PCB corrosion problem in this department. They are:

1. Continue with Aroclor fluid. Estimated cost $5000.
   a. Switch to Aroclor 1242.
   b. Provide large drain pan for pump.

c. Inert the system with N_2 and provide conservation vent.

d. Provide condenser on conservation vent.

e. Install rupture disc.

2. Change to non PCB containing fluid. Estimated cost $5000.

a. Switch to Therminol-66.

b. Inert the system with N_2 and provide conservation vent.

c. Provide vent condenser.

The alternatives were discussed with the department supervisor C. Schrock. Alternate #1 was chosen primarily for safety reasons. The use of electrical heating units in the jacket was the overriding consideration. Temperatures could exceed the auto ignition temperature. If the inerting system would fail, an explosive situation could result.

A PAFE will be submitted by 1/21/71, if no adverse comments are received.

4. "W" Building

The "W" Building has three Aroclor heater systems. The small homemade unit located in the center section is no longer used and will be isolated to prevent use.

The "yard" unit has an excellent maintenance record and addition of fluid is rare. The losses that do occur are from pump leaks and volatile losses through the open vent.

The principle source of loss for "W" Building operations is the leader unit located south of the "BBB" Building. Last year the pump seal failed on five occassions and accounts for the majority of the loss. In addition some volatile losses are incurred through the open vent.

A major overhaul of the pump was completed in November, but the seals failed within a week after startup.

All units are currently down. When operation is required only Aroclor 1242 will be used for makeup of losses. The manufacturing superintendent for the "W" Building, F. Copanas reports that current project forecasts indicate that only one heater will be required for the foreseeable future. Operations will be confined to the yard unit as long as only one heater is required.

Two basic alternatives for a permanent solution to the PCB losses from the two heaters were discussed with Messrs Sutherlin and Copanas. One was to continue with Aroclor and the other to switch to Therminol-66. Both men objected to the use of Therminol-66 from a safety viewpoint. The fluids in both units are heated by open gas flame burners. A ruptured tube in the furnace would result in a fire. Special instrumentation would be required to sense the fire, shut off the gas and extinguish the fire automatically. Curbing to prevent the spread of burning fluid from the unit would also be required.

The stated auto ignition temperature of the fluid is somewhat lower when the material is soaked into insulation. Since the fluid is frequently heated to over 300°C, a leak into the insulation could result in a fire. System alterations for either Aroclor or Therminol-66 are in the same order of magnitude.

Although the steps required to be taken for the continued use of Aroclor fluids is still under investigation, the following changes are being considered.

1. Leader Unit. Estimated cost $13,000.
   a. Change fluid from Aroclor 1248 to 1242.
   b. Provide new leakproof pump.
   c. Cold trap vent.
   d. Clean system.
2. Yard unit. Estimated cost $7000.
   a. Change fluid from Aroclor 1248 to 1242.
   b. Provide system charging pump.
   c. Provide sump pump.
   d. Provide drip pan for pump.
   e. Cold trap vent.
   f. Partial roofing of area.
   g. Clean system.

It is expected that a PAFE could be submitted for changes to both units by 4/1/71.

5. CLHS

The magnitude of PCB losses at CLHS are unknown, but are believed to be large. Mr. J. R. Savage in his memo of 9/23/70 stated that by 4/1/71 PCB containing Aroclors will no longer be handled in CLHS and that capital improvements cannot be justified on this basis.

Department supervision has been requested to exert care in preventing losses within equipment limitations. Mr. E. R. Reager has recommended a number of minor improvements to department supervision to minimize losses. The pollution group arranged a film presentation for all personnel involved for motivational purposes.

A PAFE has been submitted to replace the present Aroclor unloading pump which has always leaked badly. Prime justification for this project is not based on PCB losses, but on unloading capacity, safety and reduced repairs.

C. Sewer Sampling

Composite samples of the main effluent are submitted for PCB analysis each month. The reported results are:

Month	ppb
June	46
July	43.5
August	43.0
September	77
October	70
November	18.9

Analytical problems have been encountered by Research and the figures for September and October are open to question. New laboratory facilities have just been completed. The November results shown were obtained in the new facilities.

D. Volatile Losses

The volatile losses from the Aroclor unit in phthalyl chloride were calculated at 69 lbs./yr. Volatile losses from the other units are believed to be considerably less. No attempt to calculate or measure these losses was made since completion of the changes proposed in this report will essentially eliminate them.

A. E. Peterson

ljcm

TRAN 036837

DEC 8 1970

Monsanto

FROM (NAME & LOCATION) W. B. PAPAGEORGE - ST. LOUIS

DATE December 7, 1970

SUBJECT PCB ENVIRONMENTAL PROBLEM
NOVEMBER STATUS REPORT

cc H. S. Bergen
J. Mason
J. E. Springgate

TO :
P.J.A. Marsh - BRUSSELS
W. S. Clark
J. R. Durland - TOKYO
M. W. Farrar - 2nd Street
E. V. John
R. E. Keller - 2nd Street
R. M. Kountz
T. L. Gossage
P. S. Park
W. R. Richard
J. R. Savage
E. P. Wheeler

MARKETING:

NCR appears to be making very satisfactory progress toward the replacement of Aroclor 1242 in their carbonless reproduction paper solvent. To date, Monsanto has shipped nearly 100,000 pounds of the replacement product - monoisopropyl biphenyl (MIPB) to NCR. An additional 100,000 pounds is scheduled for delivery in January followed by 500,000 pounds in February. NCR is attempting to reach complete conversion by the end of February.

Through our Australian organization we have received an inquiry from the Electracity Trust of South Australia. They have recently received correspondence from General Electric Company, U.S.A., concerning the problems with Askarel Liquid Dielectric. As a result, they are requesting information from Monsanto as to the arrangements in Australia for the disposing of contaminated materials. We anticipate other inquiries from other parts of the world.

We met with Mr. Katayama of MMK in November. We discussed with him the PCB plans in the U.S. and reviewed the current situation in Japan. As a result, MMK representatives will meet with Kaneka (the other major supplier ofpolychlorinated biphenyl in Japan) to discuss future PCB plans for Japan.

DEPOSITION EXHIBIT
Plf's 442
7-9-92 SD

TRAN 039080

ENGINEERING:

Incineration - Krummrich - CEA 2415

Plot plans and layouts have been resolved, and process design is complete. Design of piping, electrical, and instrumentation are proceeding on schedule.

MCS 1016 - Krummrich - CEA 2417

Customer trials of the pilot plant product indicated an undesirable high level of low boilers. In a meeting with Research and Manufacturing it was decided to provide facilities in the project for removing a percentage of low boilers as well as the high boilers. The project scope and estimate are being revised, and a revised Data Transmittal is scheduled for submission in late December.

Tributyl Phosphate - Queeny - CEA 2371

An early pilot plant run indicated a severe yield problem in the process. Continued studies by Research and Engineering have pinpointed some of the problems, and it is believed a substantial yield improvement can be made.

Pre-approval funds have been requested to proceed with definitive design.

N-C Phosphate - Queeny - CEA 2451

Pilot plant studies are currently being made on this product, and a project scope report is being developed.

Solids Waste Disposal - Krummrich - CEA 8042

Engineering, Research, Manufacturing, and Marketing have been studying disposal of polychlorinated biphenyls on solids. A test was devised with Enviro-Chem, samples of wastes have been collected, and the test is scheduled to be run December 1.

Preliminary discussions have been held with potential equipment vendors.

JAPAN:

No new action or reports on toxicity to fish/animals. Court action on suits on bran oil exposure humans continuing with attendant newspaper publicity. Major executives of company which processed bran oil cannot be located. More stringent testing and licensing of equipment using PCB as heat transfer will probably occur for food processing equipment.

TRAN 039081

NCR-Japan rejecting HB-40 because they prefer one oil for both clay and resin-type granules and Jujo Paper is definitely switching to resin-coat. Kureha oil refined from heavy oil cracking bottoms (mixed aromatics of complex nature) is also being tested. MMK is pushing MIPB assuming NCR-Dayton preference for MIPB. No final decision yet. HB-40 also offered by MMK but MIPB provides better balance on biphenyl/terphenyl.

EUROPE:

1. The decision has been taken to cease sales to non-controllable applications in the UK by 1 March, 1971.

2. Sales will continue for all applications in continental Europe until the end of 1971, but reformulated products will be introduced where possible.

3. We will continue to supply products containing PCB's to German mines through 1971 even where reformulated products are available, until approval is gained for the reformulated products.

4. Customers will be informed before the end of November 1970 of this policy.

5. We have been assured by the other European producers that they will not knowingly supply former Monsanto customers in the UK or USA.

6. Bayer have indicated that they are in agreement with the Monsanto timing for withdrawal from non-controllable applications.

7. Progil/Caffaro do not yet agree and wish to study the problem further. We have invited their representatives to Ruabon for technical discussion.

8. The UK Board of Trade, through their Marine Safety Department, have proposed that Aroclor should be classified under Class 9, Dangerous Goods, for the purpose of carriage by sea. We will meet with the Board of Trade in December to discuss this and following discussion with J. T. Garrett will attempt to persuade the Board of Trade to alter the proposal.

MEDICAL:

Arrangements were made for initiating acute and sub-acute studies at Industrial Bio-Test Laboratory for Aroclor 1221, 5432, 5442 and MCS 1016. Sub-acute studies will include 90 day rat and 90 day dog studies and sub-acute fish studies (according to protocols to be developed). Rat and chicken reproduction and rabbit teratology studies are being deferred for the time being. Rabbit teratology studies were begun with Aroclors 1242, 1254 and 1260.

PUBLIC RELATIONS:

The Anniston Star, Anniston, Ala., obtained figures from the FDA which showed unusually high levels of PCB in fish samples taken from Choccolocco Creek. A Star reporter contacted the Anniston plant for comments on the data and information about our PCB production operations there. Public relations prepared replies to specific questions.

Plant management convinced the reporter to visit the plant for a firsthand view of what the plant was doing to eliminate PCB escape to the environment. A factual front-page feature appeared in the Star Sunday, November 22, edition reflecting the value of cooperation with news media planning PCB stories.

Quoting both plant management and the Alabama Water Improvement Commission, the feature emphasized the PCB problem was relatively new, was being solved by Monsanto and, at this point, was no cause for public alarm.

RESEARCH:

Biodegradation Testing - St. Louis TRAN 039083

Statistical analysis (t-tests) of the data accumulated to date in the semi-continuous activated sludge (SCAS) testing of the PCB Aroclor products indicates that some bacterial degradation is occurring. The percent disappearance rates, based on a feed level of 1 mg/cycle, were as follows: MCS 1043--55% ($p = 0.05$); MCS 1016--11% ($p = 0.05$); Aroclor 1242--30% ($p = 0.05$); Aroclor 1254--0% ($p = 0.05$). However, the observed degradation

rates are still highly scattered indicating that the units have not reached a steady state yet.

Other physical sources of data scatter are being investigated. The addition of stirring, modification of the sampling method and the elimination of the LAS from the feed all appear to be steps in the appropriated direction, but have by no means totally eliminated the scatter.

SCAS testing of trichlorobenzene (TCB) and Arobromochlor 1232 at the 1 mg/cycle level have been started and analysis of the first samples is in progress.

River die-away (RDA) tests have been started for Aroclor 1242, Aroclor 1254, MCS 1016, MCS 1043, Arobromochlor 1232, and TCB. Completion of the RDA tests is scheduled for 1-13-71.

A liquid chromatographic method for the analysis of halogenated terphenyl systems is being developed. A liquid-liquid chromatography system using Zipax Permaphaze (a new DuPont chromatography packing) as the stationary phase and water/methanol as the mobile phase appears to give sufficient separation to characterize the isomeric distribution of the materials. The system is being optimized for solvent composition and column length.

Environmental Program - U.S.

Analysis of a second set of Mississippi River fish collected above and below the WGK plant has been completed. The levels found in fillets from these fish ranged from 0.2 ppm to as high as 8 to 9 ppm total PCB's.

All the necessary equipment for PCB's, with the exception of two gas meters, required to sample the Enviro-Chem St. Charles incinerator has been assembled and laboratory tested. The PCB burn is now scheduled for 12-1-70. Additionally, analysis of background samples taken at the site 10-29-70 for PCB has been completed. Low levels of apparent PCB's were observed in all cases. The PCB analysis of the JFQ September and October sewer water composites has been completed. The levels found, 77 ppb and 70 ppb respectively, were higher than in previous months.

Shrimp from Escambia Bay, fat and liver from a dead pig found near the Anniston landfill, GE plant water samples, Delaware River phthalic acid, and a U.S. Steel plant water effluent sample have also been analyzed for PCB's.

Particle size analysis by microscopy was performed on a solids sample from the Anniston limestone waste pit. Correlations are being developed between particle size of adsorbent and waste retention in the Aroclor waste treatment studies.

Aroclor 1121 and 1129 distillation fractions were analyzed by GC for isomer distribution to compile data for plant design.

Aroclor 5442

We recently reported tetrachlorodibenzofuran as a possible impurity in Aroclor 5442. Additional work has shown that this identification is not conclusive; tetrachloromethyl biphenyl might interfere with this determination. Methylbiphenyl has been shown to be an impurity in the Santowax R used to make Aroclor 5442. Efforts are currently underway to develop a reliable method for distinguishing between chlorinated dibenzofuran and chlorinated methylbiphenyl.

Environmental Studies - Ruabon

Workers at the Tolworth Laboratory of the Ministry of Agriculture, Fisheries & Food have been studying effects of feeding Aroclor 1242 to pigeons and quail. Their analyses have indicated, what we have ourselves suspected, that the residues tend to resemble 1254/1260. Discussion with Bailey and Bunyan from this laboratory shows that they now believe that Aroclor 1242 may be a major source of the environmental pollution. They have also "discovered" that reproducing paper of the no-carbon type is a potent source of Aroclor 1242 and, although they have not published this information yet, they may wish to do so as an explanation of the presence of PCB in cardboard. Feeding trials using single isomers are also planned by the Tolworth group, who are hoping to establish metabolic routes for the degradation of PCB's in animal organs. A visit was made to the Monks Wood Experimental Station of the Nature Conservancy, but little new information emerged from the discussion.

