MONSANTO COMPANY

ANNISTON, ALABAMA

****

AROCLOR - MURIATIC ACID

PROJECTS 1663 & 1772

START-UP OPERATIONS MANUAL

APRIL 1965

****

CONFIDENTIAL

AROCLOR-MURIATIC ACID START-UP

OPERATIONS MANUAL

DISTRIBUTION LIST

COPY TO:		
1.	H. L. Minckler	G.O. - St. Louis
2.	D. B. Hosmer	G.O. - St. Louis
3.	J. A. Mullendore	G.O. - St. Louis
4.	R. P. Stevens	O.E. - St. Louis
5.	L. L. Fellinger	O.E. - St. Louis
6.	R. S. Yates	O.E. - St. Louis
7.	R. E. Howard	O.E. - St. Louis
8.	H. L. Hubbard	O.R. - St. Louis
9.	R. W. Bucknell	O.R. - St. Louis
10.	J. R. McClain	Anniston
11.	R. G. Moody	Anniston
12.	W. F. Taffee, Jr.	Anniston
13.	L. C. Fuhrmeister	Anniston
14.	P. H. Sturman	Anniston
15.	J. H. Aldridge	Anniston
16.	J. M. Willette	Anniston
17.	J. W. Molloy	Anniston
18.	M. J. Williams	Anniston
19.	T. E. Lackey	Anniston
20.	V. R. Haupt	Anniston
21. Through 23.	Extras	

COPY NO. 1

MONS 092977

AROCLOR-MURIATIC ACID AT ANNISTON

PROJECTS 1663 & 1772

START-UP OPERATIONS MANUAL - (ARO SOM)

TABLE OF CONTENTS

Table of Contents
Continued

TIME TABLE

AROCLOR-MURIATIC ACID START-UP

This time table for start-up is scheduled in three sections, with some overlap of completion due to the nature of this rehabilitation program. These sections are:

PHASE I - AROCLOR SOLIDS SYSTEM

PHASE II - RENOVATED LIQUID AROCLOR SYSTEM

PHASE III - MURIATIC ACID SYSTEM

PHASE I: AROCLOR SOLIDS SYSTEM

Begin New Operator Training	March 16
Begin All Operator Training	March 29
Department Directors' Review: PHASE I, II, and III	April 20
Start Equipment Check-Out (Production) and Start-Up Therminol System	April 28
Start Process Simulation	April 28
Complete All Mechanics Training	April 30
Complete All Operator Training PH. I	May 4
Charge Chemicals	May 5
First Batch Finished	May 8
Demonstrate Ability to Safely Process Quality Material	May 12
Achieve 50% Design Rate	May 19
Achieve 60% Design Rate	May 26
Start Up HCl Clean-Up Facilities	September 1
Demonstrate HCl Clean-Up Facilities	September 15
Achieve 100% Design Rate	October 30

Time Table

PHASE II: RENOVATED LIQUID AROCLOR SYSTEM

Instrumentation Check-Out EDC	May 10
Begin All Operator Training	May 24
Release Equipment for Construction	May 26
Start Up New Pumps at Chlorinators 1, 2, and 3	June 7-18
Complete All Operator Training PH.II	June 15
Start Up Continuous Chlorinator Blow Tank and New Biphenyl Feed System	June 18
Start Up Altered No. 3 Still Receiver	June 18
Complete Installation of Brink Demisters on Chlorinators 1-9	June 18
Start Up HCl Clean-Up Facilities	September 1
Demonstrate HCl Clean-Up Facilities	September 15
Achieve 100% Design Rate	October 1

PHASE III: MURIATIC ACID SYSTEM

Release Equipment for Alterations to Allow Construction	April 19
Begin All Operator Training	June 28
Complete All Operator Training PH.III	July 10
Start Equipment Check-Out (Production)	July 12
Start Process Simulation	July 12

Time Table

PHASE III: (Continued)

Charge Chemicals and Start Up HCl Clean-Up Facilities	July 15
Demonstrate Ability to Safely Process Quality Material	July 17
Achieve 50% Design Rate	July 25
Achieve 60% Design Rate and Efficiency	September 1
Start Up HCl Clean-Up Facilities	September 1
Demonstrate HCl Clean-Up Facilities	September 15
Achieve 100% Design Rate	October 1

These dates are targets - every effort will be made to beat them if at all possible and to accomplish the job in less time and at a lower cost than now scheduled. Guiding principles will be the best long range return for Monsanto.

ORGANIZATION

Liaison & Start-Up Superintendent for Aroclor	W. F. Taffee
Aroclor Department Supervisor	J. W. Molloy
Aroclor Department Foreman	T. E. Lackey M. J. Williams
Shift Leader	M. J. Williams
Shift Leader	N. K. Madison
Shift Leader	V. R. Haupt
15 Operators	
5 Chief Operators for Aroclor-Biphenyl Dept.	

Support Groups:

Maintenance	J. M. Willette
Laboratory	O. E. Dolin
T.S.D.	V. R. Haupt N. K. Madison
Organic Engineering	R. S. Yates R. N. Harris
Organic Research	R. W. Bücknell

COMMUNICATIONS

	Manufacturing	Engineering	Research	Plant
1. Operations Manual				
Demonstration Plan & Schedule	TPM, MPC	ER	RR	(CC, PM, MR (SM, PE
Expense - Code of Account	TPM			SM, PA, MR
Operating Instructions		ER	RR	SM, MR
Training Plan	TPM	ER	RR	SM, CC, PS, MR
Objectives	DM, TPM	ER, DE	RR, DR	PM, SM, MR
Operations Plan	TPM	ER	RR	PM, SM, MR
2. Budgets, Cost Standards, Variance Predictions	RPM			PM, SM, MR
3. Start-Up Progress Reports	TPM, MPC	ER	RR	PM, SM, MR
4. Daily Production Summary	DM, TPM, MPC	ER	RR	PM, SM, MR
5. Engineering Changes	TPM	ER	RR	PM, SM, MR
6. Process Changes	TPM	ER	RR	PM, SM, MR
7. Project Completion Report	DM, TPM	ER	RR	PM, SM, MR

COMMUNICATIONS

DISTRICUTION CODE

Manufacturing	-	Technical Production Manager	- TPM
		Manager, Production Planning & Control	- MPC
		Director of Manufacturing	- DM
Research	-	Research Representative	- RR
		Director of Research	- DR
		Research Group Leader	- RGL
Engineering	-	Engineering Representative	- ER
		Director of Engineering	- DE
Plant	-	Plant Manager	- PM
		Manufacturing Representative	- MR
		Superintendent of Manufacturing	- SM
		Plant Engineer	- PE
		Chief Chemist	- CC
		Personnel Superintendent	- PS
		Plant Accountant	- PA

CODE OF ACCOUNTS

Charge for start-up expenses will be collected against 02-09-916.51, using appropriate code from the following list:

520	Interplant Raw Material
505	Raw Material Purchased
526	Raw Material Handling
530	Steam
533	Electricity
539	Water - Purchased
542	Water - Plant
545	Gas
570	Wages
575	Salaries
578	Payroll O/H
590	Factory Supplies
610	Laboratory
614	Clothing & Laundry
621	Technical Service
635	Experimental Expense
641	Rentals - Equipment

644	Start-Up Expense
651	Production Process Research
661	Waste Disposal
694	Mechanical Expense
698	Depreciation
715	Consultant Fees
760	Factory Indirect Expense (from Service Budgets)
780	Insurance
790	Lunches Served Guests
798	Meetings & Conferences
804	Outside Contract Work
824	Plant Trucks
855	Sundries
864	Office - Stationery, Printing, & Supplies
867	Switching Expense
878	Taxes
880	Communications
883	Travel

For AROCLOR Proj. No. 1663 & 1772 Capital $ 910,000 Approx. Start-Up Date April Thru June
Project Title
Solids Line - April, HCl System - May
Liquids - June

START-UP

MONTH & YEAR		RAW MATERIALS	SALARIES & O.H.	WAGES & O.H.	MECHANICAL EXPENSE	SUPPLIES	ALL OTHER	TOTAL
Jan. 1965	--	--	1,430	1,140	500	200	1,070	4,340
Feb. 1965		--	3,710	3,420	1,000	600	1,670	10,400
Mar. 1965		--	5,080	5,275	5,000	600	5,405	23,360
Apr. 1965		3,500	2,770	11,435	5,000	1,000	5,490	39,195
May 1965		2,100	1,855	7,165	5,000	1,000	3,990	21,110
June 1965		--	1,625	1,920	5,000	1,000	600	10,145
Start-Up Sub-Total		5,600	16,470	30,355	21,500	4,400	18,225	96,550

CORRECTION

MONTH & YEAR	# PROD.							
Apr. 1965	2,750,000	10,000	1,500	2,880	15,000	1,500	4,000	39,880
May 1965	3,250,000	10,000	1,500	2,880	15,000	1,000	3,500	36,880
June 1965	3,500,000	14,000	1,500	2,880	10,000	750	2,700	32,830
July 1965	3,750,000	7,000	1,000	2,880	5,000	500	2,000	21,380
Aug. 1965	4,000,000	6,000	1,000	2,880	5,000	250	1,200	16,330
Sept.1965	4,000,000	3,000	1,000	2,880	5,000	100	500	12,480
Correction Sub-Total		50,000	7,500	17,280	55,000	4,100	13,900	147,780
GRAND TOTAL START-UP & CORRECTION		55,600	23,970	47,635	76,500	8,500	32,125	244,330

MONS 092990

ARO SOM II - 2.000 Page 1 of 1

SECTION III

SYNOPSIS OF PROCESS

AROCLOR-MURIATIC ACID DEPARTMENTS

I. GENERAL

Aroclors are the reaction products formed by chlorination of Biphenyl and/or Terphenyl using Ferric Chloride Catalyst. Crude Aroclors are produced in the chlorinators, air-blown, distilled, and loaded for shipment. Liquid Aroclors are also earth-treated, filtered, and then loaded for shipment.

The by-product HCl gas produced is absorbed in water to produce Muriatic Acid. It is carbon treated, filtered, and then loaded for shipment.

II. CHLORINATOR AREA

There are four batch liquid operated chlorinators, one continuous operated chlorinator system, and one batch solid chlorinator.

The batch liquid chlorinators are charged with 3,000 pounds of Biphenyl with 1-1/2 pounds of Ferric Chloride catalyst. Chlorine gas added through a distributor plate reacts with the raw material to release HCl gas and heat. The HCl gas goes to the Muriatic Acid Department. Heat is taken away by circulation through an external air-cooled heat exchanger. The specific gravity of the crude Aroclor is checked to determine the level of chlorination.

The continuous chlorinator system consists of four batch chlorinators cascaded with overflow from one unit to the next. In the continuous chlorination system, Biphenyl is fed to the first stage and chlorinated. Crude Aroclor overflows into the second stage, etc., - until the final product overflows from the last stage, flows to a catch tank, through a continuous air blow tank, and then is transferred to a crude holding tank prior to distillation. Each chlorinator is held at different levels of chlorination with the last stage being the final crude Aroclor desired. Normally, Aroclor 1142 is produced in this system. The system has been demonstrated on Aroclors 1148, 1154, and 1160.

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

III. STILL AREA

A. Liquid Aroclors

Aerated Aroclor from a blow tank or feed tank is 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 distilled to a

receiver. The distillation is semi-continuous since ten receivers are distilled prior to drawing bottoms or residue from the still. Every two receivers are treated with 40 pounds of earth for two hours and then filtered. The finished product is transferred to storage tanks prior to loading into drums or tank cars.

B. Solid Aroclors

Solid Aroclors are distilled in a similar manner to liquid Aroclors except for 1168. Aroclor 1168 is not air-blown and it is charged directly to the still from the chlorinator. A vacuum of 4 mm Hg absolute is applied to the receiver (10 mm Hg absolute to the still) for distillation. One receiver of solid Aroclors is distilled prior to drawing bottoms in the still.

Solid Aroclors are not earth-treated or filtered. They are drummed directly from the receiver or are flaked (Aroclor 1268 and 5460). Aroclor 2565 is one exception to this rule since it is an undistilled product.

C. Aroclor Nomenclature

Aroclor is a trade name used to designate chlorination products of Biphenyl, terphenyls, or mixtures of the two. The physical properties vary from a light, free-flowing liquids to crystalline and non-crystalline solids.

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 denotes the approximate percentage of chlorine contained in the finished product. For example, 1260 is a distilled chlorinated Biphenyl containing 60% chlorine. Deviations from the above nomenclature for solid Aroclors are as follows:

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%.

IV. MURIATIC ACID

A. Absorption

Muriatic Acid 31-36% (20-22° Bé) solutions are produced by the absorption in water of hydrogen chloride gas (HCl), a by-product from the Aroclor chlorination.

The gaseous HCl is passed through a cooling tower system to remove vapor-entrained Aroclors or Biphenyl and Santowax. The HCl gas then enters the primary stage of the absorber system at the top and flows co-currently down the tubes being absorbed in the weak acid from the tails scrubber stage. The lean gas existing from the bottom of the primary stage is directed into the bottom of the tails tower. The feed water (city water) enters the top section of the tails tower and counter-currently absorbs the HCl from the weak gas stream.

The gas stream depleted of HCl is exhausted from the tails tower through a Schutte-Koerting fume scrubber jet to the atmosphere. Feed water introduced into the tails tower is controlled by a differential pressure ratio recording controller sensing the gas flow to the primary absorber to produce acid, varying from 20 to 23° Bé. Acid from the primary absorber drains into a catch tank and is then pumped to commercial (regular) acid storage tanks. Regular acid is loaded into tank cars or trucks for shipment to customers.

The absorption unit can be shut down by directing the HCl gas flow through the Schutte-Koerting fume scrubber jet. The HCl gas stream is absorbed by this unit in water and directed to the sewer. Sewered acid flows to a limestone pit where it is neutralized to reduce the HCl to a maximum of 0.2% at a pH of 4.5 to 5.0 in the effluent from the plant.

B. Carbon Treatment and Filtration

Water-white Muriatic Acid is produced by directing the acid from the bottom of the absorber through activated carbon towers to remove odors,

organic impurities, free chlorine, and improve color. The acid is then passed through a porostone filter and to storage tanks. The acid is then loaded into tank cars or trucks for shipment to customers.

DETAILED INSTRUCTIONS

AROCLOR - MURIATIC ACID START-UP

Detailed operating instructions for the Aroclor-Muriatic Acid rehabilitation program at Anniston have been written in the form of Process Function Outlines (PFO's). The Process Function Outlines have been divided into seven major areas as follows:

1. Therminol Heater
2. Weigh Tank, No. 9 Chlorinator, and No. 2 Blow Tank
3. No. 4 Still System, Solid Aroclors
4. Batch and Continuous Liquid Chlorinators
5. Liquid Aroclor Still System
6. HCl Clean-Up Facilities
7. Muriatic Acid System

The firstfour sections have been completed and are included in this Start-Up Operations Manual. The liquid Aroclor still system has not been written since it will be a duplicate of our present operating instructions. Sections 6 and 7, the HCl Clean-Up Facilities and Muriatic Acid System, have not been written since the final details have not been established for these systems. They will be completed prior to training and start-up.

PROCESS FUNCTION OUTLINE

AROCLOR DEPARTMENT

I. THERMINOL HEATER

1.1 Scope

This covers the charging, start-up, shutdown, normal operation, and emergency situations involving the Therminol heater in the Aroclor Department.

1.2 Description of Process

Therminol FR-2 (Aroclor 1248) is circulated through a pipe system in the Aroclor Department at flow rates of 0 - 500 GPM at 60 psig. The normal operating temperature is 250°C. on the discharge of the heater at 300 GPM. This heating system is used to heat up tanks, transfer lines, pumps, and material involved in producing solid Aroclors.

II. PROCESS DIAGRAM

Attached.

III. OPERATION OF PROCESS

3.1 Charge System With Therminol FR-2 (Aroclor 1248).

A. Use temporarily relocated Pyranol pump to charge Therminol surge tank.

B. Position 55 gallon drum next to pump. Remove drum bung and vent cap.

C. Connect flexible hose to pump suction and the stainless steel pipe to be inserted into the drum.

D. Position discharge line from the pump into the tank.

E. Open valve on pump suction. Insert pipe into drum and start pump.

F. Adjust the suction valve on the pump until flow is steady.

G. Continue to fill the tank until 25 drums or approximately 1,200 gallons total are in the surge tank (Item 627).

3.2 Start-Up

A. Initial Start-Up

1. Check to be sure Therminol is in the surge tank. Temperature should be 100°C. minimum.

2. Open natural gas valves in line to furnace.

3. Open blower air valves in pilot and main air lines.

4. Turn on circuit No. 5 at still panel and switch at the field control box.

5. Actuate red inset safety lever inside the Honeywell Protectoglo unit (lower right cover of case). You must wait 10 seconds between settings of this lever in case it has to be redone.

6. Set the control point on Honeywell coil outlet temperature indicator at 325°C. (617°F.).

7. Align valves in the Therminol system lines to circulate main lines only.

8. Place TRCA-629.12 in "manual" with the output pressure at 15 psig. Blower air control valve is air to open. Set FIC-628.01 at 300 GPM in "auto" position.

9. Start Therminol circulating pump (Item 628).

10. Start air blower. Use pushbutton at side of field panel. Red light on Protectoglo unit should light up. Air pressure at the blower discharge should be above 1 psig.

11. Check pressure gauge at main air inlet to burner. It must be above 15 o.s.i.

12. Wait 3 minutes. Green light on Protectoglo unit lights up indicating purge period is over.

13. Adjust manual valve in air line to burner until pressure is below 1-1/2 o.s.i.

14. Press ignition "start" pushbutton on side of control box and hold in until white light on Protectoglo unit lights up. Red and green lights should go out.

15. Adjust manual valve in air line to burner until pressure is between 15 and 22 o.s.i. It must be above 15 o.s.i.

16. Reset the two North American safety valves in the main gas line.

17. Adjust TRCA-629.12 to temperature at outlet of coil and transfer instrument to "auto". This is for low fire start-up.

    Use care to make this change as you can cause shut-down of the furnace.

18. The furnace must be dried out prior to Step 19. Details will be provided.

19. Observe the furnace temperature at the coil outlet. Do not exceed 50°C. increase for first 2 hours. Set TRCA-629.12 in automatic and raise the temperature 50°C. per hour until you reach 220°C.

    Open the manual air valve slowly to raise the temperature.

    Place TRCA-629.12 in "auto" position and put set point at 250°C. System will circulate until needed.

20. Fill Therminol system in all branch lines.

    Open each branch valve at feed and discharge to drive out air. Fill lines one at a time.

B. Start-Up Following Temporary Shutdown

Assume circulating pump is running and the pilot light is burning.

1. Check to be sure Therminol is in the surge tank (Item 627), 6" above coil.

2. Check temperature in surge tank (Item 627), TI-627.03. It should be 100°C.

   Turn on steam to tank coil if necessary.

3. Check valves in Therminol system lines to be sure where the heating system is being circulated.

4. Adjust set point on FIC-628.01 at 300 GPM controller in "auto" position.

5. Adjust set point TRCA-629.12 at 125°-150°C. and controller in "auto" position.

6. White light on the Honeywell Protectoglo unit will be on indicating the pilot is on.

7. Reset the two North American safety valves in the main gas line.

8. Start heat to burner by throttling 6" manual valve in the main air line. The main burner will light up, heating Therminol to the desired temperature. Gradually raise the temperature set point to 250°C.

9. Open valves in branch Therminol system lines as needed. Open discharge and feed line at each feeder.

3.3 Routine Operations

When the Therminol heater system is operating normally, the following conditions will exist in the process.

A. FIC-628.01 pump flow set at 300 GPM.

B. PI-628.02 pump discharge pressure 80-85 psig.

C. PI-629.16 heater coil outlet pressure 62 psig.

D. PI-628.03 Therminol line pressure 45 psig.

E. TRCA-629.12 heater coil outlet temperature set at 250°C.

F. Honeywell coil outlet temperature indicator at 250°C. Shutdown alarm set at 325°C.

G. TI-627.03 surge tank temperature 245°C.

H. Air blower reduced discharge preasure - above 15 o.s.i., less than 22 o.p.i.

I. Main natural gas pressure 40 psig.

J. Natural gas reduced pressure 3 - 5 o.s.i.

K. Natural gas feed to burner atmospheric pressure.

3.4 Safety Features

A. Honeywell Protectoglo unit has the following safety features:

1. Ignition period 10 second delay between actuation periods for warp switch to cool.

2. Blower reduced air pressure must be above 15 o.s.i. and less than 22 o.s.i.

3. Heater coil high temperature outlet shutdown set at 325°C. (617°F.).

4. Main natural gas low pressure shutdown set at 20 psig, and at 10 psig.

5. Natural gas high reduced pressure shutdown set at 5.0 psig.

6. Circulating pump low flow rate shutdown set at 200 GPM.

7. Air blower start-up sets up automatic 3 minute timed purge before next step of start-up can proceed.

8. Minimum 15 o.s.i. air pressure is necessary at the main burner for the purge period.

9. A low air pressure ignition for lighting pilot light is necessary. Set for air pressure to be below 1-1/2 o.s.i. to main burner.

10. Pilot flame must be burning to start up unit, indicated by 1-1/2 to 2 microamperes on current meter.

B. Check surge tank, Item 627, to be sure Therminol level is at least 6 inches above coil level.

3.5 Shutdown

A. Temporary Shutdown

Main gas burner off with pilot light on and circulating pump running.

