CONFIDENTIAL

MONSANTO COMPANY
ORGANIC CHEMICALS DIVISION
ANNISTON, ALABAMA

STANDARD MANUFACTURING PROCESS
FOR
AROCLOR

Departments 826.08
826.17

Supersedes: Standard Manufacturing Process
For
Aroclor
Issued: 10/22/57

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Issued: September, 1966

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STANDARD MANUFACTURING PROCESS
FOR
AROCLOR

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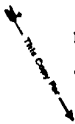

STANDARD MANUFACTURING PROCESS
FOR
AROCLOR

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MONS 046739

STANDARD MANUFACTURING PROCESS
FOR
AROCLOR

AMENDING RECORD SHEET

The disposition of the Amendments to the Standard Manufacturing Process dated October 22, 1957 are as follows:

Amendment No.	Title or Description	Date	Disposition
A	Reclaim Pyranol made with TTCB with high hydrolyzable chlorides	12/21/60	Accepted
B	Circulate chlorinator material during entire chlorination period	10/22/57	Accepted
C-Rev.#1	Use of LVM Attesorb	5/15/59	Rejected
D	Optimum Lime Concentration	12/31/58	Rejected
E	Use of Undried Earth	1959	Rejected
F	Recycle Boildown to Still	5/15/59	Rejected
G	Number of Runs before Boildown	6/16/59	Rejected
H	Earth Treat (0.2%) Aroclor 1242 at 70-80°C. Dry earth at 100-300°C or use as received	9/22/61	Accepted in part
I	Earth Treat (0.1-0.4%) Aroclor 1242 at 50-100°C	11/15/61	Never Tried (Re-submit)
J	N_2 Blanket Blend Tanks, Filtrate Receivers and Storage Tanks	8/29/63	Rejected due to large losses of N_2
K-Rev.#1	Remove Catalyst Basket from Chlorinator to make Aroclor 5060	7/29/64	Accepted
L	Optimize Earth Treatment Time	8/18/64	Accepted
M	Eliminate Earth Drying	1/20/65	Rejected
N	Increase Mesh Size of Earth	2/5/65	Rejected
O	Start-Up of No. 9 Solid Aroclor Chlorinator	5/3/65	Accepted

OF FRANCE

MONS 046741

STANDARD MANUFACTURING PROCESS
FOR
AROCLOR

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 treated, filtered, and loaded for shipment.

Aroclor is a trade name used to disignate 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%.

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 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.

Solid Aroclors

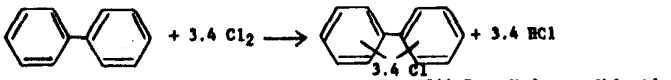
Solid Aroclors are distilled in a similar manner to Liquid Aroclors except for 1168. Aroclor 1168 is not air blown and is charged directly to the still from the chlorinator. A vacuum of 4 mm Hg absolute is applied for distillation. Solid Aroclors have one to four receivers distilled prior to drawing bottoms in the still. This is dependent upon the particular Aroclor being produced.

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

Chemical Equations

Liquid Aroclors

Based on the forecasted demands through 1969, the average Liquid Aroclor could be called 1244.7.



Biphenyl	Chlorine	Aroclor 1244.7	Hydrogen Chloride
154.2	70.9	271.5	36.5

Yields per CWT Aroclor	Theory	Standard
Chlorine	89.4	96.1
Biphenyl	56.5	58.2
Hydrogen Chloride	45.7	38.8

Solid Aroclors

Based on the forecasted demands through 1969, the average Solid Aroclor would contain 60.7% chlorine and 11.9% Biphenyl.

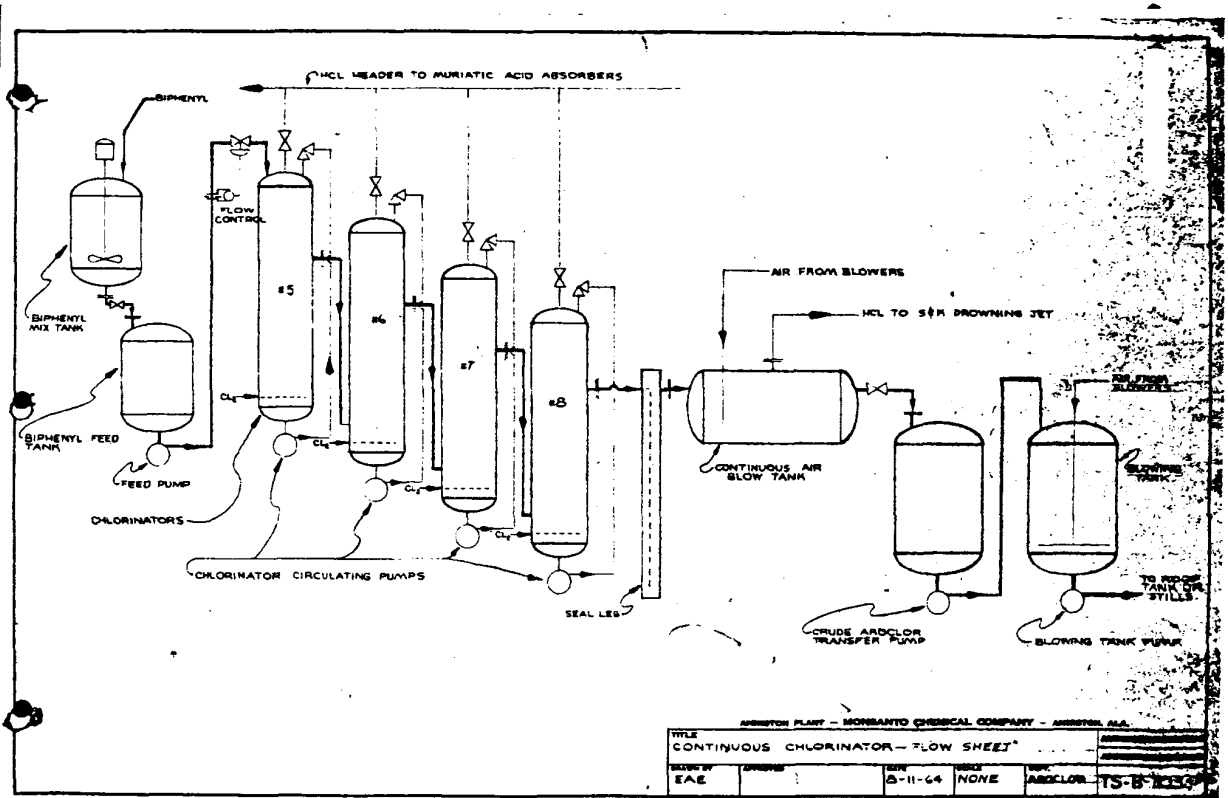
0.881 Santowax R	+ 0.119 Biphenyl	+ 10.3 Cl_2	____	Solid Aroclor	+ 10.3 HCl
230.3	154.2	70.9		586.0	36.5

Yields per CWT Aroclor	Theory	Standard
Chlorine	121.4	146.3
Biphenyl	5.01	--
Santowax R	36.2	42.3
Hydrogen Chloride	64.1	54.5

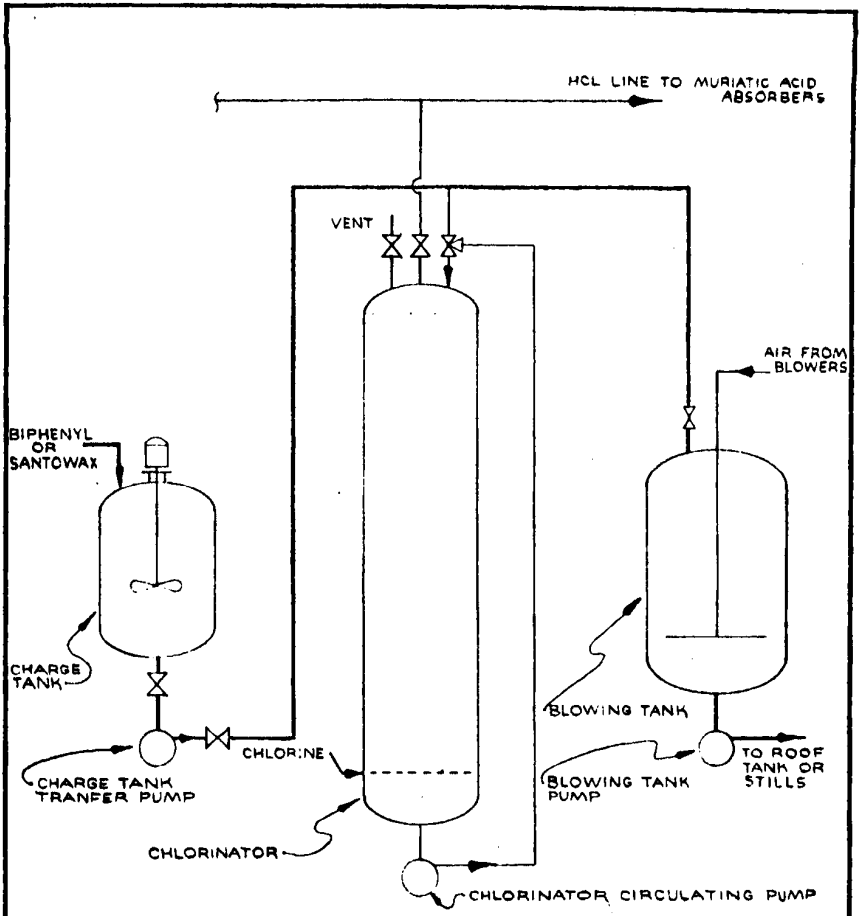
MONS 046746

STANDARD MANUFACTURING PROCESS
FOR
AROCLOR

II. FLOW SHEETS


HCL HEADER TO MURIATIC ACID ABSORBERS
BIPHENYL
FLOW CONTROL
BIPHENYL MIX TANK
BIPHENYL FEED TANK
FEED PUMP
#5
#6
#7
#8
CHLORINATORS
CHLORINATOR CIRCULATING PUMPS
SEAL LEG
AIR FROM BLOWERS
HCL TO S&K DROWNING JET
CONTINUOUS AIR BLOW TANK
CRUDE AROCLOR TRANSFER PUMP
BLOWING TANK
TO ROOF TANK OR STILLS
BLOWING TANK PUMP
ANNISTON PLANT — MONSANTO CHEMICAL COMPANY — ANNISTON, ALA.
TITLE
CONTINUOUS CHLORINATOR — FLOW SHEET
DRAWN BY
EAE
APPROVED
DATE
8-11-64
SCALE
NONE
REV.
AROCLOR
TS-B-