Biodegradation - Ruabon

TRAN 039085

It has been confirmed that 2,3,2', 3', 4', 5'-hexachlorobiphenyl is degraded by C_2 when mixed with lower chlorine isomers. This has been achieved under less vigorous conditions of flask shaking than previously, which suggests that the addition of the lower chlorine isomers has increased the solubility of the material.

We are currently studying a pentachloro-biphenyl, which should degrade, and the 4,4'-dichlorobiphenyl, which should be resistant, using a similar technique to im-

prove solubility. The analytical results are awaited on these tests.

The results of degrading a series of PCB products with C_2 until no further change with time can be observed are now available. Subject to limitations imposed by the difficulties of interpretation of the GLC chromatograms it appears that the order of degradability, or the inverse order of apparent residues, is as follows:

MCS 1016, MCS 717, MCS 762, Pyralene 1500, Aroclor 1242

Satisfactory progress in the identification of isomers corresponding to the peaks obtained using high selectivity PLOT columns is reported, but development work is still needed on GLS - Mass before this can be utilized.

The most recent results on attempts to degrade HB-40 by C_2 have shown that at low concentrations (5 ppm) considerable degradation has occurred. The main problem in this investigation has been that of sensitivity in the analysis, but this problem now seems to be overcome.

Pydraul Reformulation

Factory Mutual Visit

A representative of FM visited the fire test facility November 4 and 5. Tentative FM approval was obtained for Pydraul 625-A, F-9A, MCS 1063 (Turbinol 153A), MCS 1066 (312A), MCS 030T, 050T, 065T, 0115E, Santosafe W/G 15, 20 and 30. All fluids submitted were approved.

Pydraul 312A

A V105C pump test on MCS 1066 indicated excellent lubricity. A tentative process will be issued shortly.

Pydraul 540B

The terphenyl version is tentatively defined. The FR is equivalent to old 540. Approximately 3% of a polyglycol VI improver will be incorporated to meet old 540 viscosity specs.

Pydraul 230A

A terphenyl blend has been developed which looks good on the FM spray test. It will contain 2% of a polyglycol VI improver to meet 230 viscosity specs.

Pydraul 135A

A blend of TCB, 5432, oil and Santicizer 711 has been developed which looks excellent on the FM spray test.

Turbinol 153A

MCS 1063 demonstrated good lubricity in a V105C pump test. The moderate wear noted was attributed to high TAN Krummrich CDP. This fluid also exhibited low deposits in the Alcor Deposition test.

Pydraul A-200B

A lower viscosity F-9A type blend was blended, tested and a tentative process issued to fill an order from Chevy Messena. They refused to purchase any more fluid containing PCB's.

A V105C pump test was terminated at 225 hours due to mechanical failure of the pump. A lobe cracked off of the rotor. This is considered to be a mechanical failure and not fluid related. The test will be repeated just to make certain, though. The wear observed up to 225 hours was very low (11.8 mg total) and no problems are expected.

Carbon Adsorption Study

The pilot unit (series of four five-inch diameter columns), that was put on stream 10/2, continues to operate with minimum difficulties. The initial flow of 2 gpm/ft^2 was increased to 4 gpm/ft^2 on 10/28. Effluent quality, at the present flow, is <10 ppb Aroclor for influent concentrations in the range 100-2,000 ppb. The present plan is to increase the flow to 6 gpm/ft^2 by 11/25.

MANUFACTURING:

W. G. Krummrich Plant

PCB Levels In Sewer

A. Aroclor losses from the Aroclor Department averaged about 1.0 lbs/day and ranged from about 0.4 to 2.5 lbs/day.

   Losses from the Sauget Village treatment plant for the period 10/16 - 11/16 averaged 72 lbs/day (495 ppb). Range for 9 samples was 32 to 115 lbs/day (220-796 ppb).

Projects To Reduce Sewered PCB's From Aroclor Department

A. Blow tank demister project was successfully demonstrated. About 100 lbs/day of mist Aroclor is being collected. Sewer loss has been reduced from about 20 lbs/day to about 0.5 lb/day.

B. Project to provide paving, curbs, trenches, and catch basins in the tank car and truck loading areas has been approved as part of the Aroclor incinerator project. The design package is about 75% complete.

Program To Eliminate Sewered PCB's From Using Departments

A. A second meeting with Don Roush is scheduled for 12/7/70. Don will discuss with plant production and engineering personnel design considerations for changing Therminol units to non-Aroclor Therminols.

B. Status of work on Therminol units is as follows:

Dept. 255	Switched from FR-2 to Therminol 66 on 11/16/70.
Dept. 222 O & P, Dept. 273, Dept. 246	Plans underway to change out these systems to Therminol 66. EDC for all units is 3/1/71.

Removal of Soluble PCB's From Sewer Stream

A test is planned for the week of 12/7/70 to determine effect on Aroclor losses in the treatment plant effluent by neutralizing the sewer flow to the treatment plant. Lime will be added at Dept. 265 for about 3 days to hold the pH above 7.0 at the treatment plant. The resulting floc is expected to improve PCB removal based on Anniston work.

PCB Levels In The Atmosphere

Sampling program has been completed. Only significant area of loss is at the mix tanks due primarily to the nitrogen purge. Loss is in the range of 4 to 5 lbs/day. Plans are to replace the nitrogen purge with a nitrogen blanket.

PCB Rework Project

Project approved as part of the Aroclor Incinerator project. Construction schedule will be determined in December.

Anniston Plant

PCB Levels In Sewer

Aroclor losses during November averaged 25#/day (4620 ppb). One high value accounted for 18#/day, neglecting this the November average would be 7#/day (1410 ppb). Based on knowledge of plant operations and performance of abatement devices in November, much of the high level data is due to sample contamination.

Spills

Minor leaks were contained by use of sand and disposal in drums. No spills occurred.

Projects and Evaluations

1. Laboratory work to date indicates the presence of minimal amounts of PCB in the residue from Solid Aroclor distillation (Montar 5). This eliminates 10M pounds per year or solid wastes from our PCB disposal plan.

2. Design work to collect spent carbon from HCl carbon towers has been deferred to early 1971 to accomplish the No. 1 HCl Limestone Pit rebuild.

3. Solids removal from plant effluent (part of program to reduce PCB in plant effluent to 10 ppb) is moving forward with preliminary screening tests at Denver Equipment Company and Betz Laboratories indicating good to moderate success with flocculation and settling. Further laboratory testing is scheduled for early December. A project has been written, design is underway and equipment modifications under study working with Monsanto Biodize to set up one of their clarifiers at Anniston for pilot scale testing of the apparent best techniques recommended by Denver and/or Betz.

4. A successful test was made of removal of limestone inerts from the #2 HCl neutralization pit while in operation. A total weight of 127,000 lbs was removed of which 36% by weight was solids. Lab analysis of the total material revealed more than 100,000 ppb Aroclor or 12 to 15 lbs of Aroclor. Present indications are that this method of removal of solids while the pit is in operation will increase the efficient life of the pit by 25%.

5. A project for repair of the No. 1 HCl neutralization pit was written and approved. This project will be coordinated with the Niran pit project to apply an asphalt lining at the same time, to save money on materials.

Newport Plant

The October Newport Report has not been received.

W. B. Papageorge

W. B. PAPAGEORGE

ms

ORGANIC CHEMICALS DIVISION RESEARCH Report

REPORT NO. P-1590 JOB NO. 2-21-760.01-1113615

TENTATIVE PROCESS

FOR

AROCLOR 6037 (MOS 1057-1)

DATE - November 17, 1970 WRITTEN BY L. R. Stark

Monsanto

ST. LOUIS, MISSOURI

COMPANY CONFIDENTIAL

TRAN 037621

MONSANTO COMPANY
Organic Chemicals Division
St. Louis Research Department

SAFETY REVIEW COMMITTEE
APPROVED BY
APPROVED

FINAL APPROVAL DATE NOV 25 1970

St. Louis Research Report No. P-1590

TENTATIVE PROCESS

FOR

AROCLOR 6037 (MCS 1057-1)

Job No. 2-21-760.01-113615

Written by: L. R. Stark

Work done by: L. F. Smith
L. R. Stark

Date: November 17, 1970

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TRAN 037622

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13. Standards Department - J. F. Queeny Plant
14. Standards Department - W. G. Krummrich Plant 12-2-70
15. O. DeGarmo/J. F. Quinn

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TRAN 037623

TABLE OF CONTENTS

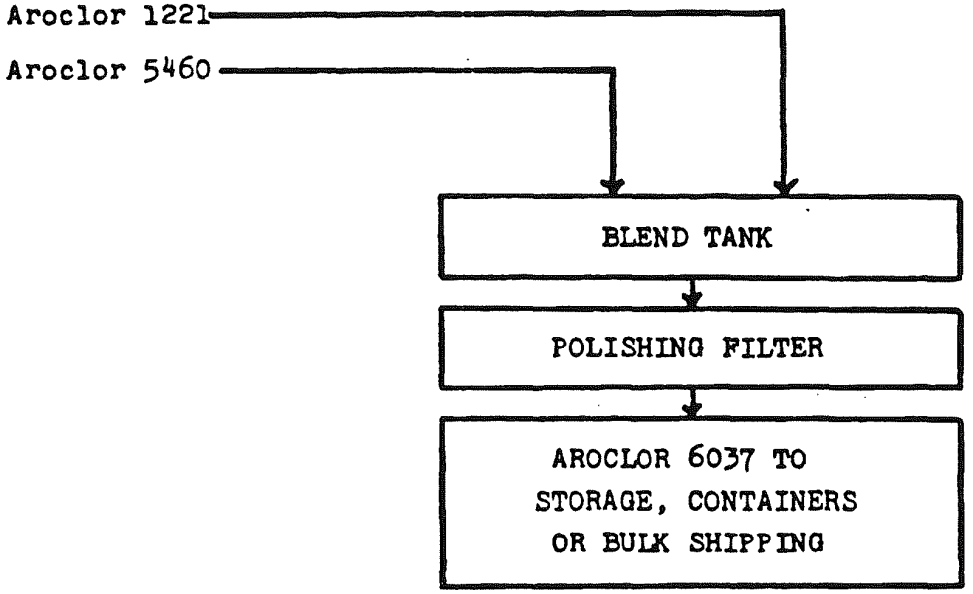
INTRODUCTION

Aroclor 6037 is a special blend of Aroclor 5460 and Aroclor 1221 to give an absolute viscosity at 75-80°F. equal to that of Aroclor 1242. This formulation was developed to replace Aroclor 1242 in an automatic transmission fluid additive formulation (Radiator Specialty Company).

SYNOPSIS OF PROCESS

Aroclor 6037 is prepared by blending Aroclor 5460 and Aroclor 1221. The blended product is filtered to remove any stray debris from raw materials or blending and is transferred to containers or storage.

FLOW SHEET



BILL OF MATERIALS

Basis: 100 lb. of product

	Raw Material	Wt., lbs.
82616	Aroclor 1221	63.0
82622	Aroclor 5460	37.0

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PROCESS IN DETAIL

The blending operation may be carried out in any suitable metal or glass-lined vessel. The materials are not corrosive and carbon steel equipment is suitable. An agitator should be provided.

Order of addition is not critical and will be determined by the physical state of Aroclor 5460 and operating convenience. If 5460 is already in the molten state, it may be added first, then Aroclor 1221. If in the solid, flaked state, the Aroclor 5460 should be added to the Aroclor 1221 heel. In both cases the lowest viscosity and consequent minimum agitator power requirements will be obtained by adding the Aroclor 1221 followed by Aroclor 5460.

After the ingredients are combined, agitation should continue 1/2 to 1 hour or until an homogeneous mixture is obtained. It is suggested that the batch be warmed only enough in the 75-150°F. range (25-65°C.) to insure adequate mixing.

The completed batch is then circulated through a polishing filter (cellulosic string wound filter cartridges of 50 micron nominal rating are sufficient or use filtration normally used in Aroclor production). Samples are taken as required for analytical and control purposes. The batch may be held for possible viscosity adjustment or sent to storage. After blending, the temperature may be reduced to 75-130°F.

DISCUSSION OF IMPORTANT VARIABLES

The most important specification property of Aroclor 6037 is viscosity. Adjustments in the blend should be made to keep the 100°F. viscosity within the required range.

If the 100°F. viscosity is low, add Aroclor 5460. One pound of 5460 per 100 pounds of mixture will increase the 100°F. viscosity about 1.2 cs.

If the 100°F. viscosity is high, add Aroclor 1221. One pound of 1221 per 100 pounds of mixture will decrease the 100°F. viscosity about 1.2 cs.

MATERIAL SPECIFICATIONS

Raw Materials

Refer to raw material specification sheets included in the Appendix.

Finished Aroclor 6037

Typical analyses and suggested specification limits follow:

Property	Tentative Specification	Typical Value	Anniston Method
Appearance	Clear yellow liquid, free of foreign matter	Same	G-1
Color, NPA	2.0 max.	1.5	G-4
Viscosity at 100°F.	20 to 24 cs. (98 to 115 SUS)	21.3 cs.	049
Specific Gravity 25/25°C.	1.31 to 1.34	1.33	052
Acidity, mg KOH/gm	0.05 max.	0.013	050
Moisture	250 ppm, max.	63 ppm	047
As Requested:			
Flash Point, C.O.C.	---	265 to 290	114
Fire Point, C.O.C.	---	345 to 360	114

ANALYTICAL METHODS

No new or special analytical procedures are required for this product. A cross reference table appears in the Appendix listing standard analytical procedures used at J. F. Queeny Plant, W. G. Krummrich Plant, and the Anniston Plant. These procedures are currently used on similar products.

TOXICITY AND HAZARDS

No unusual toxicity or hazards are expected with the raw materials or finished blend. The process is a simple blending procedure and no hazardous reactions or heats of mixing should occur between the components.

Aroclor 1221 and 5460 have been produced by Monsanto for many years. Recently these have been combined in such products as Aroclor 6040, a substitute for Aroclor 1242 in plasticizer applications. (Note: Current specific toxicity information

is being requested from the Medical Department on the Aroclor 6037 blend and it is suggested these be included in the Appendix when obtained.)

General precautions include the following:

1. Goggles should be worn where splashing or spillage may occur.

2. Any material in contact with the skin should be removed by washing with soap and water.

3. Prolonged or repeated exposure to the skin may cause irritation due to removal of skin oils with resulting dryness and chapping.