1. Adjust TRCA-629.12 set point to zero (instrument in "auto"), or

2. If instrument is in "manual", adjust controller for output pressure to zero, or

3. Close the 6" manual valve in the main air line to the furnace burner. In case it is necessary to cool the furnace quickly, leave the air valve open.

4. Normally, the circulating pump is left on to cool the heater coil and prevent overheating.

B. Complete Shutdown

Main gas burner pilot light and circulating pump off.

1. Push ignition "stop" button on side of field control panel.

2. Push "stop" button for air blower.

3. Close manual valve in the main air line.

4. Close manual valves in main gas supply line.

5. Allow circulating pump to continue pumping until furnace coil outlet has cooled to 100°C. Then shut off the circulating pump.

6. Check surge tank level to be sure the tank does not overflow.

7. If temperature of 100°C. is to be maintained in surge tank, it may be necessary to open the valve in the steam line to the tank coil.

8. Set points on TRCA-629.12, heater coil outlet, FIC-628.01, pump flow rate, and the Honeywell Protectoglo unit set point can be left in position when shut off.

9. Shut off circuit No. 5 behind the still panel if the shutdown is to be an extended one.

C. Emergency Shutdown

In case it becomes necessary to shut down fast, the following methods can normally be used.

1. From the Field

a. Push ignition "stop" button on side of field control panel to shut off pilot and main burner.

b. Turn temperature shutdown set point on Honeywell Protectoglo unit below the furnace coil outlet temperature.

c. Close manual valve in air blower discharge line or stop the air blower.

d. Push "stop" button for the circulating pump located at side of field control panel.

Main and pilot gas burner will be shut off, while air is being blown through the furnace.

Item d. is the least preferred of the above methods. Normally, the circulating pump will continue to be operated.

2. At the Still Panel

   a. Move FIC-628.01 below 200 GPM. Total use of Therminol in department must be below 200 GPM for this to cause shutdown of main and pilot gas burners.

   b. Turn off circuit No. 5 behind still panel.

3. At Motor Control Center

   a. Shut off circulating pump circuit breaker.

   b. Shut off blower circuit breaker.

D. Emergency Shutdown with Alarm.

Pilot and main gas burner off. Circulating pump still on.

1. High coil outlet temperature - above 325°C. (617°F.)
2. Low natural gas supply pressure - below 20 psig
3. Low blower outlet pressure - below 1 psig
4. High reduced natural gas pressure - above 5 psig
5. Low coil flow - below 200 GPM
6. Failure of circuit 5 behind still panel.
7. Failure of "on-off" switch at side of field control panel or blowing 115 volt fuse in panel.

3.6 Control Loops, Interlocks, and Alarms

A. Control Loops

There are three major control loops in this system.

1. Circulating Pump Flow Control - FIC-628.01

   The function of this loop is to maintain the flow through the Therminol system at 300 GPM. This is accomplished by measurement of flow through an orifice connection and throttling a control valve at the extremity of the loop as is needed. Low circulation rate (below 200 GPM) will shut off natural gas to the furnace and sound an alarm horn.

2. Therminol Heater Outlet Coil Temperature Control - TRCA-629.12

   Function of this loop is to maintain a constant temperature of 250°C. at the furnace coil outlet. This is accomplished by measurement of the temperature with a thermocouple and controlling the heat input to the furnace with a control valve in the main combustion air line. A low temperature alarm at 220°C. and a high temperature alarm at 300°C. will be actuated at too low or too high a temperature.

3. Therminol Heater Furnace Controls - 629A

   The function of this loop is to provide a source of heat for the Therminol FR-2 (Aroclor 1248) circulating system. This is obtained with a North American burner and air blower which is used to heat the Therminol circulating through a direct fired coil. Control of this heating system is obtained by FIC-628.01 and TRCA-629.12. There are four safety features in the furnace controls to shut the system down.

   a. High coil outlet temperature - above 325°C.

   b. Low natural gas supply pressure - below 20 psig or below 10 psig

   c. Low blower outlet pressure - below 1 psig

   d. High reduced natural gas pressure - above 5 psig

B. Interlocks

Interlocks in this system are as follows. Each, except Items 1.a. and b., have alarms.

1. Start-Up of Furnace

a. Actuation of pilot ignition lever on Honeywell Protectoglo unit has a 10 second delay before second try can be made.

b. Ignition "start" button at the Protectoglo unit has a 3 minute purge delay after the air blower has been started before the furnace will light up.

c. During purge period a minimum of 15 o.s.i. air pressure is necessary prior to completion of purge.

d. To light the pilot the air discharge pressure to the main burner must be below 1-1/2 o.s.i.

2. Automatic Furnace Shutdown with Alarms (Pilot and Main Gas Burner Off)

a. High coil outlet temperature - above 325°C. (617°F.)

b. Low natural gas supply pressure- below 20 psig or below 10 psig

c. Low blower outlet pressure - below 1 psig

d. High reduced natural gas pressure - above 5 psig

e. Low coil flow - below 200 GPM

f. Failure of circuit No. 5 behind still panel.

g. Failure of switch at side of field control panel or blowing 115 volt fuse in panel.

C. Alarms

1. All shutdown items under Interlocks B2 above.
2. Therminol heater coil outlet low temperature below 220°C.
3. Therminol heater coil outlet high temperature above 300°C.

3.7 Abnormal Conditions

A. Unusual high or low temperature readings can occur if the thermocouple extension wire for the Honeywell Protectoglo unit and TRCA-629.12 are mixed up. See note, Section IV-C.

IV. COMMENTS ON PROCESS

A. It is very important to be sure the coil in the surge tank (Item 627) is covered when the system is in operation. This assures the circulating pump has a positive suction and prevents surging in the heater coil. Surges in flow can cause coil hot spots and shorten the coil life.

B. Use of FIC-628.01 flow control to shut the system down at the control panel can only be used when use of Aroclor in the department is less than 200 GPM; otherwise, adjusting the controller will not throttle the control valve enough to cause automatic shutdown of the main and pilot burners.

C. At TRCA-629.12, be sure the iron constantan thermocouple extension lead wire (type J) is used to transmit to the control room and the instrument. The conduit run also contains a type K extension lead wire which is chromel alumel. If the type J wire is used, the indicator will read correctly. If the type K wire is used by mistake, the Therminol will overheat by about 100°C. The high temperature switch should shut the furnace down at 325°C.

If the type J wire is connected by mistake to the temperature indicator, it will cause it to read too high.

D. The Therminol furnace is rated at 8,000,000 Btu/hour heat input. This corresponds to 22 o.s.i. air pressure at the air inlet of the burner. The manual valve in the air line should be set for 22 o.s.i. when the automatic valve is wide open. This will assure the heat input will not exceed the design rate if the automatic valve should open wide.

E. Care must be taken not to fill the surge tank (Item 627) too full during normal operation. This can cause the tank to run over when the circulating pump is stopped. Normal level will be about 12" above the tank coils. The level in the tank will vary, dependent on the operating temperature of the system.

APPENDIX I

ITEM 627: THERMINOL HEATER SURGE TANK CALIBRATION SHEET

		Tank Innage	
Reading No.	Aroclor Drums Added	Stick Measurement* Inches	Level Gauge* Measurement - Inches
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			
17.			
18.			
19.			
20.			
21.			
22.			
23.			
24.			
25.			
26.			
27.			
28.			
29.			
30.			
Total			

Drum Weight After Empty Less Tare _____ lbs.

*NOTE: All stick measurements are to be made from the top face of the nozzle used for this purpose.

MEASURE the tank innage on the level gauge from the bottom flange of the gauge.

Make a special note when the dish is full and the tank is filled half way.

PROCESS FUNCTION OUTLINE

AROCLOR DEPARTMENT

I. WEIGH TANK, NO. 9 CHLORINATOR, AND NO. 2 BLOW TANK

1.1 Scope

This covers the charging, start-up, shutdown, normal operation, and emergency situations involving the weigh (charge) tank, No. 9 chlorinator, and the No. 2 blow tank for production of solid Aroclors.

1.2 Description of Process

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. Chlorine gas can be fed to the chlorinator from the Chlorine Plant or from tank cars.

II. PROCESS DIAGRAM

Attached.

III. DESCRIPTION OF PROCESS

3.1 Start-Up

A. Charges and Operating Temperatures for Various Crude Solid Aroclors

Depending on the product to be produced, different quantities of the raw materials are needed. See Table I.

TABLE I

BATCH CHLORINATOR OPERATING CONDITIONS - SOLID AROCLORS

	1168	2565	4065	5042	5060
Chlorinator Charge:					
Biphenyl (lbs.)	9,350	7,550	5,850		
Santowax C		2,560			
Santowax R			3,920	9800 ~~12,500~~	10,750
Total Charge (lbs.)	9,350	10,110	9,770	~~12,500~~ 9800	10,750
Approximate Pounds 100% Chlorine Required to Produce Batch:	37,250	37,750	34,620	~~47,010~~	30,625
Totalizer Chlorine Settings (80% Cl_2, Assuming 10% Air) lbs. Cl_2:	33,100	33,500	30,700	11,500 ~~15,000~~	27,200
Chlorinator Temp.:					
Beginning	130°C.	140°C.	140°C.	160°C.	160°C.
Ending	265°C.	180°C.	210°C.	240°C.	250°C.
Hold Point	155-175°C.				
Softening Point		66-72°C.	66-72°C.	50-56°C.	105-115°C.
Weight of Crude Batch	27,300	27,000	26,600 25000	~~21,200~~ 16 000	25,215

NOTE: ADD 5 POUNDS OF FERRIC CHLORIDE TO EACH BATCH CHLORINATOR CHARGE.

25940

25000

B. Charge Therminol Cooling System for No. 9 Chlorinator

Charge Therminol (1232 Aroclor) into the surge tank (Item 533) by the following procedure:

1. Use temporarily relocated Pyranol pump to charge the tank.

2. Position 55 gallon drum next to the pump. Remove drum bung and vent cap.

3. Connect flexible hose to pump suction and the stainless steel pipe to be placed in the drum.

4. Position discharge line from the pump into the surge tank (Item 533).

5. Open valve on pump suction. Insert pipe into the drum and start pump.

6. Adjust the suction valve on the pump until flow is steady.

7. Continue to fill the tank until 5 drums or 250 gallons are in the surge tank.

C. Start Up Therminol Cooling System for No. 9 Chlorinator

1. Set valves in the system to flow through the No. 9 chlorinator heat exchanger (Item 538) and through the tube side of the Aroclor cooler (Item 507).

2. Close sample valve on the suction of the circulating pump (Item 534) and at the discharge of the No. 9 chlorinator heat exchanger.

3. Close valves to put Therminol FR-2 (Aroclor 1248) from the furnace system on the No. 9 Aroclor chlorinator heat exchanger (Item 538). Blank lines.

4. Open steam valve to coil on the surge tank (Item 533). Controller should be set to control temperature in this tank to 45°C.

5. Check level in the surge tank (Item 533). Should have 40" in the tank.

6. Set TRCA-538.01 in "auto" with set point at 190°C. Low temperature alarm set at 120°C. - high temperature alarm set at 275°C.

7. Set FICA-534.02 in "auto" with set point at 300 GPM. Low flow alarm should sound at 250 GPM.

8. When the material in the surge tank is at 45°C., start the circulating pump (Item 534).

9. Check flow through the Therminol cooling system by observing the following items:

   a. Pump discharge pressure, PI-534.01, should be 55 psig.

   b. Flow through Therminol system should be 300 GPM. Check FICA-534.02.

   c. Check action of control valve to the No. 9 Aroclor heat exchanger. See TRCA-538.01. Valve should be closed on low temperature.

10. Check the following temperature points in the Therminol cooling system:

    a. Pump discharge temperature, No. 9 chlorinator heat exchanger outlet temperature, and the temperature at the head of the water-cooled heat exchanger for the Therminol system.

11. If there are no problems with the system, let it continue to circulate until needed.

D. Initial Equipment Check for Start-Up

1. Set temperature controller in weigh tank, TIC-535.01, at 150°C. Controller to be in "auto".

2. Check Therminol cooling system.

   a. Surge tank temperature controller TICA-533.01 in "auto" with the set point at 50°C.

   b. Flow controller FICA-534.02 in "auto" with the set point at 300 GPM.

3. The Therminol heater system should be circulating at 250°C. Control point should be as follows:

   a. FIC-628.01 in "auto". Set at 300 GPM. Low flow shutdown will alarm at 200 GPM.

   b. TRCA-629.12 in "auto". Set at 250°C. Low temperature alarm at 220°C. - high temperature alarm at 300°C.

4. No. 2 blow tank temperature controller TIC-541.01 in "auto" with the set point at 240°C.

5. Open valves on steam lines to the Biphenyl and Santowax supply to the weigh tank (Item 535). Open valves in the steam lines to the coil on the weigh tank.

6. Open Therminol feeder lines to heat the following equipment:

   a. Transfer lines from weigh tank (Item 535) to the transfer pump and to No. 9 chlorinator (Item 505).

   b. Circulating line at No. 9 chlorinator through the heat exchanger (Item 538) and back to the chlorinator.

   c. Sample line at No. 9 chlorinator.

   d. Transfer line at No. 9 chlorinator to the No. 2 blow tank (Item 541).

   e. Coil in No. 2 blow tank (Item 541).

   f. Transfer line from No. 2 blow tank to the pump (Item 539).

   Observe temperature to be sure the Therminol system stays at 250°C., or returns to this temperature after the various feed lines have been started up.

7. Open water valve to S&K jet (Item 531).

8. Start the air blower (Item 530).

9. Check the suction on the No. 2 blow tank (Item 541) to be sure it is adequate for operation.

10. Open the manual valves in the water system to the Aroclor cooler (Item 507).

E. Charge Weigh Tank (Charge Tank)

1. Refer to Section 3.1-A. for the actual quantities of raw materials needed for the particular solid Aroclor to be produced.

   a. Set the valves to receive the charge from the Biphenyl or Santowax Departments. Notify the operator you are ready for a charge. Biphenyl is obtained from the No. 1 or No. 2 Biphenyl catch tanks or the Biphenyl storage tanks. Santowax R or Santowax C is obtained from the Santowax storage tanks.

   b. If Biphenyl is required, charge it into the weigh tank first to the desired weight. Close the manual valve in the charge line.

   c. If Santowax R is needed also, adjust the scale weight set point to the correct charge desired; for example, in 4065, 5,850 lbs. of Biphenyl are added and then 3,920 lbs. of Santowax R are required. Place the scale set point at 9,970 lbs.

   d. Open the manual valve in the Santowax R line.

   e. Depress the pushbutton near the scale to open the automatic valve. This will put the annunciator window light out which is marked "No. 9 Chlorinator Weigh Tank Charge Complete."

   f. Have the Santowax operator start the pump to charge the weigh tank. Santowax R is now entering the weigh tank.

g. When the measured weight approaches the set point, the automatic Santowax R control valve will close and the annunciator window marked "No. 9 Chlorinator Weigh Tank Charge Complete" will be actuated.

h. Close the hand valve in the Santowax R line.

i. Start the agitator in the weigh tank. Allow agitation to take place for a minimum of one hour. Stop the agitator just before material in the weigh tank is to be charged to the chlorinator.

j. Open manual valve on top of the weigh tank (Item 535) and add 6 pounds of Ferric Chloride. Close the manual valve after adding the Ferric Chloride.

k. The material is now ready for the next chlorinator charge when needed.

F. Charge No. 9 Chlorinator and Start Chlorination

1. Manual Operation

a. Close manual chlorine valves at distributors on No. 9 chlorinator (Item 505).

b. Close vent on No. 9 chlorinator to the atmosphere.

c. Open HCl vent valve to muriatic acid area.

d. TRCA-538.01 set in "auto" and "set". Control point set at 160°C. Low temperature alarm 120°C. - high temperature alarm 275°C.

e. FRCS-505.01 in "auto" and "set". Set point at 800 pounds per hour.

f. Set valves to allow transfer of charge from weigh tank to the No. 9 chlorinator.

Be sure to stop the agitator before starting the transfer pump.

g. Start transfer pump (Item 536). Stop pump when the weigh tank is empty.

h. Set valves to circulate chlorinator through the No. 9 chlorinator heat exchanger (Item 538) and back to the chlorinator.

i. Start circulating pump (Item 506).

j. Open manual chlorine valves at the distributors on the No. 9 chlorinator (Item 505). Chlorine header pressure control PIC-500.07 will control the pressure to 20-25 psig. A low pressure alarm is set at 15 psig - high pressure alarm at 35 psig.

k. After one hour, increase chlorine rate to 1,500 lbs./hour of chlorine feed.

l. Shut off Therminol heat circulating in the jacketed lines at the chlorinator.

m. Check the following items after the start of the chlorination:

(1) Temperature on TRCA-538.01.

(2) Therminol cooling system flow on FICA-534.02 (Aroclor 1232 system).

(3) Chlorine flow on FRCS-505.01.

(4) Circulating pump discharge pressure on No. 9 chlorinator, PI-506.01.

n. Check temperature points in the system as follows: No. 9 chlorinator temperature, TE-505.02. Temperature points in the circulating Therminol system for the No. 9 chlorinator (Aroclor 1232 system).

o. Check pump discharge pressure on the Aroclor circulating system, PI-534.01.

p. Increase temperature set points through the chlorination as is necessary to maintain the material liquid and fluid. End temperature point will be approximately 255°C. Raise set point on TRCA-538.01 as necessary to achieve desired temperature.

q. Samples are taken at the discharge line of the circulating pump (Item 506) at the second level. Depending on the material being produced, the specific gravity, softening point, or hold point are run on this batch chlorination. At the start of the chlorination, a sample should be taken after two hours of operation on odd numbered hours (7, 9, 11, etc.). Samples will be taken every two hours through the chlorination. On some of the higher chlorinated products, example 1168, samples are not taken until the chlorinator has been on for four hours.

r. When the chlorination is near completion, it may be necessary to run the softening point or hold point every ten to fifteen minutes.

s. When the chlorination has been completed (see Table I), shut off the chlorine feed valves at the distributor on the chlorinator.

t. Note the chlorine pressure on the main header. If it is above 30 psig, notify the Chlorine Plant that you have removed a chlorinator from operation. Tell them when you can start it back up. If this chlorinator is to be off for a long period of time, notify the Chlorine Plant prior to shutting off the chlorinator. *

2. Programmed Chlorinator Operation

a. Close manual chlorine valves at distributors on No. 9 chlorinator.

b. Close vent valve on chlorinator to the atmosphere.

c. Open HCl vent valve to muriatic acid area.

* Pressure controller alarm PIC-500.07 will indicate low pressure at 15 psig and high pressure at 35 psig.

d. Set TRCA-538.01 in "auto-cascade". Set point 190°C. Low temperature alarm 120°C. - high temperature alarm 275°C.

e. Set FRCS-505.01 in "auto-cascade". Set point at 1,000 lbs./hour Chlorine.

f. Adjust green set point knob on the chlorine totalizer per the Table on Page 2 for measuring the chlorine flow.

Set up flow-temp. program per Appendix I attached.

g. Check the following control instruments:

(1) Weigh tank temperature - TIC-535.01 at 150°C. Controller in "auto".

(2) Therminol cooling temperature - TICA-533.01 at 50°C. Controller in "auto".

(3) Therminol Cooling flow - FICA-534.02 at 300 GPM. Controller in "auto".

(4) No. 2 blow tank temperature - TIC-541.01 at 240°C. Controller in "auto".

h. Set valves to transfer charge from weigh tank to the No. 9 chlorinator. Start transfer pump (Item 536). Stop pump when the weigh tank is empty. Close valves.

i. Set valves to circulate the No. 9 chlorinator through the No. 9 chlorinator heat exchanger (Item 538) and back to the chlorinator.

j. Start circulating pump (Item 506).

k. Push the green reset pushbutton on the chlorinator panel for No. 9 chlorinator, (Item 505). This resets the chlorine integrator and programmer and is the initiating signal for the start of a new batch. The Flexipulse timer will begin to time the batch as indicated by cascade flow. The batch chlorine flow and temperature will be controlled according to a pre-set program. At 80% of the chlorine flow as set by the chlorine integrator, an alarm bell will ring to indicate 80% of the chlorine feed has been taken into the chlorinator.

l. Open manual chlorine valves at the distributors on chlorinator No. 9. This should be done immediately after pushing the reset button so the timer will control the batch correctly. *

m. After two hours, take a sample of the Aroclor and check for specific gravity, softening point, or hold point as necessary, depending on the Aroclor being produced. This sample is a check to be sure a short charge was not transferred into the chlorinator. The next sample after that will be taken when the 80% alarm bell rings.

n. Check the following items during operation:

(1) Temperature on TRCA-538.01.

(2) Chlorine flow on FRCS-505.01.

(3) Therminol cooling system flow through the Therminol cooling (Aroclor 1232) system on FICA-535.02.

(4) Temperature points through the system on the No. 9 chlorinator and the Therminol cooling system (Aroclor 1232).

