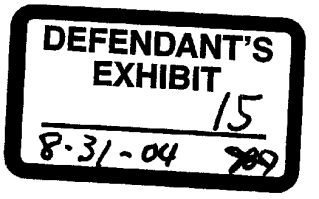
MONSANTO COMPANY
ANNISTON PLANT

STANDARD MANUFACTURING PROCESS FOR AROCLORS

July 1969



DSW 543174

COMPANY CONFIDENTIAL

Distribution:

Technical Information Center - St.L (2)
Security File - St. Louis
J. E. Smith - St. Louis
G. L. Jessee
J. L. Corder
G. W. Miller
H. E. Schulte
Technical Services (3)
D. Danna - St. Louis (3)
Plant Standards Dept. (Extras)

APPROVAL OF SAFETY REVIEW COMMITTEE

H. E. Schulte

T. W. Lawrence

J. C. Landwehr

MONSANTO COMPANY
ANNISTON PLANT

13 JAN 71

TENTATIVE AMENDMENT "F"

TO

AROCLOR STANDARD MANUFACTURING PROCESS

Dated Jul 69

TITLE: PRODUCE AROCLOR 5068

OBJECTIVE: To produce Aroclor 5068 in the existing solid Aroclor system.

PRESENT PROCEDURE: Aroclor 5068 has not been produced in plant equipment before and there has been no previously established procedure to follow.

PROPOSED AMENDMENT: Make a test batch of Aroclor 5068 in existing solid Aroclor equipment.

The process changes will be conducted as follows:

a. Approximately 8500 pounds Santowax R will be chlorinated to 60% by weight chlorine by standard operating procedures.

b. At approximately 60% chlorine, 5 pounds more catalyst will be added to the chlorinator to increase chlorine efficiency. As the batch proceeds, this procedure may be repeated to keep chlorine efficiency at an acceptable level.

DSW 543175

PROPOSED AMENDMENT: continued

c. Chlorine feed rates will be controlled so that the temperature of the batch remains approximately 260°C. to 280°C. and free chlorine in the off-gas is kept at a minimum.

d. At approximately 65% chlorine by weight and a softening point of 130°C., three or four 50-gallon drums of material will be removed from the chlorinator to be used in producing 5465.

e. Throughout the batch from 60% chlorine to 68% chlorine, hourly samples of off-gas and product will be taken to assist in design of a full production system.

f. When the softening point of the batch reaches 150°C. to 160°C., the chlorine feed will be stopped.

g. The batch will be transferred to the blow tank and air blown before being drummed out of the blow tank.

h. The product will be allowed to solidify and then will be ground to a powder for shipment to potential customers.

SOURCE OF DATA:

Anniston PR&D work (letter from G. L. Arnett to Aroclor 5068 file dated 1/11/71).

SAFETY:

There is one main potential safety problem created by this test. As the weight per cent chlorine increases, the rate of reaction will decrease and free chlorine will be released in the off gas. This free chlorine poses two potential problems:

1. The possibility of chlorine and steel combustion at temperatures above 250°C. in the off gas lines. To cope with this problem, temperatures will be watched closely and water will be sprayed on the lines to cool the steel if needed.

2. The possibility of too much free chlorine being released to the atmosphere. All process variables will be closely watched and controlled to keep the free chlorine released to the atmosphere at a minimum. However, if the free chlorine released to the atmosphere reaches an intolerable amount, the test will be discontinued.

QUALITY:

This material is requested by the Textiles Division and they require a softening point of $\geq$ 150°C. and that no lime be added to neutralize any entrained HCl.

EXTENT OF TRIAL:

A plant test batch will be made the week of January 25, 1971 and the data from this test will be evaluated before any further tests are made.

Originated by: Gary L. Moore
Gary L. Moore

:kd

DSW 543177

APPROVALS:

Department Supervisor: G. M. Miller — 1-14-71 Date

Production Superintendent: J. L. Corder — 1-15-71 Date

Plant Manager: G. L. Jessee — 1-18-71 Date

PR&D Group Leader: J. L. Brown — 1-14-71 Date

Research Group Leader: Master copy signed by J. W. Baker — 1-20-71 Date
J. W. Baker

Mgr. of Research & Dev.: Master copy signed by W. R. Richard — 1-20-71 Date
W. R. Richard

Manufacturing Manager: Master copy signed by J. R. Savage — 1-18-71 Date
J. R. Savage

DSW 543178

COMPANY CONFIDENTIAL

Distribution:

Technical Information Center - St. L (2)
Security File - St. L
J. E. Smith - St. L
G. L. Jessee
J. L. Corder
G. W. Miller
H. E. Schulte
Technical Services (3)
D. Danna - St. L (3)
Plant Standards Dept. (Extras)

APPROVAL OF SAFETY REVIEW COMMITTEE

Signed by H. E. Schulte
H. E. Schulte

Signed by T. W. Lawrence
T. W. Lawrence

Signed by J. C. Landwehr
J. C. Landwehr

MONSANTO COMPANY
ANNISTON PLANT

28 Apr 71

TENTATIVE AMENDMENT "G"

AROCLOR STANDARD MANUFACTURING PROCESS
Dated July 69

TITLE: PRODUCE AROCLOR 5465

OBJECTIVE: To produce Aroclor 5465 in the existing solid Aroclor system

PRESENT PROCEDURE: Aroclor 5465 has not been produced in plant equipment before and there has been no previously established procedure to follow.

PROPOSED AMENDMENT: Make a test run of Aroclor 5465 in existing solid Aroclor equipment

The proposed process changes are as follows:

1. Aroclor 5065 will be produced in #9 chlorinator as described in Tentative Amendment "F" dated 1/13/71.

2. Each A-5065 batch in the chlorinator will be followed immediately by an A-5032 charge preheated in the blow tank. (Similar precautions as used when producing A-1168 will be used to minimize line pluggage.) The A-5032 will then be chlorinated to A-5065.

DSW 543179

PROPOSED AMENDMENT: (cont'd.)

3. The distillation will be carried out as normal with A-5460 and within the standard process limits (5-20 mm Hg absolute pressure and 340-400°C). 400°C will be considered the maximum allowed temperature cut-off for the distillation of A-5465. The still vacuum system will be checked for its ability to reach 10 mm Hg prior to starting the test batch.

4. The distilled product will be flaked and packaged in bags or drums for evaluation purposes.

For a plant run of A-5465, the following schedule is proposed to reduce #9 chlorinator cycle and to keep the chlorinator system flushed out:

1. 1st Batch

   a. Produce A-5065 in #9 chlorinator, starting as normal.

   b. Transfer directly to #4 still as in A-1268 production.

   c. Distill under normal A-5460 conditions after vacuum degasing and lime addition. Maximum temperature, 400°C.

   d. Draw bottoms at end of distillation.

2. 2nd Batch

   a. Produce A-5032 in any other chlorinator (#2, #4, #10, #11).

   b. Transfer to #2 blow tank and hold hot.

   c. Follow first batch A-5065 in #9 chlorinator with hot A-5032 from #2 blow tank.

   d. Chlorinate A-5032 to A-5065.

   e. Transfer directly to #4 still and complete as in first batch.

3. 3rd, 4th, etc. Batches

   Same as 2nd batch.

4. Last batch of a A-5465 run

   a. Follow with A-5032 as in second batch.

   b. Chlorinate to 5060.

   c. Follow last still batch of A-5465 with A-5060.

   d. Distill as normal and finish through system to flush out.

SOURCE OF DATA:

Anniston PR&D work,

1. Letter from G. L. Arnett to A-5068 file, dated 1/11/71.

2. Mid-month report - G. L. Arnett (J. L. Brown) to J. C. Landwehr, dated 3/16/71. (See attached sheet.)

SAFETY:

There is only one main potential safety problem created by this test. Near the end of the chlorination, the rate of reaction decreases and the potential for higher free Cl_2 in the off gases will exist (discussed in Tentative Amendment "F" issued for the production of Aroclor 5068). During the plant run of A-5068 the free chlorine level in the off gas was kept low by addition of extra catalyst at the 60% chlorination level. The previous precautions will be repeated for production of A-5065.

No safety changes are expected in the distillation area due to using existing temperature limits.

JUSTIFICATION:

A plant run of Aroclor 5465 is necessary to obtain quantities sufficient to develop market feasibility and obtain operating experience to develop production economics. A potential magnitude of justification should be obtained from Marketing if necessary for initial plant tests. Some sample orders have been filled with lab produced A-5465 but numerous sample orders are now being held for lack of material.

QUALITY:

The following properties will be monitored during chlorination and distillation:

1. Crude Aroclor softening point (130 - 135°C at end of chlorination)

2. Distilled Aroclor softening point (121 - 129°C)

3. Distilled Aroclor 5465 color (2.5 NPA Max.)

Exact specs will not be set until after plant demonstration. The above data is based on the tentative specs issued from initial lab data.

OPERATIONS:

There are two known potential operating problems, both of which could add to downtime and mechanical expense.

OPERATIONS: (cont'd.)

1. Pluggage of piping and equipment associated with #9 chlorinator system

   Following the plant batch of Aroclor 5068, the chlorinator cooler, pumps and piping were plugged solid and required complete dismantling for cleaning. An attempt to flush the chlorinator system with a small volume of liquid Aroclor apparently failed. The system was shut down for four days following the A-5068 run and prior to discovering the pluggage. By immediately following any future batch of A-5065 or A-5068 with a preheated charge of A-5032, we hope to solve the chlorinator pluggage problems.

2. Thicker Montar following A-5465 distillation

   Although lab data indicates no adverse Montar conditions, it is felt that decomposition during distillation is much more significant in the plant and that thicker Montars are highly probable. Likewise, a higher potential for plugging the still pump, coil or piping will exist.

EXTENT OF TRIAL:

Three to five plant batches should be produced to prove or disprove a plant process. Plant tests will be scheduled upon approval of this tentative amendment and the ability of Anniston Production to fit into current requirements.

Originated by: K. G. Hale
K. G. Hale

/dp

Att: Lab distillation data

DSW 543182

Distillation No. 1 *Aroclor 5065 (S.P. 130°C)

	Vacuum (mm)	Pot Temp. °C	Head Temp. °C
1st Drop	9	354	300
Approx. 85%	9	376	340
Dist. Completed	9	400	345

Distillation Yield = 85.8% (5465)
Softening Point of Aroclor 5465 - 123°C Color = 2.0 NPA
Softening Point of Montar (Dist. Bottoms) = 208°C

Distillation No. 2 *Aroclor 5065 (S.P. 130°C)

	Vacuum (mm)	Pot Temp. °C	Head Temp. °C
1st Drop	20	365	325
Dist. Completed	20	400	355

Distillation Yield = 85.8% (5465)
Softening Point of Aroclor 5465 = 123°C Color = 2.0 NPA
Bottoms from this distillation were left in still and mixed with distillation No. 3 to duplicate plant conditions.

Distillation No. 3 *Aroclor 5065 (S.P. 130°C)

	Vacuum (mm)	Pot Temp. °C	Head Temp. °C
1st Drop	5	332	285
Last Portion Over	5	380	335

Distillation was stopped at 380°C pot temperature due to distillate turning black.

Distillation Yield = 88.1% (5465)
Softening Point of Aroclor 5465 = 123° Color = 2.0 NPA
Softening Point of Montar (comp. of 2 and 3) = 202°C

Distillation No. 4 *Aroclor 5065 (S.P. 130°C)

	Vacuum (mm)	Pot Temp °C	Head Temp. °C
1st Drop	15	360	325
Dist. Complete	15	400	365

Distillation Yield = 84.8% (5465)
Softening Point of Aroclor 5465 = 123°C Color = 2.0 NPA
Softening Point of Montar = 210°C

*All Aroclor 5065 material was obtained from the plant chlorination run of Aroclor 5068 (chlorination was stopped at a softening point of 130°C to obtain two drums for experimental purposes).

DSW 543183

APPROVALS:

Department Supervisor	Original signed by G. W. Miller G. W. Miller	5/10/71 Date
Production Superintendent	Original signed by Jesse L. Corder J. L. Corder	5/19/71 Date
Plant Manager	Original signed by G. L. Jessee G. L. Jessee	5/21/71 Date
PR&D Group Leader	Original signed by J. L. Brown J. L. Brown	5/24/71 Date
Research Group Leader	Original signed by Q. E. Thompson Q. E. Thompson	5/25/71 Date
Manager of Res. and Dev.	Original signed by W. R. Richard W. R. Richard	5/25/71 Date
Manufacturing Manager	Original signed by J. R. Savage J. R. Savage	5/26/71 Date

COMPANY CONFIDENTIAL

Distribution:

Technical Information Center - St.L (2)
Security File - St. Louis
J. E. Smith - St. Louis
G. L. Jessee
J. L. Corder
C. W. Miller
H. E. Schulte
Technical Services (3)
D. Danna - St. Louis (3)
Plant Standards Dept. (Extras)

APPROVAL OF SAFETY REVIEW COMMITTEE

Master signed by H. E. Schulte
H. E. Schulte

Master signed by T. W. Lawrence, Jr.
T. W. Lawrence

Master signed by J. C. Landwehr
J. C. Landwehr

MONSANTO COMPANY
ANNISTON PLANT

13 OCT 70

TENTATIVE AMENDMENT "E"

TO

AROCLOR STANDARD MANUFACTURING PROCESS

Dated Jul 69

TITLE: INCREASE CHLORINATION EFFICIENCY IN THE PRODUCTION OF SOLID AROCLOR 5060 BY USING ALUMINUM CHLORIDE AND/OR POWDERED ALUMINUM METAL AS THE CATALYST.

OBJECTIVE: To increase the efficiency of the Aroclor 5060 chlorination to alleviate free chlorine in the by-product hydrogen chloride gas.

PRESENT PROCEDURE: Santowax R is preheated to 150°C., mixed with 0.05% ferric chloride, and charged to a batch chlorinator from a weigh tank. Chlorine gas is added until the desired softening point is attained. Both chlorine flow and reaction mass temperature are closely controlled at 3000 #/hr. max. and 250°C. max. respectively.

It is then transferred to an air blowing tank to remove the hydrogen chloride gas before charging to the still.

Vacuum distillation is carried out in the presence of 0.5% lime and then the product is flaked, bagged and drummed for storage before sales.

DSW 543185

PROPOSED AMENDMENT:

Santowax R will be chlorinated using 0.05% aluminum chloride and/or powdered aluminum as the catalyst. The test will be carried out on normal plant batch chlorinations.

The process changes will be conducted as follows:

a) 0.05% (approximately 5.5 pounds) of aluminum chloride and/or powdered aluminum will be added to the Santowax R in the charge tank.

b) After proceeding with the batch as a normal chlorination batch, immediate improvement in the amount of free chlorine in the product hydrogen chloride off gas should be noted.

SOURCE OF DATA:

Anniston PR&D Report No. 1 of Job No. 446-507, 1-22-69.

SAFETY:

Aluminum chloride must be handled so as not to contaminate it with water, because HCl will be liberated.

Powdered aluminum does burn, but under plant conditions will not cause any new safety problems.

QUALITY:

Chlorinations using aluminum chloride and/or aluminum metal does slightly change the isomer content of the product. This does not change the final material specifications of the product. However, this slight change in isomer content makes Aroclor 5460 more closely resemble the isomer content of our foreign competitors, Bayer and Kanegafuchi, and therefore doesn't change any desired properties of our Aroclor 5460.

EXTENT OF TRIAL:

A drop in the free chlorine should be immediately noticeable; however, the normal six month trial period is requested to assure sufficient time to run further tests after evaluating the first.

Originated by: Gary L. Moore
Gary L. Moore

:kd

DSW 543186

APPROVALS:

Department Supervisor:	Master signed by G. W. Miller G. W. Miller	10/14/70 Date
Production Superintendent:	Master signed by J. L. Corder J. L. Corder	10/14/70 Date
Plant Manager:	Master signed by G. L. Jessee G. L. Jessee	10/14/70 Date
PR&D Group Leader:	Master signed by J. L. Brown J. L. Brown	10/14/70 Date
Research Group Leader:	Master signed by J. W. Baker J. W. Baker	10/27/70 Date
Mgr. of Research & Dev.:	Master signed by M. W. Farrar M. W. Farrar	10/28/70 Date
Manufacturing Manager:	Master signed by J. R. Savage J. R. Savage	10/29/70 Date

COMPANY CONFIDENTIAL

Distribution:

Technical Information Center - St. L(2)
Security File - St. Louis
J. E. Smith - St. Louis
G. L. Jessee
J. L. Corder
G. W. Miller
H. E. Schulte
Technical Services (3)
D. Danna - St. Louis (3)
Plant Standards Dept. (Extras)

TMA Copy Per

APPROVAL OF SAFETY REVIEW COMMITTEE

Master copy signed by H. E. Schulte
H. E. Schulte

Master copy signed by P. K. Ward
P. K. Ward

Master copy signed for J.C.Landwehr
J. C. Landwehr by V.R.H.

MONSANTO COMPANY
ANNISTON PLANT

17 Jul 70

TENTATIVE AMENDMENT "D"

TO

AROCLOR STANDARD MANUFACTURING PROCESS

Dated Jul 69

TITLE: PRODUCTION OF AROCLOR 5432

OBJECTIVE: To produce Aroclor 5432 in the existing Solid Aroclor system

PRESENT PROCEDURE: Aroclor 5432 has not been produced in plant equipment before and there has been no previously established procedure to follow.

PROPOSED AMENDMENT: Follow the standard operating instructions for producing Aroclor 5442 with the following exceptions. Chlorination level can be monitored by checking product specific gravity at 90°C. To produce a final distilled product within the specified 1.263-1.290 gravity range (30.5-33% chlorine), the chlorinators should be finished between 1.273-1.300 gravity units.

DSW 543188

Tentative Amendment "D"
Aroclor Standard Mfg. Process
Dated Jul 69

SOURCE OF DATE:

a) Anniston PR&D Report No. 1 of Job No. 446-515, 5-26-70

b) Letter P. D. Fowlkes to G. L. Arnett on Aroclor 5432 specs 7-15-70

SAFETY: The amended process has no effect on safety of operation. Normal department safety practices will be followed.

QUALITY: The following properties will be monitored during chlorination and distillation:

a) Crude Aroclor specific gravity, 1.273-1.300 gravity units at 90°C.

b) Distilled Aroclor specific gravity, 1.263-1.290 gravity units at 90°C.

c) Distilled Aroclor color, $\leq$2 NPA

EXTENT OF TRIAL:

An initial plant demonstration run will be made the last week of Jul '70. The normal six month trial period is needed to make any minor spec. changes to assure compatibility of Aroclor 5432 with the components of the various Aroclor blends Aroclor 5432 will be used to make.

Originated by: C R McIlwain and V. R. Haupt
C. R. McIlwain and V. R. Haupt

:kd

DSW 543189

APPROVALS:

Department Supervisor Master copy signed by G. W. Miller 7/20/70
G. W. Miller Date

Production Superintendent Master copy signed by H. L. Williams 7/20/70
H. L. Williams Date

Plant Manager Master copy signed for G.L. Jessee by L.C.L. 7/20/70
G. L. Jessee Date

PR&D Group Leader Master copy signed by J. L. Brown 7/20/70
J. L. Brown Date

Research Group Leader: Master copy signed by J. W. Baker 7/29/70
J. W. Baker Date

Mgr. of Research & Dev.: Master copy signed by M. W. Farrar 7/30/70
M. W. Farrar Date

Manufacturing Manager: Master copy signed by J. E. Smith 7/22/70
J. E. Smith Date

DSW 543190

COMPANY CONFIDENTIAL

Distribution:

Technical Information Center - St.L(2)
Security File - St. Louis
J. E. Smith - St. Louis
G. L. Jessee
J. L. Corder
G. W. Miller
H. E. Schulte
Technical Services (3)
D. Danna - St. Louis (3)
Plant Standards Dept. (Extras)

APPROVAL OF SAFETY REVIEW COMMITTEE

Master copy signed by H. E. Schulte
H. E. Schulte

Master copy signed by P. K. Ward
P. K. Ward

Master copy signed by V.R.H. for Landwehr
J. C. Landwehr

MONSANTO COMPANY
ANNISTON PLANT

14 Jul 70

TENTATIVE AMENDMENT "C"

TO

AROCLOR STANDARD MANUFACTURING PROCESS

Dated Jul 69

TITLE: USE SODIUM HYDROXIDE TO PRODUCE LOW COLOR SOLID AROCLOR 5460

OBJECTIVE: To produce Aroclor 5460 with a color less than 1.25 NPA

PRESENT PROCEDURE:

Santowax R is preheated to 150°C., mixed with 0.05% ferric chloride, and charged to a batch chlorinator from a weigh tank. Chlorine gas is added until the desired softening point is attained. Both chlorine flow and reaction mass temperature are closely controlled at 3000 #/hr. max. and 250°C. max. respectively.

It is then transferred to an air blowing tank to remove the hydrogen chloride gas before charging to the still.

Vacuum distillation is carried out in the presence of 0.5% lime and then the product is flaked, bagged and drummed for storage before sales.

DSW 543191

PROPOSED AMENDMENT:

Aroclor 5460 will be vacuum distilled in the presence of 0.5% lime and up to 2.5% sodium hydroxide.

The test will be carried out on the smaller still (No. 4) to minimize the pounds of intermediate color Aroclor 5460 and to minimize the risk (loss of production) of corrosion of caustic on the steel equipment.

The distillation step will be modified as follows:

a) Air blow 5060 for a minimum of 1 hour

b) Charge still and pull vacuum before adding lime and sodium hydroxide

c) Vent still and add 250 lbs. of lime and 250 lbs. of flaked sodium hydroxide

d) Begin heatup. When temperature reaches 318°C. (melting point of sodium hydroxide) in the still, hold temperature for 10 minutes

e) After 10 minute hold period, follow normal operating procedure until distillation is complete

f) Draw bottoms immediately after every batch. Solidification of sodium hydroxide begins at 318°C.

g) Repeat steps a-f using 2.5% (625 lbs.) sodium hydroxide. The system should now be flushed out

h) Intermediate color 5460 produced during flushing operation will be segregated from normal and low color 5460. It will be blended with darker 5460 to prevent regular customers from receiving this improved color product

i) Run up to 10 batches using 625 lbs. of sodium hydroxide.

SOURCE OF DATA:

a) Anniston PR&D Report No. 2 of Job No. 446-507, 9-30-69.

b) Teletype from O. Siebert indicates no corrosion problems encountered using sodium hydroxide; dated 5 Dec '69.

SAFETY:

Bottoms will contain hot caustic. Faceshield must be worn when drawing bottoms. Discard drums at plant dump. Standard safety procedures will be used in handling the anhydrous sodium hydroxide. Caustic left in an opened drum after a still has been charged will not be used in the next charge. Wet caustic will not be used at any time during the test to prevent the instantaneous formation of steam upon addition to the still batch (240°C.).

DSW 543192

QUALITY:

The color and other properties of Aroclor 5460 will be monitored closely during the test. All intermediate color 5460 will be segregated. Montar 5 (bottoms) produced will be checked for alkalinity.

Samples of the Santowax R and resultant Aroclor 5460 will be analyzed for effect on caustic treatment on the biphenyl, PCB contents.

EXTENT OF TRIAL:

Color improvement should be noticeable almost immediately. A one to two week trial should be sufficient to determine whether any further work is required. However, the normal six month trial period is needed to assure sufficient time to run further tests depending on the results of the first test.

Originated by: Master copy signed by C. R. McIlwain V. R. Haupt
C. R. McIlwain and V. R. Haupt

APPROVALS:

Department Supervisor	Master copy signed by: G. W. Miller G. W. Miller	7/23/70 Date
Production Superintendent	J. L. Corder J. L. Corder	7/29/70 Date
Plant Manager	G. L. Jessee by L.C.L. G. L. Jessee	7/23/70 Date
PR&D Group Leader	J. L. Brown J. L. Brown	7/23/70 Date
Research Group Leader	J. W. Baker J. W. Baker	8/24/70 Date
Mgr. of Research & Dev.	M. W. Farrar M. W. Farrar	8/24/70 Date
Manufacturing Manager	J. E. Smith J. E. Smith	8/26/70 Date

DSW 543193

Distribution:

Technical Information Center - St. Louis (2)
Security File - St. Louis
W. A. Kuhn - St. Louis
W. B. Papageorge
H. L. Williams
R. A. Haydel
C. K. Eastman
Technical Services (3)
D. Danna (3)
Plant Standards Department (Extras)

Approval Of Safety Review Committee

C. K. Eastman

P. K. Ward

J. C. Landwehr

MONSANTO COMPANY
ANNISTON PLANT

April 29, 1969

TENTATIVE AMENDMENT "B"

TO

AROCLOR STANDARD MANUFACTURING PROCESS

Dated: October, 1968

TITLE: Reduce lime concentration in Liquid Aroclor stills to increase yields

OBJECTIVE:

To increase the Liquid Aroclor yield to 98% by changing the distillation procedure.

PRESENT PROCEDURE:

Liquid Aroclors are produced by semi-continuous distillation of the crude material. A batch is considered to be 1,000 gallons of distilled product.

The present procedure is to add 250 lbs. of lime to the first batch of each run. The still is then operated with continuous feed for five batches. At this point 250 lbs. of lime is again added to the still. The distillation run is then continued until the tenth batch. Then the feed is discontinued and the level in the still is boiled down to a 20% still level before the bottoms are discarded.

DSW 543194

PROPOSED AMENDMENT:

The W. G. Krummrich Plant presently adds 150 lbs. for each 15 batches and runs for 30 batches before dropping bottoms. Anniston Plant PR&D work indicates that it is possible to reduce the lime addition even further than this.

It is proposed that a plant test be conducted to determine how many batches can be distilled before lack of lime effects the product. In this test 150 lbs. of lime will be added to the still and product distilled until a degradation of color, thermal chlorides, or electrical properties develops. Then 150 lbs. of additional lime will be added and the test continued until product quality begins to deteriorate or until the still bottoms become too viscous as noted by increased still pump current.

SOURCE OF DATA:

Anniston PR&D Report No. 1 of Job No. 913.70: 446506; 3/17/69.

SAFETY:

The amended process has no effect on safety of operation.

QUALITY:

The quality of Aroclor produced will be monitored closely.

No off-grade material will be allowed in the storage tanks.

EXTENT OF TRIAL:

The proposed lime concentration will be maintained until the effects are noted. Two or three runs should be sufficient to determine the maximum number of batches possible without additional lime. The test will run for the normal 6 month trial period, however, to determine long range effects.

Originated by: Edward E Bowles
E. E. Bowles

jw

DSW 543195

APPROVAL

Department Supervisor	R. A. Haydel R. A. Haydel	5/5/69 Date
Production Superintendent	H. L. Williams H. L. Williams	5/5/69 Date
Plant Manager	W B Papageorge W. B. Papageorge	5-6-69 Date
Research Group Leader	M. E. Gibbs/sw M. E. Gibbs	5/26/69 Date
Research Manager	W. R. Richards/sw W. R. Richards	5/22/69 Date
Technical Production Manager	W. A. Kuhn/sw W. A. Kuhn	5/27/69 Date

DSW 543196

COMPANY CONFIDENTIAL

Distribution:

Technical Information Center - St. Louis (2)
Security File - St. Louis
W. A. Kuhn - St. Louis
W. B. Papageorge
H. L. Williams
R. A. Haydel
C. K. Eastman
Technical Services (3)
Plant Standards Dept. (Extras)

MONSANTO COMPANY
ANNISTON PLANT

October 28, 1969

FINAL AMENDMENT "2"

TO

AROCLOR STANDARD MANUFACTURING PROCESS

Dated August 1969

TITLE: Discontinue Earth Treatment of Non-Electrical Grade Aroclors 1221, 1248, 1262.

BACKGROUND:

Treatment of electrical Aroclors is done in order to remove ionic impurities from the Aroclors and upgrade electrical properties. Historically, non-electrical Aroclors have likewise been treated at Anniston due to the fact that all Aroclors shared common lines and tanks and possibility of contamination was quite high. Recent additions to Aroclor Department, a tank farm and porocel treatment facilities, have effectively segregated individual Aroclors downstream of the treatment facilities making it unnecessary to treat non-electrical Aroclors.

DSW 543197

PRESENT SITUATION:

Earth treatment of non-electrical Aroclors (Aroclors 1221, 1248, 1262) is discontinued. Electrical Aroclors (Aroclors 1242, 1254, 1260) are treated by passage through columns packed with porocel (activated bauxite).

SOURCE OF DATA:

1) Memo - L. R. Stark to R. A. Haydel on October 3, 1969, stating that applications tests of untreated Aroclor 1248 in Pydraul fluids indicated no diverse effect.

2) Memo - N. W. Touchette to Cumming Paton on September 30, 1969, stating that applications testing of untreated Aroclors 1248 and 1262 in polysulfide formulations showed the material to be acceptable for use in the formulations.

3) Memo - C. Paton to J. E. Smith on September 15, 1969, stating that untreated Aroclor 1221 was acceptable.

SAFETY:

This process change has no effect on the safety of the operations.

QUALITY:

Applications testing of the untreated Aroclors disclosed no quality problems.

R. A. Haydel
Department Supervisor

:md

DSW 543198

CONFIDENTIAL

DSW 543199

MONSANTO COMPANY
ORGANIC CHEMICALS DIVISION
ANNISTON, ALABAMA

STANDARD MANUFACTURING PROCESS

FOR

AROCLORS

Revised by: R. A. Haydel
Prod. Supervisor

Approved by: H. L. Williams
Prod. Superintendent

Issued: July 1969

COPY NO. 3

Supersedes - Standard Manufacturing Process for Aroclors issued September 1966

DSW 543200

STANDARD MANUFACTURING PROCESS
FOR
AROCLORS

DISTRIBUTION

	Copy Number
Plant Manager	1
Production Superintendent	2
Production Supervisor	3
Maintenance Superintendent	4
Technical Production Manager	5
Organic Division Mgr. Foreign Manuf. (on common products only)	6, 7, 8
Technical Information Center	9, 10
Security File	11
Technical Services Department	12, 13, 14
Plant Standards Department	Extras Copies

DSW 543201

STANDARD MANUFACTURING PROCESS
FOR
AROCLORS

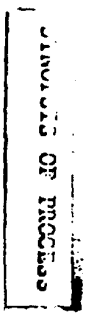
TABLE OF CONTENTS

STANDARD MANUFACTURING PROCESS
FOR
AROCLORS

AMENDING RECORD SHEET

AMENDMENT NO.	TITLE OR DESCRIPTION	DATE	DISPOSITION
A.	Packed Bed Treatment of Electrical Grade Aroclors	5/18/67	Accepted
B.	High Temperature Chlorination	12/27/67	Never Tried
B.	Reduce Lime Concentration in Liquid Aroclor Stills to Increase Yields	10/1968	

DSW 543203



DSW 543204

STANDARD MANUFACTURING PROCESS
FOR
AROCLORS

I. SYNOPSIS OF PROCESS

Aroclors are the reaction products formed by chlorination of Biphenyl and/or Terphenyls using Ferric Chloride Catalyst. The by-product HCl gas produced is absorbed in water to produce Muriatic Acid. Crude Aroclors are produced in the chlorinators, air blown, distilled, earth or Bauxite treated, filtered and loaded for shipment.

Aroclor is a trade name used to designate chlorination products of Biphenyl, Terphenyls, or mixtures of the two. The physical properties vary from light free-flowing liquids to crystalline and non-crystalline solids. Depending on the degree of chlorination and the composition of the raw materials, Santowax R, and mixtures of Biphenyl and Santowax R, or Biphenyl and Santowax C, yield products of increasing viscosity up to non-crystalline resins.

A numerical system of nomenclature, consisting of four digits, has been developed for identifying the Aroclors. The thousands digit denotes the raw material used in the chlorination. The figure 1--- indicates 100% technical grade Biphenyl. The hundreds digit denotes whether or not the product is distilled. The -1-- indicates undistilled, and the figure -2-- indicates distilled. The tens and units digit denote the approximate percentage of chlorine contained in the finished product. For example, 1260 is a distilled chlorinated Biphenyl containing 60% chlorine.

There are deviations from the above nomenclature when Solid Aroclors are produced. These are listed below:

1. Aroclors 4065 and 4465

   Aroclor 4065 is the crude and 4465 is obtained by distillation. The starting raw material contains 40% Santowax R and 60% technical Biphenyl. This is chlorinated to 65%. Since January 1969, this product is now produced by blending Aroclor 1262 and Aroclor 5460 in approximately equal proportions.

2. Aroclors 5060 and 5460

   Aroclor 5060 is the crude from which Aroclor 5460 is distilled. The starting raw material is 100% Santowax R which is chlorinated to 60%.

3. Aroclor 5042 and 5442

   Aroclor 5042 is the crude from which Aroclor 5442 is distilled. The starting raw material is 100% Santowax R which is chlorinated to 42%.

4. Aroclor 2565

This is an undistilled product. The starting raw material consists of 25% Santowax C and 75% technical Biphenyl. This is chlorinated to 65%.