4. Material may be irritating to sensitive skin areas and eyes. In case of contact with eye tissue, flush copiously with water and then get medical attention.

5. In case of internal ingestion, get immediate medical attention.

6. Avoid inhaling volation material or mists.

POLLUTION CONTROL

No waste by-products are generated by this process. Used filtering material, flushings from the system during cleaning, as well as any spoiled product should be disposed of as dictated by local regulations.

Every effort should be made to prevent chlorinated biphenyl or chlorinated terphenyl from being mixed with water and drained to the sewer. Non-aqueous solvents should be used to clean the blending tanks and equipment. Suggested fire resistant solvents are trichloroethylene or trichlorobenzene.

Minimum or no equipment cleanout would be needed if production is scheduled to have blends with similar components before and after Pydraul 6037, ie. 6040 or MCS 1004.

Vapor generation should be reduced by limiting the heating of the blend and raw materials to as low a value as possible consistent with practical blending requirements.

Solids containing the chlorinated biphenyl or chlorinated terphenyl (filter) must be disposed of at an appropriate land fill. Burning of these materials should be avoided at this time. When suitable high temperature incineration equipment is available, which will completely decompose such materials, burning will be an acceptable method of disposal.

St. Louis Research Report No. P-1590
TENTATIVE PROCESS FOR AROCLOR 6037 (MCS 1057-1)
November 17, 1970

APPENDIX

L. R. Stark

File Copy Approved by:

Manager of R&D _____ (date)

Manager of Manufacturing _____ (date)

Manager of Process Technology _____ (date)

/is
11/17/70

PHYSICAL CONSTANTS DATA

SUBSTANCE	STRUCTURAL FORMULA
PYDRAUL 6037	AROCLOR 1221 63% AROCLOR 5460 37%
COMPILED BY: L. R. Stark	DATE: 11/16/70

NAME		SOURCE & DATE
Formula	Blend	
Molecular Weight		
Appearance	Clear light yellow liquid	
Boiling Point at 760 mm		
Boiling Point at mm		
Boiling Point at mm		
Boiling Point at mm		
Crystallizing Point	None	
Melting Point	None	
Solution Point		
Specific Gravity @ 25/25 C	1.33 typical	
Specific Gravity @		
Pounds per Gal. @ 25 °C	11.1	
Coefficient of Expansion		
Refractive Index @ $n_D^{\ }$		
Infra Red Spectrum (Reference)		
Ultra Violet Spectrum (Reference)		
Viscosity @ 100 F	21.3 typical	
Viscosity @		
Surface Tension		
Solubility in Water	Nil	
Solubility in		
Solubility in		
Flash Point °F (Method) COC	265 to 290 typical	
Fire Point °C	345 to 360 typical	
Heat of Combustion		
Heat of Formation		
Thermal Stability (cal./kg./min.)		
Latent Heat of Fusion		
Latent Heat of Vap.		
Specific Heat		
Critical Temperature		
Critical Pressure		
Dissociation Constant		
Other Constants		
Toxicity (Give Reference)		

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TRAN 037630

Analytical Procedures

Property	WOK	JPQ	Anniston	ASTM *
Appearance	12809	16-B	0-1	-
Viscosity	12837	126-A	049	D-445
Flash & Fire Point	12803	50-A	114	D-92
Specific Gravity	12804	116-B	052	-
Pour Point	13005	100-A	053	D-97
Cloud Point	-	36-A	-	D-2500
Acidity	12794	80-B	050	D-664/D-974
Moisture	12810	78-B	047	D-1744
Foam	12805	54-A	-	D-892
Refractive Index	13123	104-A	048	D-1218
Distillation Range	10117	-	054	Modified D-20

* Approximate equivalent ASTM method.

TRAN 037631

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MONSANTO
ORGANIC CHEMICALS DIVISION

FINISHED PRODUCT SPECIFICATION

AROCLOR 1221 | Ann. 608

PLANT	PRODUCT CODE	USE
Anniston	826.10	Sales

DATE EFFECTIVE	SALES CODE
3-1-69	1040-225-04/11-009

APPROVALS

H. Williams 2/19/69	RESEARCH: M. E. Gibbs 3/12/69
SALES: W. Ault 3/10/69	QUALITY CONTROL (Chief Chemist): R. Blowers 3/26/69 G. W. Miller 2/15/69

GENERAL DESCRIPTION

MIXTURE

CHEMICAL FORMULA

MOL WT.

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS	ISSUED BY
4/25/61	2 x 1/2 gal. Amber Bottles	G. Miller

CHARACTERISTIC	LIMITS	METHOD
(R) Condition	Clear	G-1
(R) Color, APHA	100 Max.	046
(R) Specific Gravity (25/15.5°C)	1.182-1.192	052
(R) Acidity, (Mg KOH/g)	0.014 Max.	050
(R) Viscosity @ 100°F	38-41 SUS 4.0-5.5 Cp	049

TRAN 037632

(R) Routine Analysis. All others Analysed by request Only

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M-800

Monsanto
ORGANIC CHEMICALS DIVISION

FINISHED PRODUCT SPECIFICATION

PRODUCT: Aroclor 5460 (High Soluble Grade)			DEPT. 27-S
PLANT: Anniston	PRODUCT CODE: 826.22	USE: Sales	
DATE EFFECTIVE: 3-11-66	SALES CODE: 1040-480-04-009		

APPROVALS

PRODUCTION: R. G. Moody /s/ 12-30-65	RESEARCH: L. R. Stark /s/ 3-8-66
SALES: W. E. Ault /s/ 3-2-66	QUALITY CONTROL (Chief Chemist): O. E. Dolin /s/ 12-29-65

GENERAL DESCRIPTION: Mixture

CHEMICAL FORMULA:

MOL WT. / SUPERSEDES SPECS. OF: 4-21-61	SAMPLE FOR ANALYSIS: 1 x 16 oz. Can or W.M. Bottle	ISSUED BY: J. A. Liddle 11-30-65

CHARACTERISTIC	LIMITS	METHOD
UNRESTRICTED INFORMATION		
(R) Appearance and Color	Clear, yellow to amber brittle resin or flakes	G-1
(R) Color, NPA, Molten	2 Max.	G-4
(R) Softening Point, °C	98 - 105	115
(R) Solubility (25 g in 25 g. Acetone @ 25°C.)	3 hour, Min.	117
Acid No., Mg KOH/gm.	0.05 Max.	116
Chlorine, %	58.5 - 60.6	093
RESTRICTED INFORMATION		
Hydrolysis Stability, ppm Cl	300 Max.	092

TRAN 037633

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(R) Routine Analysis. All others Analyzed by request Only

Monsanto

FROM (NAME & LOCATION): R. H. Munch - Technology Department - South Second Street

DATE : June 1, 1971

SUBJECT : AROCLOR 1016 SPECIFICATIONS

REFERENCE :

TO : J. R. Savage

cc: W. R. Richard
R. McCutchan - WGK
W. B. Papageorge
D. R. Cova
O. DeGarmo
P. G. Benignus
J. Fallon
R. Kuster
R. A. Baxter/H. A. Vodden
Ruabon
A. F. Reagan - Newport
F. MacDonald - Newport
P. J. A. Marsh - Brussels
J. Durland - Tokyo
D. Danna

It has been suggested that specifications be set for Aroclor 1016 to be produced by Monsanto as a replacement for Aroclor 1242.

The guiding principles to be used in setting the specifications for Aroclor 1016 are as follows: The electrical specifications, specifications for appearance, color, acidity, water content, inorganic chlorides, sulfates, and stability will be the same as those for Aroclor 1242. Specifications for properties such as pour point, viscosity, specific gravity, refractive index, distillation range and fixed chlorine content will be changed to compensate for the higher homologs removed.

One new specification must be added. That is penta and hexachlorobiphenyl content. This is essential because our reason for producing Aroclor 1016 is to produce a product with a minimum content of higher homologs which are more persistent in the environment.

The ratio of penta and hexa content in Aroclor 1242 to that of Aroclor 1016 is our one readily quantifiable measure of the improvement achieved by going to Aroclor 1016. The penta and hexa content of Aroclor 1242 ranges from 6 to 7.2%. That for Aroclor 1016 produced so far has been less than 0.3%. On this basis, Aroclor 1016 can be said to be about 20 times better than Aroclor 1242.

The suggested specification for penta and hexa homologs is 0.4% max. to have some margin for analytical error and less efficient operation in the plant than in the pilot plant.

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TRAN 043014

MM-10 REV. 11-65

DEPOSITION EXHIBIT
PHS 444
7-9-92

One other change is suggested. Current specifications call for a dielectric constant of 4.7 to 4.9 measured at 1000 Hz and 100°C and power factor of 5.0% measured at 60 Hz and 100°C. It is suggested that the dielectric constant be determined at 60 Hz and 100°C so that measurements will not have to be made at two frequencies. The dielectric constant does not change with frequency in this range so the specification range will not change. The 1000 Hz power factor is often too low to measure accurately and should therefore be omitted as a specification.

The attached table compares the proposed specifications for Aroclor 1016 with the current specifications for Aroclor 1242. These specifications for Aroclor 1016 are proposed to serve as a starting point for development of final specifications acceptable to all interested groups in Monsanto and to our customers. Your comments are invited.

R. H. Munch

js

TRAN 043015

COMPANY CONFIDENTIAL

W. B. PAPAGEORGE - ST. LOUIS

APRIL 28, 1970

M. S. BEROEN
P. S. PARK
J. R. SAVAGE
J. E. SPRINGGATE

C. ROBERT SIDO

With the mounting interest in polychlorinated biphenyls (PCB) and their possible harmful effects on the environment, we are very interested in adding the following statement on products containing PCB's.

"This product contains polychlorinated biphenyls, which some studies have shown may be an environmental contaminant. Care should be taken to prevent any loss into the environment through spills, leakage, disposal, vaporization or otherwise."

This additional wording is intended for packages containing Aroclors 1232, 1242, 1248, 1254, 1260, 1262, 1268 and 4465 and Montar 1.

We also plan to use this statement on Pyranol and Inerteen labels, but we will discuss with General Electric and Westinghouse since the trademarks belong to them.

We are very anxious to make this change quickly. May I have your comments?

W. B. PAPAGEORGE

5-1-70 Called Sido - he is already aware of change - said no need to write new memo.

Bloomington Dx 364d
11-25-86 cg

300 2628

95

W. B. PAPAGEORGE - ST. LOUIS

APRIL 30, 1970

AROCLOR LABELS

H. S. BERGEN
D. A. OLSON
P. S. PARK
R. R. SIDO
C. B. SIGLER
J. E. SPRINGGATE

J. R. SAVAGE

Bob Sido is arranging for the modification of Aroclor labels to include reference to PCB in the environment. When the new labels are available, will you see that the plants order their supply and immediately begin using them on new packaged Aroclors?

Bob is also preparing a supplementary label for placing on packaged material now in inventory. When these labels are available, the plants should make sure they are added to the package before shipping. Will you arrange with C. Sigler's group regarding supplementary labeling of packaged Aroclor in outlying warehouses.

Don Olson is checking with G.E. and Westinghouse regarding the modification of Pyranol and Inerteen labels. As soon as agreement is reached, Bob Sido will make the necessary changes.

The need for using the modified labels is urgent and we should make every effort to expedite this change.

Original Signed by W. B. Papageorge

W. B. PAPAGEORGE

mb

TRAN 060812

P. G. Benignus - St. Louis General Office

April 7, 1970

WESTINGHOUSE -- PCB PROBLEM DISCUSSION
PROPOSED FOR ST. LOUIS
TUESDAY, APRIL 21

D. A. Olsen

H. S. Bergen - HBERG
W. R. Richard - WRICH
R. E. Munch - JPQ
J. G. Bryant
G. R. Graham - New York
E. Wheeler - EWHEE
R. Keller - JPQ
S. Tucker - JPQ
V. Papageorge - VPAPA
R. E. Kelley - RKELL
J. Savage - JSAVA

Gary Wilburn, Westinghouse, South Boston, Virginia confirmed that Westinghouse Transformer and Capacitor Division people are indeed anxious to meet with us to discuss the PCB pollution problem, at the earliest opportunity. The Westinghouse people will be with us Tuesday morning April 21 presumably at 8:30 a.m. here at Creve Coeur.

Mr. Wilburn will represent Westinghouse, South Boston, Dr. Sloat will represent Westinghouse, Sharon and Don McClain (who is presently home with illness) or someone in his place will represent Westinghouse, Bloomington, Indiana.

Tuesday, April 21 is a satisfactory date for Mr. Wheeler, Dr. Munch, Dr. Richard and Mr. Papageorge. These people should invite their associates to participate exactly along the lines of the meeting we held here in St. Louis in the recent past with General Electric Company. It is proposed that we will have lunch at the Bath and Tennis Club.