* Chlorine header pressure control PIC-500.07 will control the pressure to 20-25 psig. A low pressure alarm is set at 15 psig - high pressure alarm at 35 psig.

o. The alarm bell will ring when 80% of the chlorine has been fed to the chlorinator. Immediately take a sample of the circulation line to determine the point which the chlorination level has reached.

p. Continue the chlorination until complete. It may be necessary to run the softening point or hold point more often during the last one to two hours of the chlorination.

q. At completion of the chlorination (See Table I), push the green reset pushbutton on the chlorinator panel for the No. 9 chlorinator. This reduces the chlorine flow to 300 lbs./hr. and stops the timer. Shut off the chlorine feed valves to the distributor at the chlorinator.

r. Note the chlorine pressure on the main header as in "Manual Operation." Notify the Chlorine Plant if the chlorinator is to be off for any length of time, or if the pressure is above 30 psig. Pressure controller alarm PIC-500.07 will indicate low pressure at 15 psig - high pressure at 35 psig.

s. If the chlorination is complete, prepare to pump to the No. 2 blow tank. See next section of Operating Instructions.

G. Transfer to No. 2 Blow Tank and Air Blow

1. Set transfer lines to pump to the No. 2 blow tank (Item 541). Be sure Therminol heat is on jacketed lines.

   The chlorinator is vented to the HCl line.

2. Check the level indication instrument, LI-541.02, to be sure there is enough room to transfer into the blow tank.

3. Change final valve in the transfer line and allow material to pump from the No. 9 chlorinator to the No. 2 blow tank. Observe transfer and note level increase in the No. 2 blow tank by LI-541.02. At the completion of the transfer, close valves in the circulating system and shut off the circulating pump (Item 506) on the No. 9 chlorinator.

4. The chlorinator is now ready to charge back for the next chlorination.

5. Record transfer information on the chlorinator data sheet and in the log book. Normal blow tank innages after a single transfer for the following Aroclors are:

Crude Aroclor	Blow Tank Innages %
2565	
5060	
4065	
5042	
1168	

3.2 Routine Operations

During normal operations of the weigh tank, No. 9 chlorinator, and No. 2 blow tank system, the following conditions will exist in the process.

A. Therminol Heater

1. Flow through the Therminol heater system will be indicated on FIC-628.01, 300 GPM normal. Low circulation shut down set at 200 GPM. This will alarm at the annunciator.

2. TRCA-629.12 controls the temperature of the Therminol heating system. Set point normally at 250°C. Low temperature alarm set at 220°C. - high temperature alarm set at 300°C.

B. Weigh Tank

1. Assuming a batch is charged into the weigh tank ready for the chlorinator, the following conditions will exist in the control room. The annunciator panel will indicate "No. 9 Chlorinator Weigh Tank Charge Complete."

2. The control valve in the Santowax R charge line will be closed.

3. TIC-535.01 will be controlling the temperature in the weigh tank at 150°C.

4. Temperature on the Multipoint Recorder, TW-535.02, will indicate 150°C.

5. The agitator will be running to keep the Ferric Chloride in suspension.

6. The transfer pump will be shut off.

C. No. 9 Chlorinator

1. Chlorine flow will be indicated on FRCS-505.01. If in "cascade-auto" control, the Taylor Flexipulse Timer will be controlling the flow by program system.

2. Temperature will be controlled by TRCA-538.02. With the system in "cascade-auto", the temperature will be controlled by a pre-set program. Initial starting temperature of 160°C.; completion temperature 255°C.

3. No. 9 chlorinator circulating pump will be in operation. The discharge pressure on this pump will be indicated by PI-506.01. Normal pressure 30 psig.

4. The Therminol cooling system (Aroclor 1232) should have the following checks:

   a. Flow will be indicated by FICA-534.02. Normal set point 300 GPM. Low flow alarm set at 250 GPM.

   b. Temperature in the circulating system is indicated by TIC-533.01. Normal indication is 50°C. Low temperature alarm set at 40°C. - high temperature alarm set at 60°C.

c. Surge tank Therminol level (Item 533) should be above the steam coils.

d. The Therminol cooling system pump discharge pressure should be 40 psig.

5. Temperature of the No. 9 chlorinator can also be observed on the Multipoint temperature recorder.

D. No. 2 Blow Tank

1. Temperature will be indicated by TIC-541.01. Normal sat point 240°C.

2. Level in the No. 2 blow tank will be indicated by LI-541.02. Normal level with a full charge is 85%.

3. Water valve should be open to the S&K jet providing suction on the No. 2 blow tank.

4. The air blower (Item 530) should be operating with a discharge pressure of 10 psig.

E. Data Sheets

A solid Aroclor system data sheet is available for the weigh tank, No. 9 chlorinator, and the blow tank. Filling out this sheet is a normal portion of the operator's duties during the shift.

3.3 Safety Features

A. The weigh tank (Item 535) has an interlock system which will not allow starting the transfer pump (Item 536) when Santowax R is being charged into the weigh tank. This interlock is to assure that an overcharge of Santowax cannot be made to the No. 9 chlorinator. A high weight alarm set at 15,000 pounds will sound for an overcharge.

B. A high temperature alarm is set at 275°C. on the No. 9 chlorinator (Item 505) to prevent excessive carryover of trappings into the HCl offgas header. Temperatures above this should cause excessive carryover of Santowax and/or crude Aroclor. A low temperature alarm is also provided at 120°C. to prevent production of unstable Aroclors.

C. Chlorine flow stops will be placed on the chlorine flow control valve to the No. 9 chlorinator set at 300 pounds per hour to prevent shutting off the chlorine feed in cases of air failure to the control valve. The control valve normally closes on air failure. This is for protection of the Chlorine Plant.

D. If Biphenyl is required for the chlorinator charge, it should be charged into the weigh tank first to the desired weight. The Santowax R or Santowax C should be charged on top of the Biphenyl since the scale weight set point will close the control valve in the Santowax R line only. This will allow more accurate weight control to the chlorinator batches.

E. The Therminol heating circulation system has several safety features which can be found in the P.F.O. for this heater system.

F. Check the level in the Therminol cooling system surge tank (Item 533) to be sure the Therminol level is 6" above the coil level in the tank.

G. The valves to the coil in the No. 9 chlorinator (Item 505) will normally be tagged out. These valves will not be opened unless there is a specific need for heat on the coil. It may be necessary to leave the discharge valve on the coil open slightly to allow for expansion of the Aroclor in the coil during the chlorination process. This will be determined at a later date.

H. The valves in the Therminol heating system to put heat on the No. 9 chlorinator heat exchanger (Item 538) will normally be tagged out since this heat exchanger is used for cooling. The Therminol heating system is available only for cases of unplugging the heat exchanger.

I. A sight glass has been placed in the HCl offgas line of the No. 9 chlorinator to allow observation of the flow for possible entrainment. In case entrainment droplets are noticed being carried out in the HCl gas, the chlorine flow should be decreased slightly to reduce this entrainment. Excessive entrainment carryover will cause plugging of the HCl offgas line.

J. In case the chlorine flow control valve cannot be made to work, a U-tube manometer containing 60° Baumé sulfuric acid (98%) has been placed on the chlorine header. The pressure in this manometer should be noted during normal operations. This will provide a reference to let the operator know what the chlorine flow is in cases of failure of the flow meter. A chart of chlorine flow vs. pressure will be in the Operating Manual. A solid chlorinator batch could be completed using this pressure manometer if the need should arise.

K. When the chlorine and temperature programmed control system is in operation, the preset program should not be disturbed since this can cause excessive chlorine flow or temperature problems to result.

L. Normally, when the programmed flow control system is in operation, a sample of the material being chlorinated will be taken after two to four hours of operation. This sample is taken to assure a short charge has not been made to the No. 9 chlorinator. The sample should be checked for specific gravity, softening point, or hardening point, depending on the material being produced. If this sample indicates a normal batch, the next sample would be taken when the 80% bell rings as preset by the chlorine flow integrator. This sample is to assure a batch is not over-chlorinated and sets up in the chlorinator preventing its transfer to the blow tank and/or to the still.

3.4 Shutdown

Operations of the weigh tank, the No. 9 chlorinator, and the No. 2 blow tank can occur which will cause temporary or prolonged shutdowns. The following detailed information concerns individual shutdowns of each of the above items. If the entire system is to be shut down, the various sections can be combined to achieve this objective. Dependent on the

reason for the shutdown, it may be necessary to shut down the Therminol heating system to make the system safe. This must be considered, depending on the situation.

A. Weigh Tank (Item 535)

1. Temporary Shutdown

a. Close the manual valves in the Biphenyl and Santowax supply lines to the weigh tank.

b. Close the valve at the bottom of the weigh tank and at the discharge of the transfer pump.

c. Leave TIC-535.01 in "auto" with set point at 150°C.

d. Leave Therminol heat on the transfer lines to the No. 9 chlorinator.

e. The agitator and pump will normally be shut down unless in use.

2. Prolonged Shutdown

a. Close the manual valve in the Biphenyl and Santowax supply lines to the weigh tank.

b. Close the valve at the bottom of the weigh tank and at the discharge of the transfer pump (Item 536).

c. Move the weigh tank temperature control TIC-535.01 set point to 0°C. Close the manual valve in the steam supply line.

d. The agitator and transfer pump will be shut off.

e. Close the valves in the Therminol heating system lines for the charge tank transfer lines. Close valves in steam supply to Biphenyl and Santowax lines.

f. The tank may or may not be empty, dependent on the work to be done or the cause for shutdown.

g. Note shutdown information on data sheet.

f. Drain the charge tank if necessary for repair work.

g. Leave the system in this condition until needed.

h. Note shutdown information on data sheet.

B. No. 9 Chlorinator (Item 505)

Operations can occur which will require a chlorinator to be cut back or temporarily shut down. Some of these items are failure of chlorine feed, a tank car emptying, or a cut back of the Chlorine Plant. Normally, if a partial reduction in the chlorine feed occurs, the batch liquid chlorinators will be shut off and the No. 9 chlorinator will continue to be operated.

1. Temporary Shutdown

a. The circulating pump (Item 506) will normally be left in operation.

b. Close the chlorine valves at the distributor on the No. 9 chlorinator.

c. Check the chlorine header pressure and rotameter feed to the other chlorinators. It should be 20-25 psig.

d. Check to see that liquid chlorine is beind fed to the vaporizer and that steam is on the vaporizer. Steam pressure should be 10 psig. Discharge pressure on the vaporizer should be 1-2 psig greater than the pressure on the chlorine header (normally 20-25 psig).

e. Notify the Chlorine Plant of the problem and see if they have shut down or cut back.

f. If the shutdown is to be longer than two hours, it may be necessary to put Therminol heat on the No. 9 chlorinator circulating lines to keep the temperature at 120°C. minimum. Normally, the circulating pump will continue to run.

Use Therminol heat on the coil of the chlorinator as a last resort.

g. Shutdowns should be minimized. If the cause of the cut back can easily be remedied, start the chlorinator back immediately.

h. Leave the Therminol cooling system circulating.

i. Leave the Therminol heating system circulating on the jacketed lines.

j. Notify your chief operator or department supervision immediately in case of a problem.

k. Note shutdown information on data sheet.

2. Prolonged Shutdown

a. Normally, when a chlorinator will be left down for a period longer than a few hours, the chlorination will be completed and the batch pumped out prior to shutdown. If Maintenance personnel are to work on the chlorinator, it may be necessary to vent the vessel and purge the chlorine lines and the chlorinator tank with CO_2.

NOTE: In case of a complete shutdown for maintenance work, the chlorine valves on the main header to the chlorinator will be tagged, the transfer lines into the vessel, and the Therminol heating system valves to the chlorinator coil. The circulating pump circuit breaker box switch will also be tagged out.

b. Empty chlorinator by pumping it out. Then shut off the circulating pump. Drain the chlorinator.

c. Close chlorine valves at distributor on No. 9 chlorinator.

d. Check chlorine header pressure as in Item 1c above.

e. Close the HCl vent valve on the chlorinator to the HCl header.

f. Notify the Chlorine Plant of the problem if this is to be a prolonged shutdown and it causes an increase in the chlorine header pressure.

g. Notify your chief operator or department supervision the vessel is shut down.

h. Shut down the Therminol cooling system by:

(1) Shut off circulating pump (Item 534).

(2) Leave FICA 534.02 in "auto" with set point at 300 GPM.

(3) TICA-533.01 will be in "auto" with the set point at 50°C.

(4) Leave the steam on the surge tank (Item 533). This will keep the system ready for use.

(5) In case the Therminol cooling system must be worked on, it may be necessary to drain the system. If this should occur:

(a) shut off the steam to the surge tank;

(b) water to the cooler (Item 507);

(c) tag out the circulating pump (Item 534) circuit breaker; and

(d) tag out the Therminol heating valves to the No. 9 chlorinator heat exchanger system.

i. Note shutdown information on the date sheet.

C. No. 2 Blow Tank (Item 541)

1. Temporary Shutdown

a. Close the valve at the bottom of the No. 2 blow tank (Item 541).

b. Close the discharge valve on the transfer pump (Item 539).

c. Transfer pump will be shut off.

d. Adjust TIC-541.01 set point at 250°C. Leave in "auto".

e. The air blower will continue to run.

f. Water will remain on the S&K jet (Item 531).

g. The system will be left in this condition until need to start back up.

2. Prolonged Shutdown

a. Normally, if this vessel is to be shut down for any length of time, the material in the tank will be emptied.

b. Close the valve at the bottom of the weigh tank and at the discharge of the transfer pump (Item 539).

c. Shut off the transfer pump (Item 539).

d. Adjust TIC-541.01 controller to 0°C. Close the manual valve in the Therminol heating system to the coils on the No. 2 blow tank and tag out valves.

e. Shut off the air blower (Item 530).

f. Shut off water to the S&K jet (Item 531).

g. Leave the system in this condition until necessary to start back up.

D. Emergency Shutdown

Normally, an emergency shutdown does not occur concerning the weigh tank (Item 535) or the No. 2 blow tank (Item 541). However, emergencies can occur which make it necessary to shut down the No. 9 chlorinator as fast as possible. The following methods can normally be used.

1. From the Field

   a. Close the manual chlorine valves to the distributor, or the manual valve from the chlorine header feeding the No. 9 chlorinator.

   b. Shut valve in HCl pipe line to the Muriatic Acid Department.

   c. Stop circulating pump (Item 506), if necessary.

   d. Dependent on the emergency situation which has occurred, continue to shut this system down systematically by normal procedure.

2. At the Panel

   a. Stop chlorine feed to the No. 9 chlorinator. This will be done as follows, dependent on operation:

      (1) Manual Operation

      Controller FRCS-505.01 in "auto". Move chlorine flow controller set point to zero. This will reduce chlorine flow to 300 lbs./hour to the No. 9 chlorinator.

      Immediately go into the field and shut off manual valves feeding this chlorinator.

      (2) Programmed Operation

      Move controller FRCS-505.01 set points from "cascade" to set.

      Next, adjust set point on chlorine feed to zero. Proceed as in Item (1) above.

   b. Shut valve in HCl pipe line to the Muriatic Acid Department.

c. Stop the circulating pump (Item 506) if necessary.

d. Continue shutdown of this unit as is necessary to handle the emergency which has occurred.

3. Emergency Shutdown Therminol Cooling System for No. 9 Chlorinator

a. Stop circulating pump (Item 534).

b. Close manual valves as necessary in the system.

c. The pump can be shut off in Item a. above at the pump itself or at the motor control center circuit breaker.

3.5 Control Loops, Interlocks, and Alarms

A. Control Loops

There are 9 major control loops in this system.

1. Weigh Tank Scale Loop - 544

The function of this loop is to allow setting the scale by the adjustable set point for Santowax R charges. When the material reaches the desired weight, it automatically closes the control valve in the feed line to the weigh tank and rings an alarm bell indicating "No. 9 Chlorinator Weigh Tank, Charge Complete." During charging of the weigh tank, the transfer pump (Item 536) cannot be started. In case the weigh tank is overcharged, an alarm horn will sound at 15,000 lbs. This should allow approximately 5 minutes before the tank will overflow.

2. Weigh Tank Temperature Control - TIC-535.01

The function of this loop is to maintain a constant temperature of 150°C. in the weigh tank. This is accomplished by measurement of the temperature and controlling the heat input by throttling a control valve in the steam line to the coil on the weigh tank.

3. No. 9 Chlorinator Chlorine Flow Control - FRCS-505.01

The function of this loop is to control the chlorine flow to the No. 9 chlorinator to regulate the chlorination rate. This is accomplished by measurement of the chlorine flow with an orifice and controlling this flow with a control valve in the chlorine feed line. This system can be operated manually, automatically on chlorine feed control, or by a preset programmed chlorine feed control.

a. Manual Control

The chlorine flow controller FRCS-505.01 is positioned in "manual-set". The set point is regulated to give the desired chlorine flow to the No. 9 chlorinator.

b. Automatic Flow Control

The No. 9 chlorinator chlorine flow controller FRCS-505.01 is positioned in "auto-set". The chlorine feed desired is set on the controller which will maintain this chlorine feed by adjusting the control valve as required.

c. Programmed Flow Control

The chlorine flow controller has the set points in "auto-cascade". The chlorine integrator set point is adjusted for the desired chlorine alarm level dependent on the product being produced. The dial reads 0-375 and has a multiplier of 100. The range represents 0-37,500 lbs. of chlorine. When the desired quantity of chlorine has entered the chlorinator, an alarm bell will ring and an annunciator light will flash indicating "No. 9 Chlorinator, 80" Chlorinated." The totalizer settings as listed can be used with the automatic flow control above if the controller is not in "cascade". It must be reset by pushing the green set button. When the controller is in "cascade", the Taylor Flexipulse Timer will, by a predetermined program, (See Appendix I), change the chlorine flow rate to the No.9 chlorinator. The chlorine flow program is set by

turning the knob on each flow profile set point. This program, once set up, should not be disturbed without consulting supervision.

4. No. 9 Chlorinator Temperature Control - TRCA-538.01

The function of this loop is to provide temperature control of the chlorination batch in the No. 9 chlorinator. This is accomplished by measurement of the temperature in the crude Aroclor circulating line at the heat exchanger and controlling the Therminol cooling system to the shell of this heat exchanger (Item 538). The temperature controls can be operated manually, automatically, or by a predetermined program temperature profile. The temperature system has a low temperature alarm at 120°C. - a high temperature alarm at 275°C. Range of the instrument is 0-300°C.

a. Manual Control

The temperature controller TRCA-538.01 will be in "manual-set". Circulating of the Therminol cooling system across the No. 9 chlorinator heat exchanger can be controlled manually by adjusting the control valve with TRCA-538.01 set point. Adjust until the desired temperature is acquired.

b. Automatic Control

The temperature controller TRCA-538.01 is in "auto-set". The controller set point is adjusted to the desired temperature. It will automatically adjust the control valve to maintain the temperature as set.

c. Programmed Temperature Control

The temperature controller is placed in "auto-cascade". The chlorination temperature time profile is adjusted to the desired temperature by turning the knob on each temperature profile set point. A predetermined program is

set up on the Taylor Flexipulse Timer. After start of the program, the Flexipulse Timer will automatically advance through the temperature profile as set up by the program. These set points will be directed to the programmer only if TRCA-538.01 is in "auto-cascade".

5. Chlorine Header Pressure Control - PIC-500.07

The function of this loop is to maintain the chlorine header pressure to the Aroclor chlorinators within a range of 20-25 psig. This is accomplished by measuring the chlorine header pressure and throttling a control valve in the discharge from the chlorine vaporiser to maintain the chlorine header pressure within ± 1 psig of the set point. A low pressure alarm is set at 15 psig and a high pressure alarm at 35 psig.

6. Therminol Cooling System Flow Control - FICA-534.02

The function of this loop is to maintain a constant flow of 300 GPM in the Therminol cooling system. This is accomplished by measurement of the flow with an orifice flow meter and adjusting a control valve to automatically bypass the No. 9 chlorinator heat exchanger (Item 538). Flow through the No. 9 heat exchanger is regulated by the temperature control TRCA-538.01. Normal operation of the system is with the controller in "auto" and the set point at 300 GPM. A low flow alarm will sound at 250 GPM.

7. Therminol Cooling System Temperature Control - TICA-533.01

The function of this loop is to control the Therminol cooling system (Aroclor 1232) in the surge tank (Item 533) at 50°C. This is accomplished by measurement of the discharge temperature from the Therminol water cooler (Item 507) and automatically throttling the water flow on the shell side of the cooler (Item 507). The low temperature alarm on this system is set at 40°C. - the high temperature alarm is set at 60°C.

8. Therminol Surge Tank Temperature Control - TC-533.01

The purpose of this temperature control loop is to maintain a constant temperature of 45°C. in the Therminol cooling system surge tank (Item 533). This is accomplished by measurement of the temperature and throttling a control valve in the steam line to the coil on the surge tank. Set point of this controller is 45°C.

9. No. 2 Blow Tank Temperature Control - TIC-541.01

The function of this loop is to maintain a constant temperature of 240°C. in the No. 2 blow tank. This is accomplished by measuring the temperature in the blow tank and throttling the control valve in the Therminol heating system (Aroclor 1248) to the coils in the No. 2 blow tank. There are no alarms in this system.

10. No. 2 Blow Tank Level Indication - LI-541.02

This loop measures the level of crude Aroclor in the No. 2 blow tank. This is accomplished by use of a bubbler differential pressure level indication instrument. A 0-100% dial indicates the tank level.

B. Interlocks

There is one interlock in this system.

1. Weigh Tank System

The Santowax transfer pump (Item 536) cannot be started while Santowax R is being filled into the weigh tank. This interlock is energized when the control valve in the feed line is open.

C. Alarms

The following alarms exist through this system.

1. Weigh Tank (Item 535)

   a. When the measured or preset weight approaches the set point on the scales, an alarm bell will sound indicating "No. 9 Chlorinator Weigh Tank, Charge Complete." This alarm is on the chlorinator annunciator panel.

   b. A high weight horn alarm will sound if the weigh tank is filled above 15,000 lbs. This horn indicates there is approximately 5 minutes before the tank will overflow.