Chlorinator Area

There are four batch operated liquid chlorinators, one batch operated solid chlorinator, and one continuous operated chlorinator system. The continuous system consists of four batch chlorinators cascaded with overflow from one unit to the next. The product from the last stage is the finished crude Aroclor.

Batch operated liquid chlorinators are charged with 3,000 pounds of Biphenyl with 1-1/2 pounds of Ferric Chloride Catalyst. Charges for the solid chlorinator vary dependent upon the Aroclor to be produced. Chlorine gas added through a distributor plate reacts with the raw material to release HCl and heat. The HCl gas goes to the Muriatic Acid Department. Heat is taken away by use of external air cooled heat exchangers. The specific gravity of the crude is checked after chlorine feed has been on for four hours, again when 80% chlorinated, as indicated by alarm, and as needed thereafter.

In the continuous chlorination system, Biphenyl is fed to the first stage and chlorinated. Crude Aroclor overflows to the second stage, etc., until the final product overflows from the last stage. Each chlorinator is held at a different level of chlorination with the last stage being the final crude Aroclor desired. Normally, Aroclor 1142 is produced in this system.

Crude Aroclors from the batch chlorinators and the continuous system are transferred to a blowing tank to be air blown for one (1) hour minimum before distillation.

Still Area

Liquid Aroclors

Aerated Aroclors from a blowing tank or a feed tank are charged to a still, hydrated lime is added, a vacuum of 720 mm Hg (40 mm Hg absolute) is applied, the still furnace is fired, and the Aroclor is distilled into a receiver. The distillation is semi-continuous, since up to ten (10) receivers are distilled prior to drawing bottoms or residue from the still. Every two receivers (or approximately 2,000 gallons) are treated with 40 lbs. of earth for two hours and then filtered. The finished product is transferred to storage tanks prior to loading into drums or tank cars.

In 1967, an experimental absorption column was installed to treat Aroclor 1242 by passage through a bauxite bed to improve electrical qualities. This was designed as an alternate to earth treating the Aroclors. The column proved successful on 1242 and the bauxite column treatment is expected to replace earth treatment in the near future.

Solid Aroclors

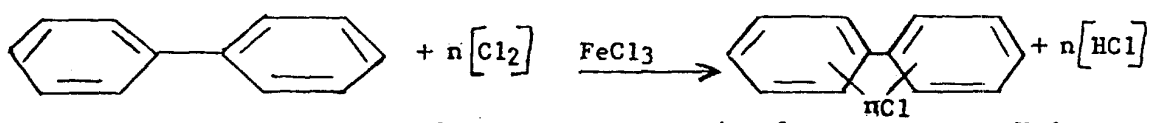
Solid Aroclors are distilled in a similar manner to Liquid Aroclors except for 1168. Aroclor 1168 is not air blown and is charged directly to the still from the chlorinator. A vacuum of 4 mm Hg absolute is applied for distillation. Solid Aroclors have one to four receivers distilled prior to drawing bottoms in the still. This is dependent upon the particular Aroclor being produced and also on which still system (No. 4 or 1) is being used.

Solid Aroclors are not earth treated or filtered. They are drummed directly from the flaker hold tank or are flaked (Aroclors 1268 and 5460).

Chemical Equations

Liquid Aroclors

The general equation for the chlorination of biphenyl to produce liquid Aroclors is as follows:



Biphenyl	Chlorine	Aroclor	Hydrogen Chloride
154.2	70.9	(193.8 - 387.8)	36.5

Where n varies from 1.15 for Aroclor 1221 to 6.8 for Aroclor 1262

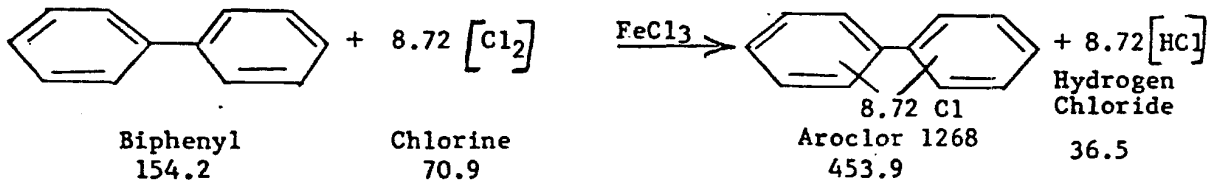
Aroclors 1221, 1232, 1242, 1248, 1254, 1260, and 1262 are produced in Anniston's liquid Aroclor systems.

DSW 543207

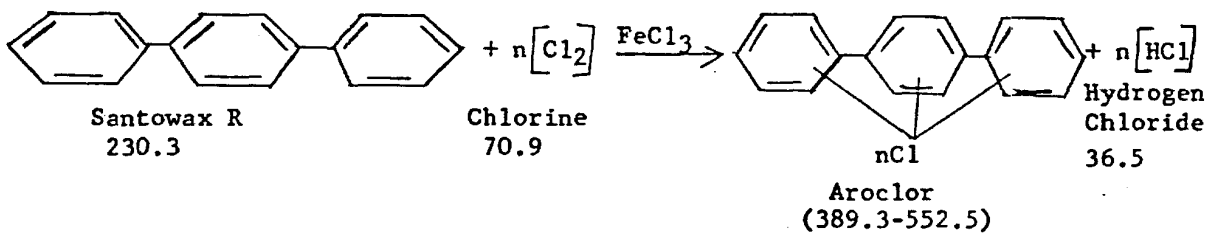
Solid Aroclors

Following are equations for Biphenyl and Santowax R based Solid Aroclors:

Biphenyl based Aroclor - 1268



Santowax R based Aroclor-5442 & 5460



n = 4.63 for 5442 and 9.4 for 5460

Also produced at Anniston are 2565 - a chlorinated mixture of Biphenyl and Santowax C, and 4465 - a blend of Aroclor 1262 and Aroclor 5460.

DSW 543208

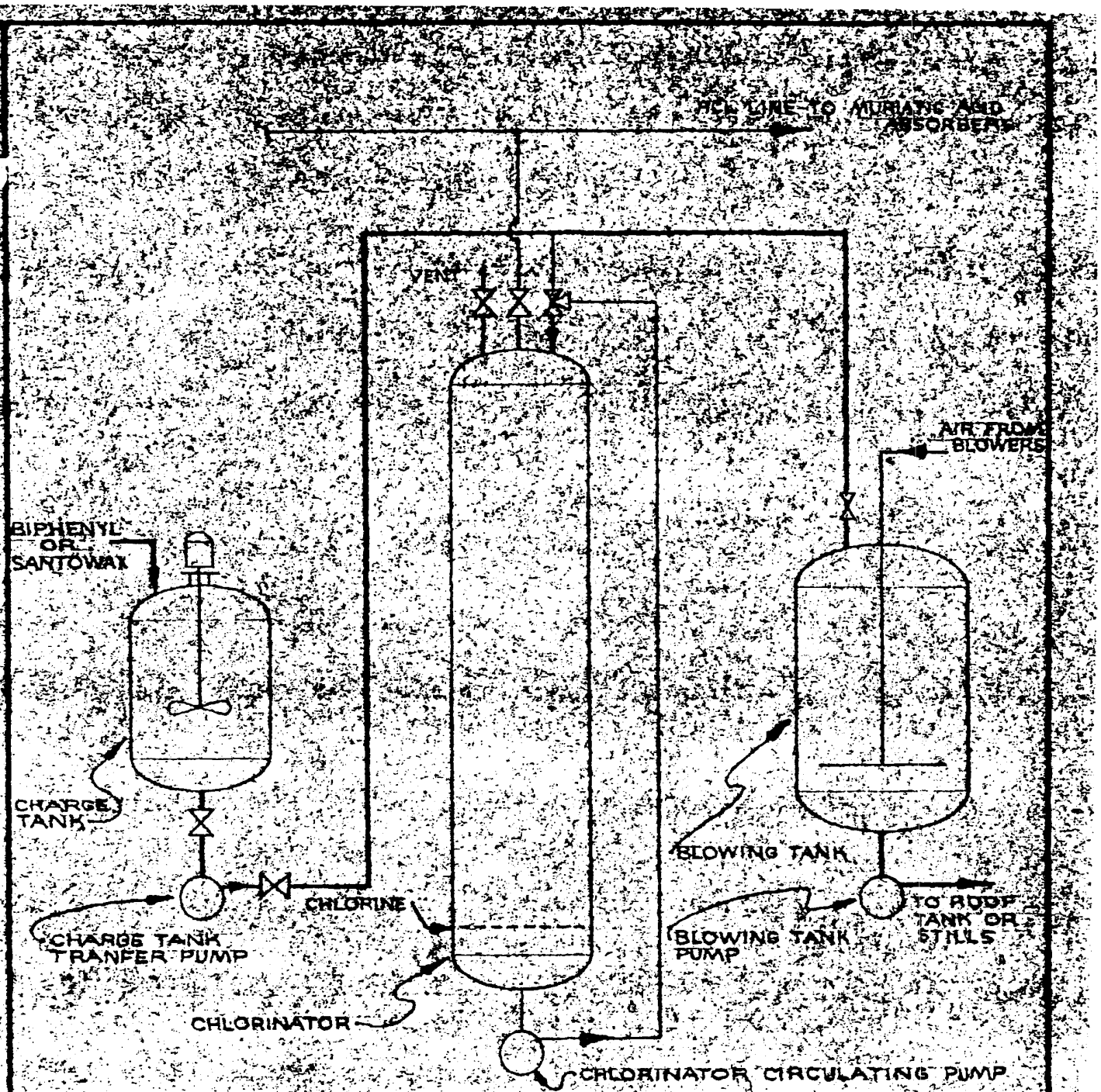
FLAW SHEETS

DSW 543209

STANDARD MANUFACTURING PROCESS
FOR
AROCLORS

II. FLOW SHEETS

DSW 543210

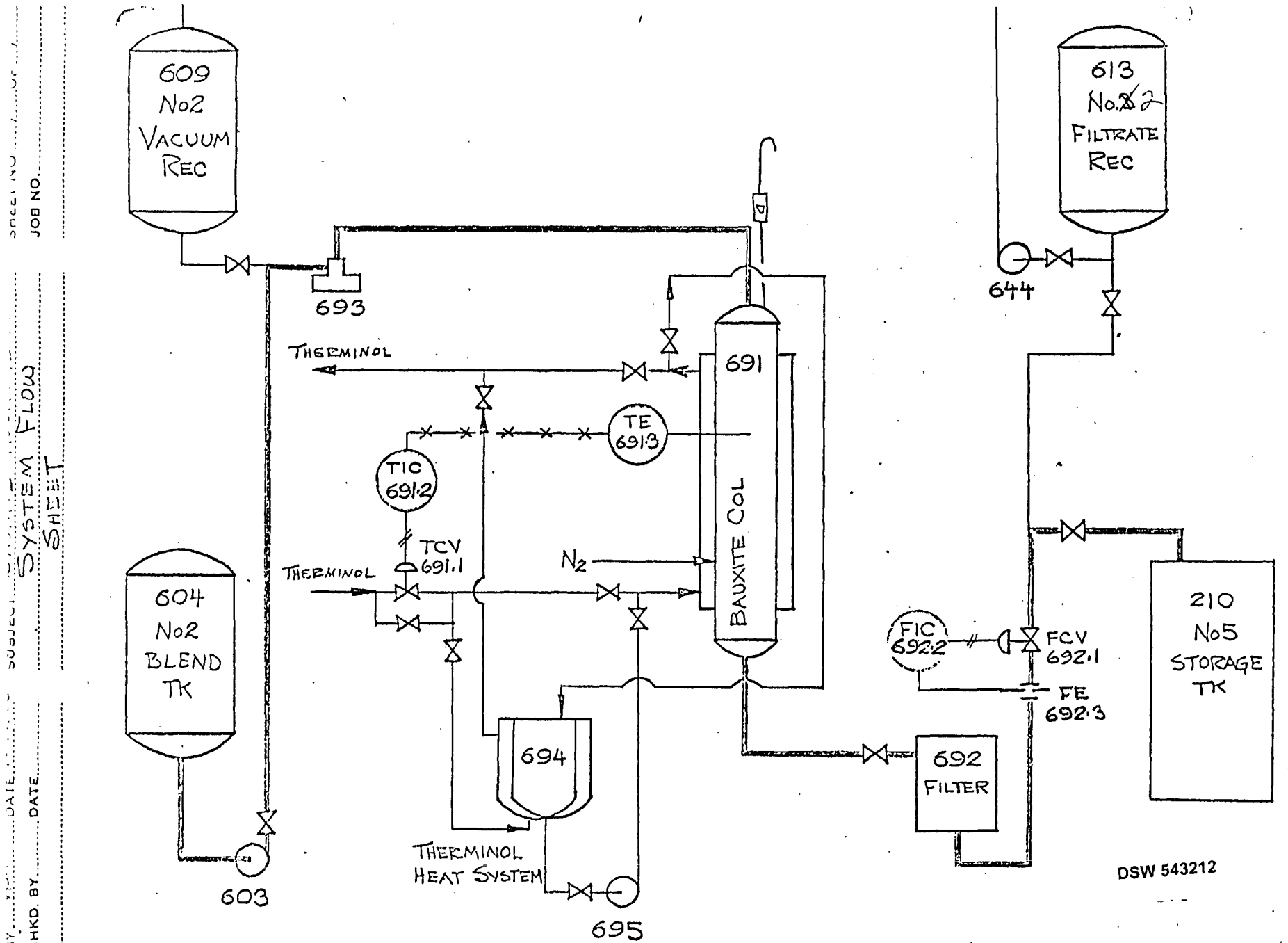


BATCH CHLORINATOR OPERATION
FLOW SHEET

DSW 543211

ANNISTON PLANT — MONSANTO CHEMICAL COMPANY — ANNISTON, ALA.

TITLE					
BATCH CHLORINATOR OPERATION — FLOW SHEET					
DRAWN BY: EAE	APPROVED:	DATE: 8-7-69	SCALE: NONE	DEPT.: 6 PROCLOR	TS-A-701



SUBJECT SYSTEM FLOW SHEET

JOB NO

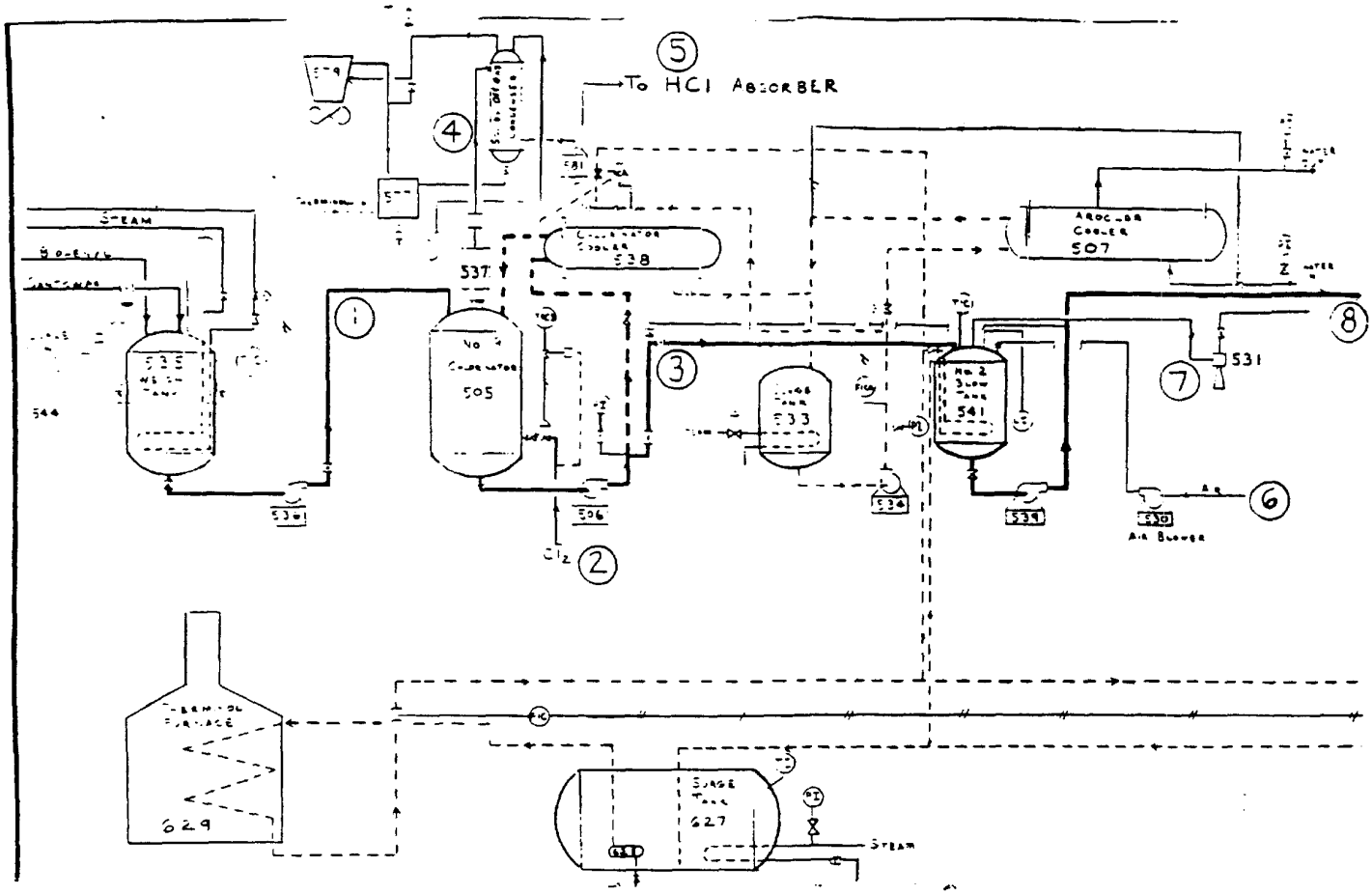
DATE

BY

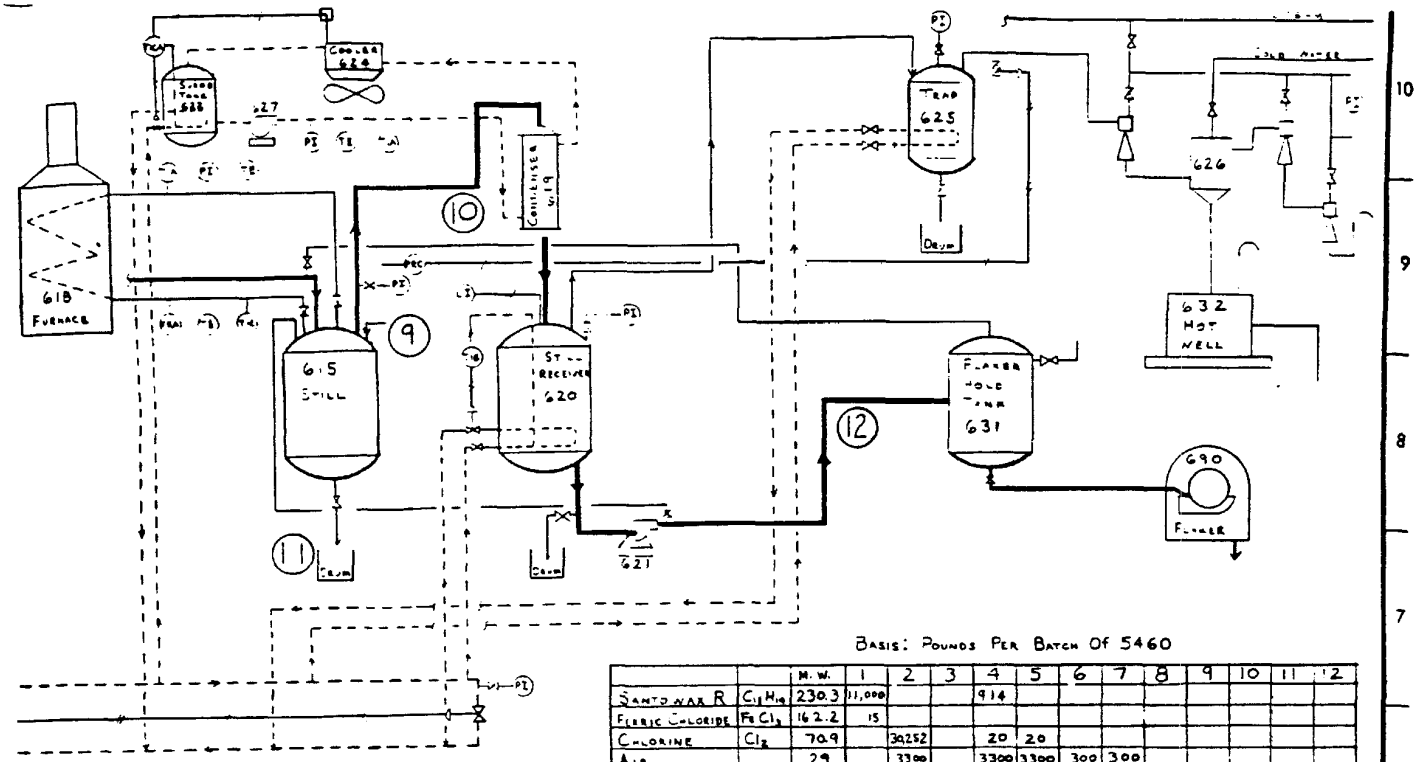
CHKD. BY DATE

PRINT SPEED = 15 - SIZE 11X17

CUT PRINT HERE



DSW 543214



BASIS: POUNDS PER BATCH OF 5460

		M. W.	1	2	3	4	5	6	7	8	9	10	11	12
SANTOWAX R	$C_{12}H_{10}$	230.3	11,000			914								
FERRIC CHLORIDE	$FeCl_3$	162.2	15											
CHLORINE	Cl_2	70.9		30252		20	20							
AIR		29		3300		3300	3300	300	300					
HYDROGEN	H_2	2		35		35	35							
CRUDE 5060	$C_{12}H_8Cl_{10}$	574.8			25,210					25,210				
HYDROGEN CHLORIDE	HCl	36.5			150	15,390	15,390		150					
LIME	$Ca(OH)_2$	74.1									250			
5460	$C_{12}H_8Cl_{10}$	574.8										18,315		18,315
MONTAR 5													6695	

COMPANY CONFIDENTIAL

This drawing is the property of Monsanto Company and must be accounted for. Information herewith is confidential and must not be reproduced, revealed to unauthorized persons or sent outside the company without proper authorization.

DSW 543215

PROCESS IN DETAIL

STANDARD MANUFACTURING PROCESS
FOR
AROCLOR

III. PROCESS IN DETAIL

A. Batch Liquid Chlorinators

Crude Liquid Aroclors are produced by batch chlorination in a vertical vessel. The reaction is cooled by external air cooled heat exchangers and agitated by a circulating pump. Biphenyl is chlorinated with chlorine gas added at the bottom of the vessel. HCl gas vented at the top of the chlorinator is a by-product which is recovered in the Muriatic Acid Department. Crude Aroclor produced in batch chlorinators is transferred to the blowing operation when the chlorination is completed. Chlorine gas is fed to the chlorinators from tank cars.

A chlorinator charge (3,000 lbs.) of specification grade Biphenyl is pumped to the chlorinator charge tank from a Biphenyl storage tank. One and one-half (1-1/2) pounds of Ferric Chloride is slurried in Aroclor and dumped into the charge tank with each chlorinator charge. The Biphenyl and Ferric Chloride is agitated for a minimum of 15 minutes and then transferred to the chlorinator.

Aroclor 1142 can be used to charge a batch chlorinator for the production of 1148, 1154, 1160, or 1162. When 1142 is used for a chlorinator charge no Ferric Chloride is added.

After the chlorinator has been charged, the circulating pump is started and the chlorine feed is put on the chlorinator. Chlorine feed rates range between 400-800 pounds per hour. Normal reaction temperatures are between 140-170°C. This temperature is automatically controlled by circulating the reaction mass through the external air-cooled exchangers throughout the chlorination cycle. The reaction temperature is alarmed both high and low. The operator checks the specific gravity of the material at intervals throughout the chlorination to determine the degree of completion of reaction. An alarm sounds when the chlorination is 80% complete. When the gravity of the chlorinated mass indicates it is finished, it is transferred to a blowing tank.

B. Continuous Chlorinator Operation

The continuous chlorinator operation consists of four cascade flow chlorinators in series where specific levels of chlorination occur. Biphenyl, with Ferric Chloride added, is fed continuously into the first chlorinator where the material is chlorinated and overflows to the second chlorinator. The finished product comes off the final unit, flows into a catch tank and is pumped to a continuous blow tank. The material is pumped from this blow tank to another blow tank for additional blowing. Chlorine is fed to each chlorinator continuously. The HCl gas evolved is recovered in the Muriatic Acid Department.

B. Continuous Chlorinator Operation (Contd.)

This chlorination system can be reduced to three (3) chlorinators in series in case problems occur with one unit. Normally 1142 is the only Aroclor produced on the continuous system, however, other liquid Aroclors can also be produced with the chlorinators set for different levels of chlorination.

The Biphenyl feed rate to the continuous system varies between 3 to 6 gallons per minute dependent on production rate desired. Chlorine feed rates also are dependent on production rates and can vary widely. Normally, the chlorine rate to each chlorinator will vary between 600 to 1,200 pounds per hour. As in the batch system, the reaction temperature of each chlorinator is controlled between 140-170°C by circulation through external, air cooled exchangers. The second and fourth chlorinators in the four chlorinator system are equipped with Accuray density controllers. These automatically control degree of chlorination to a predetermined level by controlling chlorine feed to the chlorinators. The operator also spot checks specific gravity periodically to insure proper degree of chlorination. In the case of Aroclor 1142, the specific gravity of the material from the final chlorinator is kept in the range of 1.344 to 1.357 measured at 65°C.

C. Biphenyl Mix Tank and Feed Tank

When Biphenyl is needed for the continuous chlorinator operation, a charge of about 5,500 pounds is pumped from a Biphenyl storage tank to the mix tank. Two and two-tenths (2.2) pounds of Ferric Chloride is added to the tank. The agitator in the tank is started and the Biphenyl and Ferric Chloride is agitated until a charge is needed for the Biphenyl feed tank. The feed tank is located under the mix tank. The feed tank low level alarm sounds the annunciator system at 25% full, at which time the mix tank batch is dropped into the feed tank. This will allow a minimum of one hour agitation in the mix tank. The agitator in the feed tank runs continuously while Biphenyl is being fed to the first stage of the continuous chlorinator operation.

D. Batch Solid Chlorinator

Crude Solid Aroclors are produced by batch chlorination of Biphenyl or Santowax in a vertical reaction vessel with Ferric chloride as a catalyst (5 lbs. per chlorinator charge). In the case of Aroclor 5460 (the largest volume solid Aroclor produced), 11,000 pounds of Santowax constitutes a chlorinator charge. The reaction of Santowax and Chlorine to form Aroclor 5060 takes place at a temperature of 250°C. This temperature is maintained by circulation of the reaction mass through a therminol cooled exchanger. Chlorine is added to the bottom of the vessel continuously throughout the cycle at a rate of 2,500 pounds per hour for most of the chlorination period. Aroclor 1142 can be used to charge the chlorinator for production of 1168 in which case no Ferric Chloride is added.

D. Batch Solid Chlorinator (Contd.)

By-product HCl gas vented at the top of the chlorinator is recovered in the Muriatic Acid Department. Crude Solid Aroclors produced in batch chlorination are transferred to the blowing tank operation when the chlorination is completed. (The only exception being 1168 which is not air blown but pumped directly from the chlorinator to the still). Chlorine gas is fed to the chlorinator from tank cars.

E. Blowing Tank Operation

Crude Aroclors produced in the chlorinators are air blown for a minimum of one hour, for removal of residual HCl, before the material is fed to the stills. One hundred and twenty psig (120 psig) steam is maintained on the coils of the liquid blowing tanks during this operation. Therminol heat (250-300°C) is maintained on the coil in the solid blowing tank. Residual HCl blown out of the crude Aroclor is drowned in a water ejector which pulls a slight vacuum on the blowing tanks.

F. Liquid Stills

Aerated crude Liquid Aroclor from a blowing tank or a roof tank is fed to one of three stills. Fifty pounds of hydrated lime is added to each equivalent still charge of Aroclor. A vacuum of 720 mm Hg (40 mm Hg absolute) is applied to the still. The Aroclor is circulated through a gas fired furnace which supplies the heat for distillation. The distillation takes place between 165°C and 335°C dependent on which Aroclor is being distilled and also upon the exact composition of the Aroclor at a specific point in the distillation cycle. The distillation is semi-continuous, in that up to ten receiver fulls of Aroclor are accumulated prior to discharging the residue (Montar) from the still. The Aroclor vapors from the distillation pass upward through an open column through a water cooled condenser. The condensed Aroclor is collected in a receiver and then transferred into a blend tank.

Distilled Liquid Aroclors are treated with Attapulgus Earth in the blend tank, (or pumped through a column containing activated Bauxite) filtered, analyzed, and packaged or held in storage.

Still bottoms are sold as Montars or discarded.

G. Earth Treatment and Filtration

Most Liquid Aroclors are treated in the blend tank with Attapulgus Earth. Forty (40) pounds of earth are used for every 2,000 gallons of Aroclor. This earth is dried in an oven for a minimum of four hours at a temperature of 210-250°C. The material, with the earth added, is agitated and then pumped through the filter press and back to the blend tank. When no earth is visible in a line sample of the Aroclor, it is directed to a filtrate receiver. The filtered Aroclor is then ready for drumming or transfer to a storage tank.

H. Porocel Column

At present, part of the Aroclor 1242 production is treated in a Polocel (activated Bauxite) column. The production from No. 3 liquid still system is pumped to the top of a column filled with 20/60 mesh Bauxite. Normal flow through the column is around 3 gpm. Optimum product temperature for treating is around 65°C for 1242. Fresh charge of Bauxite is dried by circulating hot Therminol (120°C) through the column jacket and blowing nitrogen through the Bauxite until the moisture content of the charge is below 1,000 ppm. Passage through the bed results in adsorption of the ionic impurities in the Aroclor 1242 by the Bauxite. The Aroclor discharges from the bottom of the column and is sent on to storage.

The column was installed in 1967 as an experimental unit designed to test the feasibility of replacing earth treatment (see G above) as a means of treating electrical grade Aroclors. The objective was higher quality Aroclors. The column proved successful and other units will be installed by September 1969 to treat other Aroclors and some raw materials used for Aroclor Blends.

I. Solid Still

Aerated Crude Solid Aroclor from a blowing tank is pumped to the No. 4 still. After the charge is transferred, 250 pounds of hydrated lime is added to the crude Aroclor.

Vacuum is applied to the still and the Aroclor is circulated through a gas fired furnace and heated to the vaporization temperature. The distillation takes place under a vacuum of 10 to 20 mm Hg absolute. Vaporization temperatures range from 340-400°C depending upon exact composition of material and stage of the distillation cycle.

The distillation is straight take-over. The vapors pass up an open column and are condensed in a vertical therminol cooled condenser. The distilled Aroclor is collected in a receiver. If within specifications, solid Aroclors are either drawn out in drums or cans, or are transferred to the flaker operation for flaking into bags.

Still residue or bottoms are sold as Montars or discarded.

J. Packaging

Solid Aroclors are packaged in fiber drums, galvanized drums, galvanized cans and in paper bags.

Liquid Aroclors are packaged in steel drums and cans. These drums and cans are lacquer lined with two coats of clear Epoxy Phenolic lacquer. Liquid Aroclors are also loaded into tank cars and trucks.

COMMENTS ON PROCESS

DSW 543221

IV. COMMENTS ON THE PROCESS

A. LIQUID AROCLORS

1. Chlorination

a. Temperature

Chlorination temperatures of 120°C or lower yield a product which will not pass the stability tests on electrical grade Aroclors. A minimum of 130°C has been set for the chlorinators. An upper temperature limit is not defined as critical to high quality Aroclor production. A practical limitation is governed by the increase of overhead product loss to the off-gas collection tank. The normal temperature range is between 140°C and 170°C.

b. Catalyst

The basket containing a bed of iron turnings in the chlorinator provides contact surface for the Chlorine and Biphenyl, and the iron reacts with the Chlorine forming Ferric Chloride which is the actual catalyst. Consumption of the turnings makes it necessary to inspect the chlorinator semi-annually and replenish the turnings if necessary. Ferric Chloride (anhydrous powder) in the amount of 0.05% is added to the chlorinator charge to provide assurance of adequate catalyst at all times during the chlorination. It is imperative that the iron turnings in each chlorinator be inspected semi-annually. Aroclor supplied to General Electric and Westinghouse must be produced in chlorinators containing the basket. (Prior to any shipment of Electrical Grade Aroclor being shipped to General Electric and Westinghouse from a process where the baskets are removed, Marketing will review the process change with both customers.)