MONS 046748



BATCH CHLORINATOR OPERATION --
FLOW SHEET --

MONS 046749

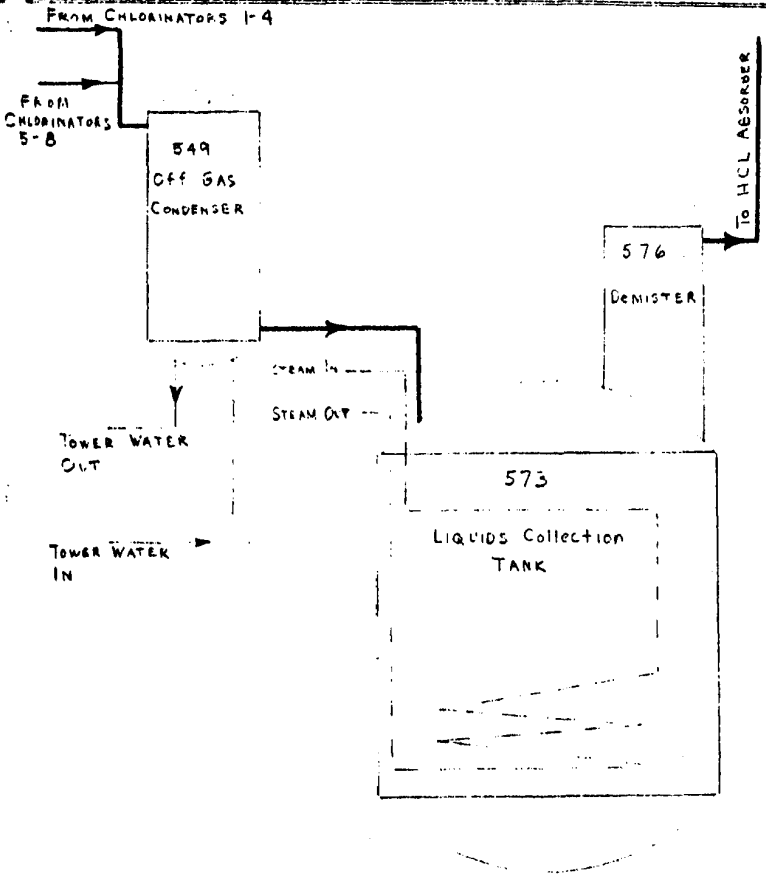
ANNISTON PLANT — MONSANTO CHEMICAL COMPANY — ANNISTON, ALA.

TITLE					
BATCH CHLORINATOR OPERATION — FLOW SHEET					
DRAWN BY	APPROVED	DATE	SCALE	DEPT.	
EAE		8-7-64	NONE	AROCLOR	TS-A-701

MONSANTO CHEMICAL COMPANY
ORGANIC CHEMICALS DIVISION
ENGINEERING DEPARTMENT
ST LOUIS MISSOURI

LIQUID HCL OFF GAS CLEAN UP
PLANT ANNISTON
LOCATION ANNISTON, ALA

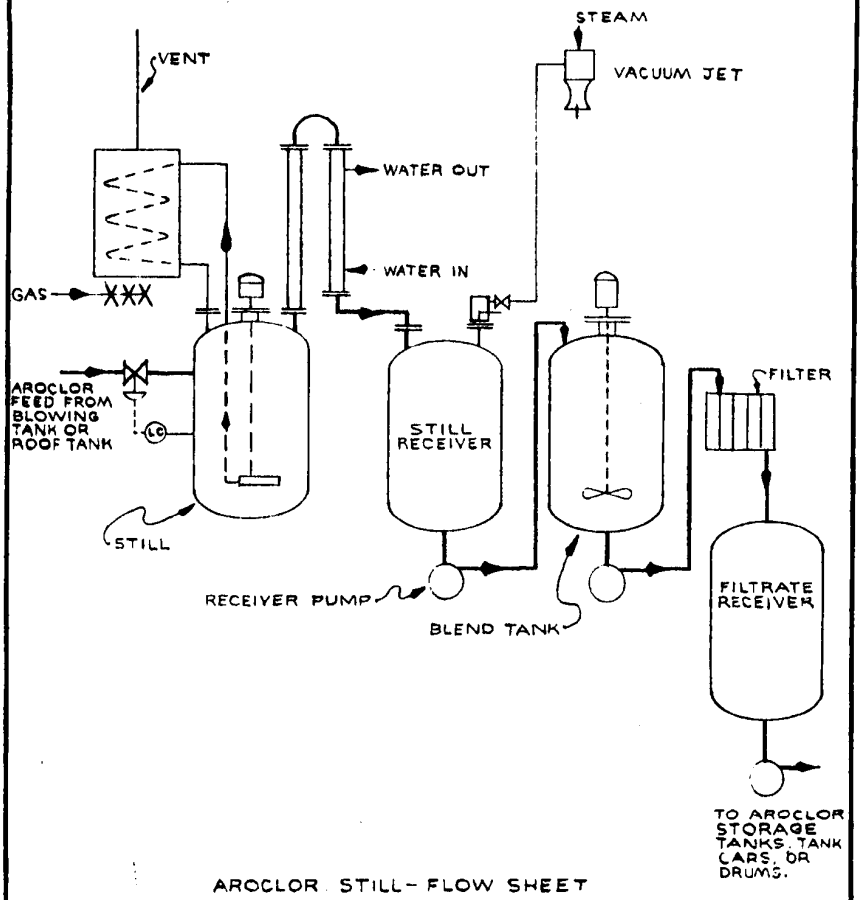
DESIGN MANUAL SECTION NO
ITEM NO
ESTIMATE NO
E A NO
PREPARED BY
DATE
SHEET OF



MONS 046750

REV. NO.	DATE	REVISION	BY	APPROVED BY / DATE

OE-43 11-61

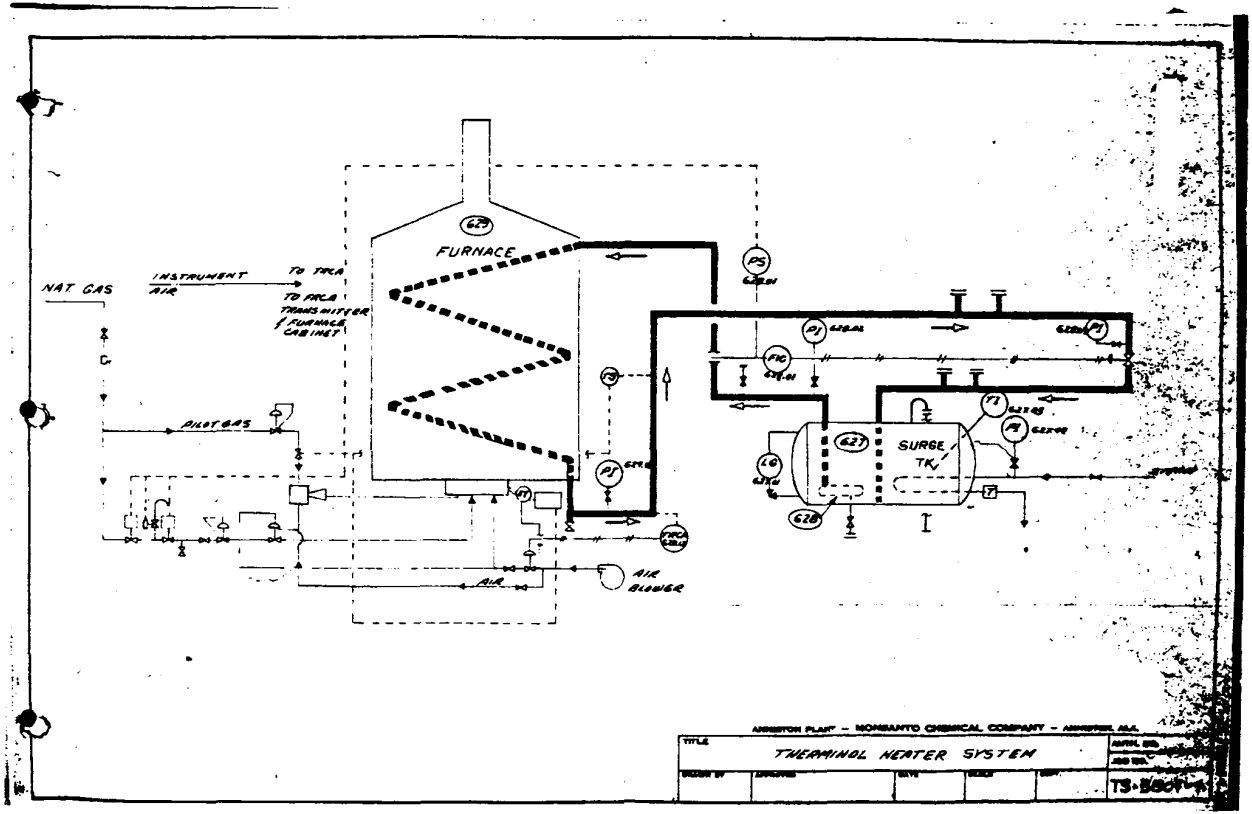


AROCLOR STILL - FLOW SHEET

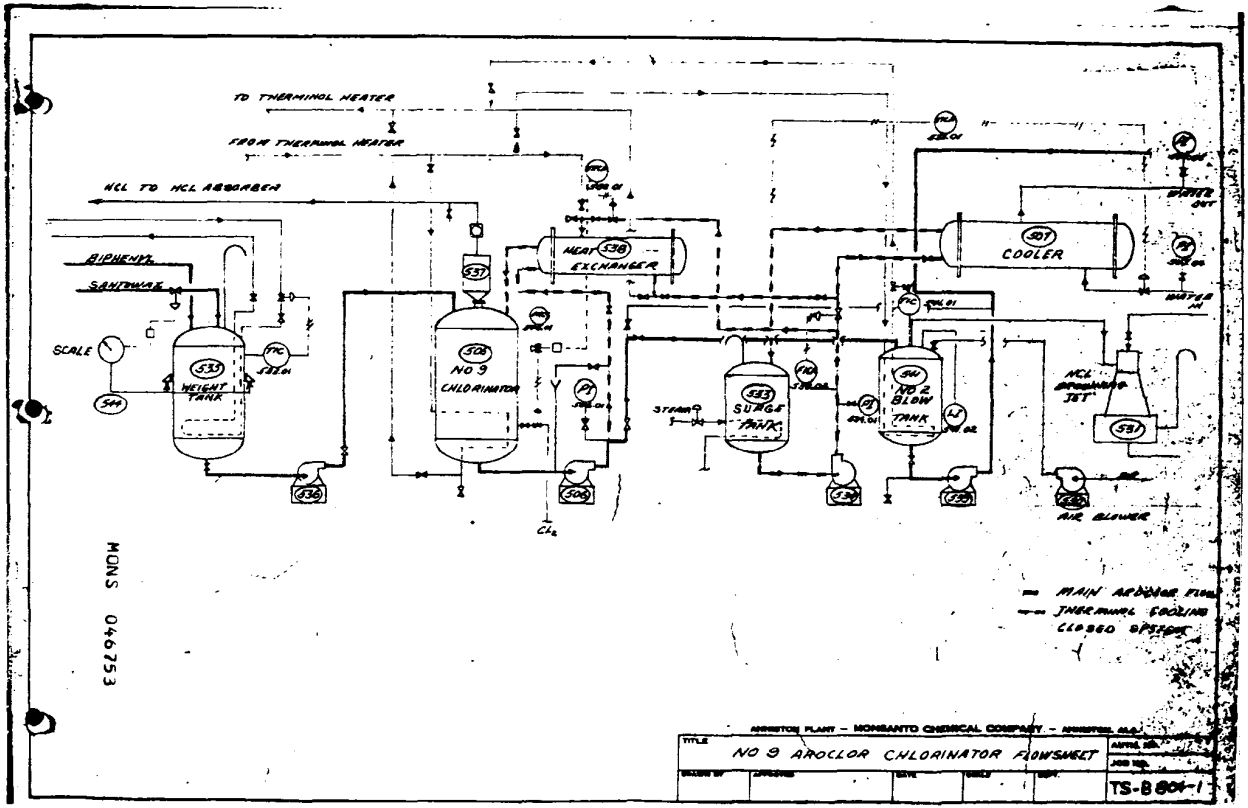
MONS 046751

ANNISTON PLANT – MONSANTO CHEMICAL COMPANY – ANNISTON, ALA.