P. G. Benignus

/sn

DEPOSITION EXHIBIT
Plf's 447
7-9-92 939

1156

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DATE	TYPE OF RECORD	SUBJECT	AUTHOR	TO	DISTRIBUTION
———	Simple Log Book	Ohio Dept Ag milk samples (3) Log# 211 OR 173711	J. Litschgi	———	None
———	"	Humphrey milk, water, silo shavings, etc samples (16) collected by W.B. Papageorge - entry notes return of 12 samples, unanalyzed, to J.F. Hiss - Canton, Ohio on 1-4-71 - remaining 4 silo shaving samples discarded - unanalyzed. Log # 511, OR 173726	"	———	"
———	"	Agway feed samples (2) Log #539, OR 173727	"	———	"
———	"	Rozansky spaghetti sample (1), Log #565 OR 173729	"	———	"
———	"	Ohio Dept Ag milk sample (1), Log #601 OR 173731	"	———	"
———	"	Holly Farms fish meal samples (7) Log #'s 614 - 619, OR 173731	"	———	"
———	"	Agway eggs, feed, and extracts Log #'s 507 - 509	"	———	"
———	"	C.F. Mueller spaghetti sample (1) Log #564 OR 173729	"	———	"

TRAN 066864

DEPOSITION EXHIBIT
Plf's 448
7-8-97

4/70	Research Note Book	OR 127096 Results of analysis of silo shavings and milk from Ohio Dept. Ag for PCBs and GC/Mass	J. Litschoi	———	None
4-14-70	"	OR 127095 Summary statement regarding milk and silo shaving samples	"	———	"
7-13-71	"	OR 157493 Sample weights and PCB levels found in Humphrey milk samples	"	———	"
4-7-71	"	OR 157463 Sample weights and PCB levels found in Rogansky & C.F. Mueller spaghetti samples	"	———	"
6-22-71	"	OR 157486 Sample weight and PCB level found in Rogansky feed sample	"	———	"
1-15-71 (also one entry a 48)	"	OR 157444 to OR 157448 Results of Analysis of samples and sample extracts from Agway	"	———	"
1-17-71	"	OR 157449 Results of EC/GC and GC/Mass analysis of Agway egg extract	"	———	"
3-9-71	"	OR 157451 Results of analysis of Agway chicken feed	"	———	"
7-23-71	"	OR 157497 Results of Analysis of Holly Farm fish meal samples	"	———	"

Jan-Aug 1971	Progress Report	Report's on alyses of Holly Farms, Agway, Rozansky, Ohio Dept Ag and C.E. Mueller Samples - levels and types	J. Litschgi E.S. Tucker		(3) See Attached Distribution List.
Jan 1971	A/S Monthly summary	Agway samples status report only	A/S		See Attached Distribution List.
Feb. 1971	"	Agway samples - PCB label mentioned.	"		"
Mar. 1971	"	"	"		"
April 1971	"	Rozansky sample status report only	"		"
May 1971	"	Ohio Dept Ag & Rozansky samples - status only	"		"
June 1971	"	"	"		"
July 1971	"	Ohio Dept Ag samples status only.	"		"
3-30-70	Letter	Discuss. of ODA method of analysis and anal. by Smith - Note samples sent to Monsanto for PCB analysis, Results unknown, & also samples	Butler Weaver Asst. Chemist ODA	E.S. Tucker	"

TRAN 060866

(4)

4-16-70	[illegible]	[illegible] U.S. Foods, Taxes, and Drugs [illegible] C. [illegible] [illegible]	E.S. Tucker	W.B Papageorge	[illegible]: F. [illegible] E.P. [illegible] W.R. Richard M.W. Farrar R.E. Keller R.H. Munch
4-17-70	Memo	Environmental materials analyzed by Monsanto for PCBs - summary including Ohio samples	R.E. Keller	W.B. Papageorge	cc: J. Mason H.S. Bergen J.E. Springgate R.E. Kelly E.P. Wheeler W.R. Richard M.W. Farrar E.S. Tucker
1-13-71	Work Request Sheets (2)	Confirmation of PCBs by GC/mass in Agway samples - PCB found.	G.W. Mappes	E.S. Tucker	NONE
1-27-71	Memo	Analysis of Agway samples for PCBs - results for (4) feed samples, (2) chicken muscle samples, (1) egg extract.	E.S. Tucker	W.B. Papageorge	cc: R.E. Keller W.R. Richard M.W. Dietrich G.W. Mappes
2-1-71	Work Request Sheet (1)	GC/mass confirmation of PCBs in Agway egg extract - none detected	G.W. Mappes	E.S. Tucker	NONE
2-12-71	Letter	informs J. Rozansky that Monsanto methodology pkg and Aroclor standards were sent to him by us, as requested	E.S. Tucker	John Rozansky Rozansky Feed Co.	bcc: W.B. Papageorge R.E. Keller W.R. Richard

TRAN 066867

WATER_PCB-SD0000023799

2-12-71	Memo	PCB's found in Ogway Chicken feed. Discusses contacts and possible sources of PCB's in.	E.S. Tucker	W.B. Pape-George	cc: R.E. Keller (6) W.R. Richard E.P. Wheeler J.T. Jarrett. W.S. Clark
No date	Letter	Notes bakery meal by-product sent to Monsanto for PCB analysis - Their Sample No. 81495	E.H. Probst Mgr. Qual. Cnt. Ogway, Inc.	E.S. Tucker	NONE
2-8-71	Jan. 1971 Status Rpt	Summary of Ogway work - part of	E.S. Tucker	P.T.A. Marsh - Brussels W.S. Clark J.R. Durland - Tokyo E.V. John R.E. Keller R.M. Kowite T.L. Passage P.S. Park W.R. Richard J.R. Savage E.P. Wheeler	cc: H.S. Bergen J. Mason
3-10-71	Memo	Ogway - PCB Content of Bakery meal by product Sample	E.S. Tucker	W.B. Pape-George	cc: R.E. Keller W.R. Richard
3-15-71	Memo	Discusses review meeting on Ohio milk problem with Hess (4-19-71)	W.B. Papageorge	D.W. Miller E.P. Wheeler R.E. Keller E.S. Tucker	cc: P. Park H.S. Bergen
3-19-71	Letter	Discussion of sample sent to us by Central Soya for Analysis	Frank Moreas Central Soya of Ohio, Inc. Bryan, Oh.	W.B. Pape-George	cc: Dr. Dick Childs Chuck Klinger Dr. E.S. Tucker
4-1-71	Letter	Identifies sample of Vermicelli Spaghetti sent to Monsanto for Analysis	Arthur Glaser Office Mgr. Rosenbusch Feed Co	E.S. Tucker	None

TRAN 066868

4-1-71	Letter	Compares level of PCBs found by Monsanto to Vermiculite with level found by Woodson Tenent Labs.	V.C. Bremer C.F. Mueller Co	W.B. Papa george	cc: L.E. Talbert Jr S. Deer (6)
4-29-71	Memo	States level of PCBs found in Spaghetti samples from Rozansky and Mueller	E.S. Tucker	W.B. Papa-george	cc: R.E. Keller
4-29-71	Letter	Discusses sample of bakery meal sent to Woodson Tenent Labs and Monsanto for comparative analysis	Arthur Glasser Office Mgr. Rozansky Feed Co.	E.S. Tucker	None
4-29-71	Monthly Summary for Functional Fluids	States status of Mueller and Central Soya samples	E.S. Tucker	W.R. Richard	None
5-14-71	Memo	Discusses call received from Tom Freeman Ofical insurance investigator for PCB mfg - reports Rozansky Feed Co. has PCB.	E.S. Tucker	H.S. Barger	cc: R.E. Keller W.B. Papageorge W.R. Richard
5-13-71	Rapid Gram + Xerox of letter	Hand written request to analyze samples for Shell-County Farmers Coop Assn Inc Letter attached from D. Goodstein - Sales Super ICFC & I.	G.L. Ramoser	E.S. Tucker	cc: W.B. Papageorge
5-18-71	Memo	States PCB samples found in customer service samples - includes Central Soya.	E.S. Tucker	W.B. Papa-george	cc: R.E. Keller W.R. Richard

TRAN 066869

5-25-71	Letter	Requests that milk sample No 42379 be sent to us by Ohio Dept. of Ag. for analysis & E.S. Tucker	W.B. Papageorge	Dr. D.A. Hill Ohio Dept Ag.	CC: R.E. Keller ① E.S. Tucker CC: J. Hess
June	Funct. Fluid Monthly Sum. Gen Rpt.	States status of analyses of Woodson Farms, Ohio Dept Ag, Inter-County Farmers Coop Assn Inc, and Rogansky Feed Co samples	E.S. Tucker	W.R. Richard	None.
7-6-71	Memo	Customer Service requests for Inter-County Farmers Coop Assn Inc and Rogansky Feed Co samples	E.S. Tucker	W.B. Papageorge	CC: R.E. Keller W.R. Richard
7-13-71	Memo	Confirms oral request by GLR to EST to analyze 6 tissue samples (Chicken) for Holly Farms and indicates that results should be sent to Don Andrews of Holly Farms - Samples never received.	G.L. Ramoser	E.S. Tucker	CC: W.B. Papageorge R.F. Southerland
-7-71	Memo	Discusses levels found in Ohio Dept of Ag milk sample	E.S. Tucker	P. Park	CC: W.B. Papageorge R.E. Keller
7-26-71	Memo (recalled & destroyed)	Lists levels of PCBs found in Barbequim (CAHH), and Holly Farm Dish Meal samples	E.S. Tucker	G.L. Ramoser	CC: W.B. Papageorge R.E. Keller E.P. Wheeler R.F. Southerland F.A. Eakin W.R. Udell M.W. Dietrich

TRAN 066870

Monsanto

FROM (NAME & LOCATION): W. R. Richard - T3A

DATE: September 20, 1971

SUBJECT: PYDRAUL REFORMULATIONS

REFERENCE:

TO : C. W. Roos - 1760

cc: H. S. Bergen - B2SA
O. DeGarmo - 1760
T. L. Gossage - B2SL
F. J. Holzapfel - B2NB
R. M. Kountz - F4WA
J. Mason - B2SA
J. R. Savage - B2NB

To keep the record straight on chlorinated products in Pydraul products, Specialty Products first removed Aroclor 1248, 1254 and 1260 as agreed with management in 1970. We believed these were the non-degrading products being found in the environment. Research next developed formulations to remove all chlorinated biphenyls from Pydrauls, feeling this would be a desirable step. (Exceptions were Turbinol 153 and Pydraul being sold in Germany where we could not pass the fire tests.)

Management agreed to remove chlorinated biphenyls from Pydraul in 1971. The list of present Pydraul products is given on page 2 and 3 of the attached. The "book" assembled by O. DeGarmo omitted several reformulations, Pydraul A-200B, Pydraul 540B, which eliminated the use of Aroclor 1242.

Research and Marketing are now trying to prepare for the replacement of PCT, should this become desirable. Key products are NCP and N_2CP plus certain VI improvers which are required. We need project approvals for changes in EE-Bldg. plus successful trial production this month on NCP.

I hope you approve of the efforts we have made and are making to control chlorinated components, phosphate ester toxicity, fire resistance and to maintain continued customer service for Pydraul fluids.

WR.

W. R. Richard

/is
Attach.

DEPOSITION EXHIBIT
P/F's 449
7-9-92

TRAN 085106

THIS MEMORANDUM is an acknowledgement that a bill of lading has been issued and is not the Original Bill of Lading, nor a copy or duplicate, covering the property named herein, and is intended solely for filing or record.

RECEIVED, subject to the classifications and tariffs in effect on the date of the receipt by the carrier of the property described in the Original Bill of Lading,

From **Monsanto** (ORIGIN) St. Louis, Mo. MONSANTO COMPANY LOCATION CODE (Plant A)

[illegible fine print]

SHIPPER'S NO.	DATE SHIPPED	CAR OR VEHICLE INITIALS & NUMBER	DELIVERING CARRIER
143456	12-25-72		

ROUTE: river-truck

DELIVERY ADDRESS (TO BE FILLED IN ONLY WHEN SHIPPER DESIRES AND GOVERNING TARIFFS PROVIDE FOR DELIVERY THEREAT)

CONSIGNED TO: W. G. K. Plant (MAIL OR STREET ADDRESS OF CONSIGNEE—FOR PURPOSES OF NOTIFICATION ONLY)

DESTINATION (CITY, STATE, AND COUNTY): Anniston, Al.

No. Packages	Kind of Package, Description of Articles, Special Marks, and Exceptions	*Weight (Sub. to Cor.)	Class or rate	Ck. Col.
6	5 gal cans-Aroclor 153	[illegible] N.T.		
	[illegible] Blue			
	[illegible]			
	[illegible]			
	[illegible] material			

Subject to Section 7 of Conditions of applicable bill of lading, if this shipment is to be delivered to the consignee without recourse on the consignor, the consignor shall sign the following statement:

The carrier shall not make delivery of this shipment without payment of freight and all other lawful charges.

(Signature of consignor.)

If charges are to be prepaid, write or stamp here, "To be Prepaid."

*If the shipment moves between two ports by a carrier by water, the law requires that the bill of lading shall state whether it is carrier's or shipper's weight. NOTE—Where the rate is dependent on value, shippers are required to state specifically in writing the agreed or declared value of the property. The agreed or declared value of the property is hereby specifically stated by the shipper to be not exceeding 50¢ per Pound

This is to certify that the above-named articles are properly classified, described, packaged, marked, and labeled, and are in proper condition for transportation, according to the applicable regulations of the Department of Transportation.

The fibre boxes used for this shipment conform to the specifications set forth in the box maker's certificate thereon, and all other requirements of Consolidated Freight Classification.

(Shipper's imprint in lieu of stamp; not a part of bill of lading approved by the Interstate Commerce Commission.)

Monsanto SHIPPER, PER H. Sayre [signature]   Carrier's Agent [signature] 1-2-73 Per

BL-1R-3 REV. 9-68

TRAN 085110

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WATER_PCB-SD0000023804

Monsanto

FROM (NAME & LOCATION): W. B. PAPAGEORGE - ST. LOUIS

DATE: OCTOBER 6, 1970

SUBJECT: PCB ENVIRONMENTAL PROBLEM
SEPTEMBER STATUS REPORT

cc: H. S. Bergen
J. Mason
J. E. Springgate

TO:
P. J. A. Marsh - BRUSSELS
W. S. Clark
J. R. Durland - TOKYO
M. W. Farrar - 2nd Street
E. V. John
R. E. Keller - 2nd Street
R. M. Kountz
T. L. Gossage
P. S. Park
W. R. Richard
J. R. Savage
E. P. Wheeler

GENERAL:

Performance against the PCB plan was reviewed with the CMC on September 14. Overall the committee was satisfied with the progress which has been made and complimented the various departments in the Division who have been involved in the action. However, it was emphasized that we must continue to emphasize to all remaining users of PCB's the importance of preventing escape to the environment and we must ensure that these warnings are fully documented so that they will support the action we have taken in this area should we become involved in legal actions.

Two variances from the original plan were requested and approved:

1. NCR - As the customer has proved unwilling to commit himself to a take or pay contract, it was agreed that we can go ahead on the basis of producing MIPB in existing equipment or using toll manufacturing facilities ensuring that a satisfactory level of profitability is maintained. The emphasis here was to phase 1242 out of NCR formulations as soon as possible.

2. It was recognized that good progress is being made in reformulating industrial/hydraulic fluids and that it was not easy to completely replace PCB's with alternate material. In view of the progress made, an extension of a further three months (i.e. end first quarter 1971) was granted to enable

PLAINTIFF'S EXHIBIT 336 MONSANTO

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DEPOSITION EXHIBIT PIF's 450 7-9-92

us to reformulate those products still containing Aroclor 1242. It was emphasized, however, that this would be the last extension granted and if we are not successful in reformulating, it will be necessary to discontinue the business in spite of the significant gross profit involved.