2. No. 9 Chlorinator System (Item 505)

   a. Chlorine Flow Alarm

      (1) If the chlorine integrator is being used, an alarm bell will ring when the batch is 80% chlorinated. The chlorine set point for the integrator depends on the crude Aroclor being produced.

   b. Temperature Alarms

      Abnormal temperature alarms are set for a low chlorination temperature of 120°C. and a high temperature of 275°C.

   c. Chlorine Header Pressure Alarm

      The chlorine header pressure will sound an alarm at a low pressure of 15 psig and a high pressure of 35 psig. This will actuate an annunciator on the chlorinator panel indicating "High/Low Chlorine Header Pressure."

   d. Low Flow Alarm

      A low flow alarm will sound in the Therminol cooling system (Aroclor 1232) if the flow falls below 250 GPM. This alarm is on the chlorinator annunciator panel.

e. Abnormal exit temperatures on the Therminol (Aroclor 1232) cooling system from the cooler (Item 507) will sound an alarm. The low temperature alarm is set at 40°C. and the high temperature alarm at 60°C.

f. An annunciator will sound in case the instrument air compressor motor should stop. This will indicate air failure in the department and will necessitate a shutdown of the equipment.

IV. COMMENTS ON PROCESS

A. Special flexible piping joints have been made to the weigh tank (Item 535) since this tank is placed on scales. Actuation of the scale system will require movement of this tank approximately 1/4". These flexible piping joints should be carefully inspected to be sure there are no leaks since the material contained in them is extremely hot. During weighing of the raw material charge, the operator should be careful to eliminate problems with excessive movement of the scale.

B. 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 process vessels have Therminol heat until the end of the process at the flaker hold tank.

C. The transfer pump (Item 536) for the weigh tank has steam on the Tharmon-traced and insulated section of the casing of the pump.

D. The Therminol heating system has been provided for this solid Aroclor facility to eliminate use of gas torches on vessels and pipe lines. Problem areas should be noted immediately so that alterations can be made to achieve this goal.

E. Care must be taken not to fill the Therminol cooling system surge tank (Item 533) too full during normal operation. This can cause the tank to run over when the circulating pump is stopped. The normal level will be 6" to 12" above the tank coils. The level in this tank will vary, dependent on the operating temperature of the system.

F. A change in the operating process has been made for the No. 9 chlorinator. It does not have a basket of iron turning. Due to this change, it is absolutely necessary that 15 lbs. of Ferric Chloride be added to each chlorinator charge in the weigh tank.

APPENDIX I

PROPOSED TEMPERATURE AND CHLORINE FLOW PROFILES FOR PROGRAMMED AROCLOR 5060 CHLORINATION

1. CHLORINE INPUT - FLOW RECORDER CONTROLLER (FRCS-505.01)

First 6 Minutes 300 Lbs./Hr. of Chlorine

One Hour @ 1,000 Lbs./Hr.

Second Hour @ 1,500 Lbs./Hr.

Third and Subsequent Hours Until End of Batch

@ 2,000 Lbs./Hr.

2. TEMPERATURE CONTROL - TEMPERATURE RECORDER CONTROLLER (TRCA-538.01)

First Hour	@	160°C.
Second 2 Hours	@	190°C.
Third 2 Hours	@	200°C.
Fourth 2 Hours	@	210°C.
Fifth 2 Hours	@	230°C.
Sixth 2 Hours	@	240°C.
Seventh 2 Hours	@	250°C.
Eighth 2 Hours	@	255°C.

3. CHLORINE INTEGRATOR SETTINGS FOR 80% OF CALCULATED INPUT BASED ON 100% CHLORINE AND 90% CHLORINE

Aroclor Product	100% Chlorine	90% Chlorine
1168	29,800	33,100
2565	30,200	33,500
4065	27,700	30,700
5042	14,250	15,800
5060	24,500	27,200

APPENDIX II

ITEM 622: THERMINOL CIRCULATING TANK FOR NO. 4 AROCLOR STILL CONDENSER COOLING SYSTEM

		Tank Innage	
Reading No.	Aroclor Drums Added	Stick Measurement* Inches	Level Gauge* Measurement - Inches
1.			
2.			
3.			
4.			
5.			
6.			
7.			
Total			

Drum Weight After Empty Less Tare _____ lbs.

* NOTE: All stick measurements are to be made from the top face of the nozzle used for this purpose.

MEASURE the tank innage on the level gauge from the bottom flange of the gauge.

Make a special note when the dish is full and the tank is filled half way.

APPENDIX III

ITEM 533: THERMINOL CIRCULATING TANK FOR NO. 9 CHLORINATOR COOLING SYSTEM

Reading No.	Aroclor Drums Added	Tank Innage: Stick Measurement* Inches	Tank Innage: Level Gauge* Measurement - Inches
1.			
2.			
3.			
4.			
5.			
6.			
7.			
Total			

Drum Weight After Empty. Less Tare _____ lbs.

* NOTE: All stick measurements are to be made from the top face of the nozzle used for this purpose.

MEASURE the tank innage on the level gauge from the bottom flange of the gauge.

Make a special note when the dish is full and the tank is filled half way.

APPENDIX IV

METHOD OF RUNNING SPECIFIC GRAVITIES

1. Catch representative sample of material in metal cylinder provided for this purpose. On the chlorinators, the sample point is at the discharge of the circulating pump. Excess material is returned to the suction of the pump through a special pipeline.

2. Take sample to the control room.

3. Allow water to run down outside of the cylinder while stirring sample vigorously until the sample is 10°C. above the temperature at which the sample is run. See Table I, Page 2.

4. Cut off the water when the sample is 10°C. above the desired temperature. Keep stirring until the sample is 1°C. above the temperature which the sample is to be run. Stop stirring. Allow the hydrometer which has been thoroughly cleaned to sink into the sample until it reaches equilibrium.

5. Observe reading on the hydrometer. Record hydrometer reading on the operating data sheet, along with the time the sample was taken.

6. In case the temperature was off 1° or 2° when the reading was taken, a correction can be applied. It is 0.001 specific gravity units per °C. If the sample was 2°C. high, add 0.002 specific gravity units to the reading. If the sample was 2°C. low, subtract 0.002 specific gravity units from the reading.

7. Carefully clean the hydrometer and thermometer. Place them in the rack provided for this purpose. Dump sample in the return line to the chlorinator pump.

APPENDIX V

METHOD OF RUNNING HOLDING POINTS

1. Obtain representative sample of material from sample line at pump discharge line. Catch sample in a pint can.

2. The receptacle for running the sample is 1" x 4-1/2" Pyrex tube, sealed at one end. The tube is inserted in a square 8-oz. bottle which is insulated in the bottom by a layer of 1" asbestos fibre. The tube is held in place by a large cork. Insulation is used in an effort to keep the Aroclor from cooling too rapidly.

3. Pour the material into the tube until it is filled within 1-1/2" of the top.

4. Material will probably crystallize in the cold tube and will have to be melted again.

5. When the material is melted, insert a suitable thermometer (0-360°C.) which is fitted with a cork to hold it in place. The bulb of the thermometer should be fitted in the center of the sample, care being taken that it is not too close to the side of the tube.

6. Heat the tube to 200°C., place it in the asbestos jacket, then put it in the bottle.

7. Take readings on the thermometer every 30 seconds. At first the temperature will drop rapidly (4-6°C. between readings). This drop will decrease and finally come to a stop and stay constant for several readings, or will start to go back up several degrees.

8. Record the point at which the temperature remains constant, or in case of a rise, the highest point of the rise is the hold point of the material.

APPENDIX VI

METHOD OF RUNNING SOFTENING POINTS

1. Obtain representative sample of material from sample line at discharge of circulating pump. Catch the sample in can lid or Pyrex beaker.

2. Heat ring and sample.

3. Place ring on can lid or metal plate and fill with sample until material stands slightly higher than edge of ring. Fill the ring from the large diameter side.

4. Cool the ring and lid from bottom of the side until sample sets up, being careful not to get any water on top of the sample.

5. Finish cooling by running water on top of the sample after it sets up.

6. Remove filled ring from lid and trim off any material that is on the outside.

7. Make slight indentation on top of the sample in the center of the ring with a heated wire to hold the ball in place.

8. Fill beaker with water or glycerin.

   a. Use water when expected softening point is under 80°C.

   b. Use glycerin when expected softening point is over 80°C.

9. Place the ring in the sample holder, place ball on sample, and put holder in the beaker.

10. Adjust the thermometer in the holder so that the tip of bulb protrudes 1/4" through the hold in the crossbar that holds sample.

11. Place the beaker on a stand with screen under it and set burner under the stand.

Week of June 28 & July 5, 1965

SECOND DAY

Time	Topic	Instructor
7:00 - 8:00 a.m.	Review of Previous Day's Training	Williams
8:00 - 9:00	Detailed Operator Review of Operating Instructions	Molloy
9:00 - 9:15	Break	
9:15 - 11:00	Field Tour Detailed Operator Review of Operating Instructions	Molloy & Williams
11:00 - 11:30	Lunch	
11:30 - 12:30 p.m.	Review HCl Facilities Instrumentation & Setting of Flow Control System	Molloy
12:30 - 1:30	Detailed Operator Review of Operating Instructions & Instruments	Haupt
1:30 - 1:45	Break	
1:45 - 2:30	Field Tour Review Afternoon Training in Detail	Haupt & Williams
2:30 - 3:00	Question & Answer Period Check-Out Procedures Review	Haupt

MURIATIC ACID START-UP TRAINING PROGRAM

WEEK OF JULY 12, 1965

MONDAY - TUESDAY

Time	Topic	Instructor
7:00 a.m. - 3:00 p.m.	Start Equipment Check-Out New Absorber Carbon Towers Surge Tanks Filter Location Storage Tanks Pumps Instrument Panel Water Batch Equipment	Haupt Molloy Williams Madison

WEDNESDAY

7:00 a.m. - 7:00 p.m.	Department shut down for change-over to start up with Chemicals. Continue Check-Out Program	

THURSDAY

7:00 - 10:00 a.m.	Charge System with Chemicals. Take readings on start-up of new System. Check Muriatic Acid production at tower. Sewer Acid until quality material is being produced.	Molloy
10:00 - 11;30	Have Tower Production Analyzed by Lab.	
11:30 - 12:00	Start flow to Carbon Towers & Filter. If material is a quality product, start collecting in a storage tank. Continue operations & development of operator knowledge of instrument system for Muriatic Acid Tower operation. Shift coverage will last two days during this time.	

AROCLOR-MURIATIC ACID START-UP TRAINING PROGRAM

WEEK OF AUGUST 23, 1965

Typical 4 Hour Training Program
Four Shift Crews to be Trained

Time	Topic	Instructor
12:00 - 1:00 p.m.	Process Flow Review & Detailed Operating Instructions for HCl Clean-Up Facilities	Williams
1:00 - 1:30	Question & Answer Period	Haupt
1:30 - 1:45	Break	
1:45 - 3:00	Field Tour - Detailed Instructions & Field Instrumentation Review by Operators	Haupt & Williams
3:00 - 4:00	Review Safety Features Question & Answer Period	Molloy

AROCLOR-MURIATIC ACID START-UP TRAINING PROGRAM

WEEK OF AUGUST 30, 1965

MONDAY & TUESDAY

Time	Topic	Instructor
7:00 a.m. - 3:00 p.m.	Start Equipment Check-Out:	Haupt
	Condensers	Molloy
	Transfer Pump	Williams
	Tank	
	Piping System	
	Instrumentation	
	Water Batch Equipment	

WEDNESDAY

7:00 a.m. - 3:00 p.m.	Department shut down for tie-in of New Equipment	
	Start up as soon as HCl gas is available.	

SHIFT LEADERS TRAINING

Tuesday, March 30

7:00 - 3:00	Attend Second Shift of Operator Training	

Wednesday, March 31

8:00 - 10:00	Process and Equipment Overview	R. S. Yates
10:00 - 11:30	Field Trip Covering Same Areas As Classroom Discussion	
11:30 - 12:00	Lunch	
12:00 - 3:00	Process, Equipment, and Instrument Overview	R. S. Yates and R. N. Harris
3:00 - 4:00	Field Trip	
4:00 - 5:00	Recap and Discussion of Day's Discussion	R. S. Yates R. N. Harris J. W. Molloy

Thursday, April 1

	Instructors	R. S. Yates and R. N. Harris
8:00 - 10:00	Process & Equipment Specifics: a. Therminol Heater Furnace b. Therminol Heater Furnace Controls c. Therminol Circulating System Above to cover equipment design, safety features, initial start-up, normal start-up, emergency shutdown, normal shutdown, and normal operating procedures, as well as check points.	

10:00 - 10:15	Break	
10:15 - 11:30	Continue 8-10 a.m. Discussion with Field Trip	
11:30 - 12:00	Lunch	
12:00 - 2:00	Solid Aroclor System Specifics: a. Charge Tank b. Chlorinator and Chlorinator Cooling System c. Blow Tank	
2:00 - 2:15	Break	
2:15 - 3:30	Field Trip (Alternate:	Continue Discussion of 12:00-2:00 p.m.)
3:30 - 4:30	Recap of Day's Discussion and Introduction of Friday's Lesson	
6:00 - 9:30	Dinner Meeting	

Friday, April 2

Instructors — R. S. Yates and R. N. Harris

8:00 - 10:00	Process & Equipment Specifics: a. Blow Tank Scrubber & Air Supply b. Still c. Still Furnace
10:00 - 10:15	Break

10:15 - 11:30	c. Still Furnace (Continued) d. Still Condaneer and Cooling System
11:30 - 12:00	Lunch
12:00 - 1:00	Still Jet System
1:00 - 3:00	Field Trip Covering Day's Discussion and Still Receiver
3:00 - 4:00	Recap of Day's Discussion Including Still Receiver and Where Material Goes
4:00 - 4:30	Discussion Period for Review of Overall Solids System, Including Therminol Heater and ALL Controls on Instrument Panel

Saturday, April 3

8:00 - 4:30	Instruction for Group on Instrument Panel. Primary Emphasis on Field Instruction

SHIFT LEADERS TRAINING

Week of April 5

Shift leaders to participate in training hourly crews Monday through Saturday.

Shift leaders meeting 4:30 p.m. each day.

Week of April 12

Shift leaders participate in training hourly crews Monday through Saturday.

Shift leaders meeting 4:30 p.m. each day.

Week of April 19

Participate in hourly training for four shifts.

Shift leader review meeting Friday, April 23 - all day - to discuss progress and problems to date.

Shift leaders meeting each day at 4:30 p.m.

Week of April 26

Shift coverage to start for start-up of Therminol system.

Start-up - process simulation of solids system - will occur late in the week.

SHIFT LEADER TRAINING

Week of May 3

1. Solid Aroclor system demonstration
2. Each shift leader to have one shift of training on liquid Aroclor system during this week.

Week of May 10

1. Solid Aroclor system demonstration
2. Shift leaders to participate in hourly shift training one shift this week.

Week of May 17

1. Solid Aroclor system demonstration
2. Each shift leader to have one shift training on continuous blow tank and new No. 3 receiver this week.

Week of May 24

1. Solid Aroclor system demonstration
2. Conclude shift work this week.
3. Each shift leader to have one shift training in HCl system.

Week of May 31

1. Three shifts of training on HCl absorber.
2. Wrap up demonstration reports on solids system.

SHIFT LEADER TRAINING

Week of June 7

1. Participate in hourly training for HCl absorber
2. Participate in hourly review training for solids system, continuous blow tank, air-cooled heat exchangers on liquid chlorinators

Week of June 14

Shift supervisors return to regular jobs for this week.

Week of June 21

Participate in hourly HCl training

Week of June 28

HCl tie-in and process simulation

SHIFT LEADER TRAINING

Week of July 5

HCl system start-up

Week of July 12

Participate in hourly review training covering solid and liquid system and HCl absorber

SHIFT LEADERS TRAINING

SCHEDULE FOR ALL DAY SESSION

April 23, 1965

8:00 - 9:00 a.m.	Group discussion (in TSD trailer) led by Vince Haupt covering Therminol Heater
9:00 - 10:00	Group discussion led by Jack Molloy covering solid Aroclor system, including sampling and other in process controls
10:00 - 10:15	Break
10:15 - 10:45	Demonstration of field test for free chlorine in chlorinator off-gas by Norman Madison
10:45 - 11:30	Group discussion of instrument system capabilities, limitations, and diagnostic methods led by Dick Harris
11:30 - 12:00	Lunch
12:00 - 12:30 p.m.	Summary of changes being made to liquid Aroclor system by Bob Yates
12:30 - 2:00	Discussion of process chemistry, research history, and questions relating to research - led by Roger Bucknell
2:00 - 4:00	Field review of process by entire group
4:00 - 4:30	Summary (in trailer)

Those Attending:

J. W. Molloy	M. J. Williams	Dick Harris
J. G. Bryant	V. R. Haupt	
Wendell Ellis	R. S. Yates	
N. K. Madison	R. W. Bucknell	

OVERALL OBJECTIVES

I. OBJECTIVE

A. This project is intended to successfully complete, staff, start-up, and demonstrate a plant which will consistantly produce 10 million pounds per year of solid Aroclors, 36 million pounds per year of liquid Aroclors, and recovery of 90% of available HCl offgas as Muriatic Acid, which meets or surpasses our present specification for Sales. The foregoing is to be accomplished within the prescribed time and money budgets and in such a menner that the normal manufacturing cost shall meet established cost standards.

B. Start up in sequence of greatest need which now appears to be: (1) Solid Aroclors (2) Liquid Aroclors (3) Muriatic Acid.

C. Every effort shall be made to better the existing schedule economically, but not sacrificing safety or quality.

II. ACTIVITIES

A. Carry out Manufacturing Representative responsibilities outlined in Bulletin O-11 and "Guide for Plant Start-Up".

B. Provide adequate liaison with Engineering and Research during design to insure benefit of all applicable Monsanto operating experience.

C. Provide adequate number of trained start-up shift leaders prior to water batching.

D. Provide adequately trained department operating supervisor and foreman prior to water batching.

E. Provide adequately trained operating force prior to water batching.

F. Provide for adequate maintenance capability for start-up, including spare parts, trained supervision, and personnel.

G. Provide for adequate laboratory support, both control and analytical, prior to chemicals processing.

PROCESS SIMULATION OBJECTIVE

I. OBJECTIVE

To demonstrate, utilizing fluids other than the usual raw materials, that all systems in the Department have been installed according to the design intent, safely and adequately perform their intended functions, individually and collectively. Our intent is to locate and correct as many problems as possible prior to charging raw materials.

II. ACTIVITIES

A. Review each process step for applicability of fluids other than process fluid for process simulation and arrange to use process materials only in cases where use of other materials is impractical.

B. Check out auxiliary facilities for operation of the solid Aroclor facilities.

C. Check out each process step, and all controls associated, simulating process conditions as closely as possible.

D. Operate the entire department on water, simulating normal operation as closely as possible.

E. Simulate probable "emergency" situations for operator and supervisory training under field conditions.

F. Complete water batching each unit in sequence one week after construction completion.

G. Field test all controls, alarms, interlocks, timers, and other safety and sequencing devices during water batching.

INITIAL OPERATION OBJECTIVES

I. OBJECTIVES

A. Demonstrate ability to produce Aroclor and Muriatic Acid in a safe manner.

B. Demonstrate ability to produce Aroclor and Muriatic Acid which meets present quality spacification for Sales.

C. Demonstrate following rates:

1. 10 $\overline{M}$ pounds per year solid Aroclors.

2. 36 $\overline{M}$ pounds per year liquid Aroclors.

3. 90% recovery of available HCl gas as Muriatic Acid.

D. Demonstrate manufacturing cost estimate usages for all cost elements as specified in Appropriation Request.

E. No decisions are to be made favoring rate over quality or safety.

II. ACTIVITIES

A. Upon successful completion of all process simulation, and not before, introduce chemicals into system and proceed with chemical processing in "Blocked" operation for two batches on solid Aroclors.

B. Establish ability to safely process chemicals one week after completion of process simulation.

C. Demonstrate ability to produce goods of specification quality on consistent basis two weeks after completion of process simulation. Quality is to take precedence over rate.

D. Reach design rates as follows:

1. Solid Aroclors

a. 50% of design rate three weeks after completion of process simulation.

b. 70% of design rate four weeks after completion of process simulation.

c. 100% of design rate four weeks after completion of HCl offgas clean-up facilities.

2. Liquid Aroclors

a. Maintain department at present 3 $\overline{M}$ lbs./mo. rate through construction phase.

b. 80% of design rate four weeks after completion of equipment alterations.

c. 100% of design rate four weeks after completion of HCl offgas clean-up facilities.

3. Muriatic Acid

a. 50% of design rate two weeks after completion of process simulation.

b. 60% of design rate four weeks after completion of process simulation.

c. 100% of design rate four weeks after completion of HCl offgas clean-up facilities.

PROJECT DEMONSTRATION

I. OBJECTIVE

The objective of the demonstration period is to successfully show that the plant can consistently be operated to produce specification-grade material at design rate within the cost element usages specified in the cost standards.