TITLE					
AROCLOR STILL - FLOW SHEET					AUTH. NO. / JOB NO.
DRAWN BY	APPROVED	DATE	SCALE	DEPT.	
EAE		8-10-64	NONE	AROCLOR	TS-A-704


NAT. GAS
INSTRUMENT AIR
TO TRCA
TO TRCA TRANSMITTER / FURNACE CABINET
FURNACE
PILOT GAS
AIR
AIR BLOWER
SURGE TK.
ANNISTON PLANT – MONSANTO CHEMICAL COMPANY – ANNISTON, ALA.
TITLE
THERMINOL HEATER SYSTEM

MONS 046752

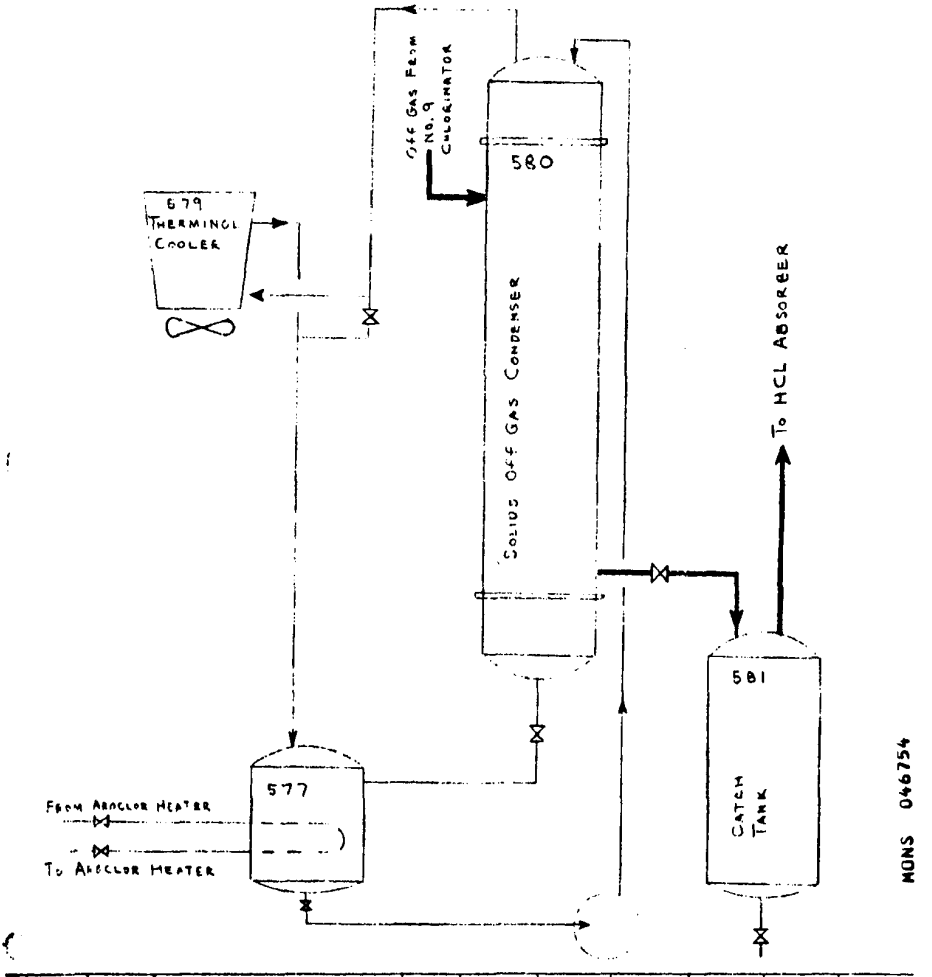

TO THERMINOL HEATER
FROM THERMINOL HEATER
HCL TO HCL ABSORBER
BIPHENYL
SANTOWAX
SCALE
WEIGHT TANK
NO 9 CHLORINATOR
HEAT EXCHANGER
COOLER
SURGE TANK
NO 2 BLOW TANK
AIR BLOWER
Cl2
= MAIN AROCLOR FLOW
= THERMINOL COOLING CLOSED SYSTEM
ANNISTON PLANT – MONSANTO CHEMICAL COMPANY – ANNISTON, ALA.
TITLE
NO 9 AROCLOR CHLORINATOR FLOWSHEET
TS-B 804-1

MONS 046753

MONSANTO CHEMICAL COMPANY
ORGANIC CHEMICALS DIVISION
ENGINEERING DEPARTMENT
ST LOUIS MISSOURI

Solid HCL Off Gas Clean Up
PLANT Anniston
LOCATION Anniston, Ala.

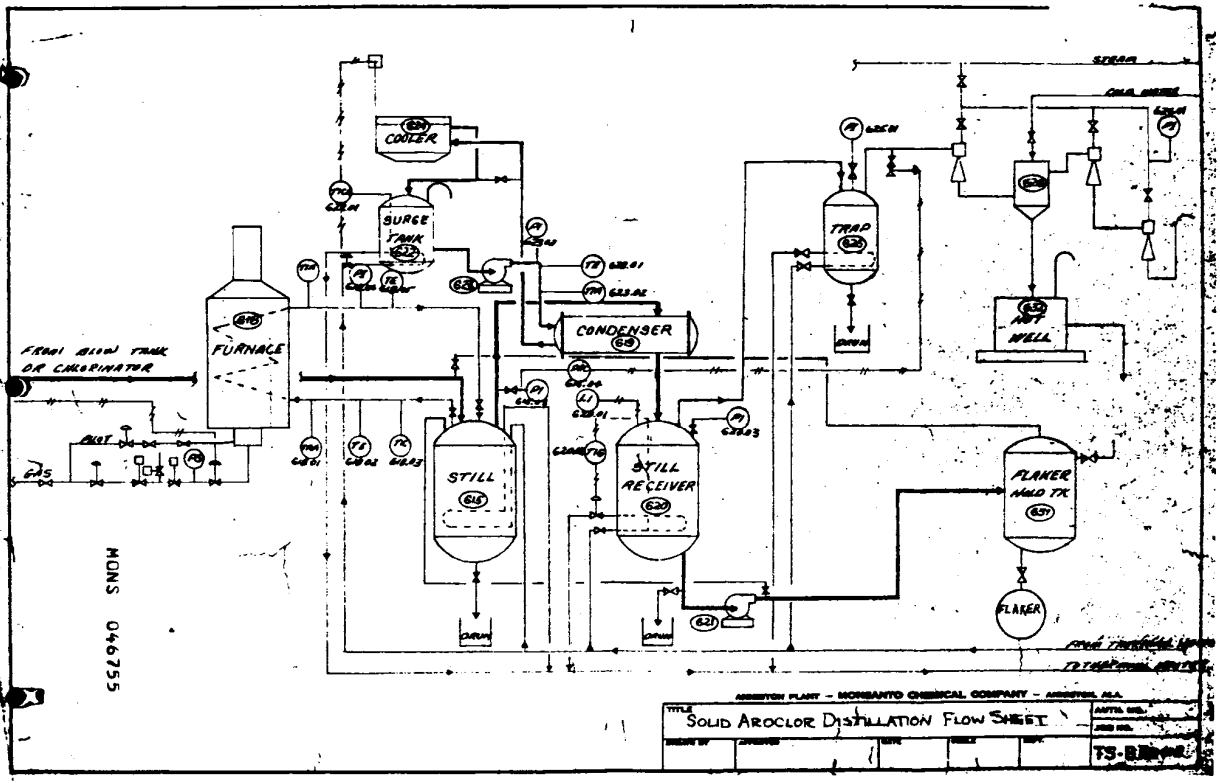
DESIGN MANUAL SECTION NO. ____ ITEM NO. ____
ESTIMATE NO. ____ E & A NO. ____
PREPARED BY ____ DATE ____
SHEET ____ OF ____



MONS 046754

REV. NO.	DATE	REVISION	BY	APPROVED BY / DATE					

OE-43 1-63


COOLER
SURGE TANK
FURNACE
FROM BLOW TANK OR CHLORINATOR
PILOT
GAS
CONDENSER
STILL
STILL RECEIVER
TRAP
DRUM
HOT WELL
FLAKER HOLD TK
FLAKER
STEAM
ANNISTON PLANT – MONSANTO CHEMICAL COMPANY – ANNISTON, ALA.
TITLE
SOLID AROCLOR DISTILLATION FLOW SHEET
AUTH. NO.
JOB NO.
DRAWN BY
APPROVED
DATE
SCALE
REV.
TS-B

MONS 046755

MONS 046756

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 the Chlorine Plant and/or 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 then the chlorine feed is put on the chlorinator. As the chlorination progresses the specific gravity is checked at intervals until the desired gravity has been attained. When a chlorinator 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. 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.

C. Biphenyl Mix Tank and Feed Tank

When Biphenyl is needed for the continuous chlorinator operation a charge is pumped from a Biphenyl storage tank to the mix tank. Three and one-half (3-1/2) 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 when a weighed quantity of Biphenyl, Santowax, or a mixture of the two is chlorinated in a vertical reaction vessel with Ferric Chloride as a catalyst. Chlorine gas is added at the bottom of the vessel.

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 the Chlorine Plant and/or 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. Steam is maintained on the coils

of the Liquid blowing tanks during this operation. Therminol heat 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 containing aerated Aroclor, is fed to the still tank. Hydrated lime is added to the crude Aroclor.

Vacuum is applied to the still and the Aroclor is circulated through the furnace coil and heated to the vaporization temperature. Vapors pass up an open column to the condenser. Distilled Aroclor is collected in a receiver and then transferred into a blending tank.

Distilled Liquid Aroclors are treated with Attapulgus Earth in the blending tank, filtered, analyzed, and packaged or held in storage.

Still residue or bottoms are sold as Montare or discarded.

G. Earth Treatment and Filtration

All Liquid Aroclors are treated in the blending tank with Attapulgus Earth. 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 the material it is then directed to a filtrate receiver. The filtered Aroclor is then ready for drumming or transfer to a storage tank.

H. Solid Still

Aerated Crude Solid Aroclor from a blowing tank is pumped to the No. 4 still pot. Hydrated lime is added to the crude Aroclor.

Vacuum is applied to the still and the Aroclor is circulated through the furnace coil and heated to the vaporization temperature.

Vapors pass up on open column to the condenser. Distilled Aroclor is collected in a receiver. Quality of the distilled Solid Aroclors is analyzed by the laboratory, and if in specification, it is drawn directly from the receiver into suitable containers or transferred to the flaker operation.