The catalyst is added to the chlorinator charge tank or mix tank (continuous chlorinators) and agitated for at least 15 minutes but usually at least an hour before charging or feeding the chlorinators. MCL and WGK Aroclor Departments do not premix the catalyst. Research has indicated the tendency to producing unstable Aroclors can be attributed to improper catalyst concentration which may be brought about by insufficient mixing prior to chlorination.

Free Chlorine in the off-gas from an individual chlorinator or from the vent at the HCl absorber sewer box indicates problem operation in the Aroclor Department. It can be caused by inadequate reaction of the Biphenyl and might indicate formation of unstable Aroclor. If this situation occurs it should be corrected immediately. Take samples from the individual chlorinator off-gas and have them analyzed for free chlorine by the laboratory. Check grab samples from each chlorinator of the crude Aroclor being produced and observe it for unusual appearances. Inadequate amounts of catalyst present as Ferric Chloride or iron turnings can cause free chlorine in the off-gas line. In case this situation occurs and cannot be resolved, remove the chlorinator from operation. Contact department supervision immediately. A badly worn chlorinator distributor can also cause free chlorine in the off-gas line.

c. Chlorine

Problems with the chlorine vaporizer can occur which would allow liquid chlorine to be fed to the chlorinators. In case this should happen, slugs of liquid chlorine would be fed into the chlorinator possibly causing excessive reaction or excessive loss and venting of chlorine to the atmosphere. Chlorine in the HCl off-gas pipe lines could cause extreme reactions which would generate excessive heat. This reaction can cause a pipe line to become red hot and melt the pipe line in two. This would result in chlorine gas escaping to the atmosphere. Every effort possible should be made to operate the vaporizer with the control system provided.

Entrainment of Biphenyl or crude Aroclor into the HCl lines can occur from excessive chlorine rates. This can be checked by observing the off-gas from the chlorinators in the sight glasses on top of the Brink Demister on each chlorinator. Normal operation of the chlorinator should be to minimize this carry-over.

Low chlorine pressure can cause operating problems within the Aroclor Department. In cases of extreme low pressure, the crude Aroclor could back up in the chlorine line and begin blow-back into the chlorine header. In this case, pluggage of chlorine feed lines with crude Aroclor would most likely occur.

d. Chlorinator Off-Gas Collection

The demister on top of the liquids collection tank is used as a final knock-out for Aroclor and Biphenyl entrained droplets in the HCl gas system. Usually this system will be operating with the steam tracing around the outer shell shut off. When the steam tracing is turned on it will allow vapors to be carried through the demister to the Muriatic Acid absorber. The sight glass on the discharge of the demister can be checked to determine if entrained droplets are being carried over. The steam is installed for use to unplug the demister in case pluggage should occur. The trappings from this clean-up system are used to produce Aroclor 1148 and 1162 only. The reason for this is to be sure that we do not produce any unstable electrical grade Aroclor.

It is extremely important that the tempered water system on the liquid HCl off-gas condenser be drained during excessive cold weather if it is shut down. The bottom head on the condenser has drain valves at two locations. Both of these drain valves must be open to remove water from the off-gas condenser when the system is shut down.

2. Air Blowing of Crude Aroclors

Air blowing of crude Aroclors takes place with compressed air from air blowers. Batches of crude Aroclor must be blown for a minimum of one hour. If this is not done, off-quality Aroclors (high color, high acid content) could result.

3. Distillation

Vacuum trouble on the stills is usually caused by flashing of product, 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 troubles can be traced systematically from the jets and usually isolated.

4. Earth Treatment

Exclusion of atmospheric moisture is naturally important where high electrical resistivity is required. For this reason, the Attapulgus earth is dried for four hours at temperatures of 210-250°C. All liquid Aroclors are earth or bauxite treated at the Anniston Plant to decrease the risk of contaminating electrical grade with non-electrical grade Aroclors. There are too many common lines downstream of the stills to chance non-treatment of non-electrical grade Aroclors.

5. Porocel Column Treatment

The bauxite in the porocel column must be well dried prior to starting up after recharging column with fresh bauxite for same reasons Attapulgus earth must be dry. The bed is nitrogen blown until moisture is about 0.1%. Optimum operating temperature of bed is about 65°C-70°C for 1242. Higher temperatures decrease adsorption efficiency of the bauxite. Bauxite bed is packed by vibration prior to starting up fresh column to minimize channeling and insure good resistivity from the start. Bed is changed out when plugging is evidenced by increased pressure drop (normal pressure drop about 40 psi), and dropping off of flow rate of Aroclor through column. Occasionally, resistivity problems are encountered which can be traced to moisture entering storage system through steam leaks into product from breaks in steam jacketed piping of system.

6. Quality

Incomplete aeration in the blow tanks, or the addition of insufficient lime to the still pot, will cause high acidities. High inorganic chlorides either indicate contamination or the presence of attapulgus earth in the product caused by a poor filtration. Batches with colors in excess of 30 APHA usually indicate excessive gas heat on the heating coils or air leaks in the vacuum system. A distillation carried too far will also show a dark distillate from the distillation of colored material from the residues.

Another reason for color can be the material formed when chlorinating at low temperatures or with insufficient catalyst. Batches with specific gravities, softening points and viscosities out of specifications can indicate over or under chlorinations, or incomplete draining of the process equipment when switching from one type of Aroclor to another. Iron has a deleterious effect on the electrical properties of the distilled Aroclors; therefore, tankage, process piping and pumps from the still receiver through the remainder of the process are either aluminum, tin and zinc sprayed, or are constructed of monel, stainless steel, or bronze.

7. Special Grades

a. Export Aroclor 1242 DSW 543225

The export specs on 1242 call for a resistivity of 5,000 min. and a Biphenyl content of 0.05% max. Domestic specs call for 500 min. resistivity and no spec on Biphenyl content. The Biphenyl content of 1242 made on the continuous chlorinators averages below the 0.05% max. spec and, therefore, causes no production problems. To meet the 5,000 min. resistivity spec the 1242 can be earth treated two to five times using normal procedures until the resistivity exceeds 7,000 (dept. spec) and then drummed out from the filtrate receiver. More recently, specs on export 1242 are met by normal treatment through the

b. Export Aroclor 1254

The export specs on 1254 call for a resistivity* of 5,000 min. and a Biphenyl content of 0.025% max. Domestic specs call for 500 min. resistivity and no spec on Biphenyl content. Presently, all 1254 is earth treated. By Fall of 1969, the 1254 will be treated in a porocel column.

*The resistivity numbers above are a shorthand version. For instance, 5,000 above is actually 5,000 x 10^9 ohm-cm. measured at 100°C.

8. Safety

Biphenyl is flammable, and burning should never be done in areas where Biphenyl or Biphenyl vapors are present.

Light Aroclors are also flammable. The viscous Aroclor oils and the resins do not support combustion when heated alone, even at their boiling points - temperatures above 350°C.

9. Dermatology and Toxicology

Aroclors do not produce primary irritancy or sensitization of the skin. At ordinary temperatures Aroclors have not presented industrial toxicological problems. If Aroclors are used at elevated temperatures such as 200°C or 300°C in open systems, methods must be designed to exhaust any vapors arising from these open systems.

B. SOLID AROCLORS

1. Chlorination

Special flexible piping joints have been made to the weigh tank since this tank is placed on scales. Actuation of the scale system will require movement of this tank approximately 1/4 inch. These flexible piping joints should be carefully inspected to be sure there are no leaks, since the material contained in them is extremely hot. Steam is provided on the transfer lines and the coil to the weigh tank. From the bottom piping on the weigh tank, all the transfer lines and coils in the Solid Aroclor process vessels have Therminol heat until the end of the process at the flaker hold tank.

The No. 9, Solid Aroclor, chlorinator does not have a basket of iron turnings. Due to this, it is absolutely necessary that five pounds of Ferric Chloride be added to each chlorinator charge in the weigh tank.

Plugging of the off-gas condenser in the Solids Clean-Up System can occur. To unplug the off-gas condenser the temperature of the Therminol system is elevated as required. During this time, the off-gas condenser can be by-passed.

The Solids knock-out tank is provided with a drain system to empty the tank completely when products are to be changed on the No. 9 chlorinator. This will eliminate contamination in the weigh tank.

2. Air Blowing of Crude Aroclor

Undistilled Aroclors 2565 and 5060 are lime treated in the blow tank to give a neutral acid number. Flaked 5060 on the acid side will cause the bags to fail. Upper limit of acid number is 0.05 mg KOH/g.

3. Distillation

Vacuum problems on the Aroclor still are usually due to flashing of product over, plugged vacuum lines, leaks in the still system, leaks at pump packing, water adjustment on inter-condenser on jets, changes in steam pressure to the jets, or problems in the jet nozzles. Flashing can be stopped by adjusting the coolant flow on the condenser or operation of the still at a slower rate. Vacuum trouble must be traced systematically from the jet, to the receiver, and then to the still.

It is important to be sure the coil in the Therminol cooling system surge tank is covered when the system is in operation. This assures the circulating pump has a positive suction and prevents surging in the heater coil. This will allow more uniform control of the temperature in the Therminol cooling system.

Care must be taken not to fill the surge tank too full during normal operation. This can cause the tank to run over when the circulating pump is stopped. A normal level will be about 6" to 12" in the sight glass.

The flow measurement recording instrument for the still heater system is an extremely important portion of the controls for the No. 4 still system. A segmental orifice is used for obtaining differential pressure readings to indicate flow. This orifice system is in a specially designed Therminol jacketed pipe section. A specially designed d/p cell records the pressure readings and indicates flow. The orifice is designed to allow sucking the coil completely empty when a distillation is complete. The hole in the orifice plate is flush with the bottom of the pipe line. This flow recorder indicates low flow rates at the end of a distillation which aids the operator in completing a normal operation.

Lime addition to the Solid Aroclor still is very important. Cutting the amount of lime below 200 lbs. per batch results in occasional off-color batches.

The longer still bottoms are circulated in the heater the higher the formation of HCl and the greater the tendency to plug the heater coil. Every effort should be made to have Crude Aroclor available to charge the still at all times.

4. Solid Aroclor 1268

The bottleneck in 1268 production is the chlorinator. Increasing chlorine feed rates only increases Biphenyl and low chlorinated Aroclor carry-over to the off-gas collection system, and increases the tendency to over-chlorination and its ensuing problems with freeze-up of lines and equipment (hold points greater than 175°C).

The still has been found to run better when there is feed always available. Circulating of still bottoms while waiting on crude increases the breakdown of the Montar into more viscous material and hydrogen chloride. Draining the still between batches increases the tendency to plug the heater coil.

To move the bottleneck from the chlorinator to the still requires charging the chlorinator with 1142 and chlorinating at a rate high enough to insure finishing the batch before the still batch is completed. Other higher chlorinated crudes can be charged to the chlorinator but they will not be as readily available as 1142 from the continuous chlorinators.

APPENDICES

DSW 543229

STANDARD MANUFACTURING PROCESS
FOR
AROCLOR

APPENDIX A - EQUIPMENT LIST

Area 500 - Chlorinator

Area 600 - Still

Area 700 - Tank Farm

Area 800 - Solid Aroclor Storage & Flaking

CHLORINATOR

Item	Equipment	Equip. No.	Description
505	No. 9 Chlorinator	22-0774	Vertical 4" -6" dia. x 20' straight side carbon steel vessel with dished heads. Capacity 2,390 gallons.
506	No. 9 Chlorinator Circulating Pump	19-0494	Self-priming, centrifugal pump (Pacific 2-1/2" SS type SVC, 10" impeller, 15 HP, 1750 RPM, 440 volt motor). Pump has a Crane No. 9 outside mechanical seal, Code QP-868. Capacity 250 GPM at 73' TDH.
507	Aroclor Cooler No. 9 Chlorinator		1'-8" dia. x 18'-6" long, carbon steel shell heat exchanger with 304-3/4" O.D. 304 stainless steel, 14 BWG x 16" long tubes. Four passes on Therminol side (tube side). Capacity 1,400,000 BTU/hour.
508	No. 4 Chlorinator Cooler	32-0260	An air-cooled 1" BWG 16.8' long steel tube with aluminum finned cooler for removing heat from crude Aroclor. 3' wide x 8' long x 6' high, equipped with an Annin pneumatic operator to adjust louvers (58 tubes). Fan has a 2 HP, 1800 RPM, 440 volt motor. Capacity 1,100,000 BTU/hour.
509	No. 3 Chlorinator Circulating Pump	19-0495	Self-priming, centrifugal pump (Pacific 1-1/2 L Type SVC, 1-7/8" impeller, 15 HP, 1800 RPM, 440 volt motor). Pump has a Crane No. 9 outside mechanical seal, code QP-868. Capacity 220 GPM at 81' TDH.
510	No. 3 Chlorinator Cooler	32-0261	Same as Item 508
511	No. 2 Chlorinator Circulating Pump	19-0496	Same as Item 509

AREA 500

Item	Equipment	Equip. No.	Description
512	No. 2 Chlorinator Cooler	32-0262	Same as Item 508.
513	No. 1 Chlorinator Circulating Pump	19-0497	Same as Item 509.
514	No. 1 Chlorinator Cooler	32-0263	Same as Item 508.
515	No. 3 Blow Tank	22-0596	7'-6" dia. x 7'-6" high Dwg. D-234-4
516	No. 3 Blow Tank Pump		Peerless Pump - Model 1-1/2 DSO.8, Serial No. 121336.
517	No. 4 Blow Tank	22-0595	Same as Item 515.
518	No. 4 Blow Tank Pump		Peerless Pump - Model 1-1/2 DSO.8.
520	Biphenyl Feed Tank	22-0788	5'-6" dia. x 5'-8" long, carbon steel tank with dished heads. Tank contains a 2" Sch. 80 coil approximately 90' long. Capacity 1,000 gallons.
520-A B & C	Biphenyl Feed Tank Agitator & Drive		6-blade, turbine type, carbon steel agitator with a 4 ELHZ Faulk motor reducer driven by a 10 HP, 1800 RPM, 440 volt motor. The agitator has a 2-3/4" dia. x 8'-8" long shaft. Capacity provides medium agitation.
521	Biphenyl Feed Pump	19-0498	Self-priming, centrifugal pump (Goulds Model 3196 AVS-260, 6-5/8" open impeller, 5 HP, 1800 RPM, 440 volt motor). The pump has a Crane No. 9 outside mechanical seal, Code QP-868. Capacity 60 GPM at 42' TDH.
522	No. 5 Chlorinator Cooler	32-0264	Same as Item 508.
523	No. 6 Chlorinator Cooler	32-0265	Same as Item 508.

Item	Equipment	Equip. No.	Description
524	No. 7 Chlorinator Cooler	32-0266	Same as Item 508.
525	No. 8 Chlorinator Cooler	32-0267	Same as Item 508.
526	Crude Aroclor Catch Tank	22-0789	5'-6" x 5'-8" steel vertical tank with flanged and dished top head. Capacity 1,000 gals.
527	Crude Aroclor Catch Tank Pump	19-0526	100 GPM @ 75' head - vertical heavy duty centrifugal Taber pump - CV-3 #393.
528	Continuous Air Blow Tank	22-0682	500 gallon steel tank. Purchased from Dixie Steel & Supply Co. See MCC Dwg. D-548-3-0.
529	Continuous Blow Tank Transfer Pump	19-0499	Self-priming, vertical centrifugal pump (Taber vertical submerged, CL2-382, 7-1/2" open impeller, 3 HP, 1800 RPM, 440 volt motor). Capacity 15 GPM at 45' TDH.
530	Air Blower North	11-0338	Model 7 H - Spec. SM-488-530. Purchased from Sutorbilt Corp.
531	Solids Off-Gas Eductor		S&K Fig. 4010 Scrubber and S&K 4040 Separator Box Haveg & P.E. Const. 6" Suct. 6" Discharge.
532	Liquids Off-Gas Eductor		S&K Fig. 4010 Scrubber - 8" Suct. 8" Discharge.
533	Therminol Surge Tank #9 Chlor.	22-0775	4'-0" O.D. x 5'-3". Steel const. Purchased from Opelika Welding,Machine & Supply, Inc.
534	No. 9 Surge Tank Pump	19-0500	Spec. SM-488-534. P.O. No. OED-7734. Purchased from Goulds Pumps, Inc.
535	Weigh Tank		6'-6" x 7'-9" C. steel equipped with heating coil. 5 turns 2" Sch. 80 C.S. pipe. Capacity 2,000 gallons.
536	Weigh Tank Pump	19-0501	Goulds Model 3196 AVS No. A 60 constructed of Ductile Iron. Capacity 125 GPM.

Item	Equipment	Equip. No.	Description
537	No. 9 Chlorinator Mist Eliminator		Monsanto Brink type demister in a 30" O.D. x 4' x 6' long carbon steel tank. Bottom nozzle 10" dia., 10" flange, with a 6" gas outlet. Designed for 30 psig at 450°F. Contains a Brink element No. 2448. Capacity 325 cfm at 8 psig and 250°C. Inlet mist loading 2,000 mg/cu.ft. Outlet mist loading 20 mg/cu.ft. Efficiency 99%.
538	No. 9 Chlorinator Cooler	32-0259	Carbon steel heat exchanger 8' long with 3/4" O.D. x 15 BWG tubes containing 184 tubes. Four pass heat exchanger on tube side. Special design Marquette expansion joint constructed of 304 SS on shell side of this heat exchanger. Capacity 1,400,000 BTU/hour.
539	No. 2 Blow Tank Pump	19-0502	Self-priming, centrifugal pump (Goulds Model 3196 AVS-A60, 7" open impeller, with a 5 HP, 1800 RPM, 440 volt motor, and a Crane No. 9 outside mechanical seal, Code QP-868). Capacity 125 GPM at 29' TDH.
540	Biphenyl Feed Pump		Self-priming, centrifugal pump (Goulds Model 3196 AVS-A60, 6-1/16" open type impeller, 3 HP, 1800 RPM, 440 volt motor, and a Crane No. 9 outside mechanical seal. Code No. QP-868). Capacity 75 GPM at 39' TDH.
541	No. 2 Blow Tank	22-0777	7'-6" O.D. x 7'-6" straight side vertical tank, flat top with a dished bottom. Tank contains a 2" Sch. 80 pipe coil approximately 75' long. Capacity 2,500 gallons.
542	No. 1 Blow Tank	22-0266-02	Same as Item 515.
543	No. 1 Blow Tank Pump	19-0355	Vertical, centrifugal, submerged Taber pump. 2-1/2" inlet - 1-1/2" outlet. Cast iron construction. Capacity 50 GPM.

Item	Equipment	Equip.No.	Description
544	Weigh Tank Scale	24-0194	Fairbanks-Morse, Inc. overhead suspension scale, Model CA, coaxial cabinet dial, having a 22" dia. chart graduated 0-24,000 pounds with a main tare bar graduated 20,000 pounds and 5,000 pounds. The dial has one adjustable Reed switch to operate at scale set point. Scale to be hung below 11' platform level built to contain the weigh tank. Capacity 0-24,000 pounds x 20 pounds increments for scale measurement. Overall capacity 0-50,000 pounds.
545	Crude Aroclor Catch Tank Transfer Pump		Self-priming, vertical centrifugal pump (Taber CV-3, #393, with a 2" suction and 1-1/2" discharge, 10" dia. x 3-1/2" I impeller, 5 HP, 1800 RPM, 440 volt motor). Capacity 80 GPM at 100' TDH.
546	Brink Demister No. 7 Chlorinator	41-0037	1'-8" dia. x 4'-2" straight side carbon steel shell with a Brink type mesh demister pad.
547	Brink Demister No. 6 Chlorinator	41-0038	Same as Item 546.
548	Brink Demister No. 5 Chlorinator	41-0039	Same as Item 546.
549	HCl Off-Gas Condenser (Liquid System)		20' I.D. x 8' long, standard Monsanto fixed tube sheet heat exchanger with 304 3/4" O.D. x 14 BWG tubes. Exchanger has four passes. Overall area 460 sq.ft. Capacity 132,000 BTU/hour heat removal.
550	Chlorine Vaporizer	32-0185	Armstrong Chlorine Vaporizer, vertical type, complete with super heater section Monel construction - purchased from R. M. Armstrong Co. 90 tons/day capacity.
551	No. 1 Chlorinator	22-0675	3'-0" dia. x 16'-0". See Drawing E-6209.
552	No. 2 Chlorinator	22-0673	See Item 551.

Item	Equipment	Equip.No.	Description
553	No. 3 Chlorinator	22-0673	See Item 551.
554	No. 4 Chlorinator	22-0674	See Item 551.
555	No. 8 Chlorinator		See Item 551.
556	No. 7 Chlorinator		See Item 551.
557	No. 6 Chlorinator	22-0677	See Item 551.
558	No. 5 Chlorinator	22-0676	See Item 551.
559	No. 4 Chlorinator	19-0414	Same as Item 509.
560	Brink Demister No. 1 Chlorinator	41-0040	Same as Item 546.
561	Brink Demister No.2 Chlorinator	41-0041	Same as Item 546.
562	Brink Demister No. 3 Chlorinator	41-0042	Same as Item 546.
563	Brink Demister No. 4 Chlorinator	41-0043	Same as Item 546.
564	Brink Demister No. 8 Chlorinator	41-0044	Same as Item 546.
565	Instrument Air Compressor	37-0098	Joy Manufacturing Company No. WFPOS-9, Size 8" x 5" skid-mounted air compressor unit with after-cooler and air receiver. Operated by a 25 HP, 1800 RPM, 440 volt motor. Capacity 105 cfm at 100 psig.

Item	Equipment	Equip.No.	Description
566	Control Room Sink and Hood		Fume Hood designed by Browne-Morse Co. #73 Green unit with a gray colorlith top. Fan is an American Blower 1-1/4 HP removing 782 cfm at 1/2 S.P., 1/3 HP, 110 volt, 1725 RPM motor. Capacity fume removal 782 cfm.
567	Control Room Air Conditioner	44-0098	Carrier Model 48 DA008-601. Roof mounted cooling and heating unit; 98.000 BTU/hour nominal cooling; 240,000 BTU/hour heating nominal direct fired natural gas heater.
569	No. 6 Chlorinator Circulating Pump	19-0414	Same as Item 509.
570	No. 7 Chlorinator Circulating Pump	19-0414	Same as Item 509.
571	No. 5 Chlorinator Circulating Pump	19-0394	Same as Item 509.
572	No. 8 Chlorinator Circulating Pump	19-0405	Same as Item 509.
573	HCl Off-Gas Catch Tank (Liquid Chlorinator System)	22-0811	8'-6" dia. x 11'-3" straight side, carbon steel tank, with dished heads and a 3" Sch. 80 carbon steel pipe coil approximately 120' long. Capacity 5,000 gallons.
574	Trappings Transfer Pump (Liquid)		Self-priming, horizontal centrifugal pump (Goulds Model 3196 AVS-A60, constructed of Ductile iron with a 7" dia. open type impeller, 5 HP, 1800 RPM, 440 volt motor, with a Crane No. 9 outside mechanical seal, Code QP-868). Capacity 125 GPM at 75' TDH.
576	Brink Mist Eliminator HCl Catch Tank		Monsanto Brink type unit, 2'-6" dia. x 11' straight side, containing a Brink element designed for 5 psig at 105°F. temperature. Capacity 635 cfm at 85% HCl gas. Designed to collect 99% of entrained droplets and return to the catch tank.

Item	Equipment	Equip.No.	Description
577	Therminol Surge Tank for Solid HCl Clean-Up Condenser		3'-6" dia. x 4'-3" straight side, carbon steel tank, containing a 2" Sch. 80 carbon steel coil approximately 10' long. Capacity 300 gals.
578	Therminol Pump for Solids Knock-Out Condenser		Self-priming, horizontal centrifugal pump (Goulds Model 3196 AVS-A60, constructed of Ductile iron, with an 8" open type impeller, driven by a 7-1/2 HP, 1800 RPM, 440 volt motor, pump equipped with a Crane No. 9 outside mechanical seal, Code QP-868). Capacity 150 GPM at 50' TDH.
579	Therminol Cooler for Solids Knock-Out Condenser System		Disler Model No. 2 VH air-cooled aluminum finned tube cooler, 3' x 3'-6" x 5'-9" high. Contains a fan driven by a 1 HP, 1800 RPM, 440 volt motor. Capacity 550,000 BTU/hour.
580	HCl Off-Gas Condenser (Solids System)		2' dia. x 10'-6" long, carbon steel heat exchanger, with 80 1-1/2" O.D. x 14 BWG x 8' long tubes (six tube passes). Condenser contains 250 sq.ft. surface area. Designed for 150 psig and 160°C.
581	HCl Off-Gas Catch Tank for Solid System		4' dia. x 3'-9" straight side, carbon steel tank with dished heads. Tank is a jacketed carbon steel tank designed for 125 psig at 160°C. Jacket designed for 110 psig at 160°C. Capacity 300 gallons.
582	Water Pump for Liquid Aroclor Knock-Out Condenser		Self-priming, horizontal centrifugal pump (Goulds Model 3196 AVS-A60, 2 x 3 - 10, with an 8" open type impeller constructed of Ductile iron with a Crane No. 9 outside mechanical seal, Code QP-868, driven by a 7-1/2 HP, 1800 RPM, 440 volt motor). Capacity 200 GPM at 75' TDH.
584	Weigh Tank	22-0776	6'-6" O.D. x 7'-9". Purchased from Art Welding Co.

Item	Equipment	Equip.No.	Description
585	Chlorinator Charge Tank	22-0787	1,000 gallon steel tank purchased from Missouri Boiler & Tank Co. P.O. NO. D-47909. Installed Nov. 1959.
586	Air Blower (South)	11-0323	Rotary positive with extended base and V-drive, intake filter muffler, exhause muffler, V-belt guard, 1" pressure relief valve. Purchased from Sutorbilt Corp.
587	Air Blower (Middle)	11-0324	Same as Item 586.
588	Biphenyl Feed Tank Agitator	18-0106	Falk 4 ELHZ, Ratio 13.9 to 1. Spec. SM-488-520C. Dwg. D-488-M116.
589	Fume Jet No. 2 Blow Tank	35-0122	Spec. SM-488-531. S&K Figure 4014, Scrubber-Separator consisting of: 1-6" Fig. 4010 Haveg 61 Fume Scrubber. 1-6" Fig. 4040 Polyester Fiberglass Separator.
592	Instrument Air Compressor	37-0073	JOY WFPOS-9, Size 6½ x 4½, Capacity 50 SCFM at 100 psig output. Water cooled, single stage double acting, carbon ring, non-lubricated, with V-belt drive.
594	Instrument Air Dryer	14-0029	Electric regenerative desiccant dryer, manufactured by Trinity Equipment Corporation.

Item	Equipment	Equip.No.	Description
601	No. 3 Blend Tank Pump	19-0293	1-1/2 DSO 8 - all bronze, SAE 63 Frame 213 - Serial No. 121340 - Peerless.
602	No. 3 Blend Tank	22-0087	7'-0" O.D. x approx. 7'-0" on shell. Dwg. 9-C-8247.
603	No. 2 Blend Tank Pump	19-0269	1-1/2 DSO 8 - all bronze, SAE 63 Frame 213 - Serial No. 121340-Peerless.
604	No. 2 Blend Tank	22-0270	Same as Item 602.
605	No. 1 Blend Tank Pump	19-0267	Same as Item 603.
606	No. 1 Blend Tank		Same as Item 602.
607	No. 1 Vacuum Receiver	22-017801	Same as Item 609.
608	No. 1 Vacuum Receiver Pump	19-0272	Fig. 3202 No. 90 VPR, all bronze. Purchased from Blackmer Pump Co.
609	No. 2 Vacuum Receiver	22-0026	5'-6" I.D. x 5'-6" Monel. Dwg. C-795.
610	No. 2 Vacuum Receiver Pump	19-0271	Same as Item 608
611	No. 3 Vacuum Receiver		6'-6" dia. x 7'-9" straight side, vertical tank, lined with Monel plating. Tank equipped with a Monel coil constructed of 1-1/2" Sch. 40 Monel pipe with approx. 48 linear feet of coil. Capacity 2,000 gallons.
612	Receiver Pump (No. 3 Still)	19-0244	Model GZ-CH NEMA 213. Fig. 3202, 90 VPR bronze, Blackmer Pump.
613	No. 2 Filtrate Receiver	22-0086	7'-0" O.D. x 7'-0". Dwg. 9C-8247. Purchased from Chattanooga Boiler and Tank Co.

Item	Equipment	Equip. No.	Description
614	No. 1 Filtrate Receiver	22-0269	Same as Item 613.
615	No. 4 Still	22-0779	7'-6" dia..x 7'-0" straight side, vertical carbon steel tank with dished heads. Tank equipped with a heating coil constructed of 2" Sch. 80 carbon steel pipe with approx. 77 sq. ft. of surface area. Capacity 2,500 gallons.
616	No. 4 Still Circulating Pump	19-0505	Self-priming, centrifugal, vertical pump, (Taber vertical submerged No. 345 CC-5, 12-1/2" dia. open type impeller, 25 HP, 1800 RPM, 440 volt motor, with a jacketed stuffing box for water cooling). Pump has a special Zallea expansion joint with rods and discharge pipeline. Capacity 150 GPM at 120' TDH.
617	Freight Elevator	10-0200	1,000# all steel freight elevator with 3' x 4" platform. Purchased from Midvale Material Handling Equipment Co. Capacity 1,000#.
618	No. 4 Still Heater	32-0271	Direct fired natural gas heater with insulation and refractory lining constructed by Alcorn Combustion Company. 7'-11" dia. x 11'-8" high shell containing a 3" dia. Sch. 80 coil, 259 sq.ft. surface area in a 6' dia. circle. Heater also contains a John Zink VBM No. 10 gas burner. Capacity 355,000 BTU/hour heat absorption (heat input 550,000 BTU/hour).
619	No. 4 Still Condenser	32-0282	20" dia. x 9'-10" long vertical condenser, carbon steel shell, 316 SS tubes - 3/4", 14 gauge tubes (304 tubes) purchased from Southern Heat Exchanger.

Item	Equipment	Equip.No.	Description
620	No. 4 Still Vacuum Receiver	22-0780	6'-6" dia. x 7'-9" straight side, carbon steel vertical tank with dished heads. Contains a 2" Sch. 80 carbon steel coil with approximately 52 sq.ft. of surface area. Designed for full vacuum operation at 400°C. Capacity 2,000 gallons.
621	No. 4 Still Vacuum Receiver Transfer Pump	19-0506	Self-priming, centrifugal pump (Goulds Model 3196 AVS-A60, 7-7/8" dia. open type impeller, 10 HP, 1800 RPM, 440 volt motor, jacketed stuffing box for Therminol heat, Crane No. 9 outside mechanical seal, Code QP-868, casing of pump jacketed for Therminol heat). Capacity 125 GPM at 50' TDH.
622	Therminol Surge Tank	22-0781	3'-6" dia. x 4'-3" straight side, carbon steel vessel with dished heads, contains a 2" Sch. 80 carbon steel coil with 7 sq.ft. surface area. Capacity 325 gallons.
623	Therminol Cir. Pump for No. 4 Still Coolant	19-0507	Self-priming, centrifugal pump (Goulds Model 3196 AVS-A60, 8-1/16" dia. open type impeller, 7-1/2 HP, 1800 RPM, 440 volt motor, with a Crane No. 9 outside mechanical seal, Code QP-868, constructed of Ductile iron). Capacity 100 GPM at 65' TDH.
624	Therminol Cooler No. 4 Still System		Air-cooled heat exchanger, Model No. 58E5A48, 1" O.D. BWG 16 tubes, 4' long, with aluminum fins, 60 sq.ft. surface area. Total fin surface area 1,171 sq. ft. Overall dimensions 2' x 4' x 4'-6" high. Manufactured by Disler Engineering Company. Fan for cooler 1 HP, 1800 RPM, 440 volt motor, capacity 5,500,000 BTU/hour.
625	No. 4 Still Catch Tank	22-0782	3' O.D. x 3'-9" straight side, carbon steel tank with dished heads and a 1-1/2" Sch. 80 coil 6' long. Capacity 200 gallons.