Preparations are underway to test the disposal of solid waste contaminated with Aroclors in Enviro-Chem Systems pilot unit in St. Charles, Mo. Solid wastes from transformer and capacitor manufactures will be introduced into the unit during the week of October 12.

Negotiations are continuing with Rollins-Purle, Inc. to establish their capabilities and cost of incineration of liquid Aroclor waste.

MARKETING:

The withdrawal of Aroclor plasticizers from the market appears to have been completed with very few loose ends. Only a couple of companies have called claiming that they had not heard of our withdrawal, and to date these inquiries have not caused any significant problems. Our distributors are well on their way to zero inventories of the Aroclors, having pretty well matched their purchases from Monsanto with firm orders from their customers. It does not appear that there will be any extensive returning of unsold materials.

Orders for the products which will replace the withdrawn Aroclors in the market are starting to come in. It will be several months before substantial volumes are being sold, however, as most companies have some inventory of the old products in stock. Two major items of information indicate that the replacement program is progressing well. The first is that 3M has replaced Aroclors 1254 and 4465 with Aroclor 5442 in five product lines in the Industrial Tape and Electro Products Division. The second is that Thiokol states that Santicizer 261 now has the inside track ahead of all other products including chlorinated paraffins as a replacement for Aroclors 1254 and 1260.

ENGINEERING:

Waste Incineration - CEA 2415

Design is in progress both internally and at John Zinck's. Approval drawings for the incinerator are expected the week of October 7.

Aroclor Distillation - CEA 2417

Definitive design is in progress. Because of recent decisions by Corporate and Division Management, marketing forecasts for MCS 1016 have been reduced. Accordingly, elements of the project are being reviewed with the idea of reducing the scope of work.

Tributyl Phosphate - CEA 2371

The project scope report is being reviewed by the plant. The II building explosion and subsequent related work has delayed this plant review. A preliminary estimate has been developed. Timing of the project has become critical so pre-approval funds will be requested for engineering and commitment of long-delivery equipment.

N-C Phosphate

Although Research has had success in bench scale operation, it has been decided to prove out the process in the E-E building at JFQ. Thus, the latest schedule for having process assurance is March 1971. Project development will not be resumed until after the process is proven.

EUROPE:

An informal meeting was held with the Directors of some of the voluntary societies, e.g. British Trust, for Ornothology, and they expressed considerable satisfaction at the responsible attitude adopted by Monsanto in Northern America and the U.K.

The N.E.R.C. REPORT on the Irish Sea incident is now expected to be published November/December.

We have been promised a copy of the latest draft.

Further contact with the other European manufacturers has not yet yielded agreement on when or how to act and it has not yet been possible to arrange a decision-making meeting with them.

MEDICAL:

The latest status reports on the dog and rat chronic feeding studies, rat reproduction studies and chicken toxicity, reproduction and residue studies were reviewed with representatives of the National Institute of Environmental Health Sciences, Bureau of Commercial Fisheries Laboratory, Food and Drug Administration, U.S. Department of Agriculture and the Patuxent Wildlife Research Center.

PUBLIC RELATIONS

The July news release, stating our position to withdraw from certain PCB markets, was used in whole or in part by 13 more major newspapers. Total to date is 22. As the month closed, plant management at Pensacola speculated Monsanto may be sued by the Southeast Fisheries Association, Inc. for polluting Escambia Bay with PCB. At this writing, the suit has not been filed. A preparedness statement was drafted for use by the Plant Manager, should a suit develop.

RESEARCH:

Carbonless Carbon Paper Solvents

NCR now seems more committed to MIPB-2 as replacement for Aroclor 1242. It appears that an additional 100,000 lbs will be required for full scale trial with a "firm" answer expected late 1970 or early 1971.

Assistance has been provided the plant in preparing for the upcoming run of MIPB. An amendment was written to allow the manufacture of a MIPB containing higher (1.5 vs. 0.6) ratios of propylene to biphenyl. The most recent information indicates that this higher ratio material will not be needed by NCR.

Manufacturing is searching for a location to make larger quantities of MIPB.

Nashua likes a blend of Aroclor 5442/HB-40-1/4 as a dye solvent even though its viscosity is above their "upper limit". Three more blends are being sent them to help zero in on the proper ratio.

Print fade on Nashua Clay coated paper is caused by light (as with NCR paper) but not by excess solvent. Use of a resin or rubber to extract excess solvent (beneficial in NCR paper) is harmful in the Nashua system.

Hydrogenation of the aliphatic double bond in AMS Dimer (liquid) eliminates most of the odor and reduced print fade, making this a very good hydrocarbon solvent.

Acute toxicity tests show the mono and dichlorinated AMS Dimer to be comparable to Aroclors of corresponding viscosities. The solid and liquid AMS Dimers and isopropyl biphenyl like HB-40 are "practically non-toxic" (or safe) but are noticeably more irritating to rabbit skin. Twenty four hour patch tests on one person showed no irritation from any of these materials.

Industrial Hydraulics

The removal of Aroclor 1242 from all Pydrauls will require reformulation of A-200, 281, 540, 312, 230, 135, 150, MCS 153 and MCS 974. The Pydraul 312 reformulation is farthest along. Fire resistance of the new formulation is greater than the fire resistance of Pydraul 312. Performance in the V-105C was excellent. Samples were sent to Ford for evaluation.

It will be desirable to make the hydraulic fluid application into a closed loop system. We cannot expect to stop leaks but we can expect to minimize contamination of water by (1) minimizing run-off to sewers; (2) treating contaminated water by adsorption (Anniston had no detectable PCB after passing through a limestone bed); (3) recycling adsorbents to remove Aroclor by squeezing, by extraction or by devolatilization-destruction.

Aroclor Pollution Study - Anniston

In the 13 day pilot run, initial concentrations of 1000-8000 ppb Aroclor in waste water were reduced to a range of 0-15 ppb upon passing through a series of packed carbon beds[1] at an average flow rate of 25 cc/min. Over 99% of Aroclor removal occurred in the prefilter. This unusual reduction is believed to be due to the filtration of solid on which Aroclor was adsorbed. In tests run at higher flow rates (0.5 gpm/ft.^{2}) through the prefilter, these plugged the prefilter. The study is presently being divided into two phases: 1) feasibility studies for continuous solids (with Aroclor) removal from limestone pit effluent and 2) carbon adsorption from the clear stream at the Aroclor sump.

There was a temporary delay in the shipment of the pilot adsorption unit.[2] Start-up is now targeted for 9/23.

[1] The adsorber consisted of a prefilter (3.5 inch diameter tube packed to 5.5 inch bed depth) and a series of one (1) inch diameter columns packed to a total bed depth of 13.5.

[2] Pittsburgh Carbon (Calgon Division) rental unit containing pumps, 5 inch diameter columns, etc.

Determination of Polychlorinated Biphenyl Residues in Rats from 30 day Aroclor feeding Studies

One of the more significant objectives of the Aroclor-Environment program has been to develop a more complete picture of what occurs to Aroclor products once they are released to the ecosystem. The importance of this information is two fold, first it can be used to guide the development of a more "degradable" Aroclor product and secondly, the general methods developed to study the current Aroclor products can be used to determine the degree of control that must be exercised over the replacement products to avoid similar problems with these materials in the future.

As a part of achieving this overall objective, Industrial Bio-Test Laboratories was requested to carry out a 30 day tissue collection study in albino rats with Aroclor 1242, Aroclor 1254 and Aroclor 1260. This report deals with the subsequent analysis of these tissues for residual PCB's.

Summary: The results of this study demonstrate that the residual PCB levels in all tissues decreased significantly as the degree of chlorination and the dietary exposure level of the material fed decreased. Additionally, it was observed that the amount of isomeric alteration increased as the degree of chlorination decreased resulting in the fact that the major PCB isomers retained by the rats fed Aroclor 1242 were those predominantly present in Aroclor 1254 and Aroclor 1260. There were no significant differences in the type of isomeric alteration from tissue to tissue or between sexes.

Aroclor - Environmental Program - St. Louis

Preliminary testing by the National Water Quality Laboratory at Duluth, Minnesota of the tolerance of fish and fish food organisms (survival and reproduction) to our Aroclor products has indicated that Aroclor 5442 is much more toxic to Daphnia than any of the PCB's. Eleven reserve samples of production Aroclor 5442, one of which was used in test, have been received from Anniston to determine if

any water soluble tramp component(s) could be responsible for the alleged increased toxicity. Initial results indicate that the pH of the water used to extract and/or solubilize the Aroclor 5442 is not changed; however, a number of EC active components can be isolated from the water extracts via a hexane extraction. An attempt will be made to identify these components.

A meeting was held to review the status of the residue analysis of the Bio-Test Laboratories tissues. It was agreed that the work should proceed and that in terms of current priorities the tissues from the chronic rat study should be done first, followed by the fish toxicity study, and then by the chronic chicken study. Provisions have been made for shipment of the rat tissues and fish samples to Monsanto.

Arrangements have also been made to have samples of fish from the semi-annual Anniston area survey and samples of shrimp from three locations around our Pensacola collected, quick frozen and shipped to St. Louis for confirmatory residue analysis.

Environmental Studies - Ruabon

The paper entitled 'Askarels - Environmental Pollution' was presented at the CIGRE conference in Paris. This was welcomed by the delegates as a useful guide to good practice and suggestions were made for wider publication. A modified version of this paper is being made available for the PCB conference organized by the Swedish National Environment Protection Board at Stockholm on Sept. 29.

The draft of the report on the deaths of sea-birds on the Irish Sea is now being made available to Monsanto, but we have not yet received a copy.

Biodegration Testing - St. Louis

Functional Fluids

Testing of Aroclor 1242, Aroclor 1254, MCS 1016 and fractionated Aroclor 1130 in our semi-continuous activated sludge units is continuing. Calculation of ED/GC analyses for the first five weeks of operation have been completed. Due to the high degree of scatter in the data, no conclusions can be made at this stage concerning differences in biodegradation rates. The source of the scatter is currently being investigated. One of the units has been equipped with a stirrer to determine if agitation is a significant factor.

Five additional units are now being added to our setup to permit simultaneous testing of a greater number of products. Testing of trichlorobenzene, Arobromchlor 1232, and Gulf 200

Bright Stock will be started shortly. Testing of the chlorinated terphenyls, e.g., Aroclor 5432, is awaiting the development of the necessary analytical methodology.

Several enrichment tests involving biphenyl-acclimated sludge and nutrient feed withdrawal are also planned.

Plasticizers

A three-day sampling of the HB-40 and mono-isopropyl biphenyl (MIPD) semi-continuous activated sludge units nine weeks after the previous sampling period has shown significant changes in the biodegradation rates. For MIPB, disappearance rates for the three days by UV analyses were 75, 70 and 77 per cent compared with the mean of 67 per cent in the previous sampling period. GC analyses indicate that the predominant mono-isopropyl biphenyl components are almost completely degraded during the cycle, leaving as the undegraded portion the dialkylated components. For HB-40, the previous sampling period had shown essentially a zero disappearance rate with a high degree of scatter. During the three-day period, disappearance rates of 54, 52 and 58 per cent were found. From GC analyses, it appears that the one-ring hydrogenated components are more readily degradable than the two-ring hydrogenated components.

Feeding of the MIPB and HB-40 is continuing. An additional sampling period is planned to determine if any further significant changes will occur.

Five additional units are now being added to our setup to permit simultaneous testing of a greater number of products. Testing of Aroclor 1221 will be started in one of the new units.

Biodegradation Testing - Ruabon

In the presence of lower chlorine isomers and biphenyl we appear to have succeeded in degrading the key hexachlorinated isomer with the biphenyl-active soil culture C_2, but the penta-chlorinated isomer has not degraded under these conditions. Work is being initiated to check whether any of the "non-degradable" isomers (e.g. 4-4'dichlorbiphenyl) can be degraded under these more severe conditions.

The sensitivity of the analytical technique used was not high enough to show conclusively whether HB-40 was degraded by C_2. This is being repeated using a higher concentration.

Progress continues in the development of GLC-Mass Spectrometry techniques to allow identification and quantification of residues remaining after prolonged biodegradation tests on various products.

MANUFACTURING

Anniston Plant

PCB Levels In Snow Creek

Average PCB loss for the month was high at 2600 ppb or 32 lbs/day, largely as a result of one very bad day (400 lbs). Contributing causes were:

1. The old limestone pit was overloaded and solid sludges were carried through,

2. Detergent cleaning of the department,

3. Sewering of excessive amounts of muriatic acid.

Since the new limestone bed was placed in service on September 23, pit effluent has been at 0-3 ppb PCB's. However, leaching of PCB's from the creek bed results in a plant effluent level of 90 - 240ppb or 1.1 - 2.8 lbs/day, gradually declining. The plant believes that the new pit can handle ordinary upsets and peak loads.

Regulatory Action

Telephone contact continued with the Alabama Water Improvement Commission. However, a planned meeting did not take place due to illness of AWIC members. Pressure for routine submission of analytical data is not intense at this time.

Department Suspended Aroclor Control

An experimental skimmer operated very well removing the PCB laden scum which accumulates in the new sump.

Solid Wastes

Solid waste data for evaluation of disposal methods has been accumulated. A report will be issued in October.

W. G. Krummrich Plant

PCB Levels In Sewer

Current losses to the river from the treatment plant range from 12 to 742 ppb with an average loss of 311 ppb for 11 samples. This is an equivalent average loss of 71.5 lbs/day.

Projects To Reduce Sewered PCB's From Aroclor Department.

Blow Tank Demister (Estimate 2031) project construction is underway with completion scheduled for October. A Process Amendment was approved.

Project for about $30,000 to provide paving, curbs, trenches and catch basin in tank car and tank truck loading areas will be added to the incineration project to speed approval.

Program To Eliminate Sewered PCB's From Using Departments

Departments 243 and 244

Plans are to replace the Therminol FR-1 with Therminol 55. Lab work has been conducted to verify that there is no reaction between Therminol 55 and any process materials. Engineering is underway on system modifications required for use of Therminol 55. Target date for changeover is 12/1/70.

Department 245

The major problem here is air pollution from the supply tank vent. Our target is to scope a solution and prepare an estimate by 11/1. Changeover to a different fluid is undesirable in this department due to the high fire potential.