Still residue or bottoms are sold as Montars or discarded.

I. Packaging

Solid Aroclors are packaged in fibre 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. Liquid Aroclors are also loaded into tank cars and trucks.

CONTENTS ON PROCESS

MONS 046761

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. BCL and WCK 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

Although the effect of air in chlorine on Aroclor quality is unknown, the amount of air in chlorine does effect the chlorination rate and therefore effects the production rate.

Problems with the chlorine vaporiser 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 vaporiser with the control system provided.

Entrainment of Biphenyl or crude Aroclor into the HCl lines can occur from excessive chlorine rates. This same situation can occur in case the Chlorine Plant is blowing too much air. 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. Abnormally high or low chlorine header pressures can cause operating problems. High chlorine header pressure causes problems within the Chlorine Plant to

the department operating personnel. Chlorine fumes are forced back into the Chlorine Department and at times sulfuric acid can be blown from the Nash compressor system. Since this presents a safety hazard to the department personnel every effort should be made to eliminate high pressure problems. 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.

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 this 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. The air is not dried by any means other than that caused by compression and cooling in the air blowers. Judging by the corrosion exhibited around nozzles atop the blowing tanks a good argument can be made for thoroughly dried air. Wet air may also be the cause of poor electrical properties that occasionally occur during period of rain and high humidity. Wet air can also carry in chlorides, SO_2, and H_2S from the atmosphere. An air dryer would tend to scrub out these undesirable gases.

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 trouble 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 and of course the Attapulgus earth needs to be well dried. All liquid Aroclors are earth 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. 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 high color 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.

6. Special Grades

a. Export Aroclor 1242

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 is 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.

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. To meet the 5,000 min. resistivity spec the 1254 is earth treated two to five times using normal procedures until the resistivity exceed 7,000 (dept. spec) and then drummed out from the filtrate receiver. Two methods have been tried to assure low Biphenyl content.

(1) Batches three through eight in the normal ten batch distillation run have a greater tendency to meet the Biphenyl spec than the remaining four. Each batch is analyzed for Biphenyl and then earth treated when in spec. This method is hit and miss and has about a 50% reliability of success and causes still downtime.

(2) Aroclor 1154 is chlorinated from low Biphenyl 1142 rather than Biphenyl. Chances of success are so great that all ten still batches have been earth treated and placed in an empty storage tank and then additional earth treatment is scheduled to avoid generating still downtime.

The second method is used whenever possible and has resulted in better inventory control of export 1254.

7. 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.

8. 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° 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

The same comments on corrosion for Liquid Aroclors hold true for the Solid Aroclor blow tanks.

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.

3. Distillation

Vacuum problems on the Aroclor stils 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 or 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.

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STANDARD MANUFACTURING PROCESS
FOR
AROCLOR

APPENDIX A - EQUIPMENT LIST

Area 200 - Bulk Storage

Area 500 - Chlorinator

Area 600 - Still

APPENDIX A - EQUIPMENT LIST
AREA - 200

BULK STORAGE

Item	Equipment	Equip. No.	Description
201	No. 1 Aroclor Storage Tank	22-0077	10' x 26' metal sprayed with zinc and tin. Capacity 15,000 gallons.
202	No. 3 Aroclor Storage Tank	22-0089	Horizontal, cylindrical dia. 8'-0", length 30'-0". Metal sprayed with zinc and tin. Capacity 11,000 gals.
203	No. 2 Aroclor Storage Tank	22-0076-01	10' x 26' metal sprayed with zinc and tin. Capacity 15,000 gallons.
204	No. 4 Aroclor Storage Tank		10' x 26' metal sprayed with zinc and tin. Capacity 15,000 gallons.
205	South Pyranol Mix Tank	22-0108	14'-0" I.D. x 10'-0" high. Dwg. D-6455.
206	North Pyranol Mix Tank		6'-6" I.D. x 8'-2" jacketed steel tank.
208	No. 1 Storage Tank Pump		Taber vertical submerged pump. Type CL-4. Capacity 75 GPM.
209	No. 2 Storage Tank Pump		Taber vertical submerged pump. Type CL-4. Capacity 75 GPM.
210	No. 5 Aroclor Storage Tank	22-0663	12,000 gal. vertical aluminum tank. See 22-0662, 19-0397, 19-0398, 94-0179, 94-0180, 49-0777, 28-0532.
211	No. 6 Aroclor Storage Tank	22-0662	12,000 gal. vertical aluminum tank. See 22-0662, 19-0397, 19-0398, 94-0179, 94-0180, 49-0777, 28-0532.
212	No. 6 Storage Tank Pump	19-0397	20-A-30, 3 x 2 - 13/110 Mark 11 pump w/crane seal #9 outside QP-191, Base steel plate #53 7PL Falk Spacer coupling.

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Item	Equipment	Equip. No.	Description
213	No. 5 Storage Tank Pump	19-0398	20-A-30, 3 x 2 - 13/110 Mark 11 Pump w/crane seal #9 outside QP-191 Base steel plate #63 7FL Falk Spacer coupling.
214	No. 3 Storage Tank Pump		Taber vertical submerged pump. Type CL-4. Capacity 75 GPM.
215	No. 4 Storage Tank Pump		Taber vertical submerged pump. Type CL-4. Capacity 75 GPM.

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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 (3" Sch. 80 coil 75' long). 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. 3 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 circ. pump	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.

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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.

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APPENDIX A - EQUIPMENT LIST
AREA 600

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 Bleckmer 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" streight 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, Bleckner 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.

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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	32-0272	1'-2" dia. x 10' long, carbon steel heat exchanger with 112-3/4" x 14 BWG x 8' long tubes, designed for four passes on tuba side. Designed for full vacuum. Condenser contains a special design Marquette expansion joint constructed of 304 stainless steel with Sch. 30 welding ends. Capacity 477,000 BTU/hour.

MONS 046784

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. 58R5A48, 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-Raydite vermiculite 124 mix, suitable for 2,000°F service. 4" Sch. 80 coil 350' long with a total surface area of 950 eq.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.

MONS 046786

Item	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. OKD-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.

MONS 046787

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 M9BON001 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 VMC 5-56, size 24" x 48". Stainless steel drum with feed pans. Purchased from Goslin.

STANDARD MANUFACTURING PROCESS
FOR
AROCLOR

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

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

II - RAW MATERIALS

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

IN 86

MONSANTO CHEMICAL COMPANY
ORGANIC CHEMICALS DIVISION
ANNISTON

FINISHED PRODUCT SPECIFICATION

PRODUCT CODE	826.10 (27-L)
METHOD IDENTITY	- -
SALES CODE	1040-225-04/11/16-09

Issued 4/25/61

By: W. W. Kleume
W. W. Kleume
Anniston Plant
Standards Dept.

PRODUCT (Trade name)	AROCLOR 1221
TYPE	Distilled
PRODUCT (Chemical name)	
TYPE	
CHEMICAL FORMULA	Mixture
MOL WT.	- -
USE	Sales

SUPERSEDES SPECS OF	SPECIAL JOB NO.	SAMPLE FOR ANALYSIS
7/29/55	- -	2 x 1/2 gal. amber jugs

UNCLASSIFIED SPECIFICATION

Routine Tests

Property	Specification	Method No.
Color, APHA	100, Max.	14-44-54
Specific Gravity @ 25/15.5°C.	1.182-1.192	14-49-54
Acidity, mg KOH/g.	0.014, Max.	14-42-54
Viscosity @ 100°F., SUS	38-41	14-4-52

General Information

Chlorine, %	20.5-21.5	14-13-54

MONSANTO CHEMICAL COMPANY
ORGANIC CHEMICALS DIVISION
ANNISTON

FINISHED PRODUCT SPECIFICATION

PRODUCT CODE	826.11 (27-L)
METHOD IDENTITY	--
SALES CODE	1040-230-04/11/16-09

Issued: 10/28/63

By: O. E. Dolin
O. E. Dolin
Anniston Plant
Standards Dept.

PRODUCT (Trade name)	AROCLOR 1232
TYPE	Distilled
PRODUCT (Chemical name)	
TYPE	
CHEMICAL FORMULA	Mixture
MOL WT.	----
USE	Sales

SUPERSEDES SPECS OF	SPECIAL JOB NO.	SAMPLE FOR ANALYSIS
4/25/61	--	2 x 1/2 gal. amber jugs

UNCLASSFIED SPECIFICATIONS

Routine Tests

Property	Specification	Method No.
Color, APHA	100, Max.	14-44-54
Acidity, mg KOH/g.	0.014, Max.	14-42-54
Specific Gravity @ 25/15.5°C	1.270-1.280	14-49-54
Viscosity @ 100°F., SUS	44-51	14- 4-52

General Information

Chlorine, %	31.5-32.5	14-13-54

RESTRICTED SPECIFICATIONS

Routine Tests

Water, ppm	35 Max.	14-53-54
Refractive Index @ 25°C	1.6180-1.6200	14-34-54
Condition	Clear Liquid	10-884

General Information

Inorganic Chlorides, ppm	0.10 Max.	014
Resistivity, ohm-cm 500V DC,0.1" gap, 100°C.	500 x 10^9 Min.	14-35-54
Dielectric Constant @ 1 KC,100°C.	4.3-4.5	14-36-54
Distillation Range, °C. corrected:		
10%, by wt.	293, Min.	14-31-54
50%, by wt.	310-320	
90%, by wt.	360, Max.	

MONS 046792

RESTRICTED SPECIFICATIONS

General Information - Continued

Four Point, °C.	Below -30	14-47-54
Corrosion Test Change in wt. aluminum, %	0.0	
Acid No. after test, mg KOH/g.	0.015, Max.	14-52-54
Inorganic Chlorides after test, ppm	0.10, Max.	014
Condition after test	Clear	C-1
Color after test, APHA	100, Max.	14-44-54

OED/gm
10/28/63

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

GENERAL DESCRIPTION: Also known as Pyranol 1499

CHEMICAL FORMULA:

MOL WT.

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

	CHARACTERISTIC	LIMITS	WGK METHOD	Anniston METHOD
	UNRESTRICTED INFORMATION			
(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)

MONS 046794

(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 - 43.5%
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

MONSANTO CHEMICAL COMPANY
ORGANIC CHEMICALS DIVISION

W.G.K. and Anniston
FINISHED PRODUCT
SPECIFICATION

PRODUCT CODE: 81102
DEPT: 246 WGK / 27 Ann.
USE: Sales
SALES CODE: 1040-260-04/11/16-03/09

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

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

Corrected 2-16-64

CHEMICAL FORMULA

Mixture

MOL WT.