Item	Equipment	Equip.No.	Description
626	No. 4 Still Vacuum Jet	35-0123	Three-stage Worthington No. 2-1/2 JPD jet ejector. First stage special design; second stage No. 5; and third stage No. 6-A. Jet also includes a 10" I.D. porcelain barometric inter-condenser.
627	Therminol Surge Tank (No. 4 Still Cooling System)	22-0783	5'-O.D. x 12' straight side, horizontal, carbon steel tank with dished heads. Tank contains a 3" Sch. 80 coil 20' long. Capacity 1,900 gallons.
628	Therminol Heater Circulating Pump	19-0508	Self-priming, centrifugal pump (Taber vertical submerged No. 346-CC6, with a 12-1/2" open type impeller; 50 HP, 1800 RPM, 440 volt motor, jacketed stuffing box for water cooling). Capacity 350 GPM at 165' TDH.
629	Therminol Heater	32-0274	A helical tube heater with cross-flow connection of the four circulation type for heating Therminol FR-2 by direct firing with natural gas, complete with insulation and refractory lining and coil, 8'-6" dia. x 15'-6" high shell with walls lined with 5" castable refractory Lummite-Haydite vermiculite 124 mix, suitable for 2,000°F service. 4" Sch. 80 coil 350' long with a total surface area of 950 sq.ft. Furnace fabricated by Alcorn Combustion Co. Furnace provided with a North American 6" No. 214-88 dual fuel burner. Capacity rated at 8,150,000 BTU/hour for the burner. Total heat absorbed 6,000,000 BTU/hour.
631	Flaker Tank & Agitator	22-0700	6-blade turbine type impeller, 26" dia., constructed of carbon steel with a 3-1/2" dia. x 8 ft. long shaft. Motor reducer is a Falk 4 ELHZ speed reducer with a 13.9:1 ratio. Slow speed shaft, 125 RPM, driven by a 10 HP, 1800 RPM, 440 volt motor. Capacity, provide medium agitation, in 250 gal. steel jacketed tk.
632	Barometric Sump Tank		3' dia. x 3' long vertical tank, fabricated by Fiberglass. Capacity 150 gallons.

Time	Equipment	Equip.No.	Description
634	Lime Hopper No. 4 Still		2' x 2' x 1' high hopper, fabricated of carbon steel. To fit a 6" nozzle. Capacity 50 lbs. of lime.
635	Montar Conveyor	33-0055	2'-0" x 20'-0" steel roller type conveyor. Drawing D-488-M132.
636	Still Bottoms Blower	11-0339	Centrifugal fan per spec. SM-488-636. Blower for fume removal. V-belt drive and motor assembly for above fan. 5 HP motor, 440 volt, 60/CY, 3/Phase, for chemical duty.
638	Drum Conveyor		2'-6" x 10'-0" used at Liquid Aroclor drum-out station.
639	Scale (Toledo)	24-0182	Model 2881 - Serial No. 4159, used for weighing Liquid Aroclor drums.
640	Polishing Filter		Sparkler Filter - 1'-9" x 3'-6" OAH.
641	Entrainment Separator #4 Still	41-0045	Purchased from Wright Auston. P.O.No. OED-7952.
642	Earth Oven	14-0033	16 KW-2 door oven with controls. Standard electric oven. Purchased from Despatch Oven Company.
643	Pyranol Filter	15-0029	Model 18-S-23 horizontal plate type 304, st. w/scavenger plate feature on pipe legs. Purchased from Sparkler Manufacturing Co.
644	Filtrate Receiver Pump	19-0268	Pump 1-1/2 DSO 8 all bronze - SAE 63 Frame 213.
645	Floor Cleaning Machine	49-0537	Model No. 204325 - Serial No. EP 17646. 5 HP, 220 volt, 3 phase motor. Purchased from G.H. Tennant.
646	Micro Pulverizer	17-0027	2 DH Micro Pulverizer with discharge chute mounted on steel base. Main motor 10 HP, 3450 RPM, fan cooled. Feed motor 1/3 HP, 1725 RPM, Serial No. 12184. Purchased from Pulverizing Machinery.

Item	Equipment	Equip.No.	Description
650	No. 1 Still Pot	20-0018-01	6'-0" dia. x 5'-6" high closed steel as per drawing C-809.
651	Circulating Pump No. 1 Still	19-0230-01	No. 345 semi-stl. CC-5, centrifugal vertical motor pump. 3" inlet, 2-1/2" outlet. Purchased from Taber Pump Co.
652	No. 1 Still Heater	42-0018	3'-9" I.D. x 4'-10-1/2" steel sheet made per Dwg. E-886.
653	No. 1 Still Condenser	32-0116	12" dia., 7'-6" long, 19-1-1/2" 1 PS Sch. 40 Monel tubes. Purchased from Dowington Iron Works.
654	No. 1 Still Ejector	35-0105	#9 N9BON001 Type G Carbate Ejector.
655	No. 2 Still Pot	20-0002-01	6'-0" dia. x 5'-6" high closed steel as per drawing C-809.
656	Circulating Pump No. 2 Still	19-0240-01	Same as Item 651.
657	No. 2 Still Heater	42-0050	No Description on File.
658	No. 2 Still Condenser	32-0141	Same as Item 653.
659	No. 2 Still Ejector	35-0106	Same as Item 654.
660	No. 3 Still Pot	20-0052	Same as Item 655.
661	Circulating Pump No. 3 Still	19-0248	Same as Item 651.
662	No. 3 Still Heater	42-0052	No description on file.
663	No. 3 Still Condenser		Same as Item 653.

Item	Equipment	Equip. No.	Description
664	No. 3 Still Ejector	35-0125	2-1/2 JPA 3rd Stage. Purchased from Worthington Corp. P.O. NO. 82036. Installed January 1966.
669	Lime Slurry Tank	22-0790	Slurry Tank for No. 3 Still. 10" IRS steel Hyd. & flange assembly, steel internal parts.
670	No. 1 Roof Tank	22-0078-01	8' dia. x 30' long. Capacity 11,000 gallons.
674	Circulating Pump (Spare)	19-0238-01	Same as Item 651.
690	Aroclor Flaker	14-0031	Model VMG 5-56, size 24" x 48". Stainless steel drum with feed pans. Purchased from Goslin.
691	Porocel Column	20-0078	28" O.D. x 13'-6" straight side, carbon steel - jacketed column constructed by Chattanooga Boiler and Tank Co.
692	Porocel Column Filter	15-0109	Sparkler Filter, model VR-17-6, 60 psi design pressure, 316 S.S.
693	Column Pump	19-0551	Viking general purpose rotary pump, 675 series, model #G-675G, 1200 RPM, motor.
694	Therminol Tank for Column heat		Style 80 FRS platecoil vessel, special model JF 1050 - Industrial Piping Supply Corp.
695	Therminol Pump		Duriron centrifugal pump Durco MK11, type 1-1/2 x 1-6, speed 1750 RPM, impeller size 5-1/2" carbon steel, mechanical seal, wood's coupling and guard, John Crane Type 9- Coke QP808, motor 2 HP, 1750 RPM, 3 phase, 60 cycle, 220/440 volts.

APPENDIX A - EQUIPMENT LIST

AREA 700

Item	Equipment	Equip.No.	Description
700	1254 Day Tank	22-0663	(Existing) 11,500 Gal. Al.
701	Transfer pump	19-0398	(Existing) 150 HPM @ 120'
702	1242 Day tank	22-0662	(Existing) 11,500 Gal. Al.
703	Transfer pump	19-0397	(Existing) 150 GPM @ 120'
704	1242 Storage	22-0899	27,000 gal. Al. (13'D. x 28')
705	1242 Storage	22-0900	27,000 gal. Al. (13'D. x 28')
707	1242 or 1254 Storage	22-0901	27,000 gal. Al. (13'D. x 28')
708	1254 Storage	22-0902	27,000 gal. Al. (13'D. x 28')
709	1248 Storage	22-0903	18,000 gal. Al. (12'D.x 22')
710	1221 or 1232 Storage	22-0904	18,000 gal. Al. (12'D. x 22')
711	1260 Storage	22-0905	18,000 gal. Al. (12'D. x 22')
712	1262 Storage	22-0906	18,000 gal. Al. (12'D. x 22')
713	1242 Transfer Pump	22-0899	3 x 2-10/10 160 GPM @ 94'
713-001	1242 Pump Motor	22-0899	15 HP 1750 RPM Encap.
714	1254 Transfer Pump	22-0900	Same as 713
714-001	1254 Pump Motor	22-0900	Same as 713-001
715	Transfer Pumps, 1248, 1221, 1232, 1262	22-0901	Same as 713
715-001	Motor for Item 715	22-0901	Same as 713-001
717	1260 Transfer Pump	22-0902	Same as 713
717-001	1260 pump motor	22-0902	Same as 713-001
719	1242 Product Filters	15-0121	2-Cuno Model PT 184 - Cuno-pore filters of 316 S.S. w/asbestos-cellulose filter media
720	1254 Product Filters	15-0122	Same as 719
721	Filters for Item 715	15-0123	Same as 719

DSW 543247

*Al. tank fabricated from type 5052 - H 112 Aluminum

APPENDIX A - EQUIPMENT LIST

AREA 700

Item	Equipment	Equip.No.	Description
723	1262 Product Filters	15-0124	Same as 719
725	Mix Tank	22-0907	11,000 gal. Al. (11'D. x 18' with 15° slope bottom)
725-002	Mix tank agitator	18-0118	208-RSES-15-Propeller type w/shut-off for seal repair
725-003	Agitator motor	18-0118	Same as 713-001
726	"CM" Storage	22-0908	18,000 gal. Al. (12'D. x 22')
727	Blend tank		(Relocated) 2,000 gal. 316 SS
728	Item 725 Transfer Pump	22-0907	Same as 713
728-001	Item 728 pump motor	22-0907	Same as 713-001
730	Item 727 Transfer pump	15-0125	Same as 713
730-001	Item 727 pump motor	15-0125	Same as 713-001
731	Filters for Item 725	15-0125	Same as 719
732	Filters for Item 727	15-0126	Same as 719
733	TCB Storage	22-0909	12,000 gal. Al. (11'D. x 18')
734	TTCB Storage	22-0910	12,000 gal. Al. (11'D. x 18')
735	TCB or TTCB Transfer Pump	22-0910	3 x 2-10/8 120 GPM @ 43.5'
735-001	TCB or TTCB Transfer pump motor	22-0910	7-1/2 HP 1750 RPM Encap.
737	TCB or TTCB Unloading pump	22-0910	3 x 2-10/9-1/2 120 @ 80'
737-001	TCB or TTCB Unloading pump motor	22-0910	10 HP 1750 RPM Encap.
739(605)	#2 Filter Receiver pump	(Existing)	
740(603)	#1 Filter Rec. pump	(Existing)	
741(601)	Pump Blend Tanks	(Existing)	
742		Motor Control Center	

DSW 543248

APPENDIX A - EQUIPMENT LIST

AREA 700

Item	Equipment	Equip.No.	Description
743	Clay Slurry Pot	22-0914	Clay addition to 725
743-001	Clay Slurry Pot Agit.	22-0914	N 33-50
743-002	Clay Slurry Pot Agit. motor	22-0914	1/2 HP TEFC
744	Scavenger Pump (PPO)	22-0914	3 GPM @ 30'
744-001	Scavenger Pump motor	22-0914	1/2 HP 1800 RPM
745	CM Transfer Pumps	22-0914	Same as 713
746	CM Product Filters	22-0914	Same as 719
747	Toluene or Xylene Drum Pump	22-0914	186 PM @ 30'
747-001	Toluene or Xylene Pump Motor	22-0914	1/2 HP 1200 RPM
750	Condensate Pig	22-0914	3' D. x 6' steel
751	Nitrogen Filter	22-0914	PK 31.20 Cuno

Item	Equipment	Equip.No.	Description
801	Drum filler		Toledo twin lance high speed drum filler with "Print Weigh" system. Capacity 4-55 gal. drums in 5½ minutes.
803.001	Conveyor on scale platform	40-006	5 ft. of chain driven live roller conveyor. Conveyor interlocked with scale so that it cannot be operated until drum filling cycle is complete.
803.002	Motor for 803.001		1/2 H.P.
803.003	Full pallet conveyor		Heavy duty gravity roller conveyor 21 ft. long with a capacity of 5 full drum pallets.
804.000	Instrument air comp.	37-0105	100 SCFM Joy air compressor. 80 psig operating pressure. (Transferred from Dept. 236 at Krummrich Plant)
804.001	Motor for 804.000	37-0105	25 HP 1750 RPM
804.002	Aftercooler	37-0105	Jacketed cooler, with water in jacket.
804.003	Entrainment Separator	37-0105	Joy Mfg. Co. - no details available.
804.004	Instrument air receiver	37-0105	36" dia. by 8 ft. high manual drain.
804.007	Inlet air filter	37-0105	No data available.
806.000	Instrument air dryer	37-0105	Trinity heatless model 100 HA4-A7, Serial No. 8484, 100 SCFM flow and 14 SCFM regeneration flow.
806.002	Dryer Desiccant filter	37-0105	Pall Trinity Micro Corp. cartridge filter assembly 3-1/4" dia. tube. Replacement cartridge Part No. MCS 1001 E B.
807.000	Sewerage Pumps	37-0105	Aurora 4" KSB
807.001	Motor for 807.000	37-0105	1-1/2 HP, 1750 RPM, TEFC 220/440 volts, 3 phase, 60 cycle severe duty
807.002	Same as 807.001		Ditto
808.000	Empty Drm. Pallet Conveyor	42-0053	Approx. 25 ft. conveyor with capacity of 6 pallets of empty drms. Conveyor to be heavy duty gravity roller with gradient for safe self movement.

Item	Equipment	Equip.No.	Description
808.001	Right Angle Transfer Conveyor	42-0053	Empty drum pallet conveyor at end of conveyor 808.000. Control mechanism for operating 90° turn located beside the Toledo Scale.
810.000	Aroclor 5460 Stg. Tank	22-0911	8'-6" D. x 11'-3" straight side vertical carbon steel tank with a working volume of 4,500 gals. Tank to be heated by therminol using panel coils.
810.001	Panel Coils	22-0911	168 ft.^{2} of heating area for 43 GPM of therminol FR-2. Heat transfer-30,000 BTU/Hr. Maintain 250°C.
811.000	Aroclor Flaker Feed Tank	22-0912	8'-6" D. x 11'-3" straight side horizontal carbon steel tank with a working volume of 5,300 gallons. Tank to be heated by therminol using panel coils.
811.001	Aroclor flaker feed tank coil	22-0912	79 ft.^{2} of heating area for 35 GPM of Therminol FR-2. Heat transfer - 200,000 BTU/Hr. Maintain temp. of 250°C.
812.000	Aroclor Flaker	14-0046	4' D. x 10' length chromium plated drum. Internal operating pressure 60 psig. H_2O flow at design rate of 125 GPM. Drum immersion range 0 to 2". Pan depth 4" and therminol heated. Overflow of pan returns to flaker feed tank. Knife pressure controlled by regulated air pressure 20 psig. Design rate 6,900 lbs/hr. of Aroclor 5460.
812.001	Aroclor Flaker Motor	14-0046	10 HP, 1750 RPM, 60 cycles, 3 phse, 220/440 volt, TEFC Class I, Group D explosion proof motor. Reeves motor drive to provide drum speed of 5 to 15 RPM (Normal 8 RPM)
812.002	Aroclor Flake Breaker	14-0046	Internal - series B. Steel.
812.003	Aroclor Flake Breaker Motor	14-0046	1 HP, 1750 RPM, TEFC motor.

AREA 800

Item	Equipment	Equip.No.	Description
813	Aroclor Flake Bin	21-0104	Surge Capacity between Aroclor flaker and bagger of 87 cu.ft., 304 SS 1/8" thick bottom slope bin (20 ft.^{2} min. working volume).
814	Aroclor Bag Filler	40-0005	St. Regis two tube series 9840 force flow packer with 14" Teflon coated chambers. Feed rate 2.3 bags of Aroclor 5460 and 1.7 bags of Biphenyl or 4.0 bags per minute.
*815	Biphenyl Flaker Feed Tank	22-0913	7'-6" O.D. x 11'-3" straight side horizontal carbon steel tank with a working volume of 3730 gallons. Tank to be heated by steam and/or cooled by water to control tank temperature at 80°C.
*815.001	Biphenyl Flaker Feed Tank Coil	22-0913	9.8 ft.^{2} of heating or cooling area to keep Biphenyl at flaking temp. and provide heat to remelt scrap flakes.
*815.002	Biphenyl Flaker Feed Tank coil	22-0913	58.5 ft.^{2} of heating area to maintain tank contents at 150°C. when Santowax is being flaked. Can be used for cooling Biphenyl.
*816	Biphenyl Flaker	14-0047	4' D. x 6' length chromium planted drum. Capacity of 5,000 lbs. per hour of Biphenyl at 18 RPM. Normal drum speed will be 16 RPM. Flaking temp. of 85°C. Drum immersion range 0 to 2". Steam heated flaker pan. Knife pressure controlled by regulated air pressure at 10 psig.
*816.001	Biphenyl Flaker Motor	14-0047	5 HP, 1750 RPM, 3 phase, 220/440 volt, 60 cycle, Class I, Group D motor. Variable speed drive of 6.7 to 20 RPM (normal 16 RPM).
*817	Biphenyl Flake Hopper	21-0105	Surge capacity between Biphenyl flaker and bagger of 87 cu.ft. 304 SS bin with vibrator, hinged top inspection door and safety glass inspection window.
*318	Biphenyl Bag Filler		Same as 814

DSW 543252

Item	Equipment	Equip.No.	Description
819	Bag Flattener	40-0007	24" wide x 13' long x 14" to 7' high conveying surface of spring belts and grooved rollers for putting pressure on bag. Includes 90° powered discharge turn using tapered grooved rollers and spring belts.
819.001	Bag Flattener Motor	40-0007	Two - 1 HP motors.
820	Bag Conveyor	40-0007	36" wide x 10' long x 26" high with conveying surface of Ashworth flat wire mesh belting, complete with pulleys, pipe idlers and take-ups.
820.001	Bag Conveyor Motor	40-0007	1 HP Motor.
821	Glue Applicator	40-0007	Steel glue container with grizzly bar cover. Two wheels mounted on axle and rotating in glue, applying glue as bag passes over wheel.
822	Bag Check Weigh Scale	40-0007	0-250# Scale relocater from Bldg. 27 Aroclor flake scale.
823	Fluidizing Blower	40-0005	Roots-Connersville type AF 53 to supply minimum of 100 CFM at 10 psig to fluidize St. Regis force flow packer.
823.001	Fluidizing Blower Motor	40-0005	7-1/2 HP, 1800 RPM, TEFC motor. Frame size 213 T, 3 phase, 60 cycle, 230/460 volt. V-belt drive 3B55 center distance 16.9, P.D. drive Sh. 6.0, P.D. driven Sh. 8.6.
824	Fluidizing Blower	40-0005	Same as 823.
824.001	Fluidizing Blower Motor	40-0005	Same as 823.001
825	Fiber Drum Fill Scale		0-1000 Lb. Scale
826	Aroclor 1268 Mill		Design is incomplete.
826.001	Mill Motor		Design is incomplete.
830	Mill Fume Hood		Design incomplete.
830.001	Drum Fume Hood		Design incomplete.

APPENDIX A - EQUIPMENT LIST

AREA 800

Item	Equipment	Equip.No.	Description
831	Aroclor Flaker Feed Pump	22-0912	3 x 2 - 11, 1150 RPM open impeller Goulds AVS carbon steel pump to feed flaker 812 with overflow about 15 GPM, mix contents of tank 811 - 120 to 150 GPM or melt flakes in basket of tank 811. Cover plate and stuffing box are jacketed.
831.001	Aroclor Flaker Feed Pump Motor	22-0912	5 HP, 1150 RPM, TEFC motor.
832	Biphenyl Flaker Feed Pump	22-0913	3 x 2 - 10, 1150 RPM 140 GPM at 40' TDH ductile iron impeller and Crane mechanical seals.
832.001	Biphenyl Flaker Feed Pump Motor	22-0913	5 HP, 1150 RPM
834	Aroclor Flake Conveyor	33-0063	12" x 10' vibrating trough constructed of 304 S.S. max. slope of 5° from East to West. Design capacity - 10,000 lbs/hr. normal capacity - 7,000 lbs/hr.
834.001	Aroclor Flake Conveyor Motor	33-0063	1/2 HP, TEFC
837	Aroclor Lot Transfer Pump	22-0911	3 x 2 - 11/10, 1750 RPM open impeller AVS Goulds pump rated at 120 GPM at 104 ft. Seal-John Crane with TC seal faces and heated by therminol. Ductile iron casing, 316 SS shaft, and cast iron impeller.
837.001	Aroclor Transfer Pump Motor	22-0911	15 HP, 1750 RPM encapsulated motor.
838	Aroclor Dust Collector	(Mill)	Design incomplete.
838.001	Motor for 838		Design incomplete.
839	Blower (Mill)		Design incomplete.
839.001	Blower Motor (Mill)		Design incomplete.
840	Flaker Vent Scrubber	41-0046	Rotoclone Steel Scrubber - 4500 CFM.
843	Flaker Vent Blower	41-0046	10" blower with capacity of 4500 CFM.
843.001	Flaker Vent Blower Motor	41-0046	15 HP, 1750 RPM Motor.

AREA 800

Item	Equipment	Equip.No.	Description
844	Fiber Drum Conveyor (Empty)		No data available.
844.001	Fiber Drum Conveyor (Full)	42-0054	No data available.
845	Bag Gravity Conveyor	40-0007	Skate wheel discharge conveyor 24" wide x 25' long to be installed at an angle of decline to carry bag to check weigh scale.
846	Aroclor Flake Diverting Gate		TE-Co, Inc. For details see Dwg. No. 9194.
847	Biphenyl Flake Diverting Gate		Same as 846.
848	Aroclor Pallet Conveyor	33-0064	Gravity conveyor for accumulating loaded pallets, 4' wide x 20' long. Conveying surface of pipe idlers, 2-1/2" D., mounted on 6" channel iron frame.
849	Biphenyl Pallet Conveyor	49-0947	Same as 848 except 29' long.
850	Therminol Heater	32-0304	Capacity - 450,000 Btu/hr. future 300,000 Btu/hr. present 100 KW present 150 KW future to delvier 287°C. Therminol FR-1. Electric service is 460 volts & NEMA 12 spec.
850.001	Therminol Pump	32-0304	60 GPM at 60 psig centrifugal pump with cast steel casing.
850.002	Therminol Pump Motor	32-0304	460 volts, 3 phase, 60 cycle, TEFC 15 HP x 3500 RPM.
850.003	Therminol Expansion Tank	32-0304	125 Gallon capacity.
851	Unit heater, steam		Trane 42 PL propeller type projection unit heaters.
852	Unit heater, steam		Same as 851.
853	Unit Heater, steam		Same as 851.

Item	Equipment	Equip.No.	Description
854	Penthouse Roof Fan	41-0046	Penn Ventilator Co., Inc. Unit No. LC-32 with 2 speed - 2 winding variable torgue motor (440/296 RPM delivers 8480/5700 CFM), 1 HP, 1750 RPM motor, 460 volt, 3 phse, 60 cycles.
855	Scrubber Water Tank	41-0046	500 Gal. 4' O.D. 4'-6" tangent length steel tank to hold re-circulation water to scrub organics from exhaust of flaker vents. Tank per Monsanto Std. D 3.1, Std. 12.
856	Scrubber Water Recirculation Pump	41-0046	12 GPM at 72' 1 x 2-8 1750 RPM AVS A-50 pump. Casing of ductile iron and 8-1/4" impeller cast iron.
856.001	Scrubber Pump Motor		3 HP, 1750 RPM.
857	Aroclor Pallet Dispenser	49-0946	FMC Corp. American Hydraulic Lift 24" x 48" platform - Model #1070. Empty chain conveyor 80 FPM, driven by 1/2 H.P. 43 RPM. Gear motor 440 V, 60 cycle, 3 phase.
857.001	Aroclor Pallet Dispenser Motor	49-0946	1/2 H.P., Pump power unit, 220/440 volt, 60 cycle, 3 phase.
858	Biphenyl Pallet Dispenser	49-0947	Same as 857.
858.001	Biphenyl Pallet Dispenser Motor	49-0947	Same as 857.001.

STANDARD MANUFACTURING PROCESS
FOR
AROCLORS

APPENDIX B - MATERIAL SPECIFICATIONS

I - FINISHED GOODS

a. Aroclor 1221
b. Aroclor 1232*
c. Aroclor 1242
d. Aroclor 1248
e. Aroclor 1254
f. Aroclor 1260
g. Aroclor 1262
h. Aroclor 1268
i. Aroclor 2565 (undistilled)
j. Aroclor 4465**
k. Aroclor 5442
l. Aroclor 5460
m. Aroclor 5060 (undistilled)

*Aroclor 1232 is a mixture of approximately 53.4% Aroclor 1221 and 46.6% Aroclor 1242 (by volume).

**Aroclor 4465 is a blend of approximately a 1 to 1 ratio of Aroclor 1262 and Aroclor 5460. The softening point range of the blend determines the exact ratio.

II - RAW MATERIALS

a. Biphenyl
b. Santowax C
c. Santowax R
d. Chlorine
e. Hydrated Lime
f. Attapulgus Earth
g. Ferric Chloride
h. Activated Bauxite

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

PRODUCTION	RESEARCH
H. Williams 2/19/69	M. E. Gibbs 3/12/69
SALES	QUALITY CONTROL (Chief Chemist)
W. Ault 3/10/69	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

DSW 543258

(R) Routine Analysis, All others Analyzed by request Only

K-392

MONSANTO
ORGANIC CHEMICALS DIVISION

FINISHED PRODUCT SPECIFICATION

AROCLOR 1232

WGK 246

PLANT	PRODUCT CODE	USE
Anniston & WGK	826.11 & 81115	Sales
DATE EFFECTIVE	SALES CODE	
3-1-69	1040-230-04/11/003/009	

APPROVALS

PRODUCTION	RESEARCH
J. Molloy 3/21/69 H. Williams 2/19/69	M. E. Gibbs 3/12/69
SALES	QUALITY CONTROL (Chief Chemist)
W. Ault 3/10/69	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
11-17-66	2 x 1/2 gal. Amber Bottles	G. Miller

CHARACTERISTIC	LIMITS	METHOD	
		Anniston	WGK
(R) Condition	Clear	G-1	10084
(R) Color, APHA	50 Max.	046	10084
(R) Specific Gravity, (25/15.5°C)	1.270-1.280	052	10114
(R) Acidity, (Mg KOH/g)	0.014 Max.	050	10087
(R) Viscosity @ 100°F	44-51 SUS 6.5-10.0 Cp	049	10086

DSW 543259

(R) Routine Analysis, All others Analyzed by request Only

392

Monsanto
ORGANIC CHEMICALS DIVISION

TENTATIVE SPECIFICATION

PRODUCT: Export Grade Aroclor 1242, Electrical Grade		DEPT.: 27-L
PLANT: Anniston	PRODUCT CODE: 826.12	USE: Sales
DATE EFFECTIVE: 6-12-67	SALES CODE: 1040-240-16-009	
AUTHORIZED BY: G. W. Miller	SOURCE OF SPECIFICATION: P. G. Benignus Memo dated 5-11-67	

GENERAL DESCRIPTION

CHEMICAL FORMULA

MOL WT.

ISSUED	EFFECTIVE UNTIL	SAMPLE FOR ANALYSIS	ISSUED BY
	6-1-68	3 x 5 pt. Amber bottles	J. A. Liddle 5/29/6

CHARACTERISTIC	LIMITS		METHOD
UNRESTRICTED INFORMATION			
(R) Color, APHA	40 Max.		046
(R) Condition	Clear		G-1
(R) Specific Gravity @ 25°/15.5°C	1.381 - 1.392		052
(R) Acidity (mg KOH/gm)	0.010 Max.		050
(R) Moisture, H_2O, ppm	35 Max.		047
(R) Refractive Index @ 25°C	1.6240 - 1.6260		048
(R) Inorganic (free) Chlorides, ppm	0.05 Max.		045
(R) Pour Point, °C	-14 or lower		053
(R) Dielectric Constant 1 KC @ 100°C	4.70 - 4.90		113
(R) Resistivity ohm-cm 500 VDC @ 100°C, 0.1" Gap	5,000 x 10^9 Min.		121
(R) Hydrolysis Stability Test (as chlorides) ppm	0.5 Max.		010
(R) Monsanto Stability Test (as chlorides) ppm	0.4 Max.		133
(R) Biphenyl, %	0.05 Max.		100
(R) Distillation Range (ASTM D-20, Corrected)			054
10% Distilled by wt.	325°C Min.		
90% Distilled by wt.	360°C Max.		
Sulfates	None		12169 (WGK)
Dielectric Strength @ 25°C	35 KV Min.		043
Flash Point (°F)	338 - 392		114
Fire Point	None to Boil		114
Viscosity @ 100°F (SUS)	82 - 92		049
RESTRICTED INFORMATION		Typical Values	
Power Factor @ 100°C			113
60 cycles	Report	0.30 - 0.50	
1000 cycles	Report	0.08 - 0.10	

/s/G. W. Miller - 5-31-67
G. W. Miller - Chief Chemist

/s/H. L Williams - 6-1-67
H. L. Williams - Production

/s/Wm. E. Ault - 6-8-67
W. E. Ault - Sales

/s/L. R. Stark - 6-12-67
L. R. Stark - Research

DSW 543260

(R) Routine Analysis, All others Analyzed by request only.

Monsanto
ORGANIC CHEMICALS DIVISION
ANNISTON AND KRUMMRICH

FINISHED PRODUCT SPECIFICATION

PRODUCT: Aroclor 1242, Electrical Grade		DEPT.: 246 27 L
PLANT: WGK, Ann.	PRODUCT CODE: 81101 - 82612	USE: Sales
DATE EFFECTIVE: 6/17/66	SALES CODE: 1040-240-04/11/16-03/09	

APPROVALS

PRODUCTION: P. E. Heisler	RESEARCH: R. W. Bucknell
SALES: W. E. Ault	QUALITY CONTROL (Chief Chemist): O. E. Dolin / W. J. Gresham

GENERAL DESCRIPTION

Also known as Pyranol 1499

CHEMICAL FORMULA

MOL WT.

SUPERSEDES SPECS. OF: 4-13-62	SAMPLE FOR ANALYSIS: 3 x 5 pt. Amber Bottles	ISSUED BY: J. P. Prader

UNRESTRICTED INFORMATION

	CHARACTERISTIC	LIMITS	METHOD: WGK	METHOD: Anniston
(R)	Color (APHA)	40, max.	10084	14-44-54
(R)	Condition	Clear	10084	G-1
(R)	Sp. Gr. @ 25/15.5°C.	1.381 - 1.392	10114	14-49-54
(R)	Acidity (mg. KOH/g.)	0.010, max.	10087	14-42-54
(R)	Moisture (H_2O)	35 ppm., max.	10620	14-53-54
(R)	Refractive Index @25°C.	1.6240 - 1.6260	10125	14-34-54
(R)	Inorganic (Free) Chlorides	0.05 ppm., max.	12741	014
(R)	Pour Point	-14°C. or Lower	10115	14-47-54
(R)	Dielectric Constant (1000 cycles @ 100°C.)	4.70 - 4.90	11608	14-36-54
(R)	Resistivity (500 VDC @ 100°C. 0.1" Gap) As OHM-CM x 10^9	500, min.	11607	14-35-57
(R)	Hydrolysis Stability Test (As Chlorides)	0.5 ppm, max.	12672	010
(R)	Monsanto Stability Test (As Chlorides)	0.4 ppm., max.	11503	14-61-57
(R)	Distillation Range (ASTM D-20, Corrected)		10117	14-31-54
	10% Distilled by wt.	325°C., min.		
	90% Distilled by wt.	360°C., max.		
	Sulfates	None	12169	------
	Dielectric Strength @ 25°C.	35 KV, min.	11605	043
	Flash Point (°F)	338 - 392	10123	14-28-54
	Fire Point	None	10123	14-28-54
	Corrosion Test (6 hrs. @ 210°C. with bright aluminum foil)		10126	14-55-57
	Change in wt. of AL %	0.0		
	A.C. Color (APHA)	60, max.	10084	14-44-54
	A.C. Condition	Clear	10084	G-1
	A.C. Acidity (mg. KOH/g.)	0.010, max.	10087	14-42-54
	A.C. Inorganic (Free) Chlorides	0.05 ppm., max.	12741	014
	Visc. @ 100°F. (SUS)	82 - 92	10086	14- 4-52

(Over)

DSW 543261

(R) Routine Analysis, All others Analyzed by request Only

GENERAL INFORMATION

Specific Heat @ 25°C.	0.30
Coefficient of Expansion (25 - 65°C)	0.00068 cc/°C.
Fixed Chlorine	42.5 - 53.5%
Power Factor @ 100°C.	(Typical Values)
60 cycles	5
1000 cycles	0.30

SPECIAL CUSTOMER REQUIREMENTS

General Electric

Thermal Chemical Chlorides	0.65 ppm., max.	12722

Westinghouse

Hydrolizable Chlorine (Westinghouse Stability Test)	1.0 ppm., max.	T-2219

DSW 543262

Monsanto
ORGANIC CHEMICALS DIVISION

FINISHED PRODUCT SPECIFICATION

PRODUCT		DEPT.
AROCLOR 1242 NON-ELECTRICAL GRADE		Ann. 608 WGK 246
PLANT	PRODUCT CODE	USE
Anniston & WGK	82612-81101	Sales
DATE EFFECTIVE	SALES CODE	
3-1-69	1040-240-04/11/009-003	

APPROVALS

PRODUCTION	RESEARCH
J. Molloy 3/21/69 H. Williams 2/19/69	M. E. Gibbs 3/12/69
SALES	QUALITY CONTROL (Chief Chemist)
W. Ault 3/10/69	R. Blowers 3/26/69 G. Miller 2/15/69

GENERAL DESCRIPTION

MIXTURE

CHEMICAL FORMULA

MOL WT.