II. ACTIVITIES

A. Operate at 100% of design rate for one or two successive weeks.

B. During this period, produce material which meets or exceeds quality requirements established for Sales.

C. During this period, demonstrate raw material yields equivalent to the cost standards.

D. Accomplish A through C utilizing the cost standards allowed amounts of labor, utilities, and supplies.

E. Demonstrate that the allowance for mechanical expense can be met.

F. Accomplish these activities by November 1, 1965:

1. Solid Aroclors
2. Liquid Aroclors
3. Muriatic Acid

AROCLOR START-UP PROCESS SIMULATION

WEEK OF APRIL 26, 1965

FOUR-DAY PROGRAM

Typical 1 Day Program
Four Shift Crews to be Trained

Time	Topic	Instructor
7:00 - 8:00 a.m.	Equipment Check-Out Review & Process Simulation	Molloy
8:00 - 9:00	Plant Tour Detailed Individual Operator Training - Operator Review of Start-up and Normal Operations - Use Water in Vessels - Solid Aroclor Equipment	Haupt & Williams
9:00 - 9:15	Break	
9:15 - 11:00	Continue plant tour and water processing in each vessel as for 8:00 - 9:00	
11:00 - 11:30	Lunch	
11:30 - 4:00 p.m.	Start-Up Therminol Heater & Check-Out Safety Features	Madison, Williams, Haupt, and Molloy
	Start-Up Circulating Therminol Systems for No. 9 Chlorinator and No. 4 Still Condenser Systems	
	Start Equipment Check-Out: Therminol Heater System Weigh Tank No. 9 Chlorinator No. 2 Blow Tank No. 4 Still & Receiver	

MURIATIC ACID START-UP PROCESS SIMULATION

WEEK OF JULY 12, 1965

Monday-Tuesday
First Day - Typical

Time	Topic	Instructor
7:00 - 8:00 a.m.	Equipment Check-Out Review & Process Simulation	Molloy
8:00 - 9:00	Plant Tour Detailed Individual Operator Training. Operator Review of Start-up & Normal Operations - Use Water in Vessels	Taylor & Williams
9:00 - 9:15	Break	
9:15 - 11:00	Continue Plant Tour & Water Processing in Each Vessel as for 8:00 - 9:00 a.m.	
11:00 - 11:30	Lunch	
11:30 - 1:00 p.m.	Complete Water Transfer in Vessels Possible	Madison & Williams
1:00 - 3:00	Review Instrumentation Details & Operation	

AROCLOR-MURIATIC ACID
PROCESS SIMULATION

WEEK OF AUGUST 30, 1965

Monday & Tuesday
First Day - Typical

Time	Topic	Instructor
7:00 - 8:00 a.m.	Equipment Check-Out Review & Process Simulation	Molloy
8:00 - 9:00	Plant Tour Detailed Individual Operator Training. Operator Review of Start-up and Normal Operation - Use Water in Vessels	Taylor & Williams
9:00 - 9:15	Break	
9:15 - 11:00	Continue Plant Tour and Water Processing in Each Vessel as for 8:00-9:00 a.m.	
11:00 - 11:30	Lunch	
11:30 - 1:00 p.m.	Complete Morning Session Drain System & Dry Out. Prepare for Start-Up Next Day.	Madison & Molloy
1:00 - 3:00	Review Instrumentation Details & Operation	

AROCLOR START-UP
INITIAL OPERATIONS

WEEK OF MAY 5,1965

WEDNESDAY

Time	Topic	Shift Supervision
7:00 - 9:00 a.m.	Final Check-Out of Equipment Systems as Follows: Therminol Heater Raise Temperature	Lackey, Haupt, Molloy, Williams, Madison
9:00 - 10:00	Continue Check-Out of: Weigh Tank No. 9 Chlorinator & Aux. No. 2 Blow Tank No. 4 Still System & Aux. Control Panel Instruments	Schedule to be determined later.
10:00 - 11:00	Start-Up Therminol System: No. 9 Chlorinator No. 4 Still Start-Up S&K Drowning Jet System for No. 2 Blow Tank	
11:00 - 1:00 p.m.	Charge Weigh Tank with 1/2 Size Santowax Batch for 5060	
1:00 - 2:00	Transfer Santowax to No. 9 Chlorinator - Start Chlorination Batch No. AE-1 - Take Offgas Samples - Fill Out Data Sheet	
2:00 - 11:00	Complete Chlorination Complete Data Sheet	
11:00 - 12:00 midnight	Transfar to Blow Tank	
12:00 - 1:00 a.m.	Air Blow Crude 5060	
1:00 - 2:00	Charge No. 4 Still with Lot AE-1	
2:00 - 7:00	Start-Up No. 4 Still and Begin Distillation Lot AE-1 Fill Out Data Sheet	

Week of May 5, 1965 (continued)

THURSDAY

Time	Topic	Shift Supervision
7:00 - 12:00 noon	Complete Distillation No. 4 Still Lot AE-1 Complete Data Sheet	Schedule to be determined later.
12:00 - 2:00 p.m.	Lab Analyze First Distillation Quality	
2:00 - 3:00	Transfer to Flaker Hold Tank	
3:00 - 4:00	Start-Up Flaker and Sample to Check Quality	
4:00 - 5:00	Charge Weigh Tank with Full Size Santowax Charge for Next Chlorination Batch Fill Out Data Sheet	
5:00 - 6:00	Charge No. 9 Chlorinator and Start Chlorination Batch AE-2 Take Offgas Sample Fill Out Data Sheet	
6:00 - 7:00	Continue Chlorination Batch AE-2	

Week of May 5, 1965 (continued)

FRIDAY

Time	Topic	Shift Supervision
7:00 - 12:00 noon	Complete Chlorination Batch AE-2	Schedule to be determined later.
12:00 - 1:00 p.m.	Transfer Batch to No. 2 Blow Tank	
1:00 - 2:00	Air Blow Batch No. AE-2	
2:00 - 3:00	Charge No. 4 Still With Lot AE-3 Begin Distillation Fill Out Data Sheet	
3:00 - 1:00 a.m.	Complete Distillation Lot AE-1 Complete Data Sheet	
1:00 - 3:00	Lab Analyze Second Distillation Quality	
3:00 - 4:00	Transfer to Flaker Hold Tank	
4:00 - 5:00	Start-Up Flaker and Sample to Check Quality	
5:00 - 6:00	Charge Weigh Tank with Full Size Santowax Charge for Next Chlorination Batch	
6:00 - 7:00 a.m.	Charge No. 9 Chlorinator and Hold for Start-Up at 7:30 a.m.	

Week of May 5, 1965 (continued)

SATURDAY

Time	Topic	Shift Supervision
7:00 - 1:00 a.m.	Start Chlorination Batch No. AE-3 Begin Programmed Batch Operation Take Offgas Samples Fill Out Data Sheet Continue Operations as Before. Start Continued Operation as soon as One Batch is Complete. Start Next Batch for Chlorination & Distillation.	Schedule to be determined later.

SUNDAY-MONDAY-TUESDAY

Continue Shift Coverage on Operation as Noted Before. If Operation is Acceptable at This Stage, Shift Coverage Will be Stopped on May 24, 1965.

AROCLOR START-UP
INITIAL OPERATIONS

WEEK OF MAY 24, 1965

MONDAY

Time	Topic	Shift Supervision
7:00 a.m. - 7:00 a.m.	Start Operation of Control Instruments on Chlorinators No. 1 through 8. Start Programmed Batch Chlorina- if Operators Developed to This Stage. If Necessary, Delay Until After Review Training Week of June 7, 1965.	Lackey Haupt Madison Molloy Williams Schedule to be determined later.
	Cover Operation for All Shifts Until Each Operator Has Demonstrated Operation of These Instruments.	

MURIATIC ACID START-UP
INITIAL OPERATIONS

JULY 15, 1965

THURSDAY

Time	Topic	Shift Supervision
7:00 - 9:00 a.m.	Final Check-Out of Equipment New Absorber Carbon Towers Surge Tanks Filter Storage Tanks Pumps Instruments	Lackey Madison Williams Molloy Schedules to be determined later.
9:00 - 1:00 p.m.	Charge System with Chemicals. Take Readings on Start-Up of New System. Check Muriatic Acid Production at Tower. Sewer Acid Until Quality Material is Being Produced.	
1:00 - 2:00	Have Tower Production Analyzed by Lab.	
2:00 -	Start Flow to Carbon Towers and Filter. Analyze Product. If Material is a Quality Product, Start Collecting in a Storage Tank. Continue Operations and Development of Operator Knowledge of Instrument System for Muriatic Acid Tower Operation. Shift Coverage will Last Two Days During This Time. It will be Extended if Problems Arise.	

AROCLOR-MURIATIC ACID INITIAL OPERATIONS

WEEK OF SEPTEMBER 1, 1965

WEDNESDAY

Time	Topic	Shift Supervision
7:00 - 9:00 a.m.	Final Equipment Check-Out: Condensers Transfer Pump Tank Piping System Instrumentation	Lackey, Taylor, Madison, Williams, Molloy Schedule to be determined later.
9:00 - 11:00	Start HCl Gas From Chlorinators Through the System Evaluate Pressure Drop Through the System. Sample Gas Systems and Analyse for Effectiveness of Clean-Up System It may be necessary to sewer Muriatic Acid during initial start-up due to possibility of new pipe causing off-color acid (high iron). Continue Operations & Development of Operator Knowledge of Instrument System for HCl Clean-Up Facilities. Shift Coverage Will Last Two Days During This Time. It Will Be Extended If Problems Arise.	

AROCLOR START-UP

PROJECT DEMONSTRATION

I. SOLID AROCLOR SYSTEM

A. Begin Project Demonstration

WEDNESDAY (5/26/65) (S-U + 14)

1. Continuous processing of acceptable quality solid Aroclors.

   a. Process batches at rate which will insure good quality solid Aroclors. Rate will not be favored over quality.

   b. Continue sampling at all key points to build analytical background data.

B. Demonstrate 50% Design Rate on Instantaneous Basis

WEDNESDAY (6/2/65) (S-U + 21)

1. Schedule continuous processing to produce solid Aroclors at 420,000 lbs./mo. instantaneous rate.

   a. Demonstrate estimated usages for all cost elements as specified in Appropriation Request for 50% rate.

   b. Continue to improve product quality upward from acceptable level.

   c. Increase emphasis on:

      (1) Safe operation

      (2) Proper functioning of equipment

   d. Continue maximum sampling schedule.

C. Demonstrate 70% Design Rate on Instantaneous Basis

WEDNESDAY (6/9/65) (S-U + 28)

1. Schedule continuous processing to produce solid Aroclors at 585,000 lbs./mo. rate.

   a. Demonstrate estimated usages for all cost elements as specified in Appropriation Request for 70% rate.

   b. Improve product quality.

   c. Continue emphasis on:

      (1) Safe operation

      (2) Proper functioning of equipment

   d. Consistent with requirements of process, begin reduction of sampling program to routine requirements.

D. Demonstrate 100% Design Rate on Instantaneous Basis

FRIDAY (10/1/65) (S-U HCl Clean-up + 30)

1. Schedule continuous processing to produce solid Aroclors at 833,000 lbs./mo. rate.

2. Operate plant as integral department of Anniston Plant with the following considerations:

   a. Maximum production

   b. Excellent quality

   c. Lowest possible production cost

   d. Good labor relations

   e. Full cooperation with other plant groups

   f. No lost-time accidents

   g. High level of housekeeping

II. LIQUID AROCLOR SYSTEM

A. Begin Project Demonstration

MONDAY (6/21/65) (S-U + 18)

1. Continuous processing of acceptable quality liquid Aroclors.

   a. Process batch and continuous material at rate which will insure good quality liquid Aroclors. Rate will not be favored over quality.

   b. Continue sampling at all key points to build analytical background data.

B. Demonstrate 80% Design Rate on Instantaneous Basis

TUESDAY (7/19/65) (S-U + 39)

1. Schedule continuous processing to produce liquid Aroclors at 2,570,000 lbs./mo. rate.

   a. Demonstrate estimated usages for all cost elements as specified in Appropriation Request for 80% rate.

   b. Improve product quality.

   c. Continue emphasis on:

      a. Safe operation

      b. Proper functioning of equipment

   d. Consistent with requirements of process, begin reduction of sampling program to routine requirements.

C. Demonstrate 100% Design Rate on Instantaneous Basis

FRIDAY (10/1/65) (S-U HCl Clean-Up + 30)

1. Schedule continuous processing to produce liquid Aroclors at 3,217,000 lbs./mo. rate.

2. Operate plant as an integral department of the Anniston Plant with the following considerations:

   a. Maximum production

   b. Excellent quality

   c. Lowest possible production cost

   d. Good labor relations

   a. Full cooperation with other plant groups

   f. No lost-time accidents

   g. High level of housekeeping

III. MURIATIC ACID SYSTEM

A. Begin Project Demonstration

TUESDAY (7/20/65) (S-U + 6)

1. Continuous processing of acceptable quality Muriatic Acid.

   a. Process at rate which will insure good quality. Rate will not be favored over quality.

   b. Continue sampling at all key points to build analytical background data.

B. Demonstrate 50% Design Rate on Instantaneous Basis

MONDAY (7/26/65) (S-U + 12)

1. Schedule continuous processing to produce Muriatic Acid at 50% recovery of available HCl gas as Muriatic Acid on instantaneous rate.

   a. Demonstrate estimated usages for all cost elements as specified in Appropriation Request for 50% rate.

b. Continue to improve product quality upward from acceptable level.

c. Increase emphasis on:

(1) Safe operation

(2) Proper function of equipment

d. Continue maximum sampling schedule.

C. Demonstrate 70% Design Rate on Instantaneous Basis

THURSDAY (8/12/65) (S-U + 29)

1. Schedule continuous processing to produce 70% recovery of available HCl gas as Muriatic Acid on instantaneous rate.

a. Demonstrate estimated usages for all cost elements as specified in Appropriation Request for 70% rate.

b. Improve product quality.

c. Continue emphasis on:

(1) Safe operation

(2) Proper functioning of equipment

d. Consistent with requirements of process, begin reduction of sampling program to routine requirements.

D. Demonstrate 100% Design Rate on Instantaneous Basis

FRIDAY (10/1/65) (S-U HCl Clean-Up + 30)

1. Schedule continuous processing to produce muriatic acid at 90% recovery of available HCl.

2. Operate plant as integral department of Anniston Plant with the following considerations:

   a. Maximum production

   b. Excellent quality

   c. Lowest possible production cost

   d. Good labor relations

   e. Full cooperation with other plant groups

   f. No lost-time accidents

   g. High level of housekeeping

Beginning week of October 1, 1965, demonstrate ability to consistently produce at:

10,000,000 lbs./yr. Solid Aroclor

38,600,000 lbs./yr. Liquid Aroclor

90% Recovery of available HCl as Muriatic Acid

Period from October 1, 1965, through October 18, 1965, to be used as demonstration period.

ANALYTICAL METHODS

Analytical methods for checking operation of the Aroclor and Muriatic Acid facilities operation will not differ from present laboratory practices. Present lab methods and techniques are being reviewed and revised. Upon completion of this review, they will become a permanent part of this section of the Start-Up Manual.

CALIBRATION CHARTS

Calibration charts for all tanks in this system have been made and included as part of the Process Function Outline instructions. After start-up, the field calibration charts will become the permanent charts for this section of the Start-Up Manual.

EQUIPMENT CHECK-OUT PROCEDURE

I. THERMINOL (AROCLOR)
ITEMS 627, 628, 629, 629-A

Objective: Test Therminol heater piping system for leaks, heater, Circulating pump & instrumentation for control and indication.

Check List:

Comp.	Init.	Date / Remarks
		1. Check circuit breakers & start-stop buttons on following motors: a. Item 628-Therminol Heater Circulating pump motor Circuit No. 10-2. b. Item 628-Start-stop button at side of furnace field control box. c. Item 629-Therminol Heater Controls - Circuit No. _____.
		2. Air pressure test gas pipe lines at 20 psig for one hour - if no leaks continue test. Soap flanges. Open valve in gas line to furnace controls (40 psig min.)
		3. Open valve in steam lines to coil on Item 627 - Therminol Heater Surge Tank. Pressure should be 90 psig minimum.
		4. Open valve in instrument air supply to control instruments on heater system cabinet (90 psig min.), TRAC-629.12, & FIC-628.01. Check instrument systems.
		5. Connect water meter to hose and fill surge tank (Item 627). Record level & meter readings per sheet attached until tank is full. Empty tank when calibration is complete.
		6. Blank off pump discharge & return line from the department. Close all valves on branch lines off the main 4" supply & 6" return line. Place a 20 psig air pressure test on pipe system. Soap all flanges and valve packing and be sure there are no leaks. Check individual branch lines one at a time. Allow 30 mins. min. check on each line.

Equipment Check-Out Procedure - Therminol

Check List:

Date: _____

	Comp.	Init.	Remarks
6. (Continued) Check following pressure gauges in pipe system: a. PI-628.02 Pump discharge b. PI-629.16 Heater coil discharge c. PI-628.03 Automatic Valve When tests complete, vent main pipe system and then each branch line individually.			
7. Charge Therminol FR-2 into surge tank (Item 627) by following procedure: a. Use temporarily relocated Pyranol pump to charge tank.			
b. Position 55 gal. drum next to pump. Remove drum bung and vent cap.			
c. Connect flexible hose to pump suction & stainless steel pipe to be inserted into drum.			
d. Position discharge line from pump into tank.			
e. Open valve on pump suction - insert pipe into drum and start pump.			
f. Adjust suction valve on pump until flow is steady.			
g. Continue to fill tank until 25 drums or 1,200 gals. are in reservoir tank.			
8. Check out furace control circuit & start up as follows: a. Open furnace flue damper.			
b. Check that Therminol is in surge tank (Item 627).			
c. Open manual natural gas valves in line to furnace.			
d. Open blower air valves in pilot & main air lines.			

Equipment Check-Out Procedure - Therminol

Check List:

Date

	Comp.	Init.	Remarks
8. (Continued)			
e. Turn on circuit No. 5 at still panel and switch at field control box.			
f. Actuate red inset lever inside the Honeywell protectoglo unit (lower right corner of case). Wait 10 sec. between settings of this lever in case it has to be redone.			
g. Set control point on Honeywell coil outlet temperature indicator at 325°C.			
h. Align valves in Therminol system lines to circulate main lines only. Throttle pump discharge valve to allow system to fill slowly.			
i. Place TRCA-629.12 in manual with output pressure at 15 psig. Set FIC-628.01 at 300 GPM in "auto" position.			
j. Start pump (Item 628). Check lines throughout the department for leaks. Fill system slowly, then open discharge valve of pump wide open.			
k. Start air blower. Use push button at side of field panel. Red light on Protectoglo unit should light up.			
l. Check pressure gauge at main air inlet to burner. It must read above 15 o.s.i.			
m. Wait 3 minutes - green light on protectoglo unit lights up indicating purge period is over.			
n. Press ignition "start" push button on side of control box & hold in until white light on protectoglo unit lights up. Red & green lights should go out.			

Equipment Check-Out Procedure - Tharminol

Check List:

	Comp.	Init.	Date / Remarks
8. (Continued)			
Note one meter on front of field control cabinet indicates pilot flame is burning as long as the current exceeds 1-1/2 to 2 microamperes.			
o. Reduce output pressure of TRCA-629.12 to zero while in manual position. This is for low fire start-up.			
p. Throttle the manual air valve in main air line to furnace to control the heat.			
Observe the furnace temperature at multipoint recorder. Do not exceed 50°C increase for first two hours. Set TRCA-629.12 in "auto" and raise the temperature 50°C per hour until you reach 220°C.			
Open the manual air valve slowly to raise the temperature.			
q. The following items will shut down the furnace automatically (pilot & main gas burner "off" and actuate alarm at still panel).			
(1) High coil outlet temperature - above 325°C.			
(2) Low natural gas supply pressure- below 20 psig.			
(3) Low blower outlet pressure - below 1 psig.			
(4) High reduced natural gas press.- above 5 psig.			
(5) Low coil flow - below 200 gpm.			
(6) Failure of circuit #5 at still panel.			
(7) Failure of switch at side of field control panel.			

Equipment Check-Out Procedure - Therminol

Check List:	Comp.	Init.	Date / Remarks
9. Check out furnace shutdown by the following methods: each method should shut the furnace down identically. Have furnace coil outlet temperature at 100°C for checks. (See Item 10 for start-up)			
Note: All items below will shut off the main and pilot gas to furnace. Air will continue to be blown through the furnace and the circulating pump will continue to pump. Push "stop button for circulating pump. Main and pilot gas to furnace will be shut off. Air will continue to be blown through the furnace.			
a. Push furnace ignition "stop" button.			
b. Put TRCA-629.12 in manual and adjust output pressure to zero.			
c. Close 6" manual valve in main air line.			
d. Adjust FIC-628.01 set point below 200 gpm. For this to work, the use of Therminol in the Department must be below 200 gpm.			
e. Cut off circuit #5 at still panel.			
f. Cut off switch at side of field control panel.			
10. Use following procedure for start-up after furnace has been in operation:			
a. Open furnace flue damper.			
b. Check that Therminol is in surge tank (Item 627) (1/2 full minimum).			
c. Check temperature in surge tank (Item 627) TI-627.03. Should be 100°C			
d. Set valves in Therminsol system lines to circulate main lines only.			MONS 093187

Equipment Check-Out Procedure - Therminol

Check List:	Comp.	Init.	Date / Remarks
10. (Continued)			
e. Adjust set point on FIC-628.01 at 300 gpm controller in "auto" position			
f. Adjust set point TRCA-629.12 at 300°C and controller in "auto" position. Be sure 6" manual valve in main air line is closed.			
g. Start circulating pump.			
h. Start heat to burner by opening 6" manual valve in main air line. The main burner will light up heating Therminol to 250°C.			
11. Fill Therminol system in all branch lines			
a. When Therminol is 250°C open each branch valve at feed and discharge to drive out air. Fill lines one at a time. Throttle valves to fill each line and allow line to fill slowly.			
b. Check Therminol when it reaches 250°C. Inspect level in gauge glass to be sure an adequate level is maintained to cover steam coils and pump suction.			
Do not add additional Therminol unless you check drainage of lines & level in tank after the circulating pump has been shut off.			
c. After complete check-out, set TRCA-629.12 at 100°C and allow system to circulate until needed.			