SUPERSEDES SPECS OF: 2-12-60
SAMPLE FOR ANALYSIS: 3 x 5 pt. Amber Bottles

UNRESTRICTED INFORMATION

Routine Tests	Specification	Method No's. WGK	Anniston
Color, APHA	50, max.	10,084	14-44-54
Condition	Clear	10,084	G-1
Sp. Gr. @65/15.5°C	1.405 - 1.415	10,114	14-49-54
Acidity (mg. KOH/gm.)	0.010, max.	10,087	14-42-54
Moisture	35 ppm., max.	10,620	14-53-54
Refractive Index @25°C	1.6285 - 1.6305	10,125	14-34-54
Inorganics (Free) Chlorides	0.05 ppm., max.	T-2092	014
Pour Point	0°C, max.	10,115	14-27-54
Dielectric Constant (1000 cycles @100°C)	4.5 - 4.7	11,608	14-36-54
Resistivity (500 VDC @100°C 0.1" GAP) as OHM-CM x 10^9	500, min.	11,607	14-35-57
Hydrolysis Stability Test (as Chlorides)	1.0 ppm., max.	T-2087	010
Monsanto Stability Test (as Chlorides)	0.5 ppm., max.	11,503	14-61-57
Distillation Range (ASTM D-20, Corrected)		10,117	14-31-54
10% Distilled by Wt.	345°C, min.		
90% Distilled by Wt.	385°C, max.		

General Tests (made only on request)

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

(over)

IN 54 (REV. 10/58)

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

GENERAL INFORMATION

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

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

PRODUCT CODE: 81102 - 82641 | DEPT. OR JOB: WGK 246-Ann.27
USE: Sales
SALES CODE: 1040-260-04/11/16-03/09

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

PRODUCT (Trade Name): Aroclor 1248 | TYPE: Non-Electrical Grade
PRODUCT (Chemical Name) | TYPE
CHEMICAL FORMULA: Mixture
MOL WT.

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

UNRESTRICTED INFORMATION

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

MONS 046798

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	
JUN 28 1965	1040-280-04/11/16-03/09	

APPROVALS

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

GENERAL DESCRIPTION

Also called Pyranol 1476

CHEMICAL FORMULA

MOL WT.

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS	ISSUED BY
4-13-62	3 x 5 pt. Amber Bottles	M. D. Dealy

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.	T-2092	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)	Hydrolytic Stability Test (as Chlorides)	1.0 ppm., max.	T-2087	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

MONS 046799

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

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

PRODUCT CODE: 81103 - 82613
DEPT. OR JOB: WGK-246-Ann.27
USE: Sales
SALES CODE: 1040-280-04/11/16-03/09

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

PRODUCT (Trade Name): Aroclor 1254
TYPE: Non-Electrical Grade
PRODUCT (Chemical Name)
TYPE
CHEMICAL FORMULA: Mixture
MOL WT.
SUPERSEDES SPECS OF: 5-4-61
SAMPLE FOR ANALYSIS: 3 x 16 oz. W. M. Bottles

UNRESTRICTED INFORMATION

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

MONS 046800

IN 84 (REV. 10/60)

IN 84 **MONSANTO CHEMICAL COMPANY**
ORGANIC CHEMICALS DIVISION

FINISHED PRODUCT SPECIFICATION

PRODUCT CODE: 82614 - Anniston; 81105 - WGK
Department: 27 - Anniston; 246 - WGK
SALES CODE: 1040-290-04/11/16/-03/09

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

PRODUCT (Trade name)	TYPE
AROCLOR 1260	Electrical Grade
PRODUCT (Chemical name)	TYPE
	(Pyranol 1482)

CHEMICAL FORMULA: MIXTURE

MOL WT.: ---

USE: Sales

SUPERSEDES SPECS OF	SPECIAL JOB NO.	SAMPLE FOR ANALYSIS
3/28/58		3 x 5 pt. Amber Bottles

UNRESTRICTED INFORMATION

Routine Tests:

Property	Specification	Method No. WGK	Method No. Anniston
Color (APHA)	150, Max.	10,084	14-44-54
Condition	Clear	10,084	--------
Specific Gravity @ 90/15.5°C	1.555-1.566	10,114	14-49-54
Acidity (mg KOH/g.)	0.014, Max.	10,087	14-42-54
Moisture (H_2O) (ppm.)	35, Max.	10,620	14-53-54
Viscosity @ 210°F (SUS)	72-78	10,086	14- 4-52
Refractive Index @ 25°C	1.6455-1.6470	10,125	14-34-54
Inorganic (Free) Chlorides	No detectable amt.	10,118	14-48-57
Pour Point (°C)	25-34	10,115	14-47-54
Distillation Range (ASTM D-20, Corrected)		10,117	14-32-54
10% Distilled by wt.	385-398°C		
50% Distilled by wt.	390-404°C		
90% Distilled by wt.	400-420°C		
Corrosion Test (6 hrs. @ 210°C with bright aluminum foil)		10,126	14-55-57
Change in weight of Al (%)	0.0		
A.C. Color (APHA)	150, Max.	10,084	14-44-54
A.C. Condition	Clear	10,084	--------
A.C. Acidity (mg.KOH/g.)	0.014, Max.	10,087	14-42-54
A.C. Inorganic (Free) Chlorides	No detectable amt.	10,118	14-48-57

General Tests (made only on request)

Flash Point	None	10,123	14-28-54
Fire Point	None	10,123	14-28-54
Fixed Chlorine (%)	59.5-60.5	10,088	14-13-54
Dielectric Strength @ 50°C	30 K.V., Min.	11,605	--------
Resistivity (500 VDC @ 100°C 0.1" gap as ohm-cm. x 10^9)	500, Min.	11,607	14-35-57
Dielectric Constant 1000 cycles, 100°C	3.6-3.8	11,608	14-36-45

MONS 046801

UNRESTRICTED INFORMATION (continued)

Property	Specification	Method No. WGK	Anniston
Restricted Information			
Monsanto Stability Test (As Chlorides in ppm.)	0.7, Max.	11,503	14-61-57
General Information			
Evaporation Loss after 6 hrs. @ 100°C (%)	0.2, Max.	10,116	14-32-54
Stability test - after 30 days at 100°C in glass sealed in air	No liberation of chlorine or chlorides	------	--------

Retyped:
March 7, 1963

/gm

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

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

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

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

CHEMICAL FORMULA

Mixture

MOL WT.

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

UNRESTRICTED INFORMATION

Routine Tests	Specification	WGK Method	Anniston No.
Condition	Clear	10084	G-1
Color, APHA	150, max.	10084	046
Sp. Gr. @90/15.5°C	1.555 - 1.566	10114	052
Acidity (mg. KOH/g.)	0.014, max.	10087	050
Moisture (H_2O) (ppm.)	50, max.	10620	047
Viscosity @210°F (SUS)	72-78	10086	049
General Tests			
Flash Point	None	10123	14-28-54
Fire Point	None	10123	14-28-54

MONS 046803

Monsanto
ORGANIC CHEMICALS DIVISION

ANNISTON AND KRUMMRICH
FINISHED PRODUCT
SPECIFICATION

PRODUCT: AROCLOR DISTILLED 1262			DEPT. Ann-2 WGK-24
PLANT: ANN. & WGK	PRODUCT CODE: 82615-Ann. 81107-WGK		USE: Sales
DATE EFFECTIVE: MAR 02 1966	SALES CODE: 1040-300-04/11/16-03-09		

APPROVALS

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

GENERAL DESCRIPTION — CHEMICAL FORMULA

MOL WT.

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS	ISSUED BY
1/24/62	2 x 16 oz. W.M. Bottles	J. P. Prader

CHARACTERISTIC	LIMITS	METHOD
UNRESTRICTED INFORMATION		
(R) Appearance	Viscous liquid	10084
(R) Color	APHA 150, max.	10084
(R) Specific Gravity @ 90/15.5°C.	1.572 - 1.583	10114
(R) Acid No. (mg. KOH/g.)	0.014, max.	10087
(R) Viscosity @ 210°F.	86 - 100 SUS	10086
GENERAL INFORMATION		
Pour Point (ASTM)	35 - 38°C.	
Distilling Range	390 - 425°C.	
Total Chlorine	61.5 - 62.5%	
Specific Gravity Temperature Coefficient (85 - 130°C.)	0.001/°C.	

MONS 046804

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

K-597

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	

MONS 046805

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

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

MONS 046806

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

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. C. 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

MONS 046807

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

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

Monsanto
ORGANIC CHEMICALS DIVISION

FINISHED PRODUCT SPECIFICATION

PRODUCT		DEPT.
Aroclor 5460 (High Soluble Grade)		27-S
PLANT	PRODUCT CODE	USE
Anniston	826.22	Sales
DATE EFFECTIVE	SALES CODE	
3-11-66	1040-480-04-009	

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
4-21-61	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 to amber brittle resin or flakes	G-1
(R) Color, NPA, Molten	2 Max.	G-4
(R) Softening Point, °C	98 - 105	115
(R) Solubility (25 g in 25 g. Acetone @ 25°C.)	3 hour, Min.	117
Acid No., Mg KOH/gm.	0.05 Max.	116
Chlorine, %	58.5 - 60.6	093
RESTRICTED INFORMATION		
Hydrolysis Stability, ppm Cl	300 Max.	092

MONS 046809

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

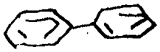
IN 84 **MONSANTO CHEMICAL COMPANY**
ORGANIC CHEMICALS DIVISION

FINISHED PRODUCT SPECIFICATION

PRODUCT CODE: 826.01 (FG)
METHOD IDENTITY:
SALES CODE: 135-000-03-09

Issued 5/5/61
Anniston Plant
By W. W. Klemmer
Revised to add typ values 11-18-65

PRODUCT (Trade name): Biphenyl — TYPE: Technical
PRODUCT (Chemical name): Biphenyl — TYPE: Technical
CHEMICAL FORMULA:



$C_{12}H_{10}$

MOL WT. 154.20
USE: Sales

SUPERSEDES SPECS OF	SPECIAL JOB NO.	SAMPLE FOR ANALYSIS
7/8/65		1 x 16 oz. can

Characteristics	Limits	Typical Values
Routine tests		
Appearance	White to pale yellow crystals	White crystals
Crystallizing Point, °C	68.7 Min.	68.8
Color, Gardner	6 Max.	1.5
General Test (determined only on request)		
Biphenyl, %		99.9
Napthalene, %		0.001
3 - Methylbiphenyl, %		0.05
4 - Methylbiphenyl, %		0.02
Unknown, %		<0.03
Distillation Range; °C 1st drop - Dry Point	Must include 255°C	

MONS 046810

This specification for internal use 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	C-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.

MONS 046811

(R) Routine Analysis All others Analyzed by request Only

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 - " "	

MONS 046812

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

WGK-892

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

MONS 046813

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

STANDARD

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	

STANDARD B&P "NORTH"

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 (%)]

MONS 046814

(2) Routine Analysis. All others Approved by normal mfg.

Monsanto
ORGANIC CHEMICALS DIVISION

RAW MATERIAL SPECIFICATION

MATERIAL CODE	MATERIAL
19400	Attapulgus Earth - RVM Grade
PLANT	USING DEPTS.
Anniston	27-L
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

Impure Hydrous Magnesium Aluminus Silicate

CHEMICAL FORMULA

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	

MONS 046815

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

[illegible] CHEMICAL [illegible]
[illegible] ORGANIC CHEMICAL [illegible]
W. G. KRUMMRICH [illegible]
RAW MATERIAL
SPECIFICATION

PRODUCT CODE
[illegible]
METHOD IDENTITY
SUPPLIER

ISSUED Feb. 26, 195[illegible]
STANDARDS DEPARTMENT
Wm. G. Krummrich Plant
By [illegible]

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.	8-570-1
Solubility:		112-[illegible]
10:10 of water	Complete to slightly turbid, Max.	
10:10 of Formula 30 alcohol	Complete to slightly turbid, Max.	