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS	ISSUED BY
9/25/67	2 x 1/2 gal. Amber Bottles	G. Miller

CHARACTERISTIC	LIMITS	METHOD Anniston	METHOD WGK
(R) Condition	Clear	G-1	10084
(R) Color, APHA	100 Max.	046	10084
(R) Specific Gravity (25/15.5°C)	1.381-1.392	052	10114
(R) Acidity, (mg KOH/g)	0.010 Max.	050	10087
(R) Moisture, ppm	50 Max.	047	10620
(R) Viscosity @ 100°F	82-92 SUS 22-26 Cp	049	10086
Flash Point, °F	338 Min.	114	10123
Fire Point, °F	None to Boiling	114	10123

DSW 543263

(R) Routine Analysis, All others Analyzed by request Only

Monsanto
ORGANIC CHEMICALS DIVISION
WGK and Anniston Plants
FINISHED PRODUCT SPECIFICATION

PRODUCT		DEPT.
Aroclor 1248 Electrical Grade(Pyranol 1498)		246 WGK 27 Ann.
PLANT	PRODUCT CODE	USE
	811.02	Sales
DATE EFFECTIVE	SALES CODE	
5/10/67	1040-260-04/11/16-03/09	

APPROVALS

PRODUCTION	RESEARCH
P. E. Heisler	N. F. Mueller
SALES	QUALITY CONTROL (Chief Chemist) G. W. Miller
W. E. Ault	W. J. Gresham

GENERAL DESCRIPTION: Mixture

CHEMICAL FORMULA:

MOL WT.

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS	ISSUED BY
1/10/64 & 2/16/64	3 x 5 pt. Amber Bottles	L. E. Hornback

	CHARACTERISTIC	LIMITS	METHOD WGK	METHOD Anniston
	UNRESTRICTED INFORMATION			
(R)	Color, APHA	50, max.	10,084	14-44-54
(R)	Condition	Clear	10,084	G-1
(R)	Sp. Gr. @65.15.5°C	1.405 - 1.415	10,114	14-49-54
(R)	Acidity (mg. KOH/gm.)	0.010, max.	10,087	14-42-54
(R)	Moisture	35 ppm., max.	10,620	14-53-54
(R)	Refractive Index @25°C.	1.6285 - 1.6305	10,125	14-34-54
(R)	Inorganics (Free) Chlorides	0.05 ppm., max.	T-2092	014
(R)	Pour Point	0°C., max.	10,115	14-27-54
(R)	Dielectric Constant (1000 cycles @100°C.)	4.5 - 4.7	11,608	14-36-54
(R)	Resistivity (500 VDC @100°C. 0.1" GAP) as OHM-CM x 10^9	500, min.	11,607	14-35-57
(R)	Hydrolysis Stability Test (as Chlorides)	1.0 ppm., max.	T-2087	010
(R)	Monsanto Stability Test (as Chlorides)	0.5 ppm., max.	11,503	14-61-57
(R)	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.		
	Sulfates	None	12,169	-----
	Dielectric Strength @25°C.	35 KV, min.	11,605	14-28-54
	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		
	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%		

DSW 543264

Monsanto
ORGANIC CHEMICALS DIVISION

FINISHED PRODUCT SPECIFICATION

PRODUCT		DEPT.
AROCLOR 1248 NON-ELECTRICAL GRADE		Ann. 608 WGK 246
PLANT	PRODUCT CODE	USE
Anniston & WGK	82641-81102	Sales
DATE EFFECTIVE	SALES CODE	
3-1-69	1040-260-04/11/009-003	

APPROVALS

PRODUCTION	RESEARCH
J. Molloy 3/21/69 H. Williams 2/19/69	M. E. Gibbs 3/12/69
SALES	QUALITY CONTROL (Chief Chemist)
W. Ault 3/10/69	R. Blowers 3/26/69 G. Miller 2/15/69

GENERAL DESCRIPTION

CHEMICAL FORMULA

MIXTURE

MOL WT.

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS	ISSUED BY
9/25/65	2 x 1/2 gal. Amber Bottles	G. Miller

CHARACTERISTIC	LIMITS	METHOD	
		Anniston	WGK
(R) Condition	Clear	G-1	10084
(R) Color, APHA	100 Max.	046	10084
(R) Specific Gravity, (65/15.5°C)	1.405-1.415	052	10114
(R) Acidity, (mg KOH/g)	0.010 Max.	050	10087
(R) Moisture, ppm	50 Max.	047	10620
(R) Viscosity, @ 130°F	73-80 SUS 19.5-22.5 Cp	049	10086
Flash Point, °F	370 Min.	114	10123
Fire Point, °F	None to Boiling	114	10123

DSW 543265

(R) Routine Analysis, All others Analyzed by request Only

Monsanto
ORGANIC CHEMICALS DIVISION

FINISHED PRODUCT SPECIFICATION

PRODUCT		DEPT.
Aroclor 1254 - Export Grade Electrical Grade		27-L
PLANT	PRODUCT CODE	USE
Anniston	826.13	Sales
DATE EFFECTIVE	SALES CODE	
3/23/67	1040-280-16-009	

APPROVALS

PRODUCTION	RESEARCH
R. G. Moody/s/R. G. Moody 3/23/67	L. R. Stark/s/L. R. Stark 3/21/67
SALES	QUALITY CONTROL *(Chief Chemist)*
W. E. Ault/s/W. E. Ault 3/17/67	G. W. Miller/s/G. W. Miller 2/23/67

GENERAL DESCRIPTION — CHEMICAL FORMULA

Mixture

MOL WT.

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS	ISSUED BY
Tentative 4/27/66	3 x 5 pt. Amber bottles	J. A. Liddle 2/21/67

CHARACTERISTIC	LIMITS	METHOD
UNRESTRICTED INFORMATION		
(R) Color, APHA	50 Max.	046
(R) Condition	Clear	G-1
(R) Specific Gravity @ 65/15.5 °C	1.495 - 1.505	052
(R) Acidity (mg KOH/gm.)	0.010 Max.	050
(R) Moisture (H_2O), ppm	35 Max.	047
(R) Refractive Index @ 25°C	1.6370 - 1.6390	048
(R) Inorganic (free) Chlorides, ppm	0.05 Max.	045
(R) Pour Point, °C	7 - 12	053
(R) Dielectric Constant 1000 Cycles @ 100°C	4.15 - 4.35	113
(R) Resistivity ohm-cm 500 VDC @ 100°C, 0.1" Gap	10,000 x 10^9 Min.	121
(R) Hydrolysis Stability Test as chlorides, ppm	1.0 Max.	010
(R) Monsanto Stability Test as chlorides, ppm	0.5 Max.	133
(R) Distillation Range, ASTM D-20, corrected		054
10% Distilled by wt.	366 - 378°C	
50% Distilled by wt.	371 - 383°C	
90% Distilled by wt.	379 - 394°C	
(R) Biphenyl, %	0.025 Max.	100
Sulfates	None	
Dielectric Strength @ 25°C	35 KV, Min.	043
Flash Point	None to Boil	114
Fire Point	None to Boil	114
Viscosity @ 210°F (SUS)	44 - 48	049
Corrosion Test 6 hours @ 210°C with bright aluminum foil		
Change in wt. of Al (%)	0.0	
A.C. Color, APHA	60 Max.	046
A.C. Condition	Clear	G-1
A.C. Acidity (mg. KOH/g.)	0.010 Max.	050
A.C. Inorganic (free) chlorides, ppm	0.05 Max.	045
RESTRICTED INFORMATION		DSW 543266
Power Factor @ 100°C & 60 Cycles	Report	113

(R) Routine Analysis, All others Analyzed by request Only

Monsanto
ORGANIC CHEMICALS DIVISION

FINISHED PRODUCT SPECIFICATION

PRODUCT		DEPT.
Aroclor 1254 Electrical Grade		246 - 27
PLANT	PRODUCT CODE	USE
WGK and Ann.	81103 82613	Sales
DATE EFFECTIVE	SALES CODE	
11/4/68	1040-280-04/11/16-03/09	

APPROVALS

PRODUCTION	RESEARCH
J. W. Molloy	R. W. Bucknell
SALES	QUALITY CONTROL (Chief Chemist)
W. E. Ault	W. J. Gresham / G. W. Miller

GENERAL DESCRIPTION

CHEMICAL FORMULA

Also called Pyranol 1476

MOL WT.

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS	ISSUED BY
6/28/65	3 x 5 pt. Amber Bottles	E. McEntire/G. Stites

UNRESTRICTED INFORMATION

	CHARACTERISTIC	LIMITS	WGK METHOD	Ann. METHOD
(R)	Color, APHA	50, Max.	10084	14-44-54
(R)	Condition	Clear	10084	G-1
(R)	Sp. Gr. @ 65/15.5°C	1.495 - 1.505	10114	14-49-54
(R)	Acidity (mg. KOH/gm.)	0.010, Max.	10087	14-42-54
(R)	Moisture (H_2O)	35 ppm, Max.	10620	14-53-54
(R)	Refractive Index @ 25°C	1.6370 - 1.6390	10125	14-34-54
(R)	Inorganic (Free) Chlorides	0.05 ppm., Max.	12741	014
(R)	Pour Point	7 - 12°C	10115	14-27-54
(R)	Dielectric Constant (1000 cycles @ 100°C)	4.15 - 4.35	11608	14-36-54
(R)	Resistivity (500 VDC @ 100°C 0.1" GAP) as OHM-CM x 10^9	500, Min.	11607	14-35-57
(R)	Hydrolysis Stability Test (as Chlorides)	1.0 ppm., Max.	12672	010
(R)	Monsanto Stability Test (as Chlorides)	0.5 ppm., Max.	11503	14-61-57
(R)	Distillation Range (ASTM D-20, Corrected)		10117	14-31-54
	10% Distilled by Wt.	366 - 378°C		
	50% Distilled by Wt.	371 - 383°C		
	90% Distilled by Wt.	379 - 394°C		
	Sulfates	None	12169	
	Dielectric Strength @ 25°C	35KV, Min.	11605	043
	Flash Point	None	10123	14-28-54
	Fire Point	None	10123	14-28-54
	Visc. @ 210°F (SUS)	44-48	10086	14-4-52
	Corrosion Test (6 hrs. @ 210°C with bright aluminum foil)		10126	14-55-57
	Change in wt. of Al (%)	0.0		
	A. C. Color, APHA	60, Max.	10084	14-44-54
	A. C. Condition	Clear	10084	G-1
	A. C. Acidity (mg. KOH/g.)	0.010, Max.	10087	14-42-54
	A. C. Inorganic (Free) Chlorides	0.05 ppm., Max.	10118	010

DSW 543267

(R) Routine Analysis, All others Analyzed by request Only

Monsanto
ORGANIC CHEMICALS DIVISION

FINISHED PRODUCT SPECIFICATION

PRODUCT		DEPT.
AROCLOR 1254 NON-ELECTRICAL GRADE		Ann. 608 WGK 247
PLANT	PRODUCT CODE	USE
Anniston & WGK	82613-81103	Sales
DATE EFFECTIVE	SALES CODE	
3-1-69	1040-280-04/11/009-003	

APPROVALS

PRODUCTION	RESEARCH
J. Molloy 3/21/69 H. Williams 2/19/69	M. E. Gibbs 3/12/69
SALES	QUALITY CONTROL (Chief Chemist)
W. Ault 3/10/69	R. Blowers 3/26/69 G. Miller 2/15/69

GENERAL DESCRIPTION: MIXTURE

CHEMICAL FORMULA:

MOL WT.

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS	ISSUED BY
9/25/67	2 x 1/2 gal. Amber Bottles	G. Miller

CHARACTERISTIC	LIMITS	METHOD	
		Anniston	WGK
(R) Condition	Clear	G-1	10084
(R) Color, APHA	100 Max.	046	10084
(R) Specific Gravity (65/15.5°C)	1.495-1.505	052	10114
(R) Acidity (mg KOH/g.)	0.010 Max.	050	10087
(R) Moisture, ppm	50 Max.	047	10620
(R) Viscosity @ 210°F	44-48 SUS 7.5-10 Cp	049	10086
Flash Point	None	114	10123

DSW 543268

(R) Routine Analysis, All others Analyzed by request Only

Monsanto
ORGANIC CHEMICALS DIVISION

ANNISTON AND KRUMMRICH
FINISHED PRODUCT
SPECIFICATION

PRODUCT		DEPT.
Aroclor 1260	Electrical Grade	Ann. / WGK - 24
PLANT: Anniston, Krummrich	PRODUCT CODE: 82614 - Ann., 81105 - WGK	USE: Sales
DATE EFFECTIVE: 5/25/66	SALES CODE: 1040-290-04/11/16-03-09	

APPROVALS

PRODUCTION	RESEARCH
P. E. Heisler	W. D. Robinson
SALES	QUALITY CONTROL (Chief Chemist)
W. E. Ault	O. E. Dolin / W. J. Gresham

GENERAL DESCRIPTION

CHEMICAL FORMULA

MOL WT.

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS	ISSUED BY
2/7/62	3 x 5 pt. Amber Bottles	J. P. Prader

UNRESTRICTED INFORMATION

	CHARACTERISTIC	LIMITS	METHOD WGK.	METHOD Anniston
(R)	Color (APHA)	150, max.	10084	14-44-54
(R)	Condition	Clear	10084	--------
(R)	Specific Gravity @ 90, 15.5°C.	1.555 - 1.566	10114	14-49-54
(R)	Acidity (mg KOH/g.)	0.014, max.	10087	14-42-54
(R)	Moisture (H_2O) (ppm)	35, max.	10620	14-53-54
(R)	Viscosity @ 210°F. (SUS)	72 - 78	10086	14- 4-52
(R)	Refractive Index @ 25°C.	1.6455 - 1.6470	10125	14-34-54
(R)	Inorganic (Free) Chlorides	0.05 ppm, max.	10118	14-48-57
(R)	Pour Point (°C)	25 - 34	10115	14-47-54
(R)	Distillation Range (ASTM D-20, Corrected)		10117	14-31-54
	10% Distilled by wt.	385 - 398°C.		
	50% Distilled by wt.	390 - 404°C.		
	90% Distilled by wt.	400 - 420°C.		
(R)	Corrosion Test (6 hrs. @ 210°C. with bright aluminum foil)		10126	14-55-57
(R)	Change in weight of Al (@)	0.0		
(R)	A.C. Color (APHA)	150, max.	10084	14-44-54
(R)	A.C. Condition	Clear	10084	--------
(R)	A.C. Acidity (mg. KOH/g.)	0.014, max.	10087	14-42-54
(R)	A.C. Inorganic (Free) Chlorides	0.05 ppm, max.	10118	14-48-57

(Over)

DSW 543269

(R) Routine Analysis, All others Analyzed by request Only

UNRESTRICTED INFORMATION (Cont'd.)

	Characteristic	Limits	Method	
			WGK	Anniston
	Flash Point	None	10123	14-28-54
	Fire Point	None	10123	14-28-54
	Fixed Chlorine (%)	59.5 - 60.5	10088	14-13-54
(R)	Dielectric Strength @ 50°C.	30 K.V., min.	11605	---------
(R)	Resistivity (500 VDC @ 100°C. 0.1" gap as ohm-cm x 10^9)	500, min.	11607	14-35-57
(R)	Dielectric Constant 1000 cycles, 100°C.	3.6 - 3.8	11607	14-36-45

RESTRICTED INFORMATION

(R)	Monsanto Stability Test (As Chlorides in ppm.)	0.7, max.	11503	14-61-57

GENERAL INFORMATION

(R)	Evaporation Loss after 6 hrs. @ 100°C. (%)	0.2, max.	10116	12-32-54
(R)	Stability test - after 30 days at 100°C. in glass sealed in air.	No liberation of chlorine or chlorides	------	--------

DSW 543270

Monsanto
ORGANIC CHEMICALS DIVISION

FINISHED PRODUCT SPECIFICATION

PRODUCT		DEPT.
AROCLOR 1260 NON-ELECTRICAL GRADE		Ann. 20 WGK 246
PLANT	PRODUCT CODE	USE
Anniston & WGK	82614-81105	Sales
DATE EFFECTIVE	SALES CODE	
3-1-69	1040-290-04/11/009-003	

APPROVALS

PRODUCTION	RESEARCH
J. Molloy 3/21/69 H. Williams 2/19/69	M. E. Gibbs 3/12/69
SALES	QUALITY CONTROL (Chief Chemist)
W. Ault 3/10/69	R. Blowers 3/26/69 G. Miller 2/15/69

GENERAL DESCRIPTION: MIXTURE

CHEMICAL FORMULA:

MOL WT.

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS	ISSUED BY
9/25/67	2 x 1/2 gal. Amber Bottles	G. Miller

CHARACTERISTIC	LIMITS	METHOD	
		Anniston	WGK
(R) Condition	Clear	G-1	10084
(R) Color, APHA	150 Max.	046	10084
(R) Specific Gravity (90/15.5°C)	1.555-1.566	052	10114
(R) Acidity, (mg KOH/g.)	0.014 Max.	050	10087
(R) Moisture, ppm	50 Max.	047	10620
(R) Viscosity @ 210°F	72-78 SUS 20-24 Cp	049	10086
Flash Point	None	114	10123

DSW 543271

(R) Routine Analysis, All others Analyzed by request Only

Monsanto
ORGANIC CHEMICALS DIVISION

FINISHED PRODUCT SPECIFICATION

PRODUCT: AROCLOR 1262 NON-ELECTRICAL GRADE			DEPT. Ann. 206 WGK 246
PLANT: Anniston & WGK	PRODUCT CODE: 82615 & 81107	USE: Sales	
DATE EFFECTIVE: 3-1-69	SALES CODE: 1040-/300/04/11/-009/003		

APPROVALS

PRODUCTION: J. Molloy 3/21/69 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. Miller 2/15/69

GENERAL DESCRIPTION: MIXTURE

CHEMICAL FORMULA:

MOL WT.

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS	ISSUED BY
3/2/66	2 x 1/2 gal. Amber Bottles	G. Miller

CHARACTERISTIC	LIMITS	METHOD: Anniston	METHOD: WGK
(R) Condition	Clear	G-1	10084
(R) Color, APHA	150 Max.	046	10084
(R) Specific Gravity (90/15.5°C)	1.572-1.583	052	10114
(R) Acidity (mg KOH/g)	0.014 Max.	050	10087
(R) Viscosity @ 210°F	86-100 SUS 26-33 Cp	049	10086

DSW 543272

(R) Routine Analysis, All others Analyzed by request Only

Monsanto
ORGANIC CHEMICALS DIVISION

FINISHED PRODUCT SPECIFICATION

PRODUCT		DEPT.
Aroclor 1268		27-S
PLANT	PRODUCT CODE	USE
Anniston	826.16	Sales
DATE EFFECTIVE	SALES CODE	
3-11-66	1040-340-04-11-16-009	

APPROVALS

PRODUCTION	RESEARCH
R. G. Moody /s/ 12-30-65	L. R. Stark /s/ 3-8-66
SALES	QUALITY CONTROL (Chief Chemist)
W. E. Ault /s/ 3-2-66	O. E. Dolin /s/ 12-29-65

GENERAL DESCRIPTION: Mixture

CHEMICAL FORMULA:

MOL WT.

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS	ISSUED BY
4-25-61	1 x 16 oz. Can or W.M. Bottle	J. A. Liddle 11-30-65

CHARACTERISTIC	LIMITS	METHOD
UNRESTRICTED INFORMATION		
(R) Appearance and color	White to off-white powder	G-1
Color, Gardner	6 Max.	
(R) Hold Point, °C	150 - 170	119
(R) Acid No., mg KOH	0.05 Max.	116
RESTRICTED INFORMATION		
Screen Test, % retained on		
No. 16 mesh	0.1 Max.	120
No. 20 mesh	10 Max.	
Specific Gravity @ 25/25°C., Pycnometer	1.804 - 1.811	
Loss @ 163°C., %	0.15 - 0.24	

DSW 543273

Monsanto
ORGANIC CHEMICALS DIVISION

FINISHED PRODUCT SPECIFICATION

PRODUCT		DEPT.
Aroclor 2565		27-S
PLANT	PRODUCT CODE	USE
Anniston	826.18	Sales
DATE EFFECTIVE	SALES CODE	
3-11-66	1040-390-04-009	

APPROVALS

PRODUCTION	RESEARCH
R. G. Moody /s/ 12-29-65	L. R. Stark /s/ 3-8-66
SALES	QUALITY CONTROL *(Chief Chemist)*
W. E. Ault /s/ 3-2-66	O. E. Dolin /s/ 12-29-65

GENERAL DESCRIPTION

Mixture

CHEMICAL FORMULA

MOL WT.

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS	ISSUED BY
4-25-61	1 x 16 oz. Can or W.M. Bottle	J. A. Liddle 11-30-65

CHARACTERISTIC	LIMITS	METHOD
UNRESTRICTED INFORMATION		
(R) Appearance and Color	Black, brittle resin	G-1
(R) Softening Point, °C	66 - 72	115
(R) Acid No., mg KOH/g	1.4 Max.	116

DSW 543274

Monsanto
ORGANIC CHEMICALS DIVISION

FINISHED PRODUCT SPECIFICATION

PRODUCT		DEPT.
Aroclor 4465		27-S
PLANT	PRODUCT CODE	USE
Anniston	826.19	Sales
DATE EFFECTIVE	SALES CODE	
3-11-66	1040-430-04-11-16-009	

APPROVALS

PRODUCTION	RESEARCH
R. G. Moody /s/ 2-29-66	L. R. Stark /s/ 3-8-66
SALES	QUALITY CONTROL (Chief Chemist)
W. E. Ault /s/ 3-2-66	O. E. Dolin /s/ 12-29-65

GENERAL DESCRIPTION

Mixture

CHEMICAL FORMULA

MOL WT.

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS	ISSUED BY
4-25-61	1 x 16 oz. Can or W.M. Bottle	J. A. Liddle 11-30-65

CHARACTERISTIC	LIMITS	METHOD
UNRESTRICTED INFORMATION		
(R) Appearance and Color	Clear, light yellow resin	G-1
(R) Color, NPA, Molten	2 Max.	G-4
(R) Softening Point, °C	60 - 66	115
Acid No., mg KOH/g	0.05 Max.	116

DSW 543275

(R) Restricted Analysis - All other analyses for research Only

Monsanto
ORGANIC CHEMICALS DIVISION

FINISHED PRODUCT SPECIFICATION

PRODUCT		DEPT.
Aroclor 5060		27-S
PLANT	PRODUCT CODE	USE
Anniston	826.20	Sales
DATE EFFECTIVE	SALES CODE	
3-11-66	1040-450-04-009	

APPROVALS

PRODUCTION	RESEARCH
R. G. Moody /s/ 12-30-65	L. R. Stark /s/ 3-8-66
SALES	QUALITY CONTROL (Chief Chemist)
W. E. Ault /s/ 3-2-66	O. E. Dolin /s/ 12-29-65

GENERAL DESCRIPTION

Mixture

CHEMICAL FORMULA

MOL WT.

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS	ISSUED BY
4-25-61	1 x 16 oz. Can or W.M. Bottle	J. A. Liddle 11-30-65

CHARACTERISTIC	LIMITS	METHOD
UNRESTRICTED INFORMATION		
(R) Appearance and Color	Black, brittle resin	G-1
(R) Softening Point, °C	105 - 115	115
(R) Acid No. mg KOH/g	0.5 Max.	116

DSW 543276

Monsanto
ORGANIC CHEMICALS DIVISION

FINISHED PRODUCT SPECIFICATION

PRODUCT		DEPT.
Aroclor 5442		27-S
PLANT	PRODUCT CODE	USE
Anniston	826.21	Sales
DATE EFFECTIVE	SALES CODE	
3-15-66	1040-470-04-009	

APPROVALS

PRODUCTION	RESEARCH
R. G. Moody /s/ 12-29-65	L. R. Stark /s/ 3-11-66
SALES	QUALITY CONTROL (Chief Chemist)
W. E. Ault /s/ 3-2-66	O. E. Dolin /s/ 12-29-65

GENERAL DESCRIPTION

Mixture

CHEMICAL FORMULA

MOL WT.

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS	ISSUED BY
4-25-61	1 x 16 oz. Can or W.M. Bottle	J. A. Liddle 11-30-65

CHARACTERISTIC	LIMITS	METHOD
UNRESTRICTED INFORMATION		
(R) Appearance and Color	Clear, yellow sticky resin	G-1
(R) Color, NPA, Molten	2 Max.	G-4
(R) Softening Point, °C	46 - 52	115
Acid No., mg. KOH/g	0.05 Max.	116

DSW 543277

Monsanto
ORGANIC CHEMICALS DIVISION

FINISHED PRODUCT SPECIFICATION

PRODUCT		DEPT.
AROCLOR 5460 (HIGH SOLUBLE GRADE)		826.17
PLANT	PRODUCT CODE	USE
Anniston	826.22	Sales
DATE EFFECTIVE	SALES CODE	
5-20-69	1040-480-04-009	

APPROVALS

PRODUCTION	RESEARCH
H. L. Williams 5/20/69	M. E. Gibbs 6/13/69
SALES	QUALITY CONTROL (Chief Chemist)
W. E. Ault 6/10/69	G. W. Miller 5/20/69

GENERAL DESCRIPTION: MIXTURE

CHEMICAL FORMULA:

MOL WT.

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS	ISSUED BY
3-11-66	1 x 16 oz. Can or W. M. Bottle	G. W. Miller

CHARACTERISTIC	LIMITS	METHOD
UNRESTRICTED INFORMATION		
(R) Appearance and Color	Clear, yellow to amber brittle resin or flaker	G-1
(R) Color, NPA, Molten	2 Max.	G-4
(R) Softening Point, °C	98 - 105.5	115
(R) Solubility (25g in 25g Acetone @ 25°C)	3 hour, Min.	117
Acid No., mg KOH/g	0.05 Max.	116
Chlorine, %	58.5 - 60.6	093
RESTRICTED INFORMATION		
Hydrolysis Stability, ppm Cl	300 Max.	092

DSW 543278

(R) Routine Analysis, All others Analyzed by request Only

Monsanto
ORGANIC CHEMICALS DIVISION

FINISHED PRODUCT SPECIFICATION

PRODUCT		DEPT.
Biphenyl Technical		20
PLANT	PRODUCT CODE	USE
Anniston	826.01	Sales
DATE EFFECTIVE	SALES CODE	
5-7-68	1315-000-03-09	

APPROVALS

PRODUCTION	RESEARCH
H. L. Williams /s/H. L. Williams 5/2/68	L. R. Stark /s/John F. Herber
SALES	QUALITY CONTROL (Chief Chemist)
W. E. Ault /s/W. E. Ault 5/7/68	G. W. Miller /s/G. W. Miller 4/29/68

GENERAL DESCRIPTION: White, crystalline solid

CHEMICAL FORMULA: $C_{12}H_{10}$

MOL WT.

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS	ISSUED BY
5-5-61	1 x 16 oz. can	J. L. Brown

CHARACTERISTIC	LIMITS	Typical	METHOD
(R) Appearance	White to pale yellow crystals		
(R) Crystallizing Point, °C	68.7 Min.		018
(R) Color, Gardner	6 Max.		019
General Tests (determined only on request)			
Biphenyl, %		99.9	165
Distillation Range	(Must include		
1st Drop - Dry point, 2.5°C	255°C)		

DSW 543279

(R) Routine Analysis, All others Analyzed by request Only

Monsanto
ORGANIC CHEMICALS DIVISION

FINISHED PRODUCT SPECIFICATION

PRODUCT		DEPT.
Santowax C		32
PLANT	PRODUCT CODE	USE
Anniston	829.10	Internal
DATE EFFECTIVE	SALES CODE	
3-9-66	7795-050-99-009	

APPROVALS

PRODUCTION	RESEARCH
R. G. Moody /s/ 2-1-66	L. R. Stark /s/ 2-3-66 - M. McEwen /s/ 2-22-66
SALES	QUALITY CONTROL (Chief Chemist)
W. E. Ault /s/ 2-22-66	O. E. Dolin /s/ 2-1-66

GENERAL DESCRIPTION

Mixture

CHEMICAL FORMULA

MOL WT.

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS	ISSUED BY
5-23-57	2 - 1 Pint cans	J. A. Liddle 1-12-66

RESTRICTED INFORMATION

CHARACTERISTIC	LIMITS	METHOD
Appearance	Brown, waxy solid	G-1
Boiling Point, °C	350 Min.	
*Ortho Terphenyl, %	**10	064
*Meta Terphenyl, %	**50	064
*Para Terphenyl, %	**26	064
*Quaterphenyl, %	**14	072
*Biphenyl, %	**0.1	064
Flash Point, °C	**375	114
Chlorine, ppm	2.0 (Typical)	
Sulfur, ppm	2.0 "	

*Distribution of isomers and quaterphenyls vary with operating condition.

**Only limited data is available; therefore, the limits given are typical values of these characteristics.

This product is mainly used as a raw material for other finished products produced at Anniston.

This specification is for internal use only.

DSW 543280

Monsanto
ORGANIC CHEMICALS DIVISION

FINISHED PRODUCT SPECIFICATION

PRODUCT		DEPT.
Santowax R		32
PLANT	PRODUCT CODE	USE
Anniston	826.02	Sales
DATE EFFECTIVE	SALES CODE	
3-2-66	7795-000-11-009	

APPROVALS

PRODUCTION	RESEARCH
R. G. Moody /s/ 1-31-66	L. R. Stark /s/ 2-3-66 - M. McEwen /s/ 2-22-66
SALES	QUALITY CONTROL (Chief Chemist)
W. E. Ault /s/ 2-22-66	O. E. Dolin /s/ 1-25-66

GENERAL DESCRIPTION — CHEMICAL FORMULA

Mixed Terphenyls

MOL WT.

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS	ISSUED BY
2-12-62	2 x 1 pint cans	J. A. Liddle 1-11-66

CHARACTERISTIC	LIMITS	METHOD
UNRESTRICTED INFORMATION		
(R) Appearance	Yellow white noncrystalline flaked solid	G-1
(R) Color (liquid), NPA	4.0 Max.	128
(R) Upper Hold Point, °C	136 - 145	129
(R) Lower Hold, °C	48 - 63	129
RESTRICTED INFORMATION		
Distillation Range, °C, 80% (Uncorrected)	350 - 400	
Ortho terphenyl, %	10.0 - Typical Value	
Meta terphenyl, %	54.0 - " "	
Para terphenyl, %	27.0 - " "	
Quaterphenyls, %	9.0 - " "	

DSW 543281

(R) Routine Analysis, All others Analyzed by request Only

Monsanto
ORGANIC CHEMICALS DIVISION

RAW MATERIAL SPECIFICATION

MATERIAL CODE	MATERIAL
826.38	Chlorine Gas
PLANT	**USING DEPTS.**
Anniston	04, 05, 27
DATE EFFECTIVE	**SUPPLIER**
8-31-66	See below

APPROVALS

PRODUCTION	RESEARCH
R. G. Moody /s/R. G. Moody - 8/11/66	L. R. Stark /s/L. R. Stark - 8/29/66
PROCUREMENT	**QUALITY CONTROL** *(Chief Chemist)*
H. L. Phillips /s/H. L. Phillips - 8/15/66	O. E. Dolin /s/O. E. Dolin - 8/10/66

GENERAL DESCRIPTION

Greenish yellow gas

CHEMICAL FORMULA

Cl_2
Mol. wt. 70.91

SUPERSEDES SPECS OF	SAMPLE FOR ANALYSIS	ISSUED BY
Sept. 11, 1957	GLC sampling container	J. A. Liddle - 5/16/66

CHARACTERISTIC	LIMITS	Typical Values	METHOD
UNRESTRICTED INFORMATION			
Material Supplied by Diamond Alkali Company			
Assay, (Vol. %)	99.4 Min.		113
Residual Gases (Vol. %)	0.5 Max.		113
Moisture, ppm	40 Max.		
Non-volatile Matter, ppm	40 Max.		
Material Supplied by Depts. 56, 57 (Anniston)			
Assay (Vol. %)		85.5 - 93.5	113
H_2 (Vol. %)		1.5 - 2.5 (3 Max.)	113
CO_2 (Vol. %)		0.5 - 1.0	113
CO (Vol. %)		Nil	113
N_2 (Vol. %)		3.0 - 8.0	113
O_2 (Vol. %)		1.2 - 3.0	113

DSW 543282

(R) Routine Analysis, All others Analyzed by request only.

Monsanto
ORGANIC CHEMICALS DIVISION

RAW MATERIAL SPECIFICATION

MATERIAL CODE	MATERIAL
38800	Lime Hydrate
PLANT	**USING DEPTS.**
Anniston	27, 28
DATE EFFECTIVE	**SUPPLIER**
7-20-66	Alabaster Lime Co.