EQUIPMENT CHECK-OUT PROCEDURE

II. Items 535-536-544 - Charge Tank, Agitator, Charge Tank Pump, & Scale System

Items 505 - 506 - Chlorinator and Circulating Pump

Items 538-533-534 - Chlorinator Cooling Facilities
507

Items 530-531-539 - Air Blower, Scrubber Jet,
541 Transfer Pump, Air Blow Tank

Items 615-618-619 - Still Heater, Condenser, Receiver,
620-621 & Transfer Pump

Items 622-623-624 - Still Cooling Facilities

Items 625-626-632 - Still Jet System

Objective: Test piping in above systems for leaks and equipment-scales, circulating pumps, and instrumentation for control and indication.

Check List:

Date _____

	Comp.	Init.	Remarks
1. Check circuit breakers & start-stop buttons on following motors:			
a. Item 535-A - Agitator on charge tank Circuit No. 11-1.			
b. Item 536 - Charge tank pump motor - Circuit No. 12-1.			
c. Item 544 - Scale electrical circuit.			
d. Item 506 - No. 9 chlorinator circulating pump motor-Circuit No. 7-2.			
e. Item 534 - No. 9 chlorinator Aroclor circulating pump motor-Circuit No.5-1			
f. Item 530 - Air Blower motor - Circuit No. 7-5.			
g. Item 539 - No. 2 Blow Tank pump motor Circuit No. 6-3.			
h. Item 616 - No. 4 Still circulating pump motor - Circuit No. 1-5			

II. Equipment Check-Out Procedure

Check List:

	Comp.	Init.	Date / Remarks
1. (Continued)			
i. Item 618-A - No. 4 Still Heater electric circuit syetem - light panel - Circuit No. C 9e.			
j. Item 623 - No. 2 Surge Tank pump motor - Circuit No. 5-Z.			
k. Item 621 - No. 4 Vacuum Receiver Transfer Pump motor-Circuit No. 4-5.			
l. Item 624 - No. 2 Surge Tank Cooler Fan Motor - Circuit No. 5-3.			
2. Check gas pressure to No.4 Aroclor Still Heater Control System - 40 psig minimum.			
3. Check steam supply to the following:			
a. Coil in charge tank, Item 535.			
b. Piping in and around charge tank, Item 535.			
c. Tracing on pump casing & stuffing box, Item 536.			
d. Coil in No. 1 Therminol Surge Tank, Item 533.			
e. Tracing on pump casing and stuffing box, Item 534.			
f. Pipe tracing for the chlorinator cooling system.			
g. Coil in No. 2 Therminol Surge Tank, Item 622.			
h. Tracing on pump casing & stuffing box, Item 623.			
i. Steam supply to No. 4 Still Jet, Item No. 626. Pressure should be 90 - 110 psig.			

II. Equipment Check-Out Procedure

Check List:	Comp.	Init.	Date / Remarks
4. Check tower water supply to No. 9 Chlorinator heat exchanger cooling system, Item 507. Open manual valves slowly and fill water system. Break flange on tube discharge line and check for leaks.			
5. Check city water to following items:			
a. Safety showers & eye baths in blow tank and Solid Aroclor areas.			
b. HCl Scrubber Jets for Blow Tanks: 1) New jet for No. 2 Blow Tank, Item 531			
2) Existing jet for No. 1, 3, 4, & continuous blow tanks, Item 532.			
c. Barometric sump on No. 4 Still Jet, Item 626.			
6. Check out Therminol (Aro. 1232) System for leaks on No. 9 Chlorinator heat exchanger system.			
a. Blank discharge & suction line at pump (Item 534) and the vent line on surge tank (Item 533).			
b. Place 20 psig air pressure on the system. Soap the flanges, gauge connections, valve packing, and welds to be sure there are no leaks.			
Break head flange connection on Crude Aroclor circulating line to heat exchanger (Item 538) to be sure there are no tube leaks.			
c. During pressure test, check circulating pump discharge pressure gauge PI-534.01.			
d. At the completion of the test, break flange in system and slowly vent off air pressure. Leave system empty and dry.			

II. Equipment Check-Out Procedure

Check List:	Comp.	Init.	Date / Remarks
7. Charge Therminol (Aro. 1232) system and check tank calibration as follows:			
a. Use temporarily relocated Pyranol pump to charge Therminol surge tank.			
b. Position 55 Gal. drum next to pump. Remove drum bung and vent cap.			
c. Connect flexible hose to pump suction and stainless steel pipe to be inserted into drum.			
d. Position discharge line from pump into tank.			
e. Open valve on pump suction. Insert pipe into drum and start pump.			
f. Adjust suction valve on pump until flow is steady.			
g. Continue to fill tank until 5 drums or approximately 250 gallons total are in surge tank (Item 533). Use calibration sheet attached.			
8. Start up Therminol System and check to be sure circulation and instruments operate.			
a. Set manual valves in system to circulate from surge tank through heat exchanger (Item 538), the water cooled heat exchanger, & back to surge tank.			
b. Open valves on pressure taps for FICA-534.02.			
c. Close valve at sample point on pump suction and at heat exchanger (Item 538).			
d. Chack snd close valves to put Therminol FR-2 (Aro. 1248) on heat exchanger (Item 538).			
e. Set TC-533.03 to control the temperature in surge tank, Item 533 at 45°C (113°F). Open steam valve to coil in surge tank. Therminol should be warm before starting pump.			MONS 093192

II. Equipment Check-Out Procedure

Check List:

Date

	Comp.	Init.	Remarks
8. (Continued)			
f. Set FICA-534.02 in "auto" with set point at 300 gpm.			
Set TRCA-538.01 in "auto" with set point at 190°C.			
Set TICA-533.01 in "auto" with the set point at 50°C.			
g. Start circulating pump (Item 534) Discharge pump pressure should be 40 psig (See pressure gauge PI-534.01)			
h. Check flow through system and the following temperature points:			
1) Pump discharge - TE-534.03			
2) No. 9 Heat Exchanger discharge - TE-538.03.			
3) Temperature in heat exchanger 538 TRCA-538.01			
4) Temperature in heat exchanger 507 discharge - TICA-533.01.			
5) Heat exchanger cooler head - TW-507.02.			
6) Heat exchanger cooler - TW-507.03 TW-507.06			
i. Check pressure at water feed and discharge lines to heat exchanger cooler, PI-507.04 & PI-507.05			
j. Check level in 533 on L.G.-533.02. Be sure Therminol is 12 inches above coils.			
k. Leave system circulating if there are no problems.			

II. Equipment Check-Out Procedure

Check List:	Comp.	Init.	Date / Remarks
9. Check out Therminol FR-2 (Aro. 1248) system for leaks on No. 4 Still Condenser			
a. Blank discharge & suction line at pump (Item 623) and the vent line on surge tank (Item 622).			
b. Place a 20 psig air pressure on the system. Soap flanges, gauge connactions, valve packing, and welds to be sure there are no leaks.			
Break flange connection on shell side of No. 4 still condenser (Item 619) to be sure there are no leaks.			
c. During pressure test, check circulating pump discharge pressure gauge PI-623.03.			
d. At completion of the test, break flanga in system and slowly vent off the air pressure. Leave system empty and dry.			
10. Charge Therminol FR-2 (Aro. 1248) system and check tank calibrations as follows:			
a. Use temporarily relocated Pyranol pump to charge Therminol Surge Tank.			
b. Position 55 gal. drum next to pump. Remove drum bung and vent cap.			
c. Connect flexible hose to pump suction and stainless steel pipe to be inserted into drum.			
d. Position discharge line from pump into tank.			
e. Open valve on pump auction. Insert pipe into drum and start pump.			
f. Adjust suction valve on pump until flow is steady.			
g. Continue to fill tank until 4 drums or approximately 200 gallons total are in the surge tank (Item 622). Use calibration sheet attached.			

II. Equipment Check-Out Procedure

Check List:

	Comp.	Init.	Date / Remarks
11. Start-up Therminol system and check to be sure circulation and instruments operate.			
a. Set manual valves in system to circulate from surge tank through No. 4 still condenser (Item 619), the air cooled heat exchanger (Item 624), & back to the surge tank.			
b. Close valve in system to by-pass the air cooled heat exchanger.			
c. Close valve on sample point at circulating pump suction.			
d. Set TICA-622.01 in "auto" with the set point at 120°C. Set point changes dependent on Aroclor being produced (see Details of Operating Instructions)			
e. Open block valves in Therminol Heater System to the coil in the surge tank (Item 622). Be sure material in surge tank is 100°C.			
f. Start circulating pump (Item 623). Discharge pump pressure should be 100 gpm at 26 psig. See pressure gauge PI-623.03. Check flow through the system and the following temperature points:			
1) Pump discharge - TIA-623.02 & TE -623.01			
2) No. 4 Still condenser temperature TW-619.02			
3) Temperature of surge tank - TICA-622.01			
g. Check level in 622 on L.G.-622.02. Be sure therminol is 12 inches above coil.			
h. Leave system circulating if there are no problems.			

II. Equipment Check-Out Procedure

Check List:	Comp.	Init.	Date / Remarks
12. Calibrate tank capacities for (Items 505, 535, 541, 615, and 620. Use a water meter and stick measurement for a check. (See attached calibration sheets.			
13. Check out use of Solid Aroclor equipment using water:			
a. Check Therminol System and close all valves to jacketed lines and coils, in the No. 9 chlorinator, No. 2 blow tank, No. 4 still and receiver.			
NOTE: This is important during water testing to be sure over-heating does not occur.			
b. Be sure blanks are in Biphenyl and Santowax lines to the weigh tank, the HCl & Chlorine lines to No. 9 Chlorinator, and No.4 Still Receiver lines to the flaker hold tank.			
c. Close valve at bottom of Weigh Tank (Item 535).			
d. Turn steam off feed lines, coils, & transfer lines to the weigh tank and pump.			
e. Adjust scale set point at 5,000 lbs.			
f. Adjust TIC-535.01 set point at 30°C.			
g. Start water feed into the tank.			
h. When the scale reaches 5,000 lbs. the annunciator alarm will ring a bell. Check the control valve in Santowax line. It should close when the alarm bell sounds. Reset the scale point and fill the tank to 15,000 lbs. At 15,000 lbs. a high weight alarm horn will sound.			
i. When full, check the following items: 1) TIC-533.01 - Weigh Tank temp. control 2) TW-533.02 - Weigh Tank temp.			

II. Equipment Check-Out Procedure

Check List:

Date_____

	Comp.	Init.	Remarks
13. (Continued)			
j. Turn on agitator in the weigh tank. Rotation should be clockwise.			
k. Set valves to transfer to the No. 9 chlorinator (Item 505).			
l. Start pump (Item 536) and tranefer the water to the chlorinator.			
m. Set valves to allow circulatin the No. 9 chlorinator to the heat exchanger (Item 538) and back to the chlorinator.			
During circulation, try operation of the sample valve. Check the temperature element TE-505.02 and preasure gauge PI-506.01.			
n. Set valves to tranefer to the No. 2 Blow Tank (Item 541).			
Check the level gauge indication during this transfer and the temperature TIC-541.01.			
o. Start the S&K Fume Jet by opening the valve in the water line to the jet.			
p. Start the air blower (Item 530) and check the discharge preasure gauge.			
Check operation of the fume auction system and the level indication in the No. 2 Blow Tank (LI-541.02).			
q. Set valves to transfer to the No. 4 Still (Item 615). Open water valve to stuffing box on No. 4 Still Pump (Item 616).			
Start transfer pump 539. Observe the level gauge in the No. 2 Blow Tank as material is transferred.			

II. Equipment Check-Out Procedure

Check List:

Comp.	Init.	Date / Remarks

13. (Continued)

r. Set valves to circulate through the furnace coil and back into the still tank.

During circulation, check the follow:

1) Flow through coil FRA-618.01

2) Discharge pressure of the coil - PI-618.05.

3) Temperature of No. 4 Still Tank - TIC-615.03.

4) Temperature coil inlet TE-618.02

5) Temperature coil outlet TE-618.04

6) Temperature coil outlet on Honeywell high temperature shutdown alarm instrument TIA.

s. Break flanges in all system and allow all water to drain out of the tanks and lines.

System should drain for one day prior to connecting up for start-up.

14. Check vacuum on the No. 4 Still furnace, still tank, condenser, still receiver, and piping system.

a. Close all valves which will allow venting the system.

b. Open valves to manometers on the No. 4 still tank (615), No. 4 Still receiver (620), and Catch Tank (625).

c. Set PRC-615.04 in "auto" with set point at 10 mm Hg.

II. Equipment Check-Out Procedure

Check List:

Comp.	Init.	Date / Remarks

14. (Continued)

d. Open velves in steam lines to the No. 4 still jet (Item 626).

Check steam pressure - it should be 90 psig minimum.

Time jet pull-down on the still system. Record this time.

Observe pressure indication at each manometer. Record data on attached data sheet.

e. Should problems occur in the vacuum system, it may be necessary to blank off the system and pressure test with HCl gas to determine the leaks.

f. Shut the steam off the jets and vent the system when test is complete. Leave system vented.

WORK SCHEDULES

Personnel for start-up of the Aroclor-Muriatic Acid rehabilitation facilities will come from the Aroclor-Biphenyl Department. A special start-up crew consisting of fifteen operators and the five chief operators for the Aroclor-Biphenyl Department will be trained for operation of the facilities.

Training will be handled on a six work day basis at time-and-a-half for each person to be trained. Each person being trained for operation of this facility will receive between 48 and 56 hours training on the new facilities. Due to the problem of training during normal operations of the existing department, this program will extend over a five week period of time.

During start-up of the facilities, an operator, in addition to normal department requirements, will be scheduled on an overtime basis to cover any unusual problems encountered during initial operations. After start-up, when the facilities have been proven out, normal operations will be taken over by present Aroclor Department personnel.

Work schedules for training, process simulation, start-up, and project demonstration will be a part of the normal Aroclor-Biphenyl Department schedules. These schedules are not included in this manual.

12. Light burner and adjust to give a temperature rise as shown on the thermometer of 5°C. per minute.

13. Bring temperature up 5°C. per minute until ball falls through the sample.

14. Record temperature at time ball falls to lower crossbar as the softening point.

PROCESS FUNCTION OUTLINE

AROCLOR DEPARTMENT

I. NO. 4 STILL SYSTEM

1.1 Scope

This covers the charging, start-up, shutdown, normal operation, and emergency situations involving the No. 4 Aroclor still system.

1.2 Description of Process

Aerated crude Aroclor from a blowing tank or a roof tank 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 veporization temperature. Vapors pass up an open column to the condenser. Distilled Aroclor is collected in a receiver. Quality of the distilled solid Aroclors is analyzed by the lab, and if in specification, it is drawn directly from the receiver into suitable containers or transferred to the flaker operation.

Still residue or bottoms from each distillation are drawn into containers and sold as Montars, or it is discarded in trash drums.

II. PROCESS DIAGRAM

Attached.

III. OPERATION OF PROCESS

3.1 Start-Up

A. Initial Start-Up

1. Therminol Cooling System for No. 4 Still Condenser

   a. Charge system with Therminol FR-2 (Aroclor 1248).

(1) Use temporarily relocated Pyranol pump to charge Therminol surge tank (Item 622).

(2) Position 55 gallon drum next to the pump. Remove drum bung and vent cap.

(3) Connect flexible hose to pump suction and the stainless steel pipe to be inserted into the drum.

(4) Position discharge line from the pump into the tank.

(5) Open valve on pump suction; insert pipe into drum and start pump.

(6) Adjust the suction valve on the pump until the flow is steady.

(7) Continue to fill the surge tank until 4 drums or approximately 200 gallons total are in the surge tank (Item 622).

2. Still and Furnace Start-Up

a. Charges to the No. 4 Still for the Various Crude Aroclors:

Under normal conditions, crude Aroclors will be charged to the No. 4 still and the charge measured by the level indication (LI-541.02) on the No. 2 blow tank. The charges for all crude Aroclors for chlorination in the No. 9 chlorinator are based on an output from the chlorinator of 2,100 gallons. This quantity of Aroclor will be able to be charged to the still without any problem. The still tank size is 2,500 gallons.

Aroclor 1168 is normally charged directly from the chlorinator to the No. 4 still. This Aroclor is not air-blown.

b. Prepare No. 2 blow tank (Item 541) for transfer of charge.

(1) Check to be sure the Therminol heating system is on the transfer pump (Item 539) and the charging lines. Material to be pumped must be hot or it will damage the mechanical seals on the transfer pumps. Cold lines can also cause plug-ups and failure to transfer material.

(2) Check temperature of material in blowing tank to be sure it is hot enough to transfer (240°C. minimum). See TIC-541.01.

(3) Check with the chlorinator operator to be sure crude Aroclor has been air-blown for one hour.

c. Prepare still to receive charge.

(1) Close valve at the bottom line under the still (Item 615).

(2) Open vent valve on the still.

(3) Open valve on vent line of the still.

(4) Set valves from the No. 2 blow tank to the No. 4 still. Be sure the Therminol heating system is on all transfer lines.

(5) Close the main valve inthe vacuum line to the still just above the receiver. Set the vacuum controller PIC-615.04 in "auto" with the set point at 10 mm Hg. Start steam to the vacuum jets. Put steam on stage 3, stage 2, and stage 1, in that order. Stage 1 is the closest to the receiver. Adjust water to the intercondenser on the middle stage. The jet on the No. 4 still should pull down to 4-5 mm Hg absolute on the receiver (Item 620). The steam to the jet on the No. 4 still should have a minimum of 90 psig supply pressure.

d. Start up the Therminol cooling system for the No. 4 still condenser (Item 619).

(1) Set TICA-622.01 at 120°C. with the controller in "auto".

(2) Adjust the set point for the Therminol low temperature alarm instrument TIA-623.02 approximately 20°C. below the control point for TICA-622.01. Ex: 100°C.

(3) Open the block valves in the Therminol heating system lines to the coil on the surge tank (Item 622). Set the valves in the Therminol cooling system for the No. 4 still condenser (Item 619) to allow circulation from the surge tank through the condenser through the Therminol cooler (Item 624) and back into the surge tank.

(4) Wait until the temperature of the Therminol cooling system is 100°C., then start the circulating pump (Item 623).

(5) Check the level in the surge tank (Item 622) to be sure the Therminol level covers the heating coils in the surge tank. Normally, this will be 6"-12" above the coil level.

(6) Do not permit distillation to start until the desired set point of 120°C. has been reached in the Therminol cooling system.

Settings for the temperature controller TICA-622.01 for the Aroclors are as follows:

Aroclor No.	5460	4465	5442	1268
Set Point, °C.	120°	120°	120°	170°

The fan on the Therminol cooler (Item 624) can be started when necessary to keep the temperature at the set point during distillation. It is operated manually.

(7) Check the following items on the Therminol cooling system circulation:

(a) Therminol cooling system circulating pump (Item 623) discharge pressure should be 37 psig.

(b) Circulating pump discharge temperature TIA-623.02 should read 120°C. with the low temperature alarm point set at 100°C.

(c) Surge tank temperature TICA-622.01 should read 120°C.

e. Charging the No. 4 still and start-up:

(1) Set valves in transfer line from No. 2 blow tank to the still.

(2) Start the blowing tank pump and transfer a full charge into the still tank.

(3) The still furnace coil can be preheated by using the pushbutton on the still control panel. This will allow bypassing the furnace interlocks to start gas into the furnace without starting the still pump. The pilot and main gas burner will be started as usual.

This is to prevent plugging the still coil during start-up.

Place gas flow controller FRC-618.06 in "manual" with the output pressure at 3-1/2 psig. Observe the furnace stack temperature on the multipoint recorder and do not exceed 200°C.

(4) Note the level of material leaving the No. 2 blow tank (Item 541) on the level indication gauge. As soon as 15% of the material has been transferred to the still, start the still circulating pump (Item 616).

(5) Set valves in the No. 4 still circulating line through the heater coil (Item 618) and back into the still tank.

(6) Stop the No. 2 blow tank transfer pump when the charge is complete as noted on the No. 2 blow tank level gauge. Allow lines to drain and then close the charging lines to the still.

(7) Close the valve under the No. 2 blow tank.

(8) Add hydrated lime through the funnel provided for this purpose on the No. 4 still. Add 200 pounds of lime for each still batch.

(9) Close the valve on the lime addition line.

(10) Set No. 4 still condenser condensate temperature alarm TIA-619.03 at 100°C.

(11) Start up the No. 4 still furnace (Item 618).

f. Furnace Start-Up for the first time:

(1) Open manual valves in the natural gas line to the furnace main and pilot gas lines.

(2) Open damper on the furnace stack.

(3) Turn on circuit No. 6 at the still panel and the switch on the outside of the field control box to "on". The "red" light at the Honeywell Protectoglo unit will light up.