Department 251

No work has yet been done on the lubrication and hydraulic type systems in this department.

Department 239

Work is in progress to develop project premise. We expect to eliminate two pumps and a cooler in the Therminol lines. (Pending results of thermal stability of Santophen 1 residue). The project will include a new expansion tank with submerged

W. G. Krummrich Plant

Department 239 (Cont'd)

pump. We also plan to upgrade controls and make furnace operation more reliable. How to sump the area around potential spills is still unresolved. To go to a flammable heat transfer fluid is considered too great a process safety hazard in this area.

Department 255

Plans are to replace FR-2 with Therminol 66 by 11/15/70.

Department 248

No progress has been made to date. A definite plan will be developed by 11/1/70 with the objective of solving any problems by 1/1/71.

Department 258 (DDS)

The unit is still down and most likely will not be started up again. The material on the pad has been removed.

Department 270

A 55-gallon drum has been placed under the vent. Chat soaked with Aroclor around the furnace must still be replaced.

Department 275

A 55-gallon drum must still be placed under the vent line (the vent will have to be shortened to do this). Chat around the furnace still needs to be replaced.

Department 273

Work completed. Drum placed under surge tank vent. Buckets placed to collect material from drip pans under Therminol circulating pumps.

Department 222

Unit in start-up. No visible source of loss observed.

Estimate 2292 will be revised. This is the project to provide 150,000 gallons of storage for scrap Aroclor. A plant level earnings expense estimate will be prepared

W. G. Krummrich Plant

Department 222 (Cont'd)

to cover the cost of altering the storage tanks. The 4,000 gallon trailer originally used to haul Aroclors to Queeny Plant will be used for scrap Aroclor hauling in the plant.

PCB Levels In Atmosphere

Vapor losses from the Aroclor Department are estimated at 2.3 #/day now and 1.6#/day after the installation of the blow tank demister.

1. Scrubber Stack (from blow tank drowning jet) 0.90#/day

   This is a measured quantity. With installation of the demister and closing the batch blow tanks, air flow should be decreased to about 20% of present flow. Assuming the concentration to be the same, loss would be reduced to ~0.2#/day.

2. Fume Removal Stack (from drowning area and sampling stations) 0.05#/day

   This is an estimated quantity based on most vapors coming from the drumming station and assuming 10,000,000 #/year drummed, and 1242 vapor pressure at 80°C. Samples are being taken to verify.

3. Aroclor Transfers Within Department 1.34#/day

   This is an estimated quantity assuming 70[illegible] #/year production and 2.5 transfers/pound at 100°C. Samples will be taken at storage vents to verify.

4. Steam Jets - unknown

   Will be measured.

W. G. Krummrich Plant

PCB Rework Project (Estimate 2095)

Phase II — Construction sufficiently complete to allow unloading tank cars to the rework still.

Phase III — Design package will be completed by mid-October.

This project will be added to the incineration project for approval. Phase III will be held up until approval is received. This will mean that material will be reworked direct from tank cars until the Phase III storage facilities are installed.

W. B. PAPAGEORGE

ms

H. S. Bergen

October, 1971

Distribution:

B28G C. L. Bradford*
5040 H. N. Dahlstrom
5090 H. F. Dixon/D. Goodwillie*
1070 H. R. Ford*
1010 R. A. Garcia*
5020 R. B. Giles/R. Garnsworthy
1800 D. R. Hansen*
5270 T. Ishijima
B28G N. T. Johnson*
B3NF A. J. Koenig*
B28K G. G. Kosup*
F4WA R. M. Kounts*
5040 P. J. A. Marsh*
B28K W. B. Papageorge*
[redacted]
B2NK E. M. Potter*
T3A W. R. Richard*
B2NB J. R. Savage*
B28D L. D. Shand*
G4WA J. R. Sayers
1650 P. L. Slayton*
B28E B. G. Tibbetts*
C38C J. E. Tucker*

~~PGB~~
~~DRF~~
D.E.R.
~~EJK~~
CP

COMPANY CONFIDENTIAL

TRAN 003508

DEPOSITION EXHIBIT
Plf's 451
7-9-92

Monsanto

FROM (NAME & LOCATION): B2SL T. L. Gossage

DATE: October 7, 1971

cc: See distribution list attached

SUBJECT: SPECIALTY PRODUCTS MONTHLY REPORT
SEPTEMBER 1971

DEPARTMENT:

TO : H. S. Bergen*

Sales Summary

September domestic sales were $3,258 M, 15% below our budget of $3,831 M, approximately $100,000 higher than August, 1971 and approximately $700,000 higher than September, 1970. All product groups were below budget with the exception of Industrial Fluids which was about 20% over budget. Europe's September sales were $744,000, over budget by $49,000. Canada was $25,000 over budget.

Hydraulics and Lubricants

Ford, Dearborn, has decided to continue their shop trial of our MCS 1044 at least through November. Laclede Steel is regained and has received five liquibins of Pydraul F9A. Pontiac Motors has decided not to shop trial our competitor's Vital 29 due to the product's polymer separation problem. New Pydraul business at Kamin Diecast, U.S. Steel, Baytown, Magma Copper and Wadco Corporation. Ford, Sheffield, continues water/glycol test.

Columbia Gulf Transmission ordered $50,000 in Turbinol 153. Northwest Airlines has extended their current Skydrol contract with Stauffer until November, 1973, while we have received renewals from World Airways, Hydro-Aire, Inc., and Overseas National Airways.

Hughes Air West entered the first commercial order for 5,000 lbs. of Skylube 450. Unfortunately, they will sign a contract with Shell for their lube requirements and will not buy Skylube 450 after the flight test.

The first batch of Pydraul has been formulated at the new Antwerp facility. A reclamation contract has been signed with WYCO.

Dielectrics and Process Fluids

Skelly Oil has successfully been turned away from FR-1 and has purchased twenty-three drums of Therminol 66 for offshore gas processing platform. Chevron Oil has threatened to purchase Dowtherm G for their new offshore gas processing plant following our refusal to sell FR-1.

We shipped a tank car of biphenyl to Tenatex, bringing year-to-date sales to 347,000 lbs. Biphenyl sales were also strong in the citrus wrap market to Crown Zellerbach, 100,000 lbs. and Paper Pak, 30,000 lbs.

COMPANY
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TRAN 003509

Agreement has been reached with NCR to supply them MIPB as their sole encapsulant through June, 1972.

Transformer fluid sales continue strong, 34% over budget and 32% over August sales.

Monsanto Europe has gained the European Tanatex business estimated at 300 tons per year. Agreement has been reached with ICI on a three-year biphenyl contract.

Paper and Wood Chemicals

Appleton Paper has signed a two-year contract for Merpise TFL. Expected volume is $400,000 per year. Domtar, St. Catherines in Canada, has ordered their first truckload ever of Merpise TFL. Hudson Pulp & Paper, Palatka, Florida, received two 5,000 gallon tanktruck orders of Santopipe DSC. This is our first business ever at this location. Indications are that additional truckloads will come in '71 and a commitment for 4-500,000 lbs. in 1972.

Scripsets are estimated at 76% of budget for September. Under budget performance is caused by Weyerhaeuser's drop off in PCW-10 usage. Their usage is expected to be at about 135,000 lbs. per month for the balance of the year as compared to a 210,000 lb. per month budget. A successful Scripset 520 trial has been completed at Mead Corporation, Chillicothe. Georgia-Pacific, Kalamazoo, has committed to 520 trial within the next two months.

Latex Binders

Major Polvin 2400 orders received from Advance Finishing, 500,000 lbs. and Walter Carpet Mills, 200,000 lbs. Advance Finishing, Dalton, Georgia, will be running Polvin 2400 in a foam precoat on all carpet grades for one month. If this run is successful, they have indicated their desire to contract for their total requirements estimated between 7 and 12 M dry pounds per year. Walter Carpet Mills, City of Industry, California, are working up a contract to sign with Monsanto covering their 1972 needs for Polvin 2400. Colex Corporation is investigating an EVCl/SBR blend as their fire retardant system. Trials are expected over the next two months to determine the cost performance of that system. James Carpets ran a five drum trial with Polvin 2400 as a replacement for an SBR aluminum hydrate fire retardant precoat. The carpet is being tested now for fire retardancy. Potential is 500,000 to 1,000,000 dry pounds per year. All of this activity is a direct result of continuing upset in the carpet industry brought about by FTC actions. Sixteen more manufacturers are being cited for failing to

meet the fire retardant standards. Three carpet manufacturers have gone bankrupt as a result of this action. There is a tremenous interest in fire retardant latex systems. Timing now becomes critical. Plant production is needed at the earliest possible date.

Sackner Products continues to order development quantities of Monflex 4400. No word has yet been heard from Ford on requirements for material made with EVCl.

Mead Packaging, Atlanta, ran the long delayed trial with Polvin 2000. The product performed well and did the job predicted. It did not, however, outperform a Dow system. Activity continues strong in other paper and board coating applications, paper saturation, barrier coatings and paint

T. L. Cossage

/ph

* Receive attachments

COMPANY CONFIDENTIAL

TRAN 003511

DEPT. 259

KEEP DRIP PANS EMPTIED

KIND OF MIX Solvinol 153

1 MIX TANK

LOT NO. KA901

NOTHING BUT PRODUCT IN SAMPLE DRUMS

DATE 10-4-71

PRODUCT	FROM TANK	MEASURE B.P.	MEASURE A.P.	GALLONS METERED	MIX TANK MEASURE	TIME FINISHED	OPERATO
1242	#17	9-11	6-24	—	8-9-3		E.D.
1221	2-E.H.	34" out	36½ out	—	9-3½-9-3	5:45 AM	E.D.
TCP	8 DRUMS						C.S.
ASK N	PHENYL						
10 1/2 GRMS	DEF						
8 1/2#	FH 139					6:30 AM	LAT

CONTROL SAMPLES TAKEN

DATE	TIME TAKEN	OPERATOR	RESULTS	TIME RECEIVED	SP. GR.	INDEX
10-5-71	9:45 AM	LAT		10:30 AM	1.367	

ADJUSTMENT MATERIAL	LOT NO. OR TANK	MIX TANK MEASURE B.P.	MIX TANK MEASURE A.P.	DATE RESAMPLED	TIME RESAMPLED	RESULTS SP. GR.	RESULTS INDEX
FH 139	120# DRUM	—	—				
FH 139	50#						
FH 139	30#	10-8-71	8:30 AM.				

REWORK ADDED

PRODUCT	LOT NO	AMOUNT

FINAL SAMPLES TAKEN BY C.D. 2nd — 3rd 4th J.T.

DATE 10-2-71 10-7-71 10-8-71

TIME 4:50 PM 11:45 AM 10:00 AM.

COMMENTS:

DEPOSITION EXHIBIT
PI's 452
7-9-92 RB

TRAN 003080

360 FLASH POINT
501 FIRE

0.118 .0388

VISC 20.5 CS @ 100
100.0 SUS @ 100

VIS 2.95 CS @ 210
36.1 SUS @ 210

ADDED 120# + N2
1.338 @ 25
.0388 % N2

21.1 CS + 3.09
ADDING
50 # S-

TRAN 003081

#1 MIX KA901 10/4/71

TURBINOL 153

1242 IS 1.388@25 TANK IS 100°C = 10.93#/GAL 13.93/37,070 = 3811 GALLON

1221 IS 1.183@25 TANK IS 28°C = 9.83#/GAL 9.83/2900 = 295 GALLON

OUTAGE ON #1 MIX DIDNOT INDICATE MATERIAL GOT TO TANK
CONTROL SAMPLE TAKEN DID INDICATE :- THOUGH 1.367

21.1 CS 21.1 .6
3.09 CS 2095

TRAN 003082

R. A. Dykstra - J. F. Queeny Plant

November 9, 1971

TURBINOL 153 (80448)
MI-139 (80974)

W. V. Klein
F. Gatens/P. Smid
W. J. Schutt
R. K. Wagner
R. P. Potter - EPOTT
G. F. Taylor - GTAYL

Don Mayer
WGK

Production of Turbinol 153 (MCS-153) has been transferred to the WGK Plant. We have a small inventory of packaged material remaining which is as follows:

QK-29 - 2 x 600 lb. drums = 1,200 lbs.
QK-331- 6 x 55 lb. cans = 330 lbs.

This material contains Aroclor and should be concentrated at the only remaining location which is your plant.

I suggest you give us an order for it and plan either to blend it off or incinerate it, based on direction from the Business Group.

The second item involved is MI-139, which as you know, is an additive in the Turbinol 153 formulation. MI-139 also contains Aroclor. We have 14 pieces which total 4,240 lbs.

It is also requested that you order this material to be sent to your plant and retain it for future MCS-153 production. The MI-139 has been devalued to zero. We would appreciate your cooperation in this matter.

R. A. Dykstra

RD:jw

F. V. T.

DEPOSITION EXHIBIT
Plf: 453
7-9-92

TRAN 003085

C. L. Bradford/J. E. Davidson - C. O.

December 8, 1971

INDUSTRIAL HYDRAULIC
FLUIDS TRANSITION PLAN

T. L. Gossage

N. T. Johnson
R. E. Hatton
J. R. Savage - B2NB
J. Solari - 1760
J. F. Herber - T30
L. R. Stark - W4A
D. H. Bolliger - P4WC
[illegible]
[illegible]

The Situation

In the past, our major strength in the industrial hydraulic fluids business was our low cost chlorinated raw materials giving superior fire resistance to our fluids. These same materials had good solubility with oil and allowed us to formulate the Pydraul 312 series. The result was a very real and sizeable competitive advantage in terms of both quality and price over other synthetic fire resistant fluids.

Our position is changing. We cannot use either polychlorinated biphenyls or polychlorinated terphenyls. This leaves us with a line of resale water glycol fluids (available now), a straight phosphate ester (available shortly), and a lower cost oil-phosphate ester blend promised for the first quarter of 1972. In terms of quality, we will have the advantages of greater stability and the fact that we are not tied to cresylic acids. In terms of cost, none of these new products will give us any significant advantage over our competitors. In addition, the changeover (the second in a year) will create an adverse affect, particularly on our major customers, of which the top five account for 42% of our business and the top 20 of which account for 60%.

This means that when the transition has been completed, we could be left with considerably less market share than we now have, with ill will at certain customers and potential accounts, and with no cost advantage to regain our position. Our sales growth in the future will not be as steep as our sales growth in the past, and our base will be less.