APPROVALS

PRODUCTION	RESEARCH
R. G. Moody /s/R. G. Moody 6/9/66	N. F. Mueller /s/N. F. Mueller 7/13/66
PROCUREMENT	**QUALITY CONTROL (Chief Chemist)**
H. L. Phillips /s/H. L. Phillips 6/10/66	O. E. Dolin /s/O. E. Dolin 6/8/66

GENERAL DESCRIPTION

White fine powder

CHEMICAL FORMULA

$Ca(OH)_2$

Mol. wt. = 74.10

SUPERSEDES SPECS OF	SAMPLE FOR ANALYSIS	ISSUED BY
Sept. 11, 1957	2 - 1 lb. cans	J. A. Liddle - 5/18/66

CHARACTERISTIC	Typical Analysis	METHOD
UNRESTRICTED INFORMATION		
CaO (%)	73.00	
MgO (%)	1.20	
SiO_2 (%)	0.36	
Al_2O_3 (%)	0.60	
Fe_2O_3 (%)	0.30	
Ignition Loss (%)	24.04	
$Ca(OH)_2$ (% Calculated)	97.50(1)	
Screen Analysis		
Through 200 mesh (%)	99.8	120
Through 325 mesh (%)	94.5	

Basis of Specifications: Suppliers typical analysis of product (5/23/66)

(1) $Ca(OH)_2$ % = 100% - [MgO(%) + SiO_2 (%) + Al_2O_3 (%) + Fe_2O_3 (%)]

DSW 543283

(R) *Routine Analysis, All others Analyzed by request only.*

Monsanto
ORGANIC CHEMICALS DIVISION

RAW MATERIAL SPECIFICATION

MATERIAL CODE	MATERIAL
19400	Attapulgus Earth - RVM Grade
PLANT	USING DEPTS.
Anniston	27-I
DATE EFFECTIVE	SUPPLIER
7-20-66	Minerals & Chemicals Philipp Corp.

APPROVALS

PRODUCTION	RESEARCH
R. G. Moody /s/R. G. Moody 6/9/66	N. F. Mueller /s/N. F. Mueller 7/13/66
PROCUREMENT	QUALITY CONTROL (Chief Chemist)
H. L. Phillips /s/H. L. Phillips 6/10/66	O. E. Dolin /s/O. E. Dolin 6/8/66

GENERAL DESCRIPTION — CHEMICAL FORMULA

Impure Hydrous Magnesium Aluminus Silicate

SUPERSEDES SPECS OF	SAMPLE FOR ANALYSIS	ISSUED BY
Sept. 9, 1957	1 lb. can	J. A. Liddle - 5/25/66

CHARACTERISTIC	LIMITS	METHOD
UNRESTRICTED INFORMATION		
Screen Analysis Through 200 Mesh (%)	95 Min.	
Loss on Ignition (% @ 950°C)	15 Max.	
Typical Analysis from Supplier (May 23, 1966)		
SiO_2 (%)	67.5	
Al_2O_3 (%)	12.8	
Fe_2O_3 (%)	4.5	
MgO (%)	11.1	
CaO (%)	1.6	
K_2O (%)	0.8	
Na_2O (%)	0.1	
TiO_2 (%)	0.6	
Other (%)	1.0	

DSW 543284

(R) *Routine Analysis, All others Analyzed by request only.*

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

PRODUCT CODE: 33500
METHOD IDENTITY:
SUPPLIER:

ISSUED Feb. 26, 1957
STANDARDS DEPARTMENT
Wm. G. Krummrich Plant
By

MATERIAL: FERRIC CHLORIDE ANHYDRIDE

CHEMICAL FORMULA: $FeCl_3$

MOL. WT.: 162.21

SUPERSEDES SPECS. OF: New

SAMPLE FOR ANALYSIS: 1x8 oz. W. M. Bottle

UNCLASSIFIED 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.	

DSW 543285

STANDARD MANUFACTURING PROCESS
FOR
AROCLORS

APPENDIX C - PHYSICAL CONSTANTS OF FINISHED GOODS, INTERMEDIATES, AND MAJOR RAW MATERIALS

FINISHED GOODS	RAW MATERIALS
Aroclor 1221 - Not Available	Biphenyl
Aroclor 1232 - Not Available	Santowax - Not Available
Aroclor 1242	Santowax R - Not Available
Aroclor 1248	Chlorine
Aroclor 1254	Hydrated Lime
Aroclor 1260	Attapulgus Earth-Not Avail.
Aroclor 1262	Ferric Chloride
Aroclor 1268 - Not Available	
Aroclor 2565 - Not Available	
Aroclor 4465 - Not Available	
Aroclor 5442 - Not Available	
Aroclor 5460 - Not Available	

NAME	AROCLOR 1142 TECHNICAL	SOURCE & DATE	AROCLOR 1148 TECHNICAL	SOURCE & DATE	AROCLOR 1154 TECHNICAL	SOURCE & DATE	AROCLOR 1160 TECHNICAL	SOURCE & DATE	AROCLOR 1162 TECHNICAL	SOURCE & DATE
FORMULA	$C_{12}H_7Cl_5$	SPECS 12-21-54	$C_{12}H_6Cl_6$	SPECS. 4-11-55	$C_{12}H_5Cl_5$	SPECS. 12-21-54	$C_{12}H_{3.75}Cl_{6.25}$	SPECS. 12-21-54	$C_{12}H_3Cl_7$	SPECS. 4-11-55
MOLECULAR WEIGHT										
APPEARANCE	BROWN-BLACK OILY LIQ.	"	BROWN-BLACK OILY LIQ	SPECS. 4-11-55	BROWN-BLACK OILY LIQ	SPECS 12-21-54	BROWN-BLACK STICKY MASS	SPECS 12-21-54	BROWN-BLACK STICKY MASS	SPECS. 4-11-55
BOILING POINT AT 760MM										
BOILING POINT AT MM										
BOILING POINT AT MM										
BOILING POINT AT MM										
CRYSTALLISING POINT										
MELTING POINT										
SOLUTION POINT										
SPECIFIC GRAVITY 65/15.5°C	1.348-1.360	SPECS. 12-21-54	1.410-1.420	SPECS. 4-11-55	1.500-1.510	SPECS. 12-21-54	1.558-1.572	SPECS. 12-21-54	1.577-1.587	SPECS. 4-11-55
SPECIFIC GRAVITY 25/15.5°C	1.384-1.397									
POUNDS PER GALLON 25°C	10.5		12		12.8		13.5		13.7	
COEFFICIENT OF EXPANSION										
REFRACTIVE INDEX										
INFRA RED SPECTRUM (REF.)										
ULTRA VIOLET SPECTRUM (REF.)										
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	0.009/°C [50-100°C]		0.00095/°C [55-105°C]	SPECS. 12-21-54	0.0010/°C [75-150°C]	SPECS. 12-21-54	0.0010/°C [85-120°C]	SPECS. 4-11-55
FLASH POINT °F (METHOD) C.O.C	350	AROCLOR BULL. OP-115 1954	382	AROCLOR BULL OP 115 1954	NONE		NONE		NONE	
FIRE POINT °C	NONE		NONE		NONE		NONE		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 — TOTAL Cl_2	41.5-42.5%	SPECS. 12-21-54	47.5-48.5%	SPECS 4-11-55	53.5-54.5%	SPECS. 12-21-54	59.5-60.5%	SPECS. 12-21-54	61.5-62.5%	SPECS. 4-11-55
TOXICITY (REFERENCE)	SCHWARTZ, U.S. PUBLIC HEALTH SERVICE BULL #224, 1936. "INDUSTRIAL POISONS, HAZARDS AND SOLVENTS" by M.B. JACOBS, Vol. 1 p. 463-464 1941.		SAME AS 1142		SAME AS 1142		SAME AS 1142		SAME AS 1142	

DSW 543287

ANNISTON PLANT — MONSANTO COMPANY — ANNISTON, ALA.

TITLE	AUTH. NO.
PHYSICAL CONSTANTS DATA — CRUDE AROCLORS	JOB NO.

DRAWN BY	CHECKED	APPROVED	DATE	SCALE	
					TS-B

NAME	AROCLOR 1242	SOURCE & DATE	AROCLOR 1248	SOURCE & DATE	AROCLOR 1254	SOURCE & DATE	AROCLOR 1260	SOURCE & DATE	AROCLOR 1262	SOURCE & DATE
FORMULA	$C_{12}H_7Cl_3$		$C_{12}H_6Cl_4$		$C_{12}H_5Cl_5$		$C_{12}H_4Cl_6$ to $C_{12}H_3Cl_7$		$C_{12}H_3Cl_7$	
MOLECULAR WEIGHT	257 AVG.		292 AVG.		326 AVG.		361 AVG.		395	
APPEARANCE	COLORLESS MOBILE OIL	MONSANTO BULL OP 115 (1954)	YELLOW VISCOUS MOBILE OIL	M.B. OP 115	PALE YELLOW VISC OIL	M.B. OP-115	LT. YELL. SOFT STICKY RESIN	M.B. OP-115	LT. YELL. STICKY RESIN	M.B. OP-115
BOILING POINT AT 760MM	325-360°C	"	345-385°C	"	365-400°C	"	385-420°C	"	390-425°C	"
BOILING POINT AT 3 MM	155-195°C AT 3MM	"	165-210°C	"	180-220°C	"	195-246°C	"		
BOILING POINT AT MM										
BOILING POINT AT MM										
CRYSTALLIZING POINT	NON-CRYSTALLIZING	"	NON-CRYSTALLIZING	"	NON-CRYSTALLIZING	"	NON-CRYSTALLIZING	"		
MELTING POINT										
SOLUTION POINT										
SPECIFIC GRAVITY	1.380 25/25°C	"	1.445 25/25°C	"	1.538 25/25°C	"	1.620 25/25°C	"	1.646 25/25°C	"
SPECIFIC GRAVITY	1.381-1.392 25/15.5°C	SPEC. 2-14-55	1.405-1.415 65/15.5°C	SPECS 9-9-54	1.495-1.505 65/15.5°C	SPECS. 2-19-55	1.555-1.561 90/15.5°C	SPECS. 2-19-55	1.577-1.587 90/15.5°C	SPECS. 4-11-55
POUNDS PER GAL. 25°C	11.5	M.B. OP 115	12.04	M.B. OP-115	12.82	M.B. OP-115	13.00	M.B. OP-115	13.72	M.B. OP-115
COEFFICIENT OF EXPANSION	0.00068 cc/cc/°C AT 25-65°C	"	0.00070 cc/cc/°C AT 25-65°C	"	0.00068 cc/cc/°C 25-65°C	"	0.00067 cc/cc/°C 25-65°C	"	0.00060 cc/cc/°C 25-65°C	"
REFRACTIVE INDEX 25°C	1.6245-1.6265 AT 25°C	SPEC. 2-14-55	1.6285-1.6305 AT 25°C	SPECS 9-9-54	1.6370-1.6390 AT 25°C	SPECS 2-19-55	1.6455-1.6465 25°C	SPECS 2-19-55	1.648-1.650 AT 25°C	"
INFRA RED SPECTRUM (REF)										
ULTRA VIOLET SPECTRUM (REF).										
VISCOSITY AT	34-35 SUS AT 210°F	M.B. OP-115	73-80 SUS AT 130°F	M.B. OP-115	44-48 SUS AT 210°F	M.B. OP-115	72-78 SUS AT 210°F	M.B. OP-115	86-100 SUS AT 210°F	SPECS. 4-11-55
VISCOSITY AT	82-92 SUS AT 100°F	"								
SURFACE TENSION DYNES/CM 20°C	45.3	J. COLL. SCI. 7, 166 (1952)	44.2	J. COLL. SCI. 7, 166 (1952)	50.2 AT 25°C	"				
SOLUBILITY IN WATER	INSOLUBLE	M.B. OP-115	INSOLUBLE	M.B. OP-115	INSOLUBLE	"	INSOLUBLE	"		
SOLUBILITY IN 3A ALCOHOL	23.3 g/100c AT 29°C	"	15g/100cc AT 25°C	"	10g/100cc AT 27°C	"				
SOLUBILITY IN PYRIDINE	132.5 g/100cc AT 30°C	"	111.4 g/100cc AT 29°C	"	114 g/100cc AT 31°C	"				
FLASH POINT (METHOD)	180°C	"	196°C	"	NONE	"	NONE	"	NONE	M.B. OP-115
FIRE POINT °C	NONE	"	NONE	"	NONE	"	NONE	"	NONE	"
HEAT OF COMBUSTION										
HEAT OF FORMATION										
THERMAL STABILITY (GAL/SQ/MIN.)										
LATENT HEAT OF FUSION										
LATENT HEAT OF VAP. CAL/GM.	61	CALCULATED	54	CALCULATED	50	CALC.	48	CALC.		
SPECIFIC HEAT AT 25°C	0.293	M.B. OP-115	0.277	M.B. OP-115	0.261	M.B. OP-115	0.228	M.B. OP-115		
CRITICAL TEMPERATURE										
CRITICAL PRESSURE										
DISSOCIATION CONSTANT										
OTHER CONSTANTS: SPECIFIC HEAT	0.380 AT 300°C	M.B. OP-115	0.356 AT 300°C	M.B. OP-115	0.336 AT 300°C	M.B. OP-115	0.303 AT 300°C	M.B. OP-115		
OTHER CONSTANTS: POUR POINT	-14°C OR LOWER	"	0°C OR LOWER	"	7-12°C	"	25-29°C	"	35-38°C	
OTHER CONSTANTS: THERMAL COND. cal/cm/°C/sec	24 AT 28°C	TO BE PUBLISHED	23.6 AT 28°C	TO BE PUBLISHED	22.9 AT 28°C	TO BE PUB.				
OTHER CONSTANTS: DIELECTRIC CONST 100°C 60cy.	4.7-4.9	M.B. OP 115	4.5-4.7	M.B OP-115	4.15-4.35	M.B. OP-115	3.6-3.8	"		
TOXICITY (REFERENCE).	CONTACT MEDICAL DEPT.	M.B. OP-115	CONTACT MEDICAL DEPT	M.B. OP-115	CONTACT MEDICAL DEPT.	M.B. OP-115	CONTACT MEDICAL DEPT.	M.B. OP-115	CONTACT MEDICAL DEPT.	M.B. OP-115

DSW 543288

ANNISTON PLANT — MONSANTO COMPANY — ANNISTON, ALA.

TITLE	AUTH. NO.
PHYSICAL CONSTANTS DATA - REFINED AROCLORS	JOB NO.

DRAWN BY	CHECKED	APPROVED	DATE	SCALE
				TS-B

NAME	PYRANOL 1467	Source & Date	PYRANOL 1470	Source & Date	PYRANOL 1481	Source & Date	PYRANOL 1488	Source & Date	AROCLOR 1254-10% SEC. BUTYL ACETATE	Source & Date	AROCLOR 1260-10% TOLUOL MIX	Source & Date
FORMULA												
MOLECULAR WEIGHT												
APPEARANCE	YELL. TINTED MOBILE OIL	REF. 1	YELL. TINTED MOBILE OIL	SPECS. 1-28-55	YELL. TINTED MOBILE OIL	SPECS. 1-28-55	YELL. TINTED MOBILE OIL	REF. 1	LT. COLORED MOBILE OIL	SPEC. 3-10-55	SYRUPY LIQUID	SPECS. 4-11-55
BOILING POINT AT 760 MM	200-415°C	"	210-415°C	"			200-415°C	"				
BOILING POINT AT MM												
BOILING POINT AT MM												
BOILING POINT AT MM												
CRYSTALLIZING POINT												
MELTING POINT												
SOLUTION POINT												
SPECIFIC GRAVITY 15/15.5°C	1.560-1.568	"	1.563-1.571	"	1.525-1.535	"	1.560-1.568	"			1.475-1.495 AT 40/15.5°C	"
SPECIFIC GRAVITY AT 29/15.5°C									1.423-1.449	"		
POUNDS PER GAL. 15.5°C	13.05	"	13.08	"	12.75	"	13.05	"	12	"	12.5	"
COEFFICIENT OF EXPANSION 20-100 C	0.0007 cc/cc/°C	"	0.0007 cc/cc/°C	"	0.0007 cc/cc/°C	REF. 2	0.0007 cc/cc/°C	"				
REFRACTIVE INDEX 25°C	1.6137-1.6147	"	1.6075-1.6085	"	1.6205-1.6215	SPECS. 1-28-55	1.6137-1.6147	"				
INFRA RED SPECTRUM (REF.)												
ULTRA VIOLET SPECTRUM (REF.)												
VISCOSITY 100°F	52-56 SUS	"	41-45 SUS	"	70-82 SUS	"	52-56 SUS	"			50.2 cs (232 SUS)	WGK LAB 3-8-56
VISCOSITY	15 cs. AT 20°C	REF. 2					15 cs. AT 20°C	REF. 2			3.5 cs (38 SUS)	" " "
SURFACE TENSION												
SOLUBILITY IN WATER												
SOLUBILITY IN												
SOLUBILITY IN												
FLASH POINT °F (METHOD) C.O.C.	NONE TO BOILING	REF. 1	NONE TO BOILING	"	NONE TO BOILING	"	NONE TO BOILING	REF. 1	70°F	WGK LAB DATA 8-12-57	105 TAG OPEN CUP	WGK LAB 12-5-46
FIRE POINT °C									70°F	" "	110 " " "	" " "
HEAT OF COMBUSTION												
HEAT OF FORMATION												
THERMAL STABILITY (CAL/KG/MIN.)												
LATENT HEAT OF FUSION												
LATENT HEAT OF VAP.												
SPECIFIC HEAT 25-80°C	0.26	REF. 2					0.26	REF. 2				
CRITICAL TEMPERATURE												
CRITICAL PRESSURE												
DISSOCIATION CONSTANT												
OTHER CONSTANTS: POUR POINT	-32°C OR LOWER	REF. 1	-44°C OR LOWER	"	-15°C OR LOWER	"	-32°C OR LOWER	REF. 1	-2°F	" "		
DIELECTRIC CONSTANT 100°C 60 CY.	3.7-4.0	"	3.8-4.2	"	4.1-4.6	"	3.7-4.0	"				
THERMAL CONDUCTIVITY cal/cm/sec/°C	20 x 10⁻⁵ AT 50°C	REF. 2					23 x 10⁻⁵ AT 50°C	REF. 2				
COMPOSITION	60% AROCLOR 1260 40% TRICHLOROBENZENE 0.125% TIN TETRAPHENYL		45% AROCLOR 1260 55% TRI-TETRA CHLOROBENZENE		75% AROCLOR 1254 25% TRICHLOROBENZENE		60% AROCLOR 1260 40% TRICHLOROBENZENE		90% AROCLOR 1254 10% BUTYL ACETATE		90% AROCLOR 1260 10% TOLUOL	
REFERENCE 1 - SPECS 6-6-55												
REFERENCE 2 - MONSANTO CHEMICAL LTD.												
TOXICITY (REFERENCE)	CONTACT MED. DEPT.		CONTACT MED. DEPT.		CONTACT MED. DEPT.		CONTACT MED. DEPT.		CONTACT MED. DEPT.			

DSW 543289

ANNISTON PLANT — MONSANTO COMPANY — ANNISTON, ALA.

TITLE	AUTH. NO.
PHYSICAL [illegible] DATA - PYRANOLS	JOB NO.

DRAWN BY	CHECKED	APPROVED	DATE	SCALE	TS-B

NAME	AROCLOR 1262-10% TOLUOL MIX	SOURCE & DATE	CHLORINE	SOURCE & DATE	DIPHENYL	SOURCE & DATE	FERRIC CHLORIDE, ANHYD.	SOURCE & DATE	HYDRATED LIME (CALCIUM HYDROXIDE)	SOURCE & DATE	INERTEEN P.P.O.	SOURCE & DATE
FORMULA					$C_6H_5C_6H_5$		$FeCl_3$	REF. 3	$Ca(OH)_2$	REF. 4		
MOLECULAR WEIGHT			70.914		154.20	CHEM. RUBBER HDB. 1941-42	166.22	" "	74.10	" "		
APPEARANCE	SYRUPY LIQUID	SPECS 4-11-55			MONOCLINIC		BLACK IRRIDESCENT CRYST.	" "	WHITE POWDER	REF. 5	YELL. TINTED MOBILE OIL	REF. 6
BOILING POINT AT 760 MM			-34.05	API	255°C	INT. CRIT. TABLES					200-415°C	" "
BOILING POINT AT MM			-71.32 AT 100 MM	REF. 1	118°C AT 10.4 MM	SWANN FILE #137 1935						
BOILING POINT AT MM			-100.06 10 MM	"								
BOILING POINT AT MM			-120.44 1 MM	"								
CRYSTALLIZING POINT					69°C	SWANN CURVES, 1934						
MELTING POINT			-100.98	REF. 2	69°C	INT. CRIT. TABLES						
SOLUTION POINT												
SPECIFIC GRAVITY	1.497-1.516 AT 40/15.5°C	" "	2.49 AT 0°C (GAS)	"	0.9896 77/4°C	" "					1.560-1.568, 15.5/15.5°C	" "
SPECIFIC GRAVITY			1.408 20°C	REF. 4	1.041 20/4°C	" "						
POUNDS PER GAL. 25°C	12.7	" "			8.23 AT 77°C	SWANN FILE #137A			4 AT 20°C	REF. 5	13.05	" "
COEFFICIENT OF EXPANSION											0.0007 cc/cc/°C (30-100°C)	" "
REFRACTIVE INDEX			1.47 AT 0°C	REF. 2	D_4^{20} 1.56822 AT 77.1°C	INT. CRIT. TABLES			n_D^{20} 1.574, ED. 1.545	REF 4	1.4137-1.6157 25°C	" "
INFRA RED SPECTRUM (REF.)												
ULTRA VIOLET SPECTRUM (REF.)												
VISCOSITY	103.3 CS. (477 SUS) 100°F	WGK LAB 3-8-56			28.8 SAY. SEC. 100°C	SWANN FILE #137A					52-56 SUS 100°F	" "
VISCOSITY	4.5 CS (41 SUS) 210°F	" "			31.2 " " 70°C	" " "					15 CS. 20°C	REF. 7
SURFACE TENSION DYNE/CM.					29.5 AT 129.2°C	INT. CRIT. TABLES						
SOLUBILITY IN WATER					INSOLUBLE	DOW 1943						
SOLUBILITY IN ABS. ALC. 19.5°C					9.983/100g SOLV.	SEIDELL 1941						
SOLUBILITY IN 100% METHANOL 19.5°C					6.57g/100g "	" "						
SOLUBILITY IN BENZENE 27.9°C					137g/100g "	" "						
SOLUBILITY IN HEPTANE 26.5°C					25.13/100g "	" "						
FLASH POINT °F (METHOD)	105 TAG OPEN CUP	WGK LAB 12-5-46			255 OPEN CUP	IND. & ENG. CHEM.					NONE TO BOILING	REF. 6
FLASH POINT °F (METHOD)	110 " " "	" "			235 CLOSED CUP	1940, 32, 882						
FIRE POINT °F					270 OPEN CUP	SWANN FILE #137A						
HEAT OF COMBUSTION					PER GMOLE 1504.4	INT. CRIT. TABLES						
HEAT OF FORMATION												
THERMAL STABILITY (CAL/KG/MIN.)												
LATENT HEAT OF FUSION					53.1 BTU/lb	REF. 4						
LATENT HEAT OF VAP.					136.5 BTU/lb, 255°C	SWANN FILE #137A						
SPECIFIC HEAT					0.43 BTU/lb°F	REE CR 964, 1956					0.26, 25-60°C	REF. 7
CRITICAL TEMPERATURE			144°C	REF. 2	528°C	REV. SCI. INST.						
CRITICAL PRESSURE			76.1 ATMOS.	"	41.4 ATN. ABS.	563, 1930						
DISSOCIATION CONSTANT												
OTHER CONSTANTS: POUR POINT	0°C	" "					DECOMPOSES ON EXPOSURE TO MOIST AIR				-32°C OR LOWER	REF. 6
OTHER CONSTANTS: SPECIFIC GRAVITY			1.377 AT 30°C	REF. 4								
OTHER CONSTANTS: SOLUBILITY IN WATER									.077% AT 100°C SOL. IN ACIDS AND NH_4Cl	REF. 4		
OTHER CONSTANTS: DIELECTRIC CONSTANT 100°C 60 CY.											3.7-4.0	" "
OTHER CONSTANTS: THERMAL CONDUCTIVITY CAL/CM/SEC/°C											20×10^{-5} AT 50°C	REF. 7
TOXICITY (REFERENCE					(1) DR. MCLESTER, ANN. PLANT REPORT COPY IN ST. LOUIS PHYSICIANS FILE. (2) PERCY MAY - "CHEMISTRY OF SYNTHETIC DRUGS" 3ED. p.19, 1937					CONTACT MED. DEPT.		

REFERENCE 1 - CALC. FROM DET. DATA
REFERENCE 2 - MONSANTO CHLORINE
REFERENCE 3 - PENN-SALT CHEM CO. TECH DATA SHEETS & SPECS.
REFERENCE 4 - LANGES HANDBOOK ED. 9, 1956
REFERENCE 5 - INFORMATION BY VENDOR
REFERENCE 6 - SPECS. 6-6-55
REFERENCE 7 - MONSANTO CHEMICAL LTD.

ANNISTON PLANT — MONSANTO COMPANY — ANNISTON, ALA.

TITLE	AUTH. NO.
PHYSICAL CONSTANTS DATA	JOB NO.

DRAWN BY	CHECKED	APPROVED	DATE	SCALE
				TS-B

DSW 543290

STANDARD MANUFACTURING PROCESS
FOR
AROCLORS

APPENDIX D - UTILITIES

The following is a list of utilities supplied to the Aroclor Department:

Steam

Steam is supplied to the department through a 6" main at 120 PSIG. Standard practice on steam is 0.213 M BTU/cwt. Liquid Aroclors, 0.432 M BTU/cwt. Solid Aroclors.

Recovered Water

Recovered water is supplied through a 6" main from a cooling tower. Standard practice is 909 gals/cwt. Liquid Aroclors, 1,437 gals/cwt. Solid Aroclors.

Electricity

Electrical power is supplied at 440 volts for power and 110 volts for lighting. Standard practice is 3.64 KWH/cwt. Liquid Aroclors, 8.38 KWH/cwt. Solid Aroclors.

Natural Gas

Natural gas is supplied through a 3" main at 40 psig. Standard practice is 0.182 M BTU/cwt. Liquid Aroclors, 0.857 M BTU/cwt. Solid Aroclors.

STANDARD MANUFACTURING PROCESS
FOR
AROCLORS

APPENDIX E - PERSONNEL

The Aroclor operations require one Chief Operator, Classification A-2, and four Operators, Classification A-4, per shift. The chief operator is in charge of all Aroclor operations during his shift. A relief chief operator relieves a regular chief operator one shift per week, and an operator four shifts per week. He also works for the regular chief operator during vacations, sickness, and other absences. Each operator is assigned a specific job and is responsible for the operations of his job. There are nine (9) laborers, Classification A-8, employed in the Aroclor-Biphenyl group of departments. The laborers are normally assigned to day shift operations. Approximately 70% of all laborers' time is spent in Aroclor operations. The laborers' duties consists of filling drums, bags, crushing, screening, and milling of various products. They also clean tank cars.

The Aroclor Department is supervised by a Production Supervisor and a Production Foreman.

Attached is a Job Classification Schedule and Schedule of Hourly Wage Rates which also shows length of time required between automatic rate increases.

The flaking, bagging, drumming and car loading operations are a semi-independent part of the Aroclor operations. The department is supervised by the Aroclor Production Supervisor and a Production Foreman. Two chief operators, Classification A-2, operate the department and act as relief for each other.

JOB CLASSIFICATION SCHEDULE AND SCHEDULE OF HOURLY WAGE RATES

AUTOMATIC RATE INCREASE GIVEN AT END OF:

Appendix A Effective 4/1/68 Department and Classification	Probationary Period Starting Rate	12 Wks.	24 Wks.	32 Wks.	40 Wks.	48 Wks.	60 Wks.	72 Wks.	108 Wks.	144 Wks.	180 Wks.	208 Wks.	Max. Day Rate	Job Shift Rate
A. Production Department														
2. Chief Operator	----Filled by upgrading			--	--	--	--	--	--	3.38	3.43	3.48	3.48	
4. Operator	----Filled by upgrading			--	--	3.10	3.15	3.20	3.25	--	--	--	3.25	Day Rate Plus 7.5%
7. Operator Trainee	2.74	2.87	2.92	2.98	3.03(1)	--	--	--	--	--	--	--	3.03	
8. Operating Labor	2.62	2.68	2.71	2.74	--	--	--	--	--	--	--	--	2.74	

(1)May be employed at any of foregoing rates when having special qualifications.

DSW 543293

STANDARD MANUFACTURING PROCESS
FOR
AROCLORS

APPENDIX F - PACKAGING AND SHIPPING

Solid Aroclors are packaged for shipment in 41 gallon Fibre drums, 40 gallon galvanized drums, 5 gallon galvanized cans, and in paper bags.

Liquid Aroclors are packaged in 55 gallon steel drums, and 5 gallon steel cans. These drums and cans are lined with two coats of B&V Series 46, #21971 clean Epoxy Phenolic lacquer. Liquid Aroclors are loaded into tank cars and trucks. Tank cars used for electrical grade material are either aluminum or zinc and tin lined. All trucks are stainless steel. Occasionally, non-electrical Aroclor is loaded into an iron car.

All tank cars and trucks are entered, cleaned and inspected prior to loading.

DSW 543294

APPENDIX I

AROCLOR FINISHED GOODS

CONTAINER WEIGHTS

Material	Weight Lbs.	Container
1221	50 or 520	5 Gal. - 55 Gal. Steel Drum
1232	50 or 550	" " " "
1242	55 or 600	" " " "
1248	55 or 600	" " " "
1254	60 or 600	" " " "
1260	60 or 600	" " " "
1262	60 or 600	" " " "
Inerteen 54201-A6	600	55 Gal. Steel drum
Therminol FR-0	60, 600, or 635	5 Gal. - 55 Gal. steel drum
Therminol FR-Lo Temp.	55 or 600	" " " "
Santicizer 794	600	55 Gal. Steel Drum
Aroclor 1242-1248	55 or 600	5 Gal. - 55 Gal. steel drum
Pyranol A13B3B	65, 360, or 675	5 Gal. - 30 Gal.-55 Gal. steel drum
Inerteen PPO	65, 360, or 674	" " " " " " " "
Inerteen 54201-KA	674	55 Gal. steel drum
Inerteen 70-30	674	" " " "
Inerteen 54201-CM	600	" " " "
Aroclor 1254 - 4465	650	" " " "
Aroclor 1260-5% Toluene	60 or 600	5 Gal. - 55 Gal. steel drum
Aroclor 1260-10% Toluene	60 or 600	" " " " " "
Aroclor 1254-10% Toluene	600	55 Gal. steel drum
Aroclor 1262-10% Toluene	60 or 600	5 Gal. - 55 Gal. steel drum
Aroclor 1262-10% Xylene	60 or 600	" " " " " "

DSW 543295

AROCLOR FINISHED GOODS

CONTAINER WEIGHTS

Material	Weight Lbs.	Container
Aroclor 5442	50 or 450	5 Gal. - 40 Gal. Galv. drum
Aroclor 4465	50,500, or 535	5 Gal. - 40 Gal. Galv. drum 55 Gal. Steel drum
Aroclor 2565	50 or 500	5 Gal. - 40 Gal. Galv. drum
MCS 295	635	55 Gal. steel drum
Aroclor 5060	50 or 100	Paper Bags.
Aroclor 5460	50 or 100	Paper Bags
Aroclor 1268	200	41 Gal. Fiber drums

DSW 543296

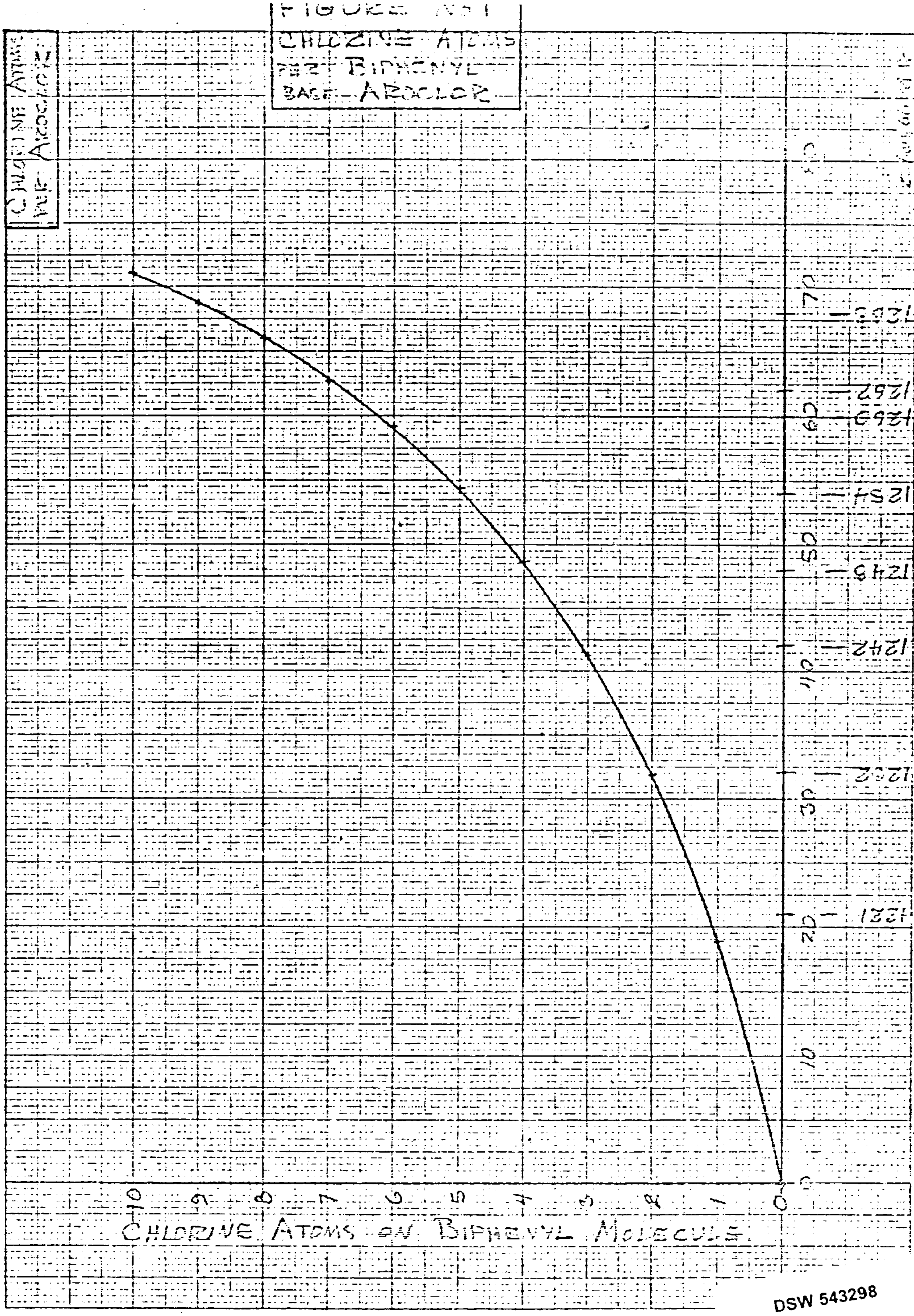
STANDARD MANUFACTURING PROCESS
FOR
AROCLORS

APPENDIX G - MATERIAL BALANCE

Standard and Theoretical usages of raw materials and hydrogen chloride produced for each Aroclor is shown in Figure 3.