MONS 046816

Name	Aroclor 1142 Technical		Aroclor 1148 Technical		Aroclor 1154 Technical		Aroclor 1162 Technical		Aroclor 1162 Technical	
Formula	$C_{12}H_7Cl_3$	Source & Date Spec. 12-21-54	$C_{12}H_6Cl_4$	Source & Date Spec. 4-11-55	$C_{12}H_5Cl_5$	Source & Date Spec. 12-21-54	$C_{12}H_{3.75}Cl_{6.25}$	Source & Date Spec. 12-21-54	$C_{12}H_3Cl_7$	Source & Date Spec. 4-11-55
Molecular Weight										
Appearance	Brown-Black Oily Liq.	"	Brown-Black Oily Liq.	Spec. 4-11-55	Brown-Black Oily Liq.	Spec. 12-21-54	Brown-Black Sticky Mass.	Spec. 12-21-54	Brown-Black Sticky Mass.	Spec. 4-11-55
Boiling Point At 760mm										
Boiling Point At mm										
Boiling Point At mm										
Boiling Point At mm										
Crystallizing Point										
Melting Point										
Solution Point										
Specific Gravity 65/15.5°C	1.348-1.360	Spec. 12-21-54	1.410-1.420	Spec. 4-11-55	1.500-1.510	Spec. 12-21-54	1.558-1.572	Spec. 12-21-54	1.577-1.587	Spec. 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)	0.0004/°C	Spec. 12-21-54	0.0004/°C [50-110°C]		0.00095/°C [55-105°C]	Spec. 12-21-54	0.0010/°C [75-130°C]	Spec. 12-21-54	0.0010/°C [85-120°C]	Spec. 4-11-55
Flash Point °F (Method) C.O.C	350	Aroclor Bull. 09-115 1954	382	Aroclor Bull. 09-115 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%	Spec. 12-21-54	47.5-48.5%	Spec. 4-11-55	53.5-54.5%	Spec. 12-21-54	59.5-60.5%	Spec. 12-21-54	61.5-62.5%	Spec. 4-11-55
Toxicity (Reference)	Schwartz, U.S. Public Health Service Bull. #229, 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	

ANNISTON PLANT — MONSANTO COMPANY — ANNISTON, ALA.

TITLE					AUTH. NO.
PHYSICAL CONSTANTS DATA—CRUDE AROCLORS					JOB NO.
DRAWN BY	CHECKED	APPROVED	DATE	SCALE	TS-B

MONS 046817

Name	Aroclor 1242	Source & Date	Aroclor 1248	Source & Date	Aroclor 1254	Source & Date	Aroclor 1260	Source & Date	Aroclor 1262	Source & Date
Formula	$C_{12}H_7Cl_3$		$C_{12}H_6Cl_4$		$C_{12}H_5Cl_5$		$C_{12}H_4Cl_6$		$C_{12}H_3Cl_7$	
Molecular Weight	297.8 +3		326 Avg.		326 Avg.		360.7 Avg.		395	
Appearance	Colorless Viscous Oil	Monsanto Bull OP-115 (1956)	Colorless Viscous Oil	M.B. OP-115	Pale Yellow Visc. Oil	M.B. OP-115	Lt. Yellow Sticky Resin	M.B. OP-115	Lt. Yellow Sticky Resin	M.B. OP-115
Boiling Point At 760 mm	325-360°C	"	345-385°C	"	365-400°C	"	385-420°C	"	390-425°C	"
Boiling Point At 3 mm	155-175°C at 3mm	"	165-210°C	"	190-220°C	"	195-245°C	"		
Boiling Point At mm										
Boiling Point At mm										
Crystallizing	Non-Crystallizing	"	Non-Crystallizing	"	Non-Crystallizing	"	Non-Crystallizing	"		
Melting Point										
Solidification 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 2-14-55	1.495-1.505 60/15.5°C	Specs 2-14-55	1.555-1.566 100/15.5°C	Specs 2-14-55	1.597-1.607 100/15.5°C	Specs 4-11-55
Pounds Per Gal. 25°C	11.5	M. B. OP-115	12.06	M.B. OP-115	12.82	M.B. OP-115	13.50	M.B. OP-115	13.72	M.B. OP-115
Coefficient Of Expansion	0.00068 cc/cc/°C at 25-65°C	"	0.00040 cc/cc/°C at 25-65°C	"	0.00064 cc/cc/°C 25-65°C	"	0.00064 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	1.6385-1.6395 At 25°C	Specs 2-14-55	1.6390-1.6390 at 25°C	Specs 2-14-55	1.6455-1.6465 25°C	Specs 2-14-55	1.648-1.650 at 25°C	"
Index Ref Spectrum (Red)										
Ultraviolet Spectrum (Red)										
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)	50.3 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/100cc At 29°C	"	15 g/100cc at 25°C	"	10 g/100cc at 27°C	"				
Solubility In Pericine	132.5 g/100cc At 30°C	"	11.6 g/100cc at 29°C	"	11.6 g/100cc at 31°C	"				
Flash Point (M.C.C.)	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 (gm/cc/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	0.241	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	0.336 at 340°C	M.B. OP-115	0.336 at 300°C	M.B. OP-115	0.303 at 300°C	M.B. OP-115		
Pour Point	16°C Or Lower	"	0°C Or Lower	"	7-12°C	"	25-34°C	"	35-38°C	
Thermal Conductivity	24 at 28°C	T. Bt Published	23.6 at 28°C	T. Bt Published	22.9 at 28°C	T. Bt Pub.				
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

MONS 068218

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	STRUPT LIQUID	SPECS. 4-17-55
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 2°/15.5°C									1.423-1.444	"		
POUNDS PER GAL. 5.5°C	13.05	"	13.05	"	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	"	1.6205-1.6216	SPECS. 1-28-56	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	"			50.2cs (232 SUS)	WGK LAB 3-8-56
VISCOSITY	15cs. AT 20°C	REF. 2					15cs. AT 20°C	REF. 2			3.5cs (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	90°F	WGK LAB DATA 8-12-57	105 TAG OPEN CUP	WGK LAB 12-5-46
FIRE POINT °C									90°F	" "	110 " " "	" " "
HEAT OF COMBUSTION												
HEAT OF FORMATION												
THERMAL STABILITY (CAL/SEC/BAL)												
LATENT HEAT OF FUSION												
LATENT HEAT OF VAR												
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	"	4.1-4.8	"	3.7-4.0	"				
THERMAL CONDUCTIVITY CAL/CM/SEC/°C	20×10^{-5} AT 50°C	REF. 2					20×10^{-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.			

ANNISTON PLANT — MONSANTO COMPANY — ANNISTON, ALA.

TITLE	AUTH. NO.
PHYSICAL CONSTANTS DATA - PYRANOLS	JOB NO.

DRAWN BY	CHECKED	APPROVED	DATE	SCALE	
					TS-B

MONS 046819

Name	Aroclor 1262-10% Solution Mix	Source & Date	Chlorine	Source & Date	Diphenyl	Source & Date	Ferric Chloride, Anhyd.	Source & Date	Hydrated Lime (Calcium Hydroxide)	Source & Date	Inertyen 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	164.22	" "	74.10	" "		
Appearance	Strong Lamp	Specs. 4-11-55			Monoclinic	Mar. 1941-42	Black Iridescent Crystal	" "	White Powder	Ref. 5	Tell Tomb Nozzle On	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 0.4 mm	Swann File #137						
Boiling Point At mm			-100.06 10 mm	"		1938						
Boiling Point At mm			-126.44 1 mm	"								
Crystallizing Point			-100.98	Ref. 2	69°C	Swann Chem. 1939	Sublimes		Decomposes	Ref. 4		
Melting Point					69°C	Int. Crit. Tables						
Solution Point			2.49 at 8°C (Gas)	"	0.9696 77/4°C	" " "			2.2 at 20°C	" "	1.560-1.568, [illegible]	" "
Specific Gravity	1.497-1.516 at 40/15.5°C	" "	1.408 20°C	Ref. 4	1.041 20/4°C	" " "						
Specific Gravity					8.23 at 77°C	Swann File #137A			4 at 20°C	Ref. 5	13.05	" "
Pounds Per Gal. 25°C	12.7	" "									0.0007 cal/sec/°C [illegible]	" "
Coefficient of Expansion			1.47 at 0°C	Ref. 2	Dr. 1.58822 at 73.1°C	Int. Crit. Tables			~0.1.574, Ea. 1.545	Ref. 4	1.6137-1.6157 25°C	" "
Refractive Index												
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	V. Soluble (Heat Rise)	" "	0.1859 at 0°C	Ref. 4		
Solubility in Abs. Alc. 19.5°C					0.98 g/100 g Solv.	Seidell 1941						
Solubility in 100% Methanol 19.5°C					6.57 g/100 g "	" "						
Solubility in Benzene 22.9°C					137 g/100 g "	" "						
Solubility in Heptane 26.5°C					25.1 g/100 g "	" "						
Flash Point °F (Method)					255 Open Cup	Ind. & Eng. Chem.					None To Boiling	Ref. 6
Flash Point °F (Method)	105 Tag Open Cup	WGK Lab 12-5-46			235 Closed Cup	1940, 32, 882						
Fire Point °F	110 " " "	" "			270 Open Cup	Swann File #137A						
Heat of Combustion					Per gmole = 1504.4	Int. Crit. Tables						
Heat of Formation												
Thermal Stability (cal/cm/sec/mm)					53.1 Btu/lb	Ref. 4						
Latent Heat of Fusion					136.5 Btu/lb. 255°C	Swann File #137A						
Latent Heat of Vap.					0.43 Btu/lb°F	Rel. CR 964, 1956					0.26, 25-60°C	Ref. 7
Specific Heat			144°C	Ref. 2	528°C	Rec. Sci. Inst.						
Critical Temperature			76.1 atmos.	"	41.4 atm. Abs.	1953, 1930						
Critical Pressure												
Dissociation Constant												
Other Constants: Pour Point	0°C	" "					Decomposes On Exposure To Moist Air				-32°C or Lower	Ref. 6
Specific Gravity			1.377 at 30°C	Ref. 4								
Solubility in Water									.0779 at 100°C	Ref. 4		
Dielectric Constant 100°C 60 cy.									Sol. in Acids And NH_4Cl		3.7-4.0	" "
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" 3rd. 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 - Landes Handbook Ed. 9, 1950
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

MONS 046820

STANDARD MANUFACTURING PROCESS
FOR
AROCLOR

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	

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 137.5 lbs/cwt. Liquid Aroclors, 239.5 lbs/cwt. Solid Aroclors.

Recovered Water

Recovered water is supplied through a 6" main from a cooling tower. Standard practice is 625 gals/cwt. Liquid Aroclors, 1,197 gals/cwt. Solid Aroclors.

Electricity

Electrical power is supplied at 440 volts for power and 110 volts for lighting. Standard practice is 3.25 KWH/cwt. Liquid Aroclors, 7.19 KWH/cwt. Solid Aroclors.