Objective

Our objective in this transition program simply stated is to be out of PCB's/PCT's by June 30, 1972, to salvage as large a share of the market as possible at a profit, and to be left with zero inventory of our current fluids. We expect to keep at least 50% of our business, but we must take several steps as quickly as possible in order to achieve this.

TRAN 002492

alone accounts for 18% of our business. We must move immediately to convert G. M. to our phosphate ester fluid. The Division, which is over half of the business and which will probably determine what course takes, has told us that they will drain and flush all PCB containing fluids from their machines and refill with a new product. We will try to sell them our phosphate ester fluid at list price and charge fully for incineration of the old fluid. If necessary to salvage the business, we will capitulate on incineration and give some price concession on initial fill. In return, we will ask for a three year supply period to recover our costs.

We will not sell a low price phosphate ester as a replacement for A200B. If goes to the phosphate ester and if we sell a low priced phosphate ester to one location, we might be forced to sell it to all of them. Due to the large share of our total business that represents, selling to them at a low price would undermine the profitability of our total Pydraul program. In addition, due to their size, it is possible that such a move would deteriorate the pricing of the phosphate esters at all accounts.

---

is having difficulty with the State of Illinois because of too high phenolics discharge in their effluent. However, they appear to be sold on the most fire resistant synthetic fluid, which means phosphate esters, and all phosphate ester fluids will create phenolics in their effluent. We have gone to them and suggested they move to our straight phosphate ester to avoid PCB problems and that they solve their phenolics problem with treatment of their effluent. In terms of pricing and incineration, we will handle them in the same way as and, if necessary, make the same concessions.

Check Point

This should be a check point in our plan. If either are lost, we should re-evaluate our situation and decide again how best to proceed.

Selector I Accounts

After testing the water with
and as soon as sufficient phosphate ester becomes available, we will move to convert all Selector I accounts to straight phosphate esters.

Selector II Accounts

We will proceed at once to develop, test and get Factory Mutual approval on a line of truly fire resistant oil/phosphate ester fluids. As soon as the development job is done and as soon as phosphate ester for these fluids becomes available, we will begin converting all Selector II accounts to these new products. It may be necessary to raise prices on these fluids depending on the amount of phosphate ester necessary to give adequate fire resistance.

Reclamation

We should move now to work with Findett Service Co. on reclamation of the Pydraul fluids. This means quoting, in conjunction with Findett, for reclamation business wherever we can be competitive. If it turns out that due to geography we cannot be competitive in conjunction with Findett in all locations, we will establish relationships with other reclaimers in those locales.

Capacity

Note that reclamation ultimately could have a negative affect on our volume of new fluid sales. This along with our loss of business during the transition must be taken into consideration when planning the capacity of our new phosphate ester plant.

Vital 29 Type Fluids

Withdrawal of current Pydraul 312A type fluids from the market and introducing replacement fluids at higher prices may force customers to go to either higher priced phosphate ester fluids, inferior quality water glycol fluids, or the Vital 29/Dasco 300 type fluids which, in our opinion, are not fire resistant. To combat this, once we determine

whether the phosphate ester content of our replacement fluid is significantly higher than Vital 29, we should go immediately to Factory Mutual, explain the situation on the fire resistance of these fluids and ask for Factory Mutual's position. In any case, we should call this question of fire resistance to Factory Mutual's attention when they come to St. Louis to test and approve our Selector II fluids. If they remove their approval, that should solve the problem. If not and if Vital 29 does start picking up business, we will develop a fluid in direct competition with Vital 29 and Dasco 300.

Customer Notification

On April 15, 1971 we sent out a letter to the Pydraul mailing list saying: "There are now no PCBs in any of our Pydraul fluids." This letter is not true and has irritated the .... Division of and probably anyone else who knows that it is not true. We will communicate immediately to the same customers clearly stating that the letter was somewhat in error and giving them the facts on the PCB contamination. If possible, we can temper this with our plans for future fluids. However, getting the information to our customers before they get this information from our competitors should be our primary consideration.

Field Sales/Product Group Relationship

Major accounts where the Product Group may directly assist in conversion are listed in Appendix H. Current opinion is that all other accounts can be handled directly by the Field Salesmen (assuming we do have Selector II replacements).

To help prepare the salesmen for this transition, a meeting will be held in St. Louis which will focus on strategic salesmen and their managers who will be in attendance. At the meeting we will lay out for them why we must reformulate, the reasons we will give the customer, replacement products with prices and benefits relative to our old products and competition, pollution aspects of PCBs, PCTs, and phosphate esters with a discussion of phenolics, B.O.D. and C.O.D., and oil contamination, and the legal aspects of our situation. We will leave them with a "Transition Handbook".

Also at this meeting we will specifically define who will handle what accounts, the order in which they will be handled, and the timing.

Advertising

To counter the negative effects of reformulation, we should plan and execute an advertising program that will explain why we are making this move and point out the advantages of our new fluids versus competition. This program should begin now.

Appendices

Attached are appendices which give some background on what our new Selector I and Selector II fluids will be along with their costs, prices and gross profit; what a typical conversion might cost us depending upon whether we get full price for the fluid and who pays for incineration; a list of our major customers; and what our profitability for 1972 may look like based on certain assumptions of conversion rates and costs of our new products.

C. L. Bradford

J. H. Davidson

/pep
Attachments

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APPENDIX A

Proposed Pydraul Line and Pricing

Fluid	Pricing[1] T/T	T/L Drums	10-T/L Drums	5-9 Drums	1-4 Drums
Selector 1					
Pydraul 10 E	4.55	4.75	4.95	5.00	5.10
Pydraul 29 E-LT	3.60	3.80	4.00	4.05	4.15
Pydraul 30 E	Quote	3.65	3.75	3.80	3.85
Pydraul 50 E	Quote	3.65	3.75	3.80	3.85
Pydraul 65 E	Quote	3.75	3.85	3.90	3.95
Pydraul 95 E	Quote	3.85	3.95	4.00	4.05
Pydraul 115 E	Quote	3.95	4.05	4.10	4.15
[2] Selector 2					
Pydraul 135 C	2.25	2.45	2.65	2.70	2.80
Pydraul 230 C	2.25	2.45	2.65	2.70	2.80
Pydraul 312 C	2.15	2.35	2.55	2.60	2.70
Pydraul 540 C	2.15	2.35	2.55	2.60	2.70

[1] 5 gallon can pricing - add .25/gallon to 1-4 drum price

[2] These prices are based on the fluids containing approximately 60% phosphate ester and development of a shear stable polymer to assure permanent fire resistance.

TRAN 002497

APPENDIX B

Pydraul Profitability

Fluid		Cost-Short Term[1] (Dixie CP)	Cost-Long Term[1] (Monsanto CP)	Gross S.P. (10-T/L Drums)	Long Term Gross Profit[2]
Selector 1					
lbs./gal.					
9.1	Pydraul 10 E	--	.191/lb	.545/lb	63%
9.4	Pydraul 29 E-LT	.222/lb	.215/lb	.425/lb	45%
9.9	Pydraul 30 E	.204/lb	.198/lb	.378/lb	43%
9.8	Pydraul 50 E	.227/lb	.213/lb	.383/lb	40%
9.7	Pydraul 65 E	.268/lb	.238/lb	.396/lb	35%
..7	Pydraul 95 E	.285/lb	.250/lb	.407/lb	34%
..6	Pydraul 115 E	.295/lb	.256/lb	.422/lb	35%
Selector 2					
8.44	Pydraul 135 C	.170/lb	.165/lb	.314/lb	42%
8.44	Pydraul 230 C	.168/lb	.160/lb	.314/lb	44%
8.44	Pydraul 312 C	.170/lb	.160/lb	.302/lb	40%
8.49	Pydraul 540 C	.175/lb	.165/lb	.302/lb	38%

[1] Finished Product Cost Including Conversion and Drum Costs

[2] Average Freight and Warehousing at $.03/pound

TRAN 002498

APPENDIX C

Pydraul Blends – Add Turbinol 30 E & Turbinol 50 E @ NCP

All prices, costs and profit figures based on the following blends.

Pydraul 10 E

Pydraul 60

Pydraul 29 E-LT

N_2CP - 35%
S-141 - 63%
Polymer - 2%

Pydraul 30 E

N_2CP ~~40%~~ 39.5
TPP ~~30%~~ 27
CDP ~~30%~~ 27
Admix 710 1.5
PC-200 50 ppm

Pydraul 50 E

N_2CP ~~70%~~ 67
TPP ~~30%~~ 31.5
Admix 1.5
PC-200 50 ppm

Pydraul 65 E

N_2CP ~~76%~~ 81
TPP ~~24%~~ 17.5
Admix 1.5
PC-200 50 ppm

Pydraul 90 E

NCP 88%
TPP ~~12%~~ 10.5
Admix 710 1.5
PC-200 50 ppm

Pydraul 115 E

NCP 100%
PC-200 50 ppm

Pydraul 135 C

N_2CP 20%
S 141 46%
*Oil 33+%
Polymer <1%

Pydraul 230 C

N_2CP 41%
S 141 16%
*Oil 42+%
Polymer <1%

Pydraul 312 C

N_2CP 46%
S 141 9%
*Oil 44+%
Polymer <1%

@ FR N23
@ " Lightly tinted
@ No sheen visible 0.1 Soluble Polymer.

Pydraul 540 C

N_2CP 56%
*Oil 43+%
Polymer <1%

1. Not available yet, time date set for completion.

*Oil could be Sunoco 800 N, Mobil 750 or H 230 but cost of all is $.04/pound

TRAN 002499

APPENDIX D

Typical Customer Conversion [1]

Customer Used for Calculations:

Date for calculation of cost to customer and cost to Monsanto for conversion from Pydraul 312 A to Pydraul 65 E:

Machine Capacity = 50 machines x 300 gallons/machine = 15,000 gallons
Flushing fluid = 15,000 gallons petroleum oil
Freight Cost = $2.00/cwt. = $.22/gallon
Cost of Incineration = $.03/pound

Case 1

-- pays full price for new fluid plus flushing fluid plus freight for returned fluid plus $.03/pound to incinerate returned fluid.

A. Cost to

1. 15,000 gallons Pydraul 65 E @ $3.45/gallon	= $51,175
2. 15,000 gallons oil flushing fluid @ $.50/gallon	= 7,500
3. 15,000 gallons (138,000 lbs.) 312 A plus 15,000 gallons (112,000 lbs.) oil incineration @ $.03/pound	= 7,500
4. Freight on returned fluid: 250,000 lbs. x .02/pound	= 5,000
TOTAL Cost	= $71,175
Cost per Gallon of new fluid (Does not include labor or downtime)	= $4.74/gallon

[1] All calculations based on bulk inventory cost of $0.223 per pound for Pydraul 65 E which assumes Monsanto manufacture of cumyl phenol at 30¢/pound

(Case 1 Con't)

B. Gross Profit to Monsanto

Sales: 15,000 gallons @ $3.45/gallon	= $51,175
COGS: 138,000 pounds x .223/pound	= 30,774
	$20,401
Freight: 146,000 pounds x .02/pound	= 2,920
Gross Profit	= $17,581

$$\% \text{ Gross Profit} = \frac{17,581}{51,175 - 2,920} = 36.4\%$$

Case II

pays full price for new fluid plus flushing fluid but Monsanto pays for incineration cost and freight.

A. Cost to

15,000 gallons Pydraul 65 E @ $3.45/gallon	= $51,175
15,000 gallons oil flushing fluid @ $.50/gallon	= 7,500
TOTAL Cost	= $58,675
Cost per gallon new fluid (Does not include labor or downtime)	= $3.92/gallon

B. Gross Profit to Monsanto

Gross Sales		= $51,175
Less: COGS	$30,774	
Freight (New Fluid)	2,920	
Incineration Cost	7,500	
Freight (Returned Fluid)	5,000	= $46,194
Gross Profit		$4,981

$$\% \text{ Gross Profit} = \frac{4,981}{51,175 - 2920} = 10.3\%$$

TRAN 002501

Case III

pays full price for fluid but Monsanto pays for flushing fluid plus incineration costs and freight

A. Cost to

15,000 gallons Pydraul 65 E	= $51,175
Cost per gallon new Fluid (Does not include labor or downtime)	= $3.45/gallon

B. Gross Profit to Monsanto

Gross Sales			= $51,175
Less:	COGS	30,774	
	Freight(New Fluid)	2,920	
	Flushing Fluid	7,500	
	Incineration Cost	7,500	
	Freight (Returned Fluid)	5,000	= 53,694
		Net Loss	= ($2,519)

TRAN 002502

Top Twenty Customers for Pydraul

	Customer	Products	1971 Projected Pounds ooo's	1971 Projected Dollars ooo's
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
12	Texas Eastern	Turbinol 153	175	60
13				
14				
15				
16				
17				
18				
19				
20				
21	All Other Pydraul Accounts		5237	1566
	TOTAL		14,267 (265)	4,200 (51)

ignificant Industrial Aroclor Accounts

TRAN 002503

APPENDIX F

1972 Financial Results

Case 1

1972 financial results as currently budgeted:

Product	(ooo's lbs) Volume	(ooo's $) Sales	(ooo's $) Gross Profit
Pydraul 60	45	22	9
Pydraul 150-A	1000	400	185
Pydraul A-200-B	2300	621	171
Pydraul F-9-A	1150	380	148
Pydraul 625-A	275	83	24
Pydraul AC-A	600	192	67
Pydraul AC-A W.G.	24	7	--
Turbinol 153	325	107	36
Sub Total	5719	1812	640
Pydraul 135-A	1400	336	98
Pydraul 230-A	240	59	16
Pydraul 312-A	6850	1507	407
Pydraul 540-B	125	26	7
Sub Total	8615	1928	528
Total	14,334	3740	1168
Projected 1971 Results (Based on October actual)	14,267	4200	1270
(Projected 1971 results based on 3/31/71 x 4)	15,076	4416	1385

TRAN 002504

APPENDIX F

1972 Financial Results

Case II

A. (1) Selector 1 fluids sold at 75% 1972 budget volume through 3/31/72

(2) NCP fluids replace Selector 1 fluids on 3/31/71 and sold at 50% 1972 budget volume from 3/31/72 through end of 1972