(4) Set the control point on the Honeywell coil outlet temperature indicator located in the box at 400°C.

(5) Gas test the atmosphere inside the heater. Use a 3 foot length of copper tubing on the end of a rubber hose. If the test shows dangerous, stop and correct the cause of trouble before lighting up the burner. When the heater is cold, there is no natural draft to carry away gas or fumes. After the unit gets hot, there will always be a natural draft provided the flue damper is open.

(6) Actuate the red reset lever inside the Honeywell Protectoglo unit in the field control box. Open the door of the flame unit. This exposes the small red lever in the lower right-hand corner of the case. You must wait 10 seconds between settings of this lever in case it has to be redone.

(7) The "green" light on the Protectoglo unit should come on within 3 minutes.

(8) Depress the ignition start button on the side of the field control box to actuate the pilot flame. Hold the button depressed for no more than 10 seconds. If all is well, the "white" light on the Protectoglo unit will come on and the "green" light will go out. When this occurs, pull your finger away. The pilot is now properly lit.

(9) Put the set point on the natural gas flow controller FRC-618.06 to the solid still heater at 0. The switch will be in "auto".

(10) Manually open the two reset safety valves in the main gas line. The heater is now ready for normal operation.

(11) Start up the solid still circulating pump. The Aroclor circulating flow meter FRA-618.01 will now record a flow above 150 GPM. Low flow below 100 GPM through the coil will cause the main burner to be shut off.

(12) Gradually raise the set point of the natural gas flow controller FRC-218.06 to the desired set point.

The furnace refractory must be dried out prior to starting heat-up to 400°C. Special instructions will be made at start-up. Temperature of the furnace will be controlled by the stack high temperature point on the multipoint recorder.

Observe the coil outlet temperature on the multipoint temperature recorder. Do not exceed 50°C. increase for the first two hours. Raise FRC-618.06 set point for the natural gas flow as required to increase the temperature 50°C. per hour until you reach 400°C. The natural gas flow controller should be in "auto". The distillation or "boiling" is considered to be started when the vapor temperature makes a sudden increase. Watch for this increase during initial heat-up of the furnace for the first time.

(13) Check the following items in the system to be sure operations are normal.

(a) Natural gas flow to the furnace on FRC-618.06.

(b) No. 4 still circulating pump flow FRC-618.01

(c) Therminol cooling system temperature on TICA-622.01

(d) Check the coil temperature differential on the inlet and outlet of the furnace (Item 618).

g. Start-up of Furnace after Temporary Shutdown

(1) Set the still temperature controller TIC-615.03 in "auto" with the set point at 240°C.

Prior to start-up, the still coil can be pre-heated before starting the circulating pump, if necessary. See Section e.(3), Page 5.

(2) Adjust natural gas flow controller to "auto" with the set point at 0. This is FRC-618.06.

(3) Start up the solid still circulating pump (Item 616). The Aroclor circulating flow meter FRA-618.01 should now indicate a flow in excess of 150 GPM. Shutdown will occur at a flow below 125 GPM.

(4) Open the main valve in the vacuum line to the vacuum jets above the receiver. Vacuum at the still receiver should be approximately 5 mm Hg. PRC-615.04 should indicate the exact vacuum on the still, which should be 10 mm Hg.

(5) Gradually raise the set point of the natural gas flow controller FRC-618.06 to the desired set point.

(6) Check the Multipoint temperature recording instrument for the temperature rise across the coil in the heater furnace. In case this temperature chart is not indicating correctly, check for plugged lines or instrument problems. Check to be sure the pump flow is being measured correctly. If necessary, shut off the pump while at a low temperature to be sure the system is operating. Have the electrician check the temperature instruments if you do not get a rise.

(7) Adjust the still furnace natural gas feed with FRC-618.06 to give the maximum rate of temperature rise without overheating. A spread of 4 - 6°C. between the coil inlet and outlet is normal. The gas supply pressure will normally be approximately 4-1/2 psig.

(8) Be sure tha Therminol heating system is off the vacuum line to the jets during operation.

(9) Check the Therminol cooling system on tha No. 4 still condenser (Item 619) to be sure the condenser does not plug up. If plugging begins to occur, raise the temperature in the Therminol cooling circulation system. Use TICA-622.01 to eccomplish this. The temperature indicating alarm TIA-619.03 set at 100°C. will indicate plugging of the condenser.

If the system is too hot, the fan on the Therminol cooling system cooler (Item 624) can be started.

(10) Vacuum problems on the stills are usually due to flashing of product over plugged vacuum lines, leaks in the still system, leaks at pump packing, or Therminol flow problems on the condenser, water adjustment on the inter-condenser, on the jet, changes in the steam pressure to the jets, or problems in the nozzles for the jet. Flashing can be stopped by lowering the temperature of the Therminol cooling system for the No. 4 still condenser. Vacuum trouble must be traced systematically from the jet to the receiver and then to the still. To accomplish this, manometer pressure indicators have been placed in the system as follows:

(a) On top of the trap in front of the jet (Item 625);

(b) On the still receiver (Item 620);

(c) On the still (Item 615).

(11) During normal operation, the manual valves to the coil on the receiver (Item 620) are open. The still receiver temperature indicating controller TIC-620.02 is set at 150°C. with the controller in "auto".

(12) A level indication gauge has been installed in the still receiver (Item 620) to allow indication of the level of material being distilled over. The level instrument is LI-620.04. This level indication can be used to determine when the distillation is near completion. This will aid the still operator along with his normal observation of coil temperature spread across the furnace.

(13) Batch data sheets are filled out during each distillation. Information includes the still lot number, materials being distilled, start time, finish time, the temperature spread on the still coils, the vacuum, the end time for the distillation, etc. See distillation table details which follow on Page 11.

TABLE II

DISTILLATION OPERATING CONDITIONS - SOLID AROCLORS

	1268	4465	5442	5460
Approximate Temperatures at which Various Aroclors Start Distilling @ 3-5 mm Vac. At Receiver:				
Column	225°C.	220°C.	215°C.	260°C.
Coil Inlet	240°C.	235°C.	240°C.	280°C.
Coil Outlet	245°C.	240°C.	245°C.	285°C.
Approximate Finishing Temperature When Bottoms Are Not to be Drawn:				
Column		310°C.		
Coil Inlet		330°C.		
Coil Outlet		375°C.		
Approximate Finishing Temperature After Which Bottoms Are to be Drawn:				
Column	285°C.	350°C.	315°C.	355°C.
Coil Inlet	295°C.	360°C.	340°C.	375°C.
Coil Outlet	330°C.	400°C.	380°C.	400°C.
Finishing Hold Point	150-170°C.			
Finishing Softening Point		60-66°C.	46-52°C.	98-105.5°C.

(14) As the distillation nears completion, temperature in the still pot will rise. Flow through the coil will remain steady. When the flow drops below 125 GPM, an alarm will sound. The main gas burner to the furnace will shut off if flow drops below 100 GPM. An additional aid is the level indicator in the still receiver (Item 620).

(15) At the end of the distillation, the batch is checked for color and softening point or hold point, depending on the material being produced. Before transfer, check that space is available in the flaker hold tank and that the hot Therminol system is on the transfer lines from the still receiver to the flaker hold tank.

(16) At the end of the distillation, shut off the furnace if it has not already been shut down automatically.

(17) Close the main valve in the vacuum line on top of the receiver (Item 620). This is to isolate the jet from the still system and eliminate plugging of the jet.

(18) Vent the furnace coil and allow it to suck dry slowly to prevent carryover to the still condenser.

(19) Shut off the fan on the Therminol cooling system cooler (Item 624). This can be done at the control panel.

3. Operation of the Still During Distillation

a. Regulate the gas pressure at the burners by use of FRC-618.06 to give the maximum distillation rate with consistent good color of the product.

b. The lower the vacuum, the faster the distillation rate, normally. (See table "Distillation Operating Conditions - Solid Aroclors")

c. Coil temperature spread:

(1) Coil inlet and outlet temperature must be watched closely at the end of the distillation. Still bottoms are very viscous; therefore, if the circulating pump is in poor condition, or the distillation is carried too far, circulation may stop and the coil will become plugged or be burned. Heat from the furnace actually burns the Aroclor to carbon when overheated. If the coil outlet temperature jumps suddenly and the inlet temperature stays the same or falls, circulation is nearly stopped. In this case, shut off the furnace gas supply FRC-618.06 quickly and suck the coil. Normally, the low flow rate FRA-618.01 will alarm with a flow below 125 GPM. If the coil cannot be sucked, it is plugged and will have to be replaced.

4. Pump Out Still Receiver

a. Transfer material from the still receiver (Item 620) to the flaker hold tank or drum out, dependent on material being produced.

b. Observe level of material in the still receiver by use of LI-620.04.

c. Check to be sure Therminol heating system is on the jackets of the transfer lines.

d. Set valves in the line to drum out material or transfer to the flaker hold tank.

e. If material is to be transferred to the flaker hold tank, start transfer pump (Item 621) under the receiver. Allow material to pump until the receiver is empty.

f. Close the valves and stop the transfer pump when the receiver is empty. This can be observed by checking level gauge LI-620.04.

B. Start-Up Following Temporary Shutdown

This start-up phase would normally be a situation where a previous distillation is complete and the still has been shut down for charging with a new batch.

1. Prepare No. 2 Blow Tank for Transfer Charge

   a. Check to be sure that the Therminol heating system is on the transfer lines from the blow tank to the still pot.

   b. Check the temperature of the material in the blow tank. It should be 150°C. minimum.

   c. Check with the chlorinator operator to be sure that the crude Aroclor has been air-blown one hour.

   d. The No. 4 still vacuum system should be operating with the valve just above the No. 4 still receiver closed. Water should be on the intercondenser and steam on the jet steges. Vacuum on the trap (Item 625) in the vacuum pipe line should be indicating 4-5 mm Hg.

2. Set the vacuum control PRC-615.04 in "auto" with the set point at 10 mm Hg.

3. The No. 4 still receiver temperature still controller TIC-620.02 should be in "auto" with the set point at 150°C.

4. The Therminol cooling system should be circulating through the No. 4 still condenser and back to the surge tank. The temperature controller TICA-622.01 should be in "auto" with the set point at 120°C. The fan for the Therminol cooler (Item 624) should be running, if necessary, to cool Therminol. The No. 4 still temperature control TIC-615.03 will be in "auto" with the set point at 150°C.

5. The natural gas flow controller FRC-618.06 will be in "auto" with the set point at 0.

6. The No. 4 still furnace (Item 618) will be on as indicated by the Honeywell Protectoglo unit in the field panel. The "white" light on the Protectoglo unit will be on.

7. Set valves in the transfer line from the No. 2 blow tank to the No. 4 still.

8. Open the vent valve on the No. 4 still. Close the valve at the bottom of the still.

9. Start the No. 2 blow tank transfer pump and charge the No. 4 still. Observe level indication gauge in the No. 2 blow tank to measure the still charge.

10. Start up the solid still circulating pump. The Arochlor circulating flow meter FRA-618.01 will now record a flow in excess of 150 GPM.

11. The still circulating pump will be started as soon as 15% of the material from the No. 2 blow tank has been charged to the still.

12. Stop the No. 2 blow tank transfer pump as soon as the blow tank is empty. Close the valves at the bottom of the blow tank and at the discharge of the transfer pump.

13. Add 200 lbs. of lime to the still charge.

14. Close the vent valve on the No. 4 still. Open the vacuum valve on the No. 4 still receiver and start the vacuum on the system.

15. Gradually raise the set point of the natural gas flow controller FRC-618.06 to the desired set point. Watch the temperature rise across the furnace coil inlet and outlet as the temperature is raised. Normally, a 4 - 6°C. spread will be obtained across the furnace coil.

16. During normal operation of the still system, the following items will be observed.

    a. Temperature spread across the still furnace.

    b. Flow of the Aroclor through the furnace coil. See FRA-618.01.

    c. Level indication in the No. 4 still receiver See LI-620.04.

    d. Natural gas flow control to the No. 4 still furnace. SEE FRC-618.06.

    e. Temperature in the Therminol circulating system. See TICA-622.01.

    f. Temperature control in the No. 4 still. See TIC-615.03.

    g. Temperature control in the No. 4 still receiver. See TIC-620.02.

17. At the end of the distillation the batch is checked for color, softening point or hold point, depending on the material being produced. As the distillation continues, the temperature in the still pot will rise; flow through the coil will remain steady. When the flow drops to 125 GPM, an alarm will sound. Shut-off of the main gas to the still furnace will occur if flow drops below 100 GPM. An additional aid to finishing the batch is the level indication in the No. 4 still receiver LI-620.04.

18. Shut off the natural gas if it has not alarmed. Clear the coil by doing the following:

    a. Close the vacuum valve on top of the No. 4 still receiver in the line to the jet.

    b. Vent the still heater coil and suck the coil dry.

    c. Shut off the fan at the Aroclor cooler (Item 624).

19. Set lines to either drum material or transfer to the flaker hold tank, dependent on the material being produced. In case the material is to be transferred to the flaker hold tank, be sure the Therminol heating system is on the pump suction and discharge lines. Set the valves in the transfer line and start transfer pump to the flaker hold tank. When the No. 4 still receiver is empty, stop the circulating pump and close the valves in the transfer lines.

3.2 Routine Operations

When the No. 4 still system is operating normally, the following conditions will exist in the process.

A. No. 4 still pressure control PRC-615.04 set at 10 mm Hg.

B. No. 4 still circulating pump flow recorded on FRA-618.01 with flow above 125 GPM.

C. No. 4 still temperature control TRC-615.03 set at 150°C.

D. Natural gas feed to the still furnace controller FRC-618.06 set to give desired coil outlet temperature (about 500 cfh).

E. Furnace high temperature alarm instrument set at 400°C.

F. Therminol cooling system circulating temperature controller TICA-622.01 set at 120°C.

G. No. 4 still receiver temperature control TIC-620.02 set at 150°C.

H. No. 4 still level indication gauge LI-620.04 will indicate level in the receiver.

I. Main natural gas pressure 40 psig.

J. Natural gas reduced pressure 2-1/2 to 4 psig.

3.4 Safety Features

A. The Honeywell Protactoglo unit has the following safety features for the No. 4 still furnace (Item 618):

1. Ignition period 10 second delay between actuation periods for the warp switch to cool.

2. Heater coil high temperature outlet shutdown set at 400°C.

3. Natural gas high reduced pressure shutdown set at 5.0 psig.

4. Circulating pump low flow rate shutdown alarm set at 125 GPM.

5. Pilot flame must be burning to start up the unit. This is indicated by 1-1/2 to 2 microamperes on the field control panel.

B. Therminol cooling system temperature control alarm set for low alarm at 100°C. and high alarm at 175°C.

C. Check surge tank (Item 622) to be sure Therminol level is at least 6"-12" above the coil level.

3.5 Shutdown

A. Temporary Shutdown

Main gas burner on the furnace off with the pilot light on. The No. 4 still circulating pump running and the vacuum system on.

1. Adjust FRC-618.06. Set point to 0. Instrument in "auto".

2. Close the manual valve in the natural gas feed supply line to the main burner.

3. The vacuum may be cut off by closing the manual valve above the No. 4 still receiver. The still would then be vented and shut down systematically, if necessary.

B. Complete Shutdown

Main gas burner and pilot light shut off in the furnace. Still circulating pump off. The vacuum shut down and the Therminol cooling system shut off.

1. Push ignition stop button on side of the field control panel for the furnace control system.

2. After the furnace has cooled slightly, push the stop button for the No. 4 still circulating pump (Item 616).

3. Close manual valve above the No. 4 still receiver in the vacuum line.

4. Shut off steam to the vacuum jet by closing main valve in the steam supply line.

5. Close valve in the water line to the inter-condenser on the No. 4 still jet.

6. Shut off Aroclor to the coils on the still tank and the receiver by adjusting the temperature controller set points to 0 for each tank.

7. Stop the Therminol cooling system circulating pump (Item 623).

8. Check the surge tank level to be sure the tank does not overflow after this pump is shut off.

9. Adjust TICA-622.01 controller set point to 0. This will stop the Therminol heating system flow to the coils on the surge tank (Item 622).

10. Stop the fan on the Therminol cooling system cooler (Item 624).

3.6 Control Loops, Interlocks, and Alarms

A. Control Loops

There are 9 major control loops in this system.

1. Vacuum Control for the No. 4 Still - PRC-615.04

   The function of this loop is to maintain a constant vacuum on the No. 4 still tank. This is accomplished by measurement of the vacuum on the still and throttling a control valve at the suction of the No. 4 still jet. Normal setting of this instrument is 10 mm Hg.

2. No. 4 Still Circulating Pump Flow Recorder - FRA-618.01

   The function of this loop is to measure and record the flow through the furnace heater coil on the No. 4 still. This is accomplished by measurement with a segmental orifice which indicates the flow to a panel recorder with alarm. This is a special flanged jacketed orifice assembly using a Taylor volumetric d/p cell to measure flow. Normal flow will be above 150 GPM. A low flow alarm shutdown for the furnace (Item 618) main gas system will be actuated if the flow drops below 125 GPM. Shutdown occurs if flow drops below 100 GPM.

3. No. 4 Still Temperature Control - TIC-615.03

   The function of this loop is to maintain a minimum temperature in the No. 4 still, dependent on the material being produced (See Page 8 of this P.F.O.). This is accomplished by measurement of the temperature and throttling a control valve on the discharge of the Therminol heating system from the coils in the No. 4 still (Item 615).

4. Furnace Natural Gas Flow Control - FRC-618.06

The function of this loop is to control the gas input to the No. 4 still furnace. This is accomplished by measurement of the natural gas through an orifice flow meter and throttling the control valve in the reduced gas line.

5. No. 4 Still Furnace Controls - 618A

The function of this control system is to control the natural gas feed pressure to the still furnace and assure a pilot light is always burning when natural gas is being fed to the furnace. This is accomplished with a Minneapolis-Honeywell Protectoglo pilot light control mechanism. There are six safety features in the furnace controls to shut the system down:

a. High furnace coil outlet temperature will shut down the furnace above 400°C.

b. Low reduced natural gas pressure 2-1/2 psig.

c. High reduced natural gas pressure 10 psig.

d. Failure of circuit No. 6 at the rear of the still panelboard, or electrical failure.

e. Failure of any component in the Honeywell pilot flame mechanism.

f. Failure of the pilot system is indicated by the "red" light on the Protectoglo unit lighting up.

6. Therminol Cooling System Temperature Control - PICA-622.01

The function of this loop is to measure the temperature in the Therminol cooling system surge tank and control this temperature to 120°C. This is accomplished by measuring the temperature in the surge tank and throttling a control valve in the discharge of the coil in the surge tank. The louvers in the Therminol cooling system heat exchanger (Item 624) are also throttled to allow more or less air to pass across the coils. A low temperature alarm sounds at 100°C. and a high temperature alarm at 175°C.

7. No. 4 Still Receiver Temperature Control - TIC-620.02

The function of this loop is to control the temperature in the No. 4 still receiver to 150°C. This is accomplished by measuring the temperature in the receiver and throttling a control valve in the Therminol heating system discharge line on the coil from the No. 4 still receiver.

8. No. 4 Still Receiver Level Indication - LI-620.04

The function of this loop is to indicate the level of distilled product in the No. 4 still receiver. This is accomplished by a float level instrument which indicates the Aroclor level on a 0-8 ft. dial gauge.

9. No. 4 Still Condensate Temperature - TIA-619.03

The function of this loop is to indicate the temperature of the condensate from the No. 4 still condenser and sound an alarm if this temperature should become too low. Normally, a temperature of 20-30°C. below the product temperature indicates the condenser is plugging up, will sound an alarm.

B. Interlocks

Interlocks in this system are as follows:

1. Start-Up of No. 4 Still Furnace (Item 618)

a. Actuation of the pilot ignition lever on the Honeywell Protectoglo unit has a 10 second delay before a second try can be made.

b. The ignition "start" button at the Protectoglo unit has a 3 minute purge delay after the "start" button has been pushed. This is to allow air purging of the furnace before it lights up.

2. Automatic No. 4 Still Furnace Shutdown With Alarms (Pilot and Main Gas Burner Off)

   a. High furnace coil outlet temperature above 400°C.

   b. Low reduced natural gas pressure 2-1/2 psig.

   c. High reduced natural gas pressure 10 psig.

   d. Low coil flow below 100 GPM.

   e. Failure of circuit No. 6 at the rear of the still panel.

   f. Failure of the switch at the side of the field control panel, or blowing the 115 volt fuse in the panel.

C. Alarms

1. All shutdown items under "Interlocks" (B-2 above) have alarms.

2. No. 4 still circulating pump low flow alarm below 125 GPM.

3. Therminol cooling system TICA-622.01 has a low temperature alarm at 100°C. and a high temperature alarm at 175°C.

4. Condensate temperature alarm on low temperature for the distilled product coming out of the No. 4 still condenser (Item 619). This controller TIA-619.03 is set to alarm at approximately 20-30°C. below the condenser product outlet temperature.

IV. COMMENTS ON THE PROCESS

A. It is very important to be sure the coil in the Therminol cooling system surge tank (Item 622) is covered when the system is in operation. This assured 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.

B. Care must be taken not to fill the surge tank (Item 622) 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" above the tank coils. The level in the tank will vary, dependent on the operating temperature of the system. Normally, this will be 120°C.