Figures 1 and 2 show the relationship between average number of chlorine atoms and per cent chlorine for Biphenyl and Santowax base Aroclors.

Figure 4 gives molecular weights of the various Biphenyl base Aroclors.



DSW 543298

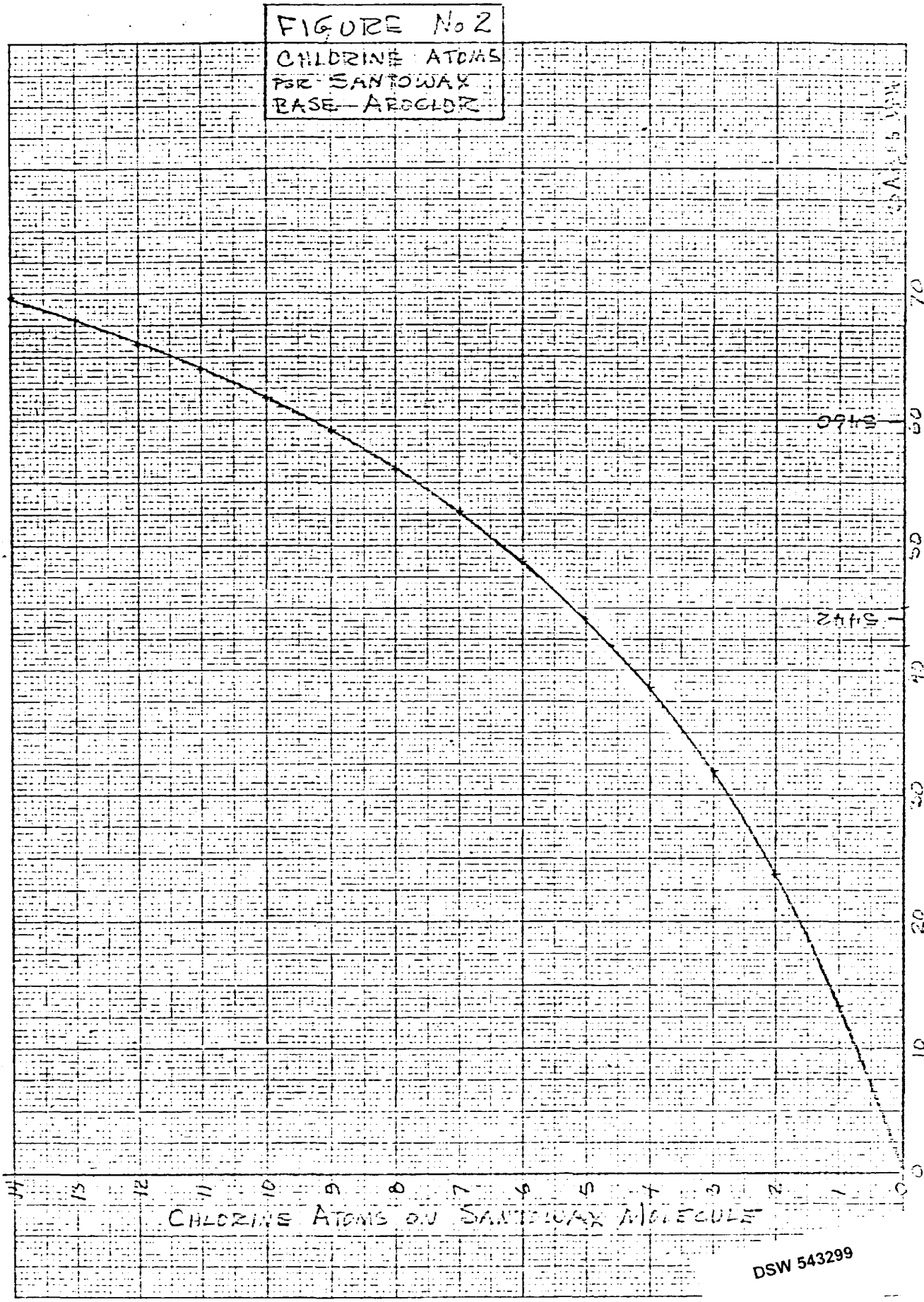
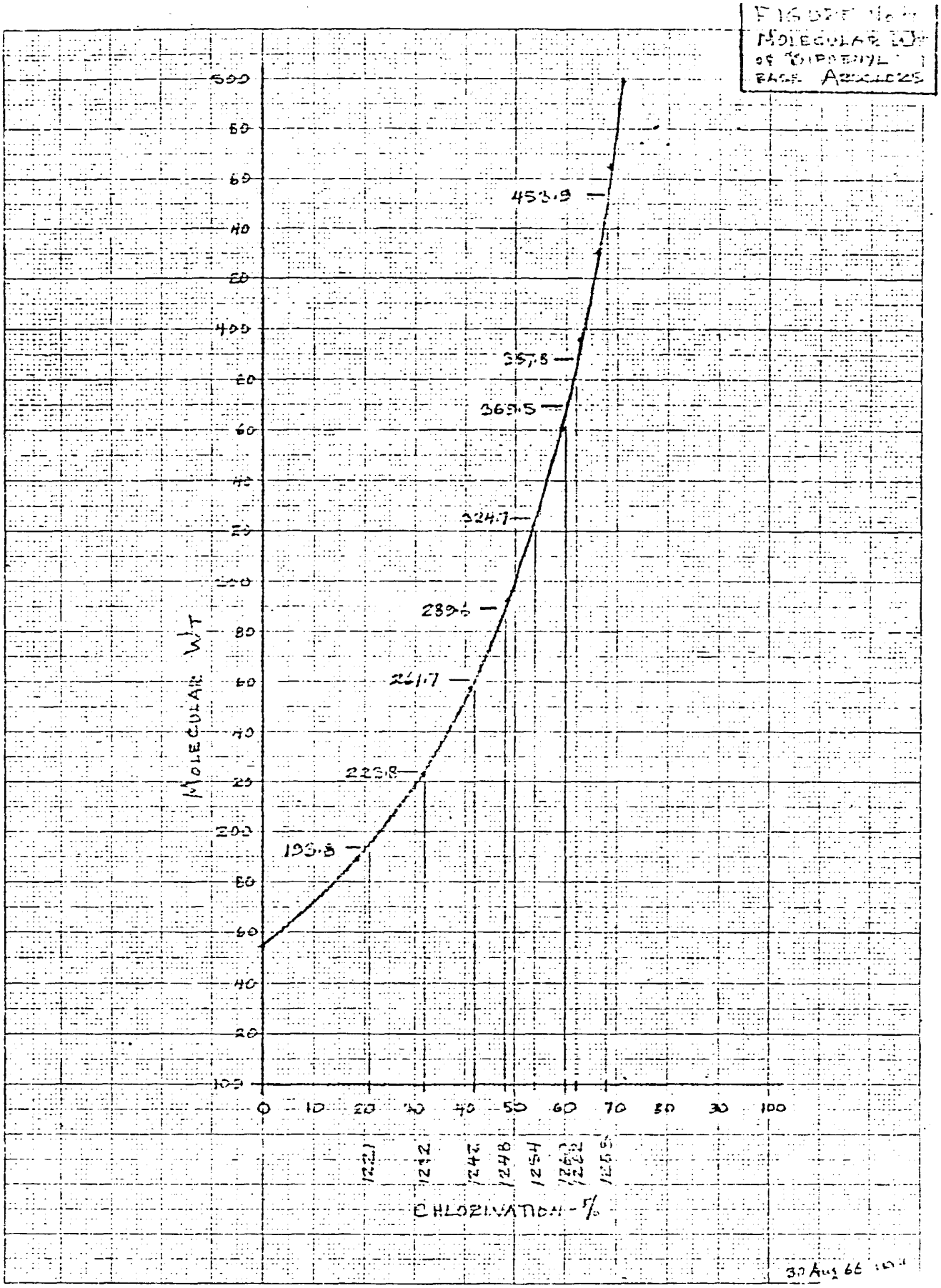


FIGURE NO. 3
Theory and Standard Usage for Aroclors
Lbs. per CWT Aroclor

Aroclor	Biphenyl		Santowax R		Santowax C		Chlorine		Hydrogen Chloride (S&U)	
	Theor.	Std.	Theor.	Std.	Theor.	Std.	Theor.	Std.	Theor.	Std.
1221	79.60	82.06	--	--	--	--	42.00	46.15	23.73	13.76
1232	68.91	71.04	--	--	--	--	64.00	70.33	36.16	21.10
1242	59.19	61.02	--	--	--	--	84.00	92.31	47.47	27.53
1248	53.37	55.02	--	--	--	--	96.00	105.49	54.24	31.46
1254	47.53	49.00	--	--	--	--	108.00	118.68	61.03	35.39
1260	41.71	43.00	--	--	--	--	120.00	131.87	67.81	39.33
1262	39.76	40.99	--	--	--	--	124.00	136.28	70.08	40.65
1268	33.93	46.48	--	--	--	--	136.00	186.30	95.80	55.56
2565	27.63	28.78	--	--	9.21	9.59	130.00	135.42	69.63	40.38
4465	22.10	30.27	14.74	20.19	--	--	130.00	178.08	91.57	53.11
5442	--	--	59.19	81.08	--	--	84.00	115.07	59.17	34.32
5060	--	--	41.71	43.44	--	--	120.00	125.00	64.28	37.28
5460	--	--	41.71	49.07	--	--	120.00	146.34	84.52	49.02

DSW 543300



DSW 543301

STANDARD MANUFACTURING PROCESS
FOR
AROCLORS

APPENDIX H - ATMOSPHERIC & STREAM DISCHARGE & WASTE DISPOSAL

The following is an estimate of the atmospheric and stream discharge from the Aroclor operations at the maximum rate of 4,400,000 lbs/month Liquids and 950,000 lbs/month Solids.

	Type	Amount
Chlorine	Atmospheric	Negligible
HCl (Gas)	Atmospheric	Negligible
Montars	Plant Dump	Approximately 10% of Total Aroclor Production

DSW 543302

STANDARD MANUFACTURING PROCESS
FOR
AROCLOR

APPENDIX I - PROCESS CONTROL PROCEDURES

Control samples are taken from the chlorinator circulating line at intervals throughout the chlorination. The samples are checked, by the operator, for specific gravity, softening point or hold point dependent upon the Aroclor being produced. Temperature readings are taken every hour and recorded on data sheet.

A representative sample is taken of all distilled Aroclors and sent to the Analytical Laboratory for control tests prior to drumming, bagging, or loading into tank cars or trucks. The following control tests are performed by the Laboratory:

Test (Liquid Aroclors)	Anniston Analytical Method No.
Specific Gravity	052
Moisture	047
Resistivity	122

Test (Solid Aroclors)	Anniston Analytical Method No.
Softening Point	115
Hold Point	119
Color	128
Solubility	117

A complete analysis is run by the laboratory on all final lot samples.

STANDARD MANUFACTURING PROCESS
FOR
AROCLOR

APPENDIX J - SAFETY & TOXICITY DATA AND ACCIDENT REPORTS

Safety of operations in the Aroclor Plant depends on the individual operator. Materials being handled and operations must be observed closely to guard against the following:

Cause and Action to Prevent

1. Chlorine Gas

Chlorine gas is a very toxic corrosive gas. Leaks or high pressure can occur to liberate it.

Action to Prevent

a. Report Chlorine gas exposure immediately for treatment with Antidote. Milk may be used in mild cases to relieve throat irritation. Oxygen from the resuscitator in the Dispensary is available.

b. Keep gas mask in good condition. Keep a good canister in the mask. Use these type masks only in chlorine concentrations to 2-3% chlorine in air.

c. Use a Scott Air Pak in concentrations of chlorine gas above 3% in air. Three units are available in the Aroclor-Biphenyl Department.

d. If caught in chlorine gas without a mask, hold your breath and go cross wind until you are out of range of the gas. Place a handkerchief over your nose in small quantities of chlorine.

e. Report all chlorine leaks for repair immediately. Make temporary repairs with tape if possible.

f. In case of a major chlorine leak, the source of chlorine gas must be stopped.

Notify the Chlorine Plant immediately if the pressure on the chlorine manifold exceeds 30 psig. Cut off liquid chlorine from the car.

DSW 543304

2. Thermal Burns

Cause and Action to Prevent

Contact with hot uninsulated product lines ar the chlorinators and still areas.

Contact with uninsulated steam lines and open steam.

Contact with hot Aroclors from broken lines or leaks.

Contact with open flames at stills or from heating lines in the department.

Action to Prevent

a. Know that contact with equipment and product will cause a thermal burn due to the high temperatures. Make changes in operations with this hazard in mind.

b. Know the first aid treatment for burns. Cold Water Treatment attached.

c. Wear gloves and long sleeve shirts with the sleeves rolled down when operating. Gloves and clothing can make the difference between first and second degree burns.

d. Report uninsulated lines for repair of insulation.

e. Use only steam lines with hose and hose clamps in good condition.

f. The following operations are hazardous and should be done with care:

(1) Catching samples at the Aroclor chlorinator circulating pumps.

(2) Sampling the Solid Aroclor still receiver.

(3) Drawing bottoms on the Aroclor stills.

DSW 543305

Cause and Action to Prevent

3. Explosion

An explosion could occur in the chlorinators by slugging liquid chlorine to the distributor. Slugs of liquid chlorine could react fast enough to cause excessive pressure in the vessel. A rupture of the chlorinator could occur.

Action to Prevent

a. Observe operation of the chlorine vaporizer and do not let liquid chlorine get into the rotameters. Pipe lines will be frosted.

b. In case chlorine feed lines are frosted, close liquid chlorine feed valve to the vaporizer. Check steam addition to the vaporizer. Do not start up until source of trouble has been located.

c. Observe temperature of the chlorinator periodically and be sure it is not too hot (180°C. maximum).

4. Falls

Slipping on cement floors, stairs, Aroclor on floor, ice conditions; tripping over objects (hose, pipe, valve handles, etc.); or losing footing on ladders, etc., can cause falls.

Action to Prevent

a. The majority of minor, serious, and near-miss injuries in the Aroclor Dept. are the result of falls. Prevention is always within the ability of the operator by use of expert operating practices.

Cause and Action to Prevent

4. Falls (Contd.)

b. The following items should be done:

(1) Return hose to rack after using.

(2) Keep operating areas clean of all foreign objects.

(3) Return ladders to racks when not in use.

(4) Keep gloves on and hands out of pockets, especially going up stairs.

(5) Place guards around any area that presents a hazard that should be guarded.

c. Poor lighting due to burned out bulbs should be corrected at once. Poor lighting due to inadequate facilities should be reported.

d. Spills must be cleaned up immediately following their occurrence. Report any spill that cannot be cleaned up within the shift to the Chief Operator. Spills are to be reported in the log book.

5. Fires

Fires can occur by:

Biphenyl, Santowax R, or Santowax C ignition.

Chlorine problems in the vaporizer allowing reaction with steam to release hydrogen.

Furnace burner backfire.

Wood, rags, or paper on hot lines.

Sparks from welding apparatus of open flames.

Cause and Action to Prevent

5. Fires (Contd.)

Action to Prevent

a. Area must be clear of trash or flammable materials. Use trash skips and cans.

b. Smoke only in areas so designated.

c. Use spark producing equipment only with a fire permit and proper inspection.

d. Use care in lighting gas torch or the still furnaces.

e. Fire fighting equipment includes:

(1) Two wheeled dry powder units.

(2) Hose house with 200 ft. of hose.

(3) Two dry powder hand extinguishers, One CO_2 hand extinguisher.

(4) Two 3/4" water hoses.

(5) Hose connection north of Santowax.

(6) Scott Air Paks.

(7) Fire truck in fire house.

f. Observe visitors in the plant and be sure they observe safety rules.

Cause and Action to Prevent

6. The following is a list of chemicals handled in the Aroclor Plant operations and the precautions to be taken during their handling:

a. Chlorine Gas

This is a corrosive gas which is toxic. Leaks or back pressure can occur and liberate chlorine gas in the area. Operators should have their cartridge type respirators handy at all times while in the area. Use of gas masks is explained in Section 1. Chlorine Gas.

If you are caught without a gas mask, and large amounts of chlorine gas are liberated, hold your breath and go cross wind until you are out or range of the gas. Once out of the area, obtain an emergency gas mask and return to the area and correct the trouble.

A victim of chlorine gas fumes must be removed as quickly as possible from the gaseous area. Place patient on his back with head and back elevated. Milk may be used in mild cases as a relief from throat irritation. If the patient has stopped breathing, start artificial respiration immediately.

b. Biphenyl

Biphenyl is a flammable material which will burn. Burning should not be done in the presence of Biphenyl or Biphenyl vapors. The melting point is 68.7°C., and the auto ignition temperature is 258°C. Inhalation of Biphenyl fumes is not recommended, since it can cause a drugged effect on the person.

c. Santowax R

Santowax R is a flammable material which will burn. It is relatively non-toxic to human beings. However, the vapors of Santowax R are irritating to the mucous membranes and bronichial tract. Prolonged breathing of the vapors should be avoided. The melting point is 140°C.

	Cause and Action to Prevent
6. (Continued)	
d. Santowax C	Same as Santowax R, since it is the crude material prior to distillation.
e. Ferric Chloride	Ferric Chloride is a black-brown solid. It causes only slightly irritating effects on the skin or mucous membranes. When heated it will decompose and release toxic fumes of Chlorine. It will react with water to produce toxic and corrosive HCl fumes.
f. Attapulgus Earth	This material is a dried earth. No danger in handling. Wash off with water to clean.
f. Hydrated Lime	No particular hazard in handling this material. The dust is irritating to the eyes and skin, and should be washed off with water.
h. Crude Aroclors	Crude Aroclors are hot, since all are handled in steam traced or jacketed lines. They can easily cause thermal burns in contact with the skin. Prior to air blowing, the material has HCl fumes entrained in it which are irritating to the skin or mucous membranes.
i. Hydrogen Chlorine Gas	This is a corrosive gas which is toxic. It is irritating to the mucous membranes, to the eyes, and to the respiratory tract. It will react with water to form Hydrochloric Acid.
j. Still Bottoms or Residue	Fumes from still bottoms are toxic. They are extremely irritating to the mucous membranes, to the eyes, and respiratory tract.

STANDARD MANUFACTURING PROCESS
FOR
AROCLORS

APPENDIX K - BACKGROUND INFORMATION

History of the Process in Monsanto

In the years 1927 - 1928, the Swann Chemical Company developed a process for making diphenyl, but as the expected demand for it did not continue, other outlets were sought for the diphenyl. Aroclors were produced in the laboratory in 1928, and as they showed good electrical properties, fire resistance, and general inertness, the General Electric Company became interested, and developed the use of Aroclors in transformers and capacitors. Biphenyl production began on February 28, 1928; Aroclor production (3,000 lbs/day) started on December 16, 1928.

In 1935 Monsanto acquired the Swann Company, so gaining access to their Aroclor patents. As the demand for Aroclors increased, additional production equipment was installed, located at the Monsanto Illinois factory (then Plant "B" and now called the Krummrich Plant). This equipment came on stream in September 1936.

The Krummrich plant site was chosen partly because of the availability of chlorine there, but when chlorine consumption overtook the production, and chlorine had to be purchased, proximity to the diphenyl production at Anniston had more weight, and additional capacity, largely designed on the plant "B" model, was installed at Anniston in 1941.

By 1946 both plants had doubled their capacity, to give a total production capacity approaching 2 million pounds a month. About 1954, chlorine cells were installed at Anniston.

The Newport plant was designed, mainly on Krummrich plant information, but to a less extent on Anniston information, under Newport Project No. 12 of the London Central Engineering Department.

Chlorination started at Newport in June 1951, Mr. Jack Clegorn from Anniston spending some time at Newport to assist in starting the diphenyl and Aroclor plants there.

The first production of Pyranol by MCC was in 1936, when Pyranol 1488 was made for the General Electric Company, the blending being done at first in rail tanks. Pyranol 1495 was made in July 1938.

Batch chlorinated Aroclors were made until November 1957 when continuous chlorinated Aroclors were first made in plant equipment.

Several test runs were made and sold to customers for evaluation. On February 14, 1961, continuous chlorinated Aroclor 1242 was made on a full time basis. Today Aroclor is made by both batch and continuous chlorination of Biphenyl and/or Santowax.

In May 1965 an Aroclor expansion was completed to bring the capacity to 58 M pounds per year which includes 10 M pounds per year of Solid Aroclors.

In the Fall of 1968, a new tank farm, car loading facilities, and automated drumming, bagging, and flaking facilities were added to the Aroclor department.

Aroclor Uses

Monsanto Aroclors are used "as is" or in special formulations for the liquid coolant-insulation fluids in transformers and capacitors.

In capacitors, they provide for power factor correction in electric utility transmission lines. In fixed paper capacitors, Aroclors are the dielectric substance. These capacitors are used in home appliances such as air conditioners, furnaces, washers, and driers, in electric motors, and for ballast in fluorescent fixtures.

General Electric, Westinghouse, and other producers of electric capacitors use Monsanto Aroclors in special formulations for the dielectric substance.

Other important applications of both Liquid and Solid Aroclors in the electrical field are in wire and cable coatings and as impregnants for cotton and asbestos braided insulation. In addition, they are excellent dielectric sealants and are used to close the pores of carbon resistors and to seal electrical bushings and terminals.

Aroclors are outstanding for use as the heat transfer liquids in indirect heating systems. Aroclor systems can transfer closely controllable, uniform heat to chemical process vessels, food cookers, potato chip and firto fryers, drying ovens, to heat corrugating rolls, crimping presses, and calenders in material processing, to heat treating metals such as Titanium and Vanadium, and to efficiently indirect heat distillation equipment.

It is interesting to note that as recently as 1941 only two methods of delivering process heat were known. Today non-pressurized, high temperature, fire resistant heat transfer systems based on Monsanto's Aroclor Liquids overcome practically all the deficiencies and drawbacks of Direct-Firing and Pressurized Vapor Heating.

Presently, there are numerous other uses for Liquid and Solid Aroclors and Aroclors in formulations. Only some of these uses are listed below:

As the actuating medium in bellows controls, thermostats, industrial temperature control regulators, and other kinds of automation equipment.

Liquid sealant for furnace roofs.

Vacuum diffusion pump oil-pumps used to pull high vacuum for metalizing plastics, dehydrating foods, and medicinals.

Dust entrapment-used to coat fibrous glass air filter pads, metal mesh, and other materials used for filtering air and gas streams.

As a vapor suppressant to increase the kill life of insecticides.

In waxes-waxes containing Aroclor are widely used in making dental castings, in the precision casting of aircraft parts, and for casting costume jewelry.

In specialized lubricants, adhesives, ink formulation, caulking compounds, plastics, rubbers, paints, varnishes, and lacquer formulations.

New uses for the various Aroclors are continually being developed. Continuous quality control, coupled with the unusual chemical and physical characteristics of the Aroclors, has resulted in widespread customer acceptance and a limitless expansion of uses for them.

STANDARD MANUFACTURING PROCESS
FOR
AROCLORS

APPENDIX K - BACKGROUND INFORMATION

The following is an up-to-date (Aug. 1, 1968) bibliography of Research reports on Aroclors:

Ashworth, G. W., Keller R. E. Development of Analytical Methods - 1960 Part 9 - Evaluation of General Electric's Improved Thermal Stability Test for Pyranols. Organic Research St. Louis No. 3033, January 1964 (On Aroclor 1242).

Ashworth G. W. et al Analytical Chemistry and Spectroscopy Investigations-1962 Part 2 - Special Studies. Organic Research St. Louis No. 3067 1/64 (On identification of Aroclors)

Argo W. B., Knapp W. G., Gibbs M. E., Smull W. L. Heat Transfer Studies in a Fifty Gallon Glass-lined Jacketed Reactor. Organic Research St. Louis No. 2536 6/21/61 (On Aroclor 1248)

Barkley L. B., Lippman A. E., Nufer H. L. O-Phenyl-O-14-Nitrophenyl methylphosphonothioate. Ag. Research No. P2 6/15/61 (On Aroclor 1254 as a solvent)

Bindbeutel A. J., Fowler L., Koerner W. E., Luebke H. W., Manno A. L., Trump W. N., Vogler C. E. Therminol Fluid Vapor Pressure and Thermal Stability Instrument. Organic Research St. Louis No. 2961 7/6/63 (Aroclors and Aroclor 1232)

Brooks R. F., Koerner W. E., Spector M. B. IBM 704 Computer Program for Therminol Fluid Heat Transfer Coefficients. Organic Research St. Louis No. 2904 9/6/62 (On Aroclor 1242, 1248, 1254)

Bucknell R. W., Campbell D. M. W. Building Manufacture of Santicizer 640. Organic Research St. Louis No. 2440 2/8/60 (On Aroclor 1260)

Close H. J., Knapp W. G. Aroclor HDK-1 Pilot Plant Preparation. Organic Research St. Louis No. 3007 11/30/61 (On Aroclor HDK-1 and Aroclor 1132)

Cunningham E. P., Densmore D. W., Rinehart W. M. Evaluation of Chemical Modifiers for Asphalts. Organic Research No. 2529 1/4/60 (On Aroclor 1232)

Darby J. R., Touchette N. W., Wangler L. R. Application Work on Present Plasticizers - 1959. Organic Research St. Louis No. 2488 3/21/60 (Aroclors mentioned)

Ellenburg G. M. Assistance to Sales and Development Departments on Aroclors, Biphenyl and Related Products - 1954. Organic Research St. Louis No. 2420 1/8/60 (On Aroclor 1242, 1248, 1254, 1260, and 5460)

Ellenburg A. M. 1960 Minor Plant Investigations - Suitability of Biphenyl from Union Carbide as Raw Material for Aroclor Production. Organic Research St. Louis No. 3133 9/29/64 (On Aroclor 1148 and 1248)

Ellenburg A. M. New Dielectrics - 1959 and 1960. Organic Research St. Louis No. 2737 2/22/61 (On Aroclors)

Ellenburg A. M., Busch W. A. High Dielectric Constant Aroclor. Organic Research St. Louis No. 2676 12/27/60 (On Aroclor 1242)

Ellenburg A. M., Merten H. L. Exploratory Fluorination Studies of Biphenyl Derivatives. Organic Research St. Louis No. 2455 4/19/60 (On Aroclor 1260)

Ellenburg A. M., McHugh K. L. Manufacture of Aroclor HDK-1. Organic Research St. Louis No. P1090 12/28/60 (On Aroclor HDK-1)

Erickson F. B., Sakornbut S. S. Paper Transparentizers - A Literature Survey. Organic Research St. Louis No. 2486 4/4/60 (On Aroclor 1260)

Fallwell W. F., Raether L. O. Final Report on Fire Retardents for Polyesters, Epoxies, Acrylics and Phenolics. Organic Research No. 2855 4/3/62 (On Aroclor 1260)

Freeman R. C., Marco G. J., Speziale A. J. The Preparation of Radioactive CP 40294 (O-Phenyl-C14*-P-Nitrophenyl Methylphosphonothioate) Ag. Research No. 18 8/1/62 (On Aroclor 1242)

Gaertner V. R., Schisla R. M. Chlorinated Diphenyl Ether Dielectrics. Central Research No. 1472 8/7/61 (On Aroclor 1242)

Gebura S. E. Glycidyl Ethers and Polyethers of Bisphenol-A, Tetrachlorobisphenol-A and Hydrolyzed Aroclor 1262. Plastics Research Springfield No. 1413, 2/2/57 (On Aroclor 1262)

Graham P. R., Darby J. R., Wangler L. R. Study of Plasticizers in Plastisols Part II. Organic Research St. Louis No. 2648 11/14/60 (On Aroclor 1254)

Hatton R. E., Cunningham E. P., Luebke H. W., Stark L. R. Functional Fluids Application Research. Organic Research St. Louis No. 2472 2/16/60 (On Aroclors)

Hatton R. E., McEvan M., Sands T. P. Status Report on Synthetic Functional Fluids - 1950-66. Organic Development, Greve Coeur No. 1298 12/29/61 (On Aroclors)

Knowles W. S., Smith T. C. Final Report on Preparation of Perfluorinated Compounds for Use as Functional Fluids Part I. Organic Research St. Louis No. 3176 3/25/65 (On Aroclor 1242 and 1268)

Lancey R. C. Industrial Heat Transfer Fluids - A Market Study. Organic Development Creve Coeur No. 1266 3/10/61 (On Aroclor 1248)

Lancey R. C. Utilization of By-product Aroclors from the HDK-1 Process. Organic Development Creve Coeur No. 1263 12/7/60 (On Aroclor 1242, 1248, 1254, 1260, HDK-1, 1221)

McHugh K. L., Ellenburg A. M. Improved Aroclor 1242 Process Studies /Aroclor HDK-1/ Organic Research St. Louis No. 2755 3/6/61 (On Aroclor 1132, 1248, 1254, 1260, HDK-1)

McHugh K. L., Sullivan J. D. MCS 177. Organic Research No. P1179 5/16/62 (On Aroclor 1134, 1234)

McHugh K. L., Sullivan J. D. Tentative Process for MCS-177. Organic Research St. Louis No. P1234 3/12/63 (On Aroclor 1232)

Mestdagh J. J. Flame Retardent Phenolic Phenolic Varnishes. Plastic Research Springfield No. 1581 10/14/60 (On Aroclor 5460)

Parks R. M. Polymerite File Market Study - Special Report. Organic Development Creve Coeur No. 1277 7/26/61 (On Aroclors)

Terpstra M. A. Hydrolyzed Aroclor 1268 /Alkaline - Methanol Hydrolysis/ Organic Research St. Louis No. 2585 9/7/60 (On Aroclor 126S)

Ellenburg A. M. Assistance to the Aroclor Production. Phosphorous Research SF 2084 Job No. 171-299 12/31/46

Ellenburg A. M., Feltham J. E., Richards H.B., Jr. Aroclor 1142, Production, Increase in Chlorination Rate. Phosphorous Research SF 2790 Job No. 171-1028 7/3/52

Ellenburg A. M. Aroclor 1154, Removal of Hydrogen Chloride from Waste Gases. Phosphorous Research An. SF 1978 Job No. 207 9/21/45

Ellenburg A. M., Simone R. A. Aroclor 1142 and 1154 prepn. from biphenyl by contin. chlorination. Organic Research SL Fin. 1530 Job No. 3040 6/4/56

Metzner W. P., Becker T. H. Use of Standard Reactors for Making Aroclor 1160. Organic Research SL Fin. X-1491-IV Job No. 117-1491, IV 4/21/42

Ellenburg A. M., Cleveland T. H. Evaporation Loss of Aroclors. Phosphorous Research An. SF 2234 Job No. 451 7/14/48

Ellenburg A. M., Richards H. B., Sears J. K. Aroclor 1221 and 1242, chlorination with DeNora CL-air mixt. Phosphorous Research SF 2673 Job No. 171-790 12/10/51

Durgin C. B., Trementozzi Q. A. Specific Heats of Aroclors 1221 and 1232 Phosphorous Research SF 2083 1/17/47

Ellenburg A. M., Forbus F. C. Aroclor 1232, Brominated, Prepn. Phosphorous Research SF 2512 Job No. 171-628 9/13/50

Ellenburg A. M., Good R. J., Wade W. W. The Effects of Prolonged Heat on the Electrical Properties of Aroclors. Job No. 171-616 12/7/50

Nellums R. O., Gruetzemacher E. C. Aroclors 1232 and 1248, as components of hydraulic fluids. Organic Research SL Fin. 1753 Job No. 3388 2/14/57

Ellenburg A. M., Good R. J., Richards H. B., Jr. Aroclor 1236, Dielectric Properties Phorphorous Research SF 2612 Job No. 171-615 5/21/51

Ellenburg A. M., Forbus F. C., Richards H. B., Jr. Aroclors 1236, 1238, and 1240 for General Electric Company. Phosphorous Research SF 2539 Job No. 171-609 12/11/50

Ellenburg A. M., Klaus I. S. Aroclor 1242, as heat transfer medium, Properties. Organic Research SL Fin 2252 Job No. 3371 3/11/59

Ellenburg A. M., Wade W. W. Aroclor 1242, Brominated, Prepn. Phosphorous Research SF 2419 Job No. 171-535 12/9/49

Ellenburg A. M., Richards H. B., Jr. Containers for Aroclor 1242. Phosphorous Research SF 2523 Job No. 171-623 11/23/50

Ellenburg A. M., Richards H. B., Jr. Containters for Aroclor 1242. Phosphorous Research SF 2772 Job No. 171-719

Ellenburg A. M., Richards H. B., Jr. Aroclor 1242, 1254, and 1260, distillation at 20-30mm. Hg. Phosphorous Research SF 2694 Job No. 171-1028 2/15/52

Ellenburg A. M. Aroclor 1242, Electric Properties, Under Vacuum storage at 75° and 100°C. Organic Research SL Fin. 1849 Job No. 2910 8/2/57

Metzner W. P., Behr L. C., Tyler L. D. Aroclor 1242, Formulation, for use as potential hydraulic fluid. Organic Research SL Fin. X-1332 Job No. 117-1332 10/21/42

Ruehrwein R. A., Pritchett T. R. Heat Content of Dowtherm A and the Aroclors. CR Sp. 687 - Job No. 4-8065, 4/18/52.