Natural Gas

Natural gas is supplied through a 3" main at 40 psig. Standard practice is 0.1625 MCF/cwt. Liquid Aroclors, 0.5389 MCF/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. He is also in charge of the Biphenyl group of products. 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 operation of his job. There are ten (10) laborers, Classification A-8, employed in the Aroclor-Biphenyl group of departments. Each shift has a minimum of two laborers while some shifts have three laborers. Approximately 60% 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.

JOB CLASSIFICATION SCHEDULE AND SCHEDULE OF HOURLY WAGE RATES
AUTOMATIC RATE INCREASE GIVEN AT END OF:

Appendix A October 15, 1965 Department and Classification	Probationary Period Starting Rate	12 Weeks	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					--	--	--	--	--	--	3.12	3.17	3.22	3.22	Day Rate Plus 7.5%
4. Operator	--	--	--	--	--	2.84	2.89	2.94	2.99	--	--	--	2.99	
7. Operator Trainee	2.48	2.61	2.66	2.72	2.77-(1)	--	--	--	--	--	--	--	2.77	
8. Operating Labor	2.40	2.46	2.49	2.52	--	--	--	--	--	--	--	--	2.52	

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

MONS 046824

STANDARD MANUFACTURING PROCESS
FOR
AROCLOR

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 one coat of A & W 4.A 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.

APPENDIX I

AROCLOR FINISHED GOODS

CONTAINER WEIGHTS

Material	Weights Lbs.	Container
1221	50 or 520	5 Gal.-55 Gal. Steel Drum
1232	50 or 550	" " " "
1242	55 or 600	" " " "
1248	55 of 600	" " " "
1254	60 or 600	" " " "
1260	60 or 600	" " " "
1262	60 or 600	" " " "
1262 - 10% Toluene	60 or 600	" " " "
1262 - 10% Xylene	60 or 600	" " " "
1260 - 10% Toluene	60 or 600	" " " "
A13B3B	65 or 675	" " " "
5442	50 or 450	5 Gal.-40 Gal. Galv. Drum
4465	50 or 500	" " " "
2565	500	" " "
Inerteen PPO	65, 360 or 674	5 Gal.-30 Gal.-55 Gal. Drums
Inerteen 54201-KA	674	" " "
Santicizer 794	600	" " "
MCS 295	695	" " "
5060	100	Paper Bag
5460	100	Paper Bag
1268	200	41 Gal. Fibre Drums

APPENDIX C - MATERIAL BALANCE

Standard and Theoretical usages of raw materials and hydrogen chlorine 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.

FIGURE No 1

CHLORINE ATOMS PER BIPHENYL MOLECULE

CHLORINATION - %

MONS 046828

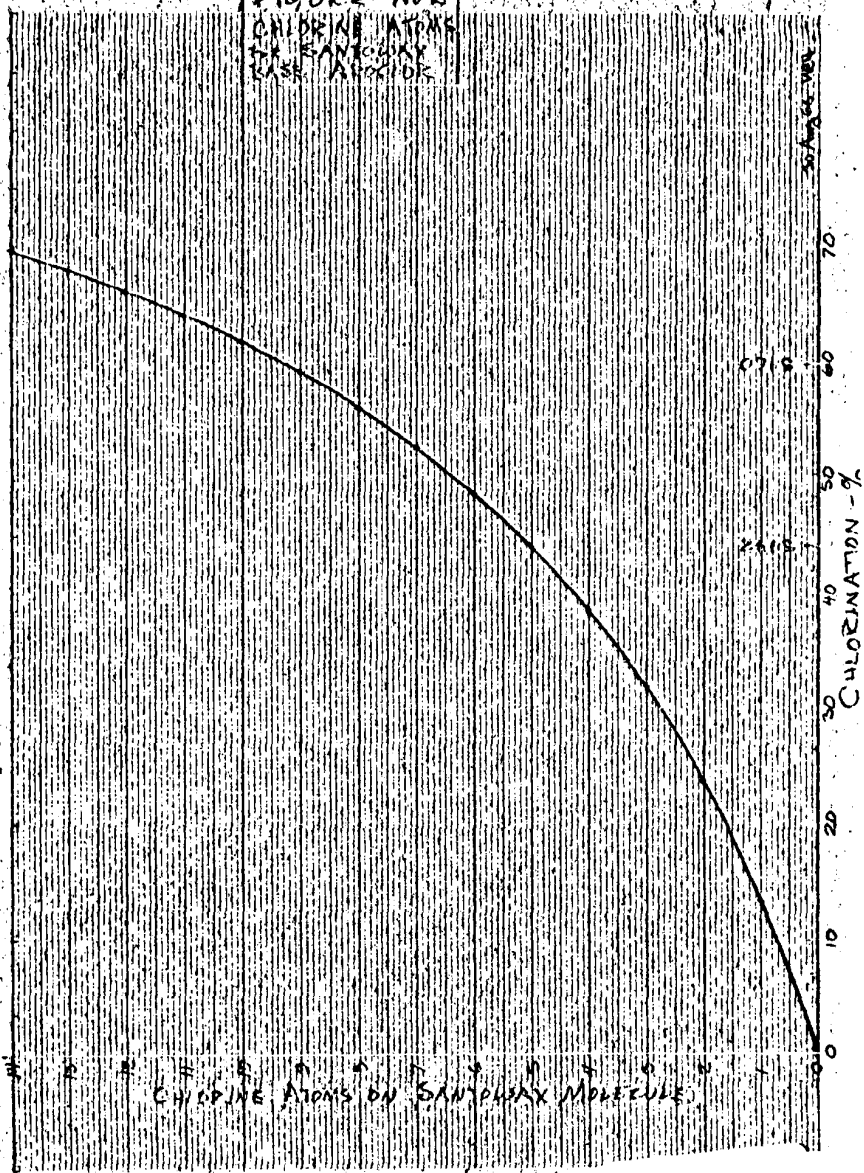


FIGURE No 2
CHLORINE ATOMS
BY SANTOWAX
BASE ARCTOR
CHLORINATION - %
0
10
20
30
40
50
60
70
CHLORINE ATOMS ON SANTOWAX MOLECULE

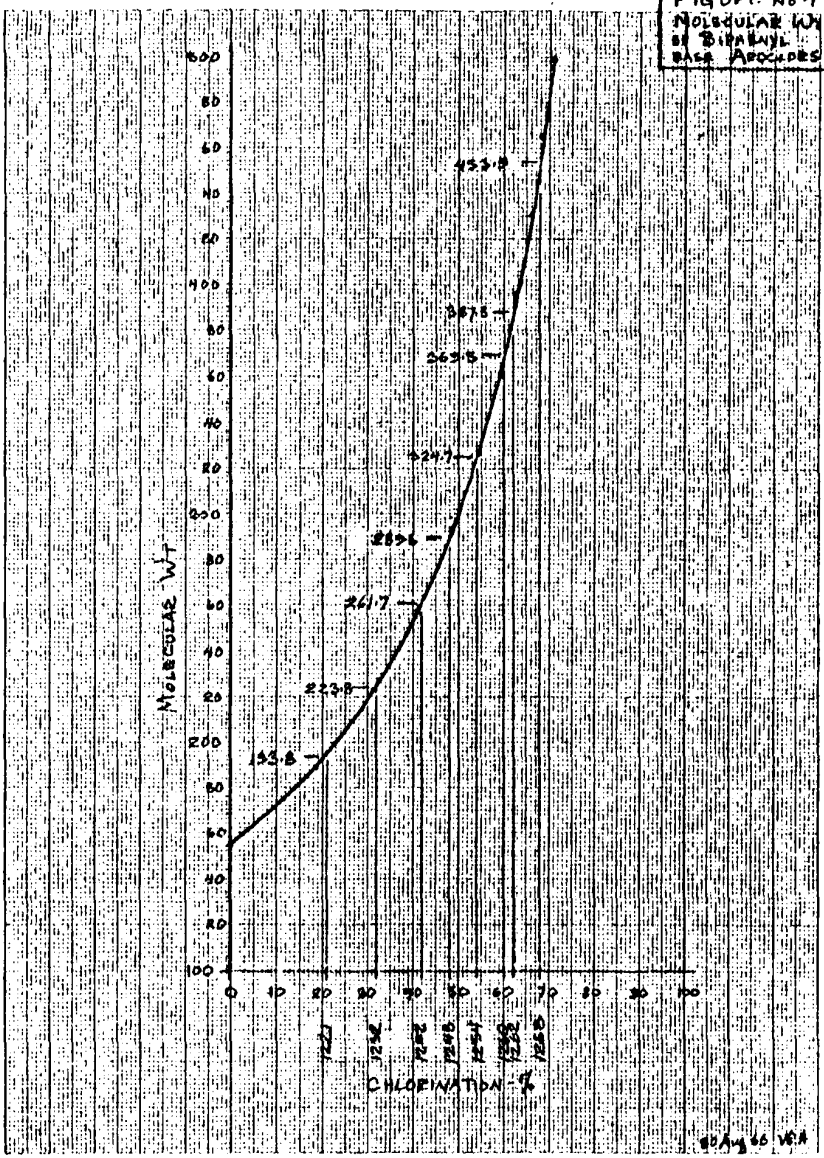
MONS 046829

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

Aroclor	Biphenyl		Santowax R		Santowax C		Chlorine		Hyd. Chloride	
	Theor.	Std.	Theor.	Std.	Theor.	Std.	Theor.	Std.	Theor.	Std.
1221	79.60	82.06	--	--	--	--	42.00	45.16	21.59	18.35
1242	59.19	61.02	--	--	--	--	84.00	90.32	32.90	36.70 ???
1248	53.37	55.02	--	--	--	--	96.00	103.23	43.18	41.94
1254	47.53	49.00	--	--	--	--	108.00	116.13	49.34	47.19
1260	41.71	43.00	--	--	--	--	120.00	129.03	55.51	52.43
1262	39.76	40.99	--	--	--	--	124.00	133.33	61.68	54.18
1268	33.93	39.68	--	--	--	--	136.00	163.86	69.90	59.42
2565	27.63	28.19	--	--	9.21	9.40	130.00	132.65	66.82	56.80
4465	22.10	25.86	14.74	17.24	--	--	130.00	156.63	66.82	56.80
5442	--	--	59.19	69.23	--	--	84.00	101.20	43.18	36.70
5060	--	--	41.71	42.55	--	--	120.00	122.45	61.68	52.43
5460	--	--	41.71	48.78	--	--	120.00	144.58	61.68	52.43

MONS 04630

FIGURE No 4
MOLECULAR WT
OF BIPHENYL
BASE AROCLORS



EUGENE DIETZGEN CO.
MADE IN U.S.A.
NO. 340-M DIETZGEN GRAPH PAPER
MILLIMETER

STANDARD MANUFACTURING PROCESS
FOR
AROCLOR

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 4,027,000 lbs/month.

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

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.

Cause and Action to Prevent

2. Thermal Burns

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.

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.

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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.

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 frito 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.

APPENDIX K - BACKGROUND INFORMATION

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MONS 046858

STANDARD MANUFACTURING PROCESS
FOR
AROCLOR

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 90,000 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 Aroclors is the still system.

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	9,500
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	28,500
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	22,900
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

MONS 046860

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.