B. (1) Selector 2 fluids sold at 75% of 1972 budget volume through 6/30/72.

(2) NCP/oil fluids replace Selector 2 fluids on 6/30/72 and sold at 50% 1972 budget volume from 6/30/72 through end of 1972

C. plants on NCP from 1/1/72 but at the same relative rates as A and B above.

A-200-B to 50 E
312-A to 65 E

Product[1]	Volume (ooo's lbs)	Sales (ooo's)	Gross Profit[2] (ooo's $)
Selector 1			
Pydraul 10 E	45	22	9
Pydraul 29 E-LT	560	222	101
Pydraul 30 E	193	63	31
Pydraul 50 E	1910	656	261
Pydraul 65 E	1225	437	147
Pydraul 95 E	340	128	43
Pydraul 115 E	152	59	18
Sub Total	4425	1587	610
Selector 2			
Pydraul 135 C	825	263	72
Pydraul 230-C	144	39	12
Pydraul 312 C	2800	689	221
Pydraul 540 C	72	17	5
Sub Total	3841	1008	310
TOTAL	8266	2595	920

[1] Financial results for new products include results for old products as specified above

[2] Based on our cost long term, Appendix B

TRAN 002505

APPENDIX G

Incineration Costs

Gallons*	Incin. Cost @ $.03/pound	Freight @ .025/pound	Total
100,000	$28,800	$24,000	$52,800
150,000	43,200	36,000	79,200
200,000	57,600	48,000	105,600
250,000	72,000	60,000	132,000
300,000	86,400	72,000	158,400
400,000	115,200	96,000	211,200
500,000	144,000	120,000	264,000

*Average density of fluid @ 1.15 = 9.6 pounds/gallon

TRAN 002506

Monsanto

APPENDIX H

FROM (NAME & LOCATION): Norman T. Johnson

DATE: November 24, 1971

cc: T. L. Gossage - B2S L

SUBJECT: Pydraul Accounts

REFERENCE:

TO : C. L. Bradford
B2S G

The following are those accounts which I feel may require product group participation during the transition to reformulated Pydrauls:

Texas Eastern Transmission Houston

TRAN 002507

FORM 10 REV 11-68

I would hope that all other industrial fluids accounts can be handled directly by the salesmen. However, if we have no low cost Pydraul replacement the need for product group assistance to retain the business will be substantially increased.

Norman Johnson

lb

TRAN 002508

Monsanto

FROM (NAME & LOCATION): W. B. Papageorge - B2NK - General Offices

DATE: February 10, 1972 cc

SUBJECT: PCB/PCT Action Plan

REFERENCE:

TO :

H. S. Bergen	B2SL	C. Paton	B2SC
C. L. Bradford	B2SF	E. M. Potter	B2NK
F. J. Camargo	A2NH	W. R. Richard	T3A
W. S. Clark	B3NC	J. R. Savage	B2SL
W. R. Corey	B2SL	W. E. Schalk	B3NJ
J. R. Durland	5260	R. E. Sprague	B2NC
K. W. Easely	1920	J. E. Springgate	B3NA
D. Goodwillie	5080	J. F. Stapleton	B2SA
T. L. Gossage	B2SL	H. A. Vodden	5470
E. Greene	A2NA		
N. T. Johnson	B2SF		
P.J.A. Marsh	5040		
J. Mason	5040		

This is the first attempt to present a composite of the action plans of the various product and area groups involved in the PCB/PCT program.

Will each of the managers concerned please forward to me the missing information and any comments relating to additions or deletions which should be considered.

W. B. Papageorge

W. B. Papageorge

WBP:gw

IN 10 REV. 11 69

DEPOSITION EXHIBIT
P/F: 455
7-9-92

TRAN 003025

PCB/PCT ACTION PLAN

Heat Transfer Fluids

ACTION	ASSIGNED TO	TARGET DATE	ACTUAL DATE	REMARKS
U. S. DOMESTIC				
1. Notify key customer	WRC,HSB, TLG	12/20	12/28	
2. Mail customer notification	CP	12/15	12/16	
3. Terminate sales FR fluids		12/15	12/15	Exception -
4. Special undertaking with	WRC,JFS	2/15		
5. Organize conversion team	CP	12/15	12/15	
6. Establish returned material liability	WBP,JFS	1/15		
7. Notify Monsanto installations	WBP	1/15	1/14	CED notified on 2/1/72
8. Develop conversion bulletin	CP		Jan.	
9. Recheck off-shore installations -Gulf of Mexico	CP	2/28		
10. Notify OEM's by mail		1/31	2/15	
11. Follow-up visit to OEM's	CP	2/28		
12. Evaluate response; review policy	CP	4/1		
U. S. EXPORT				
1. Canada				
a. Notify customers	DG	1/31	12/23/71	
b. Notify governmental agencies	DG	1/31	12/28/71	
c. Notify OEM's	DG	1/31	12/28/71	
d. Terminate sales	DG	1/31		

PCB/PCT ACTION PLAN

Heat Transfer Fluids

ACTION	ASSIGNED TO	TARGET DATE	ACTUAL DATE	REMARKS
U. S. EXPORT (Cont)				
2. AIPC				
a. Notify country managers	GEW	1/31	1/20	
b. Terminate sales	GEW	1/31	1/31	
3. Latin America				
a. Notify managers	FJC	1/31	1/20	
b. Notify agents	FJC	1/31	1/19	
c. Terminate sales	FJC	1/31	1/31	
4. Australia/Asia-Pacific				
a. Notify manager	EG	1/31	1/14	
b. Terminate sales	EG	1/31	1/31	

PCB/PCT ACTION PLAN

Dielectrics

ACTION	ASSIGNED TO	TARGET DATE	ACTUAL DATE	REMARKS
U. S. DOMESTIC				
1. Notify customers of restrictive sales policy.	HSB	12/31	12/21	Six additional mailed on 1/7/72
2. Terminate sales to non-approved customers	HSB,TLG	1/15	1/14	
3. Notify customers replacement fluid available from original equipment supplier.	TLG	1/31	2/8	
4. Notify original equipment supplier he must supply replacement fluid.	TLG	1/31	2/8	
5. Notify customers using dielectrics in magnets, motors and switch gear of restrictive sales policy	TLG	1/31	2/4	
6. Notify customers of procedure for returning scrap fluid.	PGB	1/31	1/25	
U.S. EXPORT				
1. Canada				
a. Notify customers of restrictive sales policy	DG	1/31	1/6	
b. Terminate sales to non-approved customers	DG	1/31	1/31	
2. AIPC				
Latin America				
Australia/Asia Pacific				
a. Inform area directors of policy	EG		1/14	
b. Notify customers of restrictive sales policy	WAM's	1/31	1/21-31	
c. Check enforceability of hold-harmless letter in appropriate countries.				
d. Terminate sales to non-approved customers.		3/31		

TRAN 003028

PCB/PCT ACTION PLAN

Industrial Fluids

ACTION	ASSIGNED TO	TARGET DATE	ACTUAL DATE	REMARKS
Santovac				
1. Phase Out	CLB	1/1	1/1	
Turbinol				
1. Present alternate fluid to and Texas Eastern	CLB	1/31	1/31	
2. Begin field trial alternate fluid at T. E.	CLB	4/1		Field trial date will depend on length of winter and T.E.'s inventory of Turbinol 153.
3. T.E. transition to new fluid Turbinol 30E/50E literature Turbinol for bearing literature Price sheets	CLB	6/30		
Pydraul				
1. Finalize reclamation program	CLB	2/15		Being reviewed now
2. Visit top accounts	CLB	1/30	1/30	Completed-Favorable reactions of practically all accounts.
3. Mail out customer notification	CLB	1/31	1/31	
4. Selector I & II Factory Mutual approvals	CLB	2/7	2/7	
5. Visit all accounts	CLB	2/15		
6. Aroclor 6037 replacement	CLB	2/15		
7. Aroclor 5460 replacement	CLB	2/15		
8. Selector II informal price sheet	CLB	2/21		
9. Selector II, 1st literature	CLB	2/29		

Industrial Fluids

Hydraul (Cont)	Assigned TO	Target Date	Actual Date	Remarks
10. Application for approval at Bureau of Mines	CLB	3/1		
11. Finalize advertising program	CLB	3/1		
12. Formal price sheet, Selector I & II	CLB	4/1		
13. Start warehousing new fluids	CLB	4/1		
14. Stop stocking warehouses with PCT fluids	CLB	4/15		
15. Start delivering new fluids	CLB	4/15		
16. No old fluid accepted for credit after this date	CLB	5/1		
17. Stop manufacturing PCT fluids	CLB	5/1		
18. Consolidate PCT warehouse stocks	CLB	5/1		
19. Sell last of PCT fluids	CLB	5/30		
20. Bureau of Mines approval	CLB	6/1		
21. Incinerate any remaining PCT fluids	CLB	6/30		
22. Issue revised sales forecasts	CLB	2,3,4,5, 6/1	2/1	
U. S. Export				
1. Write plan to withdraw all PCT fluid sales after 6/30/72 and convert to new products.	CLB	2/15		

PCB/PCT ACTION PLAN

Plasticizers

ACTION	ASSIGNED TO	TARGET DATE	ACTUAL DATE	REMARKS
U. S. Domestic & Canada				
1. Generate withdrawal plan:				
a. Get time table approved	WSC	12/10	12/10	
b. Get "Rationale" approved	WSC	12/10	12/12	
c. Get customer/distributor letter approved	WSC	12/10	12/18	
d. Notify Plasticizer personnel	WSC	12/20	12/20	
e. Notify ex-plasticizer personnel	CP/WSC	12/20	12/20	
f. Set up controls for final shipments w/COP Dist.	WSC	12/23	12/22	
g. Set sales limits for all customers w/reg. mgrs.	Reg. Mgrs.	12/28	1/4/72	Travel schedules caused delays.
2. Customer Notification:				
a. Generate key acct. list	WSC/JDW	12/10	12/8	
b. Set up trips for Mgmt pers.	WSC	12/16	-	Delayed pending initial customer contact.
c. Mail "Withdrawal" package to field salesmen	WSC	12/17	12/16	
d. Send wire to reg. mgrs/ salesmen	WSC	12/20	12/17	
e. Make calls on regional offices	WSC	12/20	12/17-20	Done by telephone
f. Notify	WSC	12/17	12/17	
g. Key customer calls	Field Sales	12/21 12/31	12/21 12/31	
h. Contact all customers by telephone	Field Sales	12/31	1/7/72	This is probably 95-98% complete.
i. Formal customer notification by mail.	WSC	12/31	12/31	

Plasticizers

ACTION	ASSIGNED TO	TARGET DATE	ACTUAL DATE	REMARKS
U. S. Domestic & Canada (Cont)				
3. Replacement Program:	Reg.Sales			
a. Generate replacement suggestions		12/20	12/20	
b. Publish replacement info to field sales force	WSC	12/31	1/7/72	Delayed pending input from AWMC and by WSC.
c. Continued contact w/ customers	WSC/Reg.Sls. Field Sales	3/31		
4. Termination	WSC	3/31		
U. S. Export				
1. Generate withdrawal plan			12/27	Key plasticizer actions generated by Gossage, Bergen, and Corey.
a. Published letter to LePage and Simpson	WSC		12/20	
b. Notified all world area mgrs. of 3/31/72 date	WSC		12/23	
c. Detailed plan published to World Area Mgrs.	WSC		1/4/72	
2. Customer Notification:				
a. Approved letter wired to all World Area Mgrs.	WSC	?	1/19/72	
b. Letter sent to customers	WAM's	12/31		Written confirmation received on all world areas except South America and a couple of accounts in Asia Pacific.
3. Replacement Program:				
a. Generate replacement suggestion and distribute	WSC		1/10/72	
b. Continued contact w/customers	WAM's	3/31/72		
4. Termination - PCT's	WAM's	3/31/72		
- PCB's	WAM's	1/31/72	1/31/72	Australia & Latin America ceased sales on 12/31/71.

PCB/PCT ACTION PLAN

MONSANTO EJROPE

ACTION	ASSIGNED TO	TARGET DATE	ACTUAL DATE	REMARKS
1. Dielectric Fluids:				
a. Review Monsanto legal liability situation	PJM			
b. Notify customers of restricted sales policy.				
c. Terminate sales to non-approved customers		3/31		
d. Terminate sales to "service" users		3/31		
2. Heat Transfer Fluids:				
a. Notify customers of termination of sales				
b. Notify OEM's of policy				
c. Terminate Santotherm FR sales		1/31	1/31	
3. Industrial Fluids:				
a. Notify distributors of termination of PCB Pydrauls				
b. Notify Customers of termination of PCB Pydraul				
c. Notify OEM's of termination of PCB Pydrauls				
d. Terminate PCB Pydrauls		1/31	1/31	
e. Notify customers of termination of Santovac 1 and 2 Sales				
f. Terminate Santovac 1 & 2 sales		1/31	1/31	
g. Notify distributors of termination of PCT Pydrauls				
h. Notify customers of termination of PCT Pydrauls				
i. Notify OEM's of termination of PCT Pydrauls				
j. Terminate PCT Pydraul sales		6/30		
k. Develop plan for European mine applications	WRC, EJP, JM			

TRAN 003033

MONSANTO EUROPE

ACTION	ASSIGNED TO	TARGET DATE	ACTUAL DATE	REMARKS
4. Plasticizers:				
a. Notify customers of termination of non-electrical PCB sales.			1/31	
b. Terminate non-electrical PCB sales		1/31	1/31	
c. Notify customers of termination of PCT sales			1/31	
d. Terminate PCT sales		3/31		

PCB/PCT ACTION PLAN

MMK

ACTION	ASSIGNED TO	TARGET DATE	ACTUAL DATE	REMARKS
JAPAN				
1. Plasticizers				
a. Discontinue sales of PCB			12/31/71	
b. Discontinue sales of PCT		7/1		
2. Dielectric Fluids				Legal counsel advises hold-harmless letter probably not enforceable in Japan.
a. Notify customers of termination of sales				
b. Terminate sales		7/31		
3. Heat Transfer Fluids				
a. Terminate sales to new installations		3/31		Proposed exception:
4. Exports				
a. Terminate non-electrical PCB sales		1/31	1/31	
b. Terminate unapproved dielectric sales		3/31		
c. Terminate all dielectric sales		6/30		