Ellenburg A. M., Morgan J. F., Wade W. W. The Preparation of Aroclor 1244, 1242, 1248, 1254, and P1467 for the General Electric Company. Phosphorous Research SF 2362 Job No. 171-498 6/2/49

Keller R. E., Ashworth G. W. Aroclor 1242, High Chloride content, analysis, Comparison of G. E., Westinghouse, and Monsanto Methods. Organic Research SL Fin. 2188 Job No. 3427 6/24/58

Ellenburg A. M., Good R. J., Wade W. W. Aroclor 1242 and 1254, Effect of u.v. light on Electric Properties. Phosphorous Research SF 2500 Job No. 171-623 6/23/50

Ellenburg A. M. Aroclor 1242, 1248, and 1254, Density and Resistivity Studies. Organic Research SL Fin. 2420 Job No. 2681 1/8/60

Gaertner V. R., Weingarten H. I. Dielectric Liquids: Formation, Composition and Improvement of Aroclor 1242 and 1232. RE. Res. Da. Int 1318 Job No. 9442 1/29/60

Ellenburg A. M., Wade W. W. Aroclor-lithium stearate mixtures. Phosphorous Research SF 2496 Job No. 171-614 5/29/50

Ellenburg A. M., Wade W. W. Aroclor 1242, Mixture with Santodex, as hydraulic fluid. Phosphorous Research SF 2497 Job No. 171-530 12/5/49

Ellenburg A. M., Garrett L. C., Wade W. W. Aroclor 1242 and 1248 hydraulic fluid flammability tests for the Ford Motor Company. Phosphorous Research SF 2447 Job No. 171-614 2/4/50

Keller R. E., Koerner W. E., Brackbill C. H., Cecil O. B., Livasy J., Williams W. D. Aroclor 1242, Mixts. with polymers, electrical properties of. Organic Research SL Fin. 2314 Job No. 3168 7/6/59

Ward D. W. Physical properties of the aroclors 1242, 1248, 1254, and 1260. CR Research Sp 597 Job No. 4-8065 11/29/49

Ellenburg A. M., Ashworth G. W., Merten H. L. Study of the Use of Ferric Chloride as Catalyst for the Production of Aroclor 1242. Organic Research SL Fin. 1842 Job No. 3368 7/12/57

Ellenburg A. M., Good R. J., Morgan J. F., Richards H. B., Jr. Utilization of Airco process for Aroclor production. Phosphorous Research SF 2642 Job No. 171-781 9/28/51

Ellenburg A. M., Wade W. W. Preliminary evaluation of anion exchange resins in the removal of inorganic chlorides from Aroclors. Phosphorous Research SF 2349 Job No. 171-535 4/21/49

Cleveland T. H., Gemeninhardt P. G., Powers E. L., Sanguinetti P. A. Aroclor 1242, reaction medium for manufacturing of tolylene diisocyanate. Phosphorous Research Int. 2943 Job. No. 171-1098 10/21/53

Cleveland T. H., Machwart G. M. Aroclor 1242, reaction medium for phenyl isocyanate production. Phosphorous Research SF 2816 Job No. 171-1013 11/25/52

Saunders J. H., Gemeinhardt P. G., Liss R. L., Powers E. L. Aroclor 1242, reaction medium for tolylene diisocyanate. Phosphorous Research SF 2699 Job No. 171-720 2/20/52

Saunders J. H., Cleveland T. H. Aroclor 1242, reaction medium for tolylene diisocyanate. Phosphorous Research Fin. 2700 Job No. 171-743 2/22/52

Ellenburg A. M., Simone R. A. Resistivity Improvement of Aroclor 1242. Organic Research SL Fin. 2096 Job No. 3203 6/6/58

Weddell D. S. Aroclor 1242, rubber swelling by. Phosphorous Research Fin. 2082 Job No. 171-308 12/19/46

Cleveland T. H., Davis B. R., Flores Hector, Herndon A. B., Saunders J. H. Aroclor 1242, solvent in prepn. of m-tolylene diisocyanate. Phosphorous Research Fin. 2547 Job No. 171-603 12/22/50

Ellenburg A. M., Merten H. Aroclor 1242 - Study of Unstable Product. Organic Research SL Fin. 1640 Job No. 3269 10/22/56

Ellenburg A. M., Good R. J., Richards H. B., Jr. Low Temperature dielectrics. Phosphorous Research Int. 2912 Job No. 171-1054 12/2/53

Ellenburg A. M., Ashworth G. W., Merten H. L. 1. Aroclors (1242, 1254, 1260), chloride stability of, dependence on process variables. 2. Aroclor 1242, up-grading off-grade product. Organic Research SL Fin. 2072 Job No. 3428 5/4/58

Chadwick D. H., Duncan J. M., Kaufman S., Koegle J. S., Llewellyn G. H., Reetz T. Aroclor 1242-tolylenediisocyanate, liquid-vapor equil. data. Organic Research An Fin. 880 Job No. 171-1101, 117-2669, VII 2/26/54

Ellenburg A. M. Aroclor 1248 as a Heat Transfer Medium in a Lamont Forced Circulation Heater. Organic Research SL Fin. 1306 Job No. 2957 3/15/55

Ellenburg A. M., Richards H. B., Jr. Aroclor in gases. Phosphorous Research SF 2325 Job No. 171-1089 10/16/53

Wallace P. P., Spring W. E. Insecticides plus Aroclors. Organic Research CC Fin. 965 Job No. 117-2542 4/14/54

Howard R. E., Hulette V. H., Vandeven P. Design and testing of a portable Aroclor heating unit. Organic Research SL Fin. 238 Job No. 117-2060, II. 8/1/48

Ellenburg A. M , Knight R. R. Treating contaminated Aroclor 1248. Phosphorous Research SF 2342 Job No. 171-451 3/25/49

Ellenburg A. M., Forbus F. C. Aroclor 1248 and Santodex - hydraulic fluid. Phosphorous Research SF 2529 Job No. 171-614 9/7/50

Ellenburg A. M., Morgan J. F. Pour point depressants for Aroclor 1248. Phosphorous Research SF 2396 Job No. 171-530 8/9/49

Hatton R. E., Sullivan J. D. Functional Fluids - Application Research (1956-1957). Organic Research SL Fin. 2176 Job No. 3132 10/14/58

Fordyce R. G. Arochlor 1254, as plasticizer for Cerex 226. CR Int. 397 Job No. 4004 10/15/45

Ellenburg A. M., Good R. J. Aroclor 1254, comparison with Fenclor. Phosphorous Research SF 2887 Job No. 171-1075 6/11/53

Ellenburg A. M., Good R. J. Aroclor 1254, comparison with Fenclor 54. Phosphorous Research SF 2527 Job No. 171-623 9/6/50

Ellenburg A. M. Galvanized plate drums versus galvanized hot dipped drums for Aroclor 1254. Phosphorous Research SF 2055 Job No. 171-297 7/18/46

Ellenburg A. M., Good R. J., Knight R. R., Wade W. W. Aroclor 1254 drum storage tests to check power factor change. Phosphorous Research SF 2421 Job No. 171-524 11/30/49

Ellenburg A. M., Richards H. B., Jr. Effect of exposure to mild steel on electrical properties of Aroclor 1254. Phosphorous Research SF 2771 Job No. 171-718 5/28/52

Ellenburg A. M., Knight R. R. Complaint of high power factor of Aroclor 1254. Phosphorous Research SF 2355 Job No. 171-524 5/13/49

Ellenburg A. M., Wade W. W. Corrosion inhibitor tests with Aroclor 1254. Phosphorous Research SF 2336 Job No. 171-530 3/17/49

Ellenburg A. M., Richards H. B., Jr. Aroclor 1254, distillation at 20mm. Hg. Phosphorous Research SF 2689 Job NO. 171-1028 1/30/52

Nellums R. O., Argo W. B. Aroclor 1254, heat transfer studies (Votator). Organic Research SL Fin. 1906 Job No. 2828 10/23/57

Ash J. R., Daniloff K. B., Dahn W. M. Preparation and Testing of an Emulsion of Chlorinated Rubber and Aroclor 1254. West Research SF 912 Project No. 13012-49-1002 3/28/49

Ellenburg A. M., Richards H. B., Jr. Phosphorous Research SF 2949 Job No. 171-1075 10/28/53

Ellenburg A. M., Sanguinetti P. A. Aroclor 1254, mixt. with Aroclor 4465, as waterproofing agent for electrical cables. Phosphorous Research Fin. 2027 Job No. 171-206 3/8/46

Ellenburg A. M., Richards H. B., Jr. Mixing Aroclor 1254 with secondary butyl acetate. Phosphorous Research SF 2788 Job No. 171-1029 6/25/52

Ellenburg A. M., Sanguinetti P. A. Aroclor 1254, mixt. with dibenzothiophene sulfone, dielectric constant. Phosphorous Research SF 2020 Job No. 171-243 2/8/46

Ellenburg A. M. Aroclor 1254, mixt. with trichlorobenzene, coefficient of expansion. Phosphorous Research SF 2964 Job No. 171-1075 1/18/54

Ruehrwein R. A., White W. A. Studies on light stability of electrical resistivity of Aroclor 1254. CR Sp. 543 Job No. 4-8065 1/11/49

Ellenburg A. M., Good R. J., Wade W. W. Power factor vs. resistivity of Aroclor 1254. Phosphorous Research SF 2458 Job No. 171-623 3/15/50

Metzner W. P. Aroclor 1254, recovery from sample contaminated with mineral oil dielectric. Organic Research SL Fin. X-1334-II Job No. 117-1334, II 4/23/42

Ellenburg A. M., Good R. J., Richards H. B., Jr. Line Material Company, Milwaukee, Wisconsin, complaint on Aroclor 1254 (Elemex). Phosphorous Research SF 2511 Job No. 171-614 9/12/50

Hubbard H. L., Mitoray J. P. Aroclor 1260, color of, investign. Organic Research SL Fin. 1570 Job No. 2319 7/19/56

Ellenburg A. M., Merten H. L. Aroclor 1260, fluorination of. Organic Research SL Fin 2455 Job No. 3199 4/19/60

Ellenburg A. M., Knight R. R. Aroclor 1260, mixts. with tri-(2-ethel-hexyl)- and trioctyl silicon fluorides, dielec, props. Phosphorous Research SF2376 Job No. 171-532 7/12/49

Ellenburg A. M., Richards H. B., Jr. Aroclor investigation on difference between Anniston and Krummrich Aroclor 1260. Phosphorous Research SF 2881 Job No. 171-1088 5/6/53

Hubbard H. L., Brooks R. F. Aroclor 1260, viscosity and Refr. Index studies, comparison between Anniston and WGK. Organic Research SL Fin. 2118 Job No. 2602 7/16/58

Darby J. R., Cannon J. A. Aroclor 1262, as plasticizer for Saran, Evaln. Organic Research SL Fin. 2379 Job No. 3591, IV 10/26/59

Drumm M. F., Gebura S. E. Aroclor 1262, hydrolyzed, glycidyl ethers of. Pl Res Spf Fin. 1413 Job No. 1845 2/2/57

Nellums R. O., Terpstra M. A., Goss J. C., Lynch D. K. Pilot Plant Preparation of Hydrolyzed Aroclor No. 1262. Organic Research SL Fin. 1335 Job No. 3036 11/14/55

Ellenburg A. M., Wade W. W. Aroclor 1268, hydrolysis to hexachlorodihydroxybiphenyl. Phosphorous Research SF 2317

Sharp D. B., Dazzi J., Gabbert J. D., LeBlanc J. R. Hydrolysis of Aroclor 1268 in Methanolic Sodium Hydroxide. RE Research Da Fin. 1061 Job No. 9411 7/11/57

Terpstra M. A. Hydrolyzed Aroclor 1268 (Alkaline-Methanol Hydrolysis). Organic Research SL Fin. 2585 Job No. 3502 9/7/60

Knapp W. G., Cooper R. L., Vandeven P. Pilot Plant Preparation of Hydrolyzed Aroclor 1268. Organic Research SL Fin. 2334 Job No. 3899 8/17/59

Nellums R. O., Terpstra M. A., Goss J. C., Lynch D. K. Pilot Plant Preparation of Hydrolyzed Aroclor No. 1268. Organic Research SL Fin. 1528 Job No. 3093 5/29/56

Adams J. F., Knapp W. G., Matthews R. L., Vandeven P. Pilot Plant Preparation of Hydrolyzed Aroclor 1268. Organic Research SL Fin. 2124 Job No. 3665 7/17/58

Gable C. L. Aroclor 1268, thiolysis product, as peptizing agent for rubber. Organic Research Ni SF 7649 Job No. 1550 7/8/57

Jenkins R. L., Metzner W. P. Aroclor 1269, solubility tests in various organic solvents. Organic Research SL Fin. X-1249-I & II Job Nos. 117-1249, I 1/30/40 (Pt. 1) 3/20/40 (Pt. II)

Metzner W. P., Dobratz E. H. Aroclor 1270 from B-221-o. Organic Research SL Fin. 104 Job No. 117-1533 2/20/46

Lefforge J. W., Smith R. E. Impregnation of wood with Aroclor "4465" and "330". Phosphorous Research SF 2101 Job No. 171-398 3/17/47

Bogaard T. D., Saunders J. H., Slocombe R. J. Aroclor 5442, as plasticizer in residue from distn. of TDT. Phosphorous Research SF 2403 Job No. 171-523 9/21/49

Ellenburg A. M., Rueckert T. C. Muriatic Acid Tower Repairs. 5442. Phosphorous Research An SF 2140 Job No. 376 10/17/47

Gittings L. D., Moose J. E. Aroclor 5460, adhesives from. Phosphorous Research Fin. 2054 Job No. 171-203, 171-298 7/11/46

Crenshaw R. L., Ellenburg A. M., Morgan J. F., Wade W. W. Investigation of precipitate formation in organic solutions containing Aroclor 5460. Phosphorous Research SF 2492 Job No. 171-623 5/22/50

Ellenburg A. M., Richards H. B., Jr. Aroclor 5460 from Dow Tarophen D-25. Phosphorous Research SF 2883 Job No. 171-1077 5/12/53

Ellenburg A. M., Wade W. W. Aroclor 5460, mixt. with Li stearate. Phosphorous Research SF 2496 Job No. 171-614 5/29/50

Ellenburg A. M., Richards H. B., Jr. Aroclor 5460, soly, in mineral oil. Phosphorous Research SF 2949 Job No. 171-1075 10/28/53

Ellenburg A. M. Solubility of Aroclor 5460. Phosphorous Research SF 2088 Job No. 171-397 2/6/47

Ellenburg A. M., Morgan J. F., Wade W. W. The Solubility of Aroclor 5460 in Various Solvents. Phosphorous Research An SF 2272 Job No. 451 12/9/48

Ellenburg A. M., Richards H. B., Jr. Preparation of a concentrated solution of Aroclor 5460 in xylene. Phosphorous Research SF 2960 Job No. 171-1075 10/28/53

Ellenburg A. M. Investigation of decomposition in Aroclor still. Phosphorous Research SF 2046 Job No. 171-299 5/16/46

Metzner W. P., Durland J. R. Aroclors, (1254 and 1260), odor improvement, study of. Organic Research SL Fin. X-1402-III Job No. 117-1402, III 12/5/40

Darby J. R., Allen W. G., Cannon J. A., Cowell E. E., Touchette N. W., Wangler L. R. Aroclors 1262 and 1232, migration studies (1956). Organic Research SL Fin. 1730 Job No. 3129, III 1/22/57

Terpstra M. A., Lynch D. K. Hydrolyzed Aroclors 1262 and 1268 Sample Preparation. Organic Research SL Fin. 1706 Job No. 3038 1/8/57

Bennett G. E., Sharp D. B., Dazzi Joachim. Exploratory Aroclor Chemistry. Part I. Ethers by Alcohylysis. Hydrolyzed Aroclor Derivatives. RE Research Da Int. 1181 Job Nos. 4-9261, 4-9310, 9378. 8/1/58

Chadwick D. H., Ellenburg A. M., Marshall W. W. Alkylation of Aroclors for Evaluation as Extender Plasticizers. Organic Research SL Fin. 1184 Job No. 2682 (SL) 171-1042 (An) 1/17/55

Darby J. R., Cowell E. E. Application Work on Present Plasticizers 1953-54 - Flammability Studies with the SPI Tester Organic Research SL Fin. 1649 Job No. 2616, IV 11/20/56

Nielsen M. L. Aroclors, as glowproofers. CR Fin 572 Job No. 5-8064 7/19/49

Hatton R. E., Cunningham E. P., Luebke H. W., Stark L. R. Aroclors, as industrial fluid base stocks, evaln. Organic Research SL Fin. 2472 Job No. 3505, II 2/16/60

Metzner W. P., Durland J. R., Powers E., Lyles J. M. General Electric Stability Test for Aroclors and trichlorobenzene. Organic Research SL Fin. X-1436 Job No. 117-1436 4/17/42

Kyrides L. P., Craver J. K. Compatibilities of Aroclors with Resins. Organic Research SL Fin. X-1362 Job No. 117-1362 6/4/40

Ellenburg A. M., Sears J. K. Exploratory Research Cyanogenation of Aroclors. Organic Research SL Fin. 1677 Job No. 2678 11/18/55

Ruehrwein R. A., Kenyon A. S., White W. A. Degradation of Aroclors. RE CR Da Int. 833 Job No. 4-4042 7/29/54

Ellenburg A. M., Richards H. B., Jr. Aroclor in Gases. Phosphorous Research Int. 2892 Job No. 171-1089 6/17/53

Ellenburg, A. M., R. A. Simone - Aroclors, dielectric properties, Organic Research SL Fin. 2305 - New Dielectrics - 1957 and 1958. Job No. 3316, 6/16/59.

Sharp, D. B., Joachim Dazzi - Exploratory Aroclor Chemistry Part III. Glycidylation of Hydrolyzed Aroclors. Research RE Da Int 1183, Job No. 9411, 10/9/58.

Hubbard, E. M., F. R. Short - Determination of the oxirane (o-epoxide) group by hydrochlorination in dioxane. RE CR Da Fin. 943. Job No. 9378, 1/30/56.

Darby, J. R., R. M. Parks - Preliminary Evaluation of Plasticizers - 1954. Part I: The Intensive Evaluation of Secondary Plasticizers Including the Aroclors. Org Res SL Fin. 1281. Job No. 2821, I, 5/16/55.

Darby, J. R., W. G. Allen, J. A. Cannon, A. Y. Coran, P. R. Graham, L. R. Wangler. Org Res SL Fin. 1666. Job No. 2892, II, 10/28/56.

Craver, J. K., J. Dazzi, J. A. Herbig, J. R. LeBlanc, J. Schwendemann. Synthesis and Application Studies on Hydrolyzed Aroclors and Derivatives. RE Res Da Fin. 1115. Job Nos. 9411, 9411-03-3, 9416-03-3, 12/30/57.

Sharp, D. B., Joachim Dazzi, J. E. Katon. Exploratory Alcoholysis and Hydrolysis of Chlorinated Aromatics. RE Res Da, SF 1175. Job No. 9378, 9/9/55.

Sharp, D. B., Joachim Dazzi, Exploratory Aroclor Chemistry, Part II. Diphenols by Hydrolysis. RE Res Da, Int. 1182. Job Nos. 9310, 9378, 9411, 5/13/58.

DeGarmo, O, W. S. Dempsey, G. F. Ludvik, W. E. Spring. Insecticide Special Problems - Comparative Laboratory Evaluation of Niran, Niran and Benzil, and Niran and Aroclor 5460 Formulations (July 14 to October 12, 1955). Org Res SL Fin. 1382. Job No. 2760, 12/55.

Metzner, W.P., J. R. Durland. Moisture in TCB and Pyranol Mixes. Org Res SL Fin. X-1508. Job No. 117-1508, 3/21/41.

Sharp, D. B., Joachim Dazzi. Exploratory Aroclor Chemistry Part V. Nitrogen Derivatives by Ammonolysis. RE Res Da Int. 1177, Job No. 9411, 8/4/58.

Ellenburg, A. M., P. A. Sanguinetti. Aroclors, operation of hydrogen Chloride absorpiton tower. Phos Res An Fin. 1979. Job No. 230, 6/14/45.

Jenkins, R. L., W. P. Metzner. Aroclors, prepn. by chlorination of mixtures of diphenyl and high boilers. Org Res SL Fin X-1168-IV. Job No. 117-1168, IV, 10/7/40.

Ellenburg, A. M., H. L. Merten. Continuous Chlorination of Aroclors - Pilot Plant Demonstration. Org. Res. SL Fin. 2036. Job No. 3192, 5/7/58.

Ellenburg, A. M., J. K. Sears. Aroclors, pyrolysis with HCN, lit. survey. Org Res SL Lit. 1246. Job No. 2680, 4/26/55.

Darby, J. R., E. E. Cowell, P. R. Graham, R. M. Parks, P. W. Spink, L. R. Wangler. Org Res SL Fin 1523. Job No. 2595, 2563, 5/24/56. Aroclors, stabilizn.

DSW 543329

STANDARD MANUFACTURING PROCESS
FOR
AROCLORS

APPENDIX L - TIME CYCLES

The continuous chlorinator operation, used for production of Crude Liquid Aroclors, consists of four cascade flow chlorinators in series. The maximum daily production from the continuous system is about 110,000 pounds.

There are four batch operated liquid chlorinators and one batch operated solid chlorinator. See following table for time cycles and batch weights.

The bottleneck in the production of Liquid Aroclors is the still system. The bottleneck in the production of Solid Aroclors is the chlorinator.

AROCLOR TIME CYCLES AND BATCH WEIGHTS

AROCLORS	1121	1142	1148	1154	1160	1162	1168*	2565*	4065*	5042*	5060*
Chlorinator Charge: Lbs. Biphenyl	3,000	3,000	3,000	3,000	3,000	3,000	9,500	7,550	5,850		
Santowax C								2,560			
Santowax R									3,920	9,800	11,000
Approximate Lbs. Chlorine Required to Produce Batch	1,600	4,330	5,560	7,040	9,030	9,600	40,375	37,750	34,620	14,875	30,252
Approximate Weight of Crude Batch	3,750	5,080	5,660	6,350	7,160	7,500	22,420	27,000	25,000	16,000	25,210
Approximate Time Required to Produce Batch	6 hrs.	9 hrs.	10 hrs.	13 hrs.	17 hrs.	18 hrs.	20 hrs.	17 hrs.	16 hrs.	9 hrs.	13 hrs.

*Solid Aroclors

DSW 543331

STANDARD MANUFACTURING PROCESS
FOR
AROCLORS

APPENDIX M - QUALITY CONSIDERATIONS

Aroclors for electrical equipment uses must be highly pure with only slight traces of contaminants. Two to three drops of sweat contain enough salt to reject a drum of Aroclor on chlorides. They must be chemically stable and non-corrosive to a side variety of structural materials.

Obviously, continuous quality control must be maintained during manufacture, packaging, and shipping to assure that the customer is always satisfied with the performance of our Aroclors.

Normal power factor correcting capacitors used in air conditioners contain about ten cents worth of Aroclor. If the capacitor should explode and cause a fire, damage as high as $20,000 could result. These capacitors are designed for 12 to 20 year's life. Quality ingredients, such as Anniston Aroclor, must be used to guarantee this life as there is no non-destructive procedure for pre-determining this life. This vividly illustrates the "mushrooming" damage and the major reason for such intense desire for quality products by our customers.

Each sales lot of Aroclor is analyzed prior to shipment. Preliminary samples are analyzed prior to loading in cars, trucks, and/or drums. The specs to be met are given in greater detail in Appendix B.

Each Aroclor tank car is thoroughly cleaned before filling to prevent contamination by material left in the car by the customer. Examples of the quality control charts kept by the Laboratory are included in this appendix. The charts are for Aroclors 1242 and 5460 (our heaviest demand products). All electric grade Aroclors have control charts that are monitored by the Laboratory, Quality Control Board, and Production. These charts are used to spot trends which would eventually lead to poor quality Aroclor. Besides showing maximum and/or minimum specs on each property, the averages and two sigma values are shown which make it relatively easy to spot both good and bad trends. Production is responsible for knowing the cause and corrective measures to be taken for any trends toward poorer quality Aroclors. Export lots of Aroclors 1242 and 1254 must meet additional specs of higher resistivities and lower biphenyl content.

Aroclor	Property	Spec.
1242	Biphenyl	0.05 % max.
	Resistivity	5,000 giga ohm cm min.
1254	Biphenyl	0.025% max.
	Resistivity	5,000 giga ohm cm min.

MONSANTO CHEMICAL COMPANY - CONTROL CHART

SHEET 1 OF 5

~~Haupt~~ Hoydel

LEGEND:
AVERAGE
WARNING LIMIT
SPECIFICATION

PRODUCT AROCLOR 1242
GRADE ELECTRICAL GRADE
PERIOD FROM 11/1/65 TO 1 8 66

DAY
MONTH
ANALYST
LOT NUMBER (SERIES)
DISPOSITION — PASSED / REJECTED
APPEARANCE — PASS / REJECTED

SPECS OF 6/17/66

REPORT DIVERGENCE WHEN:

SP. GR. G/CC

1.392
1.390
1.388
1.386
1.384
1.382
1.380

SPECS 1.381 - 1.392

1 OUT SPEC
1 OUT LIMIT
6 IN RUN

REF. INDEX

1.6260
1.6258
1.6256
1.6254
1.6252
1.6250
1.6248
1.6246
1.6244
1.6242
1.6240

SPECS 1.6240 - 1.6260

1 OUT SPEC
1 OUT LIMIT
6 IN RUN

DISTILLATION °C

10%

334
332
330
328
326
324

SPEC 325. min.

1 OUT SPEC
1 OUT LIMIT
6 IN RUN

90%

360
358
356
354
352
350
348
346
344

SPEC. 340 max.

1 OUT SPEC
1 OUT LIMIT
6 IN RUN

BIPHENYL %

2.0
1.5
1.0
0.5

DSW 543333

T
D

Hooker Hayden

LEGEND:
AVERAGE
RUNNING LIMIT
SPECIFICATION

PRODUCT: Aroclor 1242
GRADE: ELECTRICAL
PERIOD: April 1966

DAY	
MONTH	
ANALYST	
LOT NUMBER (SERIES)	
DISPOSITION	PLOTTED / REJECTED
APPEARANCE	PLOTTED / REJECTED

SPECS OF 6/17/66

REPORT DIVERGENCE WHEN:

RESISTIVITY ohm-cm
3000 2800 2600 2400 2200 2000 1800 1600 1400 1200 1000 800 600 400
SPEC. 500 min.
1 OUT SPEC
1 OUT LIMIT
6 IN RUN

POWER FACTOR % (1000 Cycles)
.30 .20 .10
SPEC. .3 max.

DIEL. CONSTANT
4.96 4.94 4.92 4.90 4.88 4.86 4.84 4.82 4.80 4.78 4.76 4.74
SPEC. 4.70 - 4.90

MONSANTO STABILITY ppm Cl⁻
.4 .3 .2 .1 0
SPEC. 0.4
1 OUT SPEC
1 OUT LIMIT
6 IN RUN

HYDROLYSIS STABILITY ppm Cl⁻
.6 .5 .4 .3 .2 .1 0
SPEC. .5 max.
1 OUT SPEC
1 OUT LIMIT
6 IN RUN

DSW 543334

MONSANTO CHEMICAL COMPANY • CONTROL CHART

T O: Haupt Haydel

LEGEND: AVERAGE; WARNING LIMIT; SPECIFICATION

PRODUCT: ARACLOR 1242
GRADE: ELECTRICAL GRADE
PERIOD: FROM 1/1/66 TO / /

DAY
MONTH
ANALYST
LOT NUMBER (SERIES)
DISPOSITION (PASSED / REJECTED)
APPEARANCE (PASSED / REJECTED)

REPORT DIVERGENCE WHEN:

COLOR APHA

60 50 40 30 20 10 0

SPEC 40 MAX.

1 OUT SPEC
1 OUT LIMIT
6 IN RUN

H_2O PPM

40 30 20 10 0

SPEC 35 MAX.

1 OUT SPEC
1 OUT LIMIT
6 IN RUN

INORGANIC CHLORIDES PPM.

.050 .040 .030 .020 .010 0

SPEC .05 MAX.

1 OUT SPEC
1 OUT LIMIT
6 IN RUN

THERMAL-CHEMICAL CHLORIDES PPM.

.9 .8 .7 .6 .5 .4 .3 .2 .1 0

SPEC .65 MAX.

1 OUT SPEC
1 OUT LIMIT
6 IN RUN

DSW 543335

MONSANTO CHEMICAL COMPANY - CONTROL CHART

SHEET OF

TO ~~Haupt~~ Haydel

LEGEND:
AVERAGE
WARNING LIMIT
SPECIFICATION

PRODUCT ARCLOR 5460
CODE
DEPT.
PERIOD Rev. 12/65 to / /

DAY
MONTH
ANALYST
LOT NUMBER (SERIES)
DISPOSITION PASSED / REJECTED
APPEARANCE PASSED / REJECTED

SPECS OF 3/11/66 REPORT DIVERGENCE WHEN:

SOFT. POINT °C

108
107
106
105
104
103
102
101
100
99
98
97

SPEC: 98-105.5

1 OUT SPEC
1 OUT LIMIT
6 IN RUN

COLOR

MORE 2
2
LESS 2

SPEC: 2 max.

1 ABOVE 2
6 IN RUN

SOLUBILITY

O.N.
MORE THAN 3
LESS THAN 3 ON
1-3 HR
LESS 1 HR

2 BELOW ON
1 INSTANT

DSW 543336

STANDARD MANUFACTURING PROCESS
FOR
AROCLORS

APPENDIX N - MISCELLANEOUS

DSW 543337