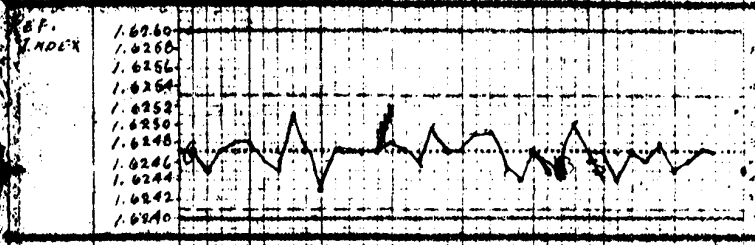
Each Aroclor tank car is thoroughly cleaned before filling to prevent contamination by material left in the car by the customer. Examples of the quality control charts kept by the Laboratory are included in this appendix. The charts are for Aroclors 1242 and 5460 (our heaviest demand products). All electric 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.

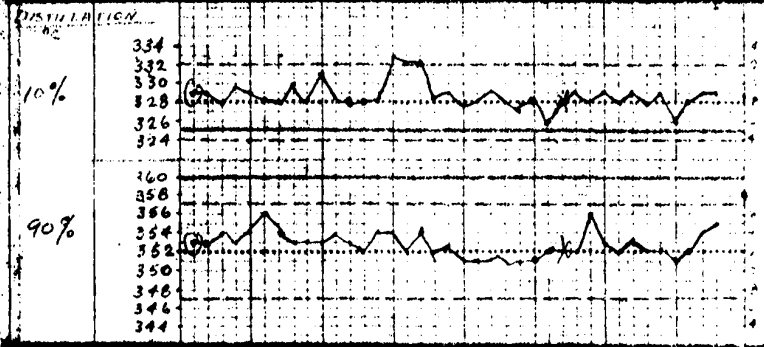
Aroclor	Property	Spec.
1242	Biphenyl	0.05 % max.
	Resistivity	5,000 giga ohm cm min.
1254	Biphenyl	0.025% max.
	Resistivity	5,000 giga ohm cm min.

MONSANTO CHEMICAL COMPANY - CONTROL CHART

AROCLOR 1242
ELECTRICAL GRADE







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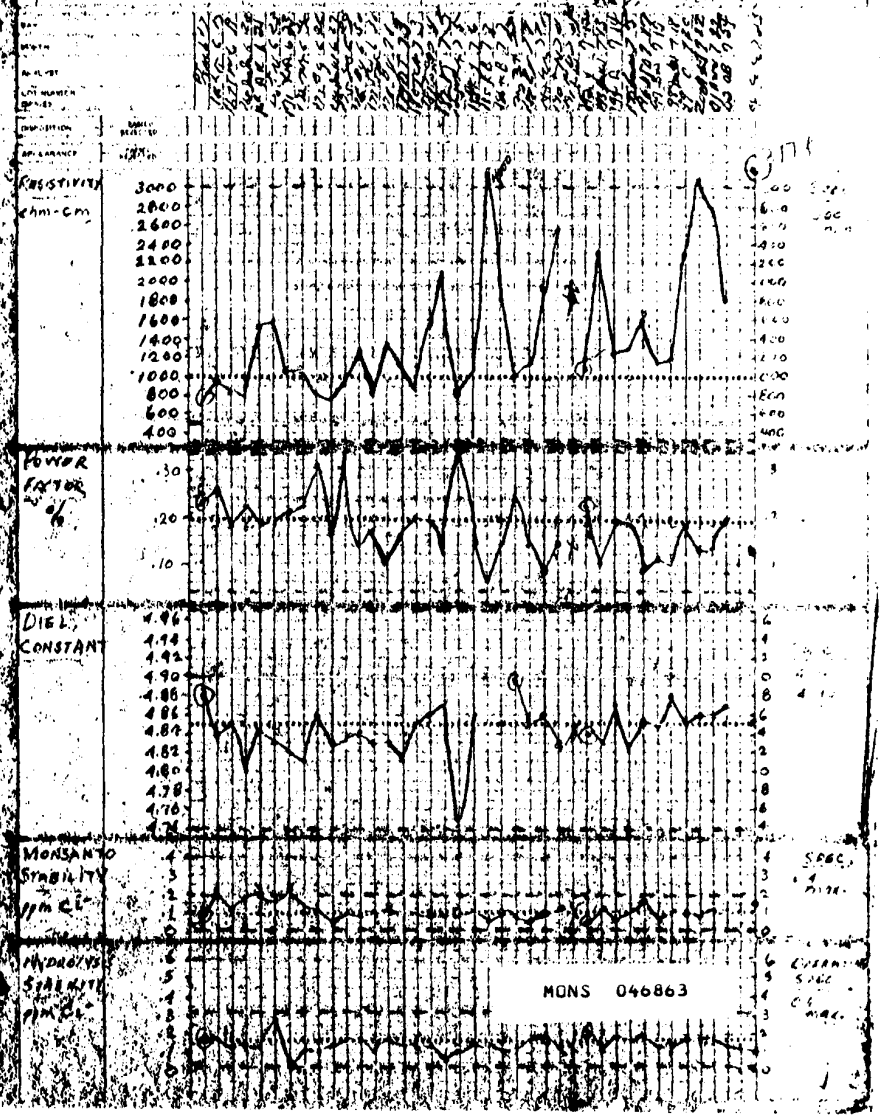
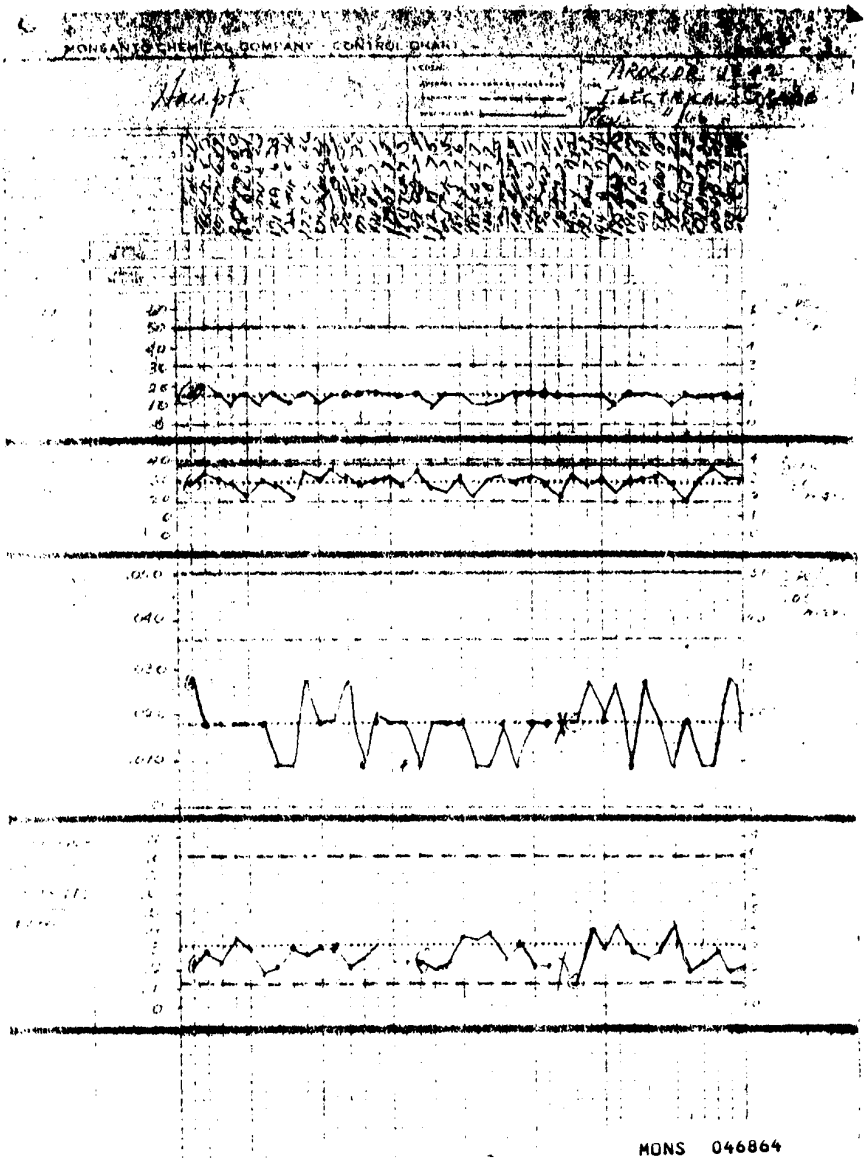
MONSANTO CHEMICAL COMPANY - CONTROL CHART

Aroclor 1242




MONSANTO CHEMICAL COMPANY - CONTROL CHART
Haupt
ARCLOR
ELECTRICAL GRADE

MONS 046864

MONSANTO CHEMICAL COMPANY · CONTROL CHART

Hampton

Aroclor 5460

Rev

6

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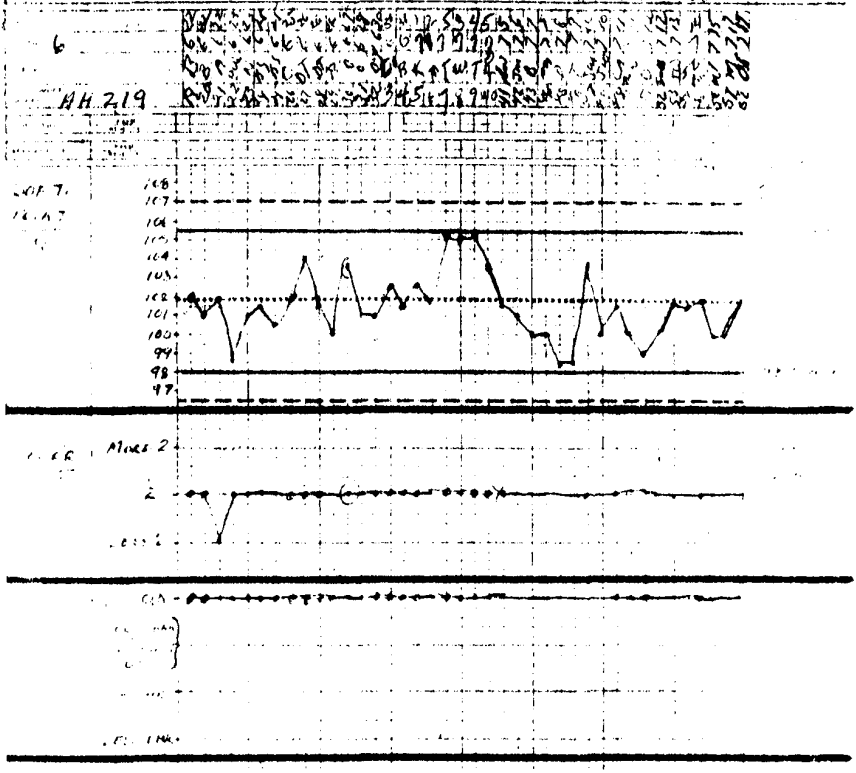

MONS 046865

STANDARD MANUFACTURING PROCESS
FOR
AROCLORS

APPENDIX N - MISCELLANEOUS

MONS 046866