C. Be sure that chromel-alumel thermocouple extension lead wire is used to connect up the furnace natural gas high temperature coil outlet alarm. Type K wire is in the same conduit as Type J wire. If Type J wire is used by mistake, the indicator will read too high and cause furnace shutdowns.

D. After the first two or three still batches have been run so the natural gas heat input rate is known, adjust the linkage on the reduced gas pressure control valve so a 3-15 psig instrument signal will fully stroke the valve. Make the adjustment so that only 10-15% above the maximum needed gas pressure can be obtained. This will reduce charring of the coils in the still furnace (Item 618). In setting this instrument, a manometer is furnished with the furnace controls for adjusting the control valve. The manometer readings across the orifice will be:

0.595"	at	400,000 Btu/hour Input
0.74 "	at	500,000 Btu/hour Input
0.89 "	at	600,000 Btu/hour Input
1.04 "	at	700,000 Btu/hour Input
1.19 "	at	800,000 Btu/hour Input

E. The flow measurement recording instrument for the still heater system FRA-618.01 is an extremely important portion of the controls for the new 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 should indicate low flow rates at the end of a distillation which will aid the operator in completing a normal distillation.

F. A restricting orifice has been installed in the furnace circulating line on the No. 4 still as the pipe line re-enters the still tank. This orifice is designed to maintain a pressureof 6 psig through the still furnace coil. This increased pressure at the coil outlet will suppress any boiling or vaporization within the coil. Actual vaporization and distillation should take place in the still tank (Item 615).

G. During distillation of solid Aroclors, vacuum problems occur in the pipe line to the jet system and plugging of the jet nozzles occur due to flashing and normal vapor pressure carryover. The vacuum line from the No. 4 still receiver (Item 620) has Therminol heat on the jacket of the pipe line up to the suction line on the jet (Item 626). The trap tank (Item 625) in the vacuum line has Therminol heat on the coils in the tank. It is very important that the Therminol heating system be cut off the jacketed lines and the coils in the trap tank during normal operation. If these lines are kept hot during normal operation, it will cause carryover into the jet nozzles and cause more rapid plugging than in the past. When using the Therminol heating system to clean out the lines or drain the trap tank, the jet should be isolated from the No. 4 still system. This can be done by either shutting the steam off to the jets or closing the block valve in the pipe line at the suction of the jet.

H. In the existing No. 1 Aroclor still system, leaks occur in the still condenser where the tubes are welded to the tube sheet at the ends of the condenser. The new condenser for the No. 4 still has a specially designed flexible expansion joint in the shell of the condenser. It is felt that this expansion joint will eliminate our present leakage problems in the new No. 4 still system. It is extremely important that we watch for potential leaks since the material leaking into the distilled product will be Therminol FR-2 (Aroclor 1248).

PROCESS FUNCTION OUTLINE

AROCLOR DEPARTMENT

I. CHARGE TANK, BATCH AND CONTINUOUS LIQUID CHLORINATORS, AND BLOW TANKS

1.1 Scope

This covers the charging, start-up, shutdown, normal operation, and emergency situations involving the charge (melt) tank, the batch and continuous liquid chlorinators, and the blow tanks for production of liquid Aroclors.

1.2 Description of Process

Crude liquid Aroclors are produced by batch or continuous chlorination when a measured quantity of Biphenyl is chlorinated in a vertical reaction vessel with Ferric Chloride as a catalyst. Chlorine gas is added at the bottom of the vessel. The reaction is cooled by circulating the reaction mass through an external air-cooled heat exchanger.

By-product HCl gas vented at the top of the chlorinator is recovered in the Muriatic Acid Department. Crude liquid Aroclors produced in the batch chlorination are transferred to the blow tank operation when the chlorination is complete. A continuous blow tank is installed in the continuous chlorination system so aerated material is transferred directly to still feed tanks (or roof tanks).

Chlorine gas can be fed to the chlorinators from the Chlorine Plant or from tank cars.

II. PROCESS DIAGRAM

Attached.

III. DESCRIPTION OF PROCESS

3.1 Start-Up

A. Charges and Operating Temperatures for Various Crude Liquid Aroclors - Batch Chlorinators

Depending on the product to be produced, different quantities of raw materials are needed. See Table I on Page 2.

TABLE I

BATCH LIQUID CHLORINATOR OPERATING CONDITIONS

	AROCLOR					
	1121	1142	1148	1154	1160	1162
Chlorinator Charge						
Biphenyl (Lbs.)	3,000	3,000	3,000	3,000	3,000	3,000
Approximate Pounds 100% Chlorine Required to Produce Batch	1,600	3,330	5,560	7,040	9,030	9,480
Totalizer Chlorine Setting (80% Cl_2, Assuming 10% Air)						
Lbs. Cl_2	1,420	3,000	4,940	6,250	8,020	8,420
Chlorinator Temp.						
Beginning - °C.	130	130	130	130	130	130
Ending - °C.	140	150	155	155	160	160
Final Specific Gravity Range	1.150 1.160	1.344 1.357	1.410 1.420	1.500 1.510	1.558 1.572	1.582 1.586
@	65°C.	65°C.	65°C.	65°C.	90°C.	90°C.
Weight of Crude Batch						
Lbs.	3,750	5,080	5,550	6,350	7,160	7,545
Gallons	390	450	470	505	550	570

B. Filling Charge (Melt) Tank for Batch Chlorinators

1. Refer to Section 3.1-A for the actual quantities of raw materials needed for the particular Aroclor to be produced (Table I, Page 2).

2. Set the valves to receive the charge from the Biphenyl Department. Notify the operator you are ready for a charge. Biphenyl is obtained from the No. 1 or No. 2 Biphenyl catch tanks or the Biphenyl storage tanks. A normal 3,000 pound Biphenyl charge is 35" innage in the charge tank for Biphenyl.

3. Be sure steam is on transfer lines and the coil for the Biphenyl charge tank.

   One and one-half (1-1/2) pounds of Ferric Chloride are slurried in Aroclor and dumped into the charge tank with each chlorinator charge. When the correct charge of Biphenyl is in the charge tank, close the manual valve in the line to the tank. Notify the operator who started the charge that it is complete.

4. Start the agitator in the charge tank and let it run for one hour minimum prior to charging the chlorinator. This is after the Ferric Chloride has been added.

5. Material in the charge tank should be a minimum 100°C. when charging the chlorinator.

6. The material is now ready for the next chlorinator charge when needed.

C. Charge the Batch Chlorinator and Start-Up

1. Manual Operation

   a. Close manual chlorine valve at the distributor on the chlorinator to be charged.

   b. Close vent on the chlorinator to the atmosphere.

   c. Open HCl vent valve to muriatic acid area.

d. Set temperature recorder controller in "auto" with the set point at 150°C. Low temperature alarm 120°C. - high temperature alarm 190°C.

e. Place selector switch for chlorinator fan in "auto".

f. Place chlorine flow control instrument in "auto" and set. The chlorine set point will be 400 lbs./hour.

g. Set the valves to transfer charge from charge tank to the chlorinator.

Be sure to stop the agitator before starting the transfer pump.

h. Start chlorinator charge pump. Stop pump when the charge tank is empty and close the valves at the charge tank.

i. Set the chlorinator valves to circulate the chlorinator through the external heat exchanger and back to the chlorinator.

j. Start the circulating pump.

k. Open manual chlorine valve at the distributor on the chlorinator. Chlorine header pressure control PIC-500.07 will control the pressure to 20-25 psig. A low pressure alarm is set at 15 psig - high pressure alarm at 35 psig.

l. After one hour, increase the chlorine rate to 600 lbs./hour chlorine feed.

After two hours, increase the chlorine feed rate to 800 lbs./hour.

m. Check the following items after the start of the chlorination.

(1) Temperature at the temperature controller.

(2) The chlorine flow at the flow controller.

(3) Circulating pump discharge pressure.

(4) Temperature of the chlorinator batch on the Multipoint Recorder.

n. Samples are taken at the discharge line of the circulating pump at the second level.

The specific gravity is run on the batch chlorination. At the start of the chlorination, a sample is taken after two hours of operation on odd numbered hours (7, 9, 11, etc.). Samples will be taken every two hours through the chlorination.

o. When the chlorination is near completion, it may be necessary to run the specific gravity more often to determine the exact end point.

p. When the chlorination has been completed (see Table I), shut off the chlorine feed valve at the distributor on the chlorinator.

q. Note the chlorine pressure on the main header. If it is above 30 psig, notify the Chlorine Plant that you have removed the chlorinator from operation. Tell them when you can start it back up. If this chlorinator is to be off for a long period of time, notify the Chlorine Plant prior to shutting off the chlorinator. Pressure controller alarm PIC-500.07 will indicate a high pressure in case it should occur at 35 psig.

r. The chlorinator is now ready to be pumped out when the operator is ready.

2. Programmed Chlorinator Operation

a. Close the manual chlorine valve at the distributor on the chlorinator.

b. Close the vent valve on the chlorinator to the atmosphere.

c. Open the HCl vent valve to the muriatic acid area.

d. Set the temperature recorder controller in "auto" with the set point at 150°C.

e. Set the chlorine flow recorder controller in "auto-cascade". Have the set point at 400 lbs./hour.

f. Adjust the green set point knob on the chlorine totalizer per Table I on Page 2 for measuring chlorine flow. Set up the chlorine flow program per Appendix I, attached.

g. Set the valves to transfer the charge from the charge tank to the chlorinator. Start the transfer pump. Stop the pump when the charge tank is empty. Close the valves in the charge line.

h. Set the valves to circulate the chlorinator to the external air-cooled heat exchanger and back to the chlorinator.

i. Start the circulating pump.

j. Push the green reset button on the chlorinator panel for the chlorinator to be started up. This resets the chlorine totalizer and is the initiating signal for the start of a new batch. The Flexipulse Timer will begin to time the batch as indicated by cascade flow. The batch chlorine flow will be controlled according to a preset program. At 80% of the chlorine flow as set by the chlorine totalizer, an alarm bell will ring to indicate 80% of the chlorine feed has been taken into the chlorinator.

k. Open the manual chlorine valve at the distributor on the chlorinator.

This should be done immediately after pushing the reset button so the timer will control the batch correctly. Steps j. and k. can be reversed if desired, dependent on where the operator is when starting the batch.

The chlorine header pressure control PIC-500.07 will control the pressure to 20-25 psig. It will indicate a low pressure alarm at 15 psig and a high pressure alarm at 35 psig.

l. After two hours, take a sample of the crude Aroclor and check for specific gravity. This sample is a check to be sure a short charge was not transferred into the chlorinator. The next sample after that will be taken when the 80% alarm bell rings.

m. Check the following items during operation.

(1) Temperature at the temperature recorder controller.

(2) Chlorine flow at the chlorine recorder controller.

(3) Circulating pump discharge pressure.

(4) Temperature of the chlorination batch on the Multipoint recorder controller.

(5) Note program time and approximate time until completion of batch.

n. The alarm bell will ring when 80% of the chlorine has been fed to the chlorinator. Immediately take a sample at the circulation line to determine the point which the chlorination level has reached.

o. Continue the chlorination until complete. It may be necessary to run the specific gravity more often during the last one to two hours of chlorination.

p. At completion of the chlorination (see Table I), push the green reset pushbutton on the chlorinator panel for the chlorinator. This reduces the chlorine flow to 300 lbs./hour, and stops the timer. Shut off the chlorine feed valves to the distributor at the chlorinator.

q. Note the chlorine pressure on the main header as in "Manual Operation". Notify the Chlorine Plant if the chlorinator is to be off for any length of time, or if the pressure is above 30 psig. The chlorine header pressure controller alarm will indicate an abnormal low or high pressure.

r. If the chlorination is complete, prepare to pump to the blow tank as desired, depending on the product being produced. See next section of Operating Instructions.

D. Transfer to Blow Tank

1. Set transfer lines to pump to the blow tank, dependent on the material being produced. Be sure steam heat is on the transfer line. The chlorinator is vented to the HCl line during transfer.

2. Check the level indication instrument on the blow tank to be sure there is enough room to transfer into the tank.

3. Change the final valve in the transfer line and allow material to pump from the chlorinator to the blow tank. Observe transfer and note level increase on the blow tank level indicator. At the completion of the transfer, close the valves in the circulating system and shut off the circulating pump on the chlorinator.

4. The chlorinator is now ready to charge back for the next chlorination.

5. Record transfer information on the chlorinator data sheet and in the log book. Normal blow tank innages after a single transfer are as follows:

Aroclor	Blow Tank Innage	Blow Tank Level Instrument
1121	14 Inches	
1142,1148, 1154	16-17 Inches	
1160,1162	18 Inches	

6. If the chlorinator which is to be shut down had 1160 or 1162 in it, it should be washed out with approximately 100 gallons of 1142 prior to complete shutdown.

E. Fill Biphenyl Mix and Feed Tank for the Continuous Chlorinator System

1. Check the level in the mix tank. The tank low level alarm should have sounded (set for 25% full). Silence the alarm by pushing the acknowledge button on the control panel.

2. Set the valves to receive the charge of Biphenyl. Notify the Biphenyl still operator to pump a charge to the mix tank. Fill the tank to 75% full level. Close the valve in the charge line when this level is obtained.

3. Start the agitator in the mix tank.

4. Add 3-1/2 pounds of Ferric Chloride to the mix tank. Allow the Biphenyl and Ferric Chloride to mix until the feed tank requires filling.

5. The feed tank low level alarm sounds the annunciator system at 25% full in the feed tank. The mix tank batch can be dropped into the feed tank any time after the alarm sounds.

   The low alarm in the feed tank sounds approximately 30 minutes prior to the tank running empty.

6. Stop the agitator in the mix tank.

7. Open the valve under the mix tank and allow the Biphenyl-Ferric Chloride mix to drop into the feed tank. The level indicator in the feed tank should indicate approximately 85% full.

8. Start the Biphenyl feed tank agitator.

9. Close the valve under the mix tank when the tank is empty.

10. Prepare another mix for the Biphenyl mix tank as noted above. The low level alarm in the mix tank should have sounded and been acknowledged.

F. Continuous Chlorinator Operation

The continuous chlorinator operation consists of four cascade flow chlorinators in series where specific levels of chlorination occur. Biphenyl is fed into the first chlorinator where the material is chlorinated and overflows to the second unit. This continues until the finished product comes off the final unit, flows to the catch tank, and through the continuous blow tank. This chlorination system can be reduced to three (3) chlorinators in series in case problems occur with one unit. Normally, 1142 is the only liquid Aroclor produced on the continuous system; however, 1148, 1154, and 1160 can also be produced with the chlorinators set for different levels of chlorination.

1. Four Stage Continuous Chlorinator Operation

a. Set the temperature controllers for chlorinator No. 5, 6, 7, and 8 at 150°C.

b. Set the chlorine flow controllers in "auto" with the set points at 600 lbs./hour for chlorinators No. 5, 6, 7, and 8.

c. Set the specific gravity recorder controller for No. 8 chlorinator in "auto" with the set point at 1.350. The Accuray controller will adjust the chlorine feed automatically to No. 8 chlorinator to maintain the indicated specific gravity.

d. Set the Biphenyl feed controller in "auto" with the set point for 2 GPM (instrument reading 4).

e. Charge each of the four chlorinators (No. 5, 6, 7, and 8) with Biphenyl as for a regular batch chlorination. Start the circulating pumps on the chlorinators.

f. Follow normal procedure to chlorinate the material to the following levels:

Stage	Chlorinator	Specific Gravity
First	5	1.078 - 1.104
Second	6	1.170 - 1.196
Third	7	1.254 - 1.280
Fourth	8	1.336 - 1.362

g. Close the valve on the chlorine distributor on each chlorinator when the correct specific gravity level has been reached. Hold this chlorinator until all four are ready. It may be necessary to put steam on the chlorinator to keep the temperature at 120°C.

h. Check the Biphenyl feed tank to be sure mix has been charged and the agitator is running.

i. Set the valves on the Biphenyl feed line to the No. 5 chlorinator and allow circulation back to the feed tank.

j. Start the Biphenyl feed pump.

k. Set the valves on the overflow lines at the chlorinators as follows:

Crude from No. 5 chlorinator to overflow to No. 6 chlorinator; No. 6 chlorinator to No. 7; No. 7 overflows to No. 8; No. 8 overflows to the crude Aroclor catch tank and then to the continuous air blow tank.

l. When all four chlorinators have reached the correct specific gravity level, start the chlorine feed to each of the chlorinators (600 lbs./hour on each) and open the valve to start Biphenyl feed to the No. 5 chlorinator. Open manual valves at each chlorinator distributor. Chlorine feed is adjusted at the automatic flow controllers in the control room to maintain the required specific gravity level.

Normally, No. 5 chlorinator chlorine feed is lower than the other three chlorinators. This is to decrease Biphenyl carryover into the HCl header line.

Be sure and close the manual valve in the Biphenyl feed line to No. 5 chlorinator.

m. Samples will be caught and specific gravity run on chlorinators No. 5, 6, and 7 every other hour on even hours (8, 10, 12, etc.). A sample will be run on No. 8 chlorinator every four hours (8, 12, 4, 8, etc.).

n. Check the following items during operation.

(1) Temperature of the individual chlorinators on the automatic temperature controllers.

(2) Chlorine flow on the chlorine flow controllers.

(3) Discharge pressure of the circulating pumps for each chlorinator.

(4) Temperature on the Multipoint temperature recorder for the chlorinator batch temperature for each unit.

(5) Specific gravity of No. 8 chlorinator.

o. The continuous blow tank level controller LICA-529.01 has a set point at 50%. The controller is always in automatic.

p. The crude Aroclor catch tank level indicating controller LICA-545.01 is set at 50%. The controller is always in automatic.

q. When the level in the crude Aroclor catch tank reaches the 50% set point, set the valves to allow transfer from the crude Aroclor catch tank to the continuous blow tank. Start the crude Aroclor catch tank pump.

r. Set the valves to allow transfer from the continuous blow tank to the No. 4 blow tank. When the level in the continuous blow tank has reached 50%, start the transfer pump which will allow pumping to the No. 4 blow tank or the No. 1 roof tank.

e. The levels in the two tanks will be maintained automatically. Periodically the No. 4 blow tank must be transferred to the No. 1 roof tank to feed the No. 3 still. When the continuous blow tank system has been proven to satisfactorily air blow the crude Aroclor, valves can be set to allow pumping directly to the roof tank.

2. Three Chlorinator System

a. Routine repairs to the chlorinators requires removal of one of the four continuous chlorinators from the system. In this case, the following procedure would be followed to run three chlorinators continuously.

b. Switch valves on the overflow lines from one chlorinator to another to allow bypassing a particular chlorinator.

c. Shut off the Biphenyl feed to the first stage chlorinator and chlorinate the material to the following levels:

Stage	Chlorinator*	Specific Gravity
First	5	1.108 - 1.124
Second	6	1.224 - 1.240
Third	8	1.345 - 1.355

*Note: Indicates No. 7 chlorinator out of system; however, any one of the four can be bypassed.

d. Start the chlorine and Biphenyl feed again in the same manner as for the four stage continuous operation.

e. Continue operation of the system as a three stage unit, merely omitting the one stage which has been bypassed.

f. The chlorinator removed from service should be chlorinated to a finished Aroclor end pumped out. The chlorinator will be shut down in a routine fashion. See details in "Shutdown" section.

G. Chlorine Vaporizer

Liquid chlorine from tank cars is vaporized in a shell and tube heat exchanger, using steam for heat. Vaporized chlorine at 25 psig enters the chlorine header to the Aroclor chlorinators.

1. Open manual valve on the steam line to the vaporizer.

2. Set the vaporizer temperature control at 65-75°C. to allow the steam control valve to open.

3. Check to be sure steam pressure to the vaporizer is 12 psig or lower.

4. Set the chlorine header pressure control valve in "auto" with the set point at 0. The chlorine valve feeding liquid chlorine into the header will be closed.

5. Hook up the take-off lines to the chlorine car. Wear a gas mask while making this connection. Open the valve on the car to take on chlorine when the car is connected. This valve must be opened slowly or the check valve ball will jump up in the valve and make it impossible to take chlorine out of the car.

6. Open the valve in the liquid chlorine line to the vaporizer located at the tank car.

7. Open the block valves on each side of the automatic liquid chlorine take-on valve. Close the bypass valve at the control valve.

8. Check the vaporizer level control to be sure it closes the liquid chlorine control valve when the vaporizer is approximately one-half full.

9. Set the chlorine pressure control instrument PIC-500.07 at 25 psig with controller in "auto".

10. Open the chlorine vapor valve slowly to eliminate surges in the chlorine header system.

11. Observe operation to be sure the chlorine header pressure does not exceed 25 psig and the steam pressure to the vaporizer remains below 12 psig.

    High chlorine pressure can cause extreme problems in the Chlorine Plant and result in chlorine released to the atmosphere in that department. In case a high pressure alarm (presently set at 35 psig) should occur, contact the Chlorine Plant immediately and try to eliminate their pressure problem if possible. The pressure indicating controller indicates a low pressure alarm at 15 psig.

3.2 Routine Operations

During normal operations of the batch and continuous chlorinators, the following conditions will exist in the process.

A. Batch Chlorinators

1. Chlorine flow will be indicated on the flow controller. If in "cascade-auto" control, the Taylor Flexipulse Timer will be controlling the flow by programmed system.

2. Temperature will be controlled by the temperature recorder controller with the system in "auto". Normal temperature is 150°C.

3. The chlorinator circulating pump will be in operation. Discharge pressure on the pump will be 35 psig. Normal flow of the pump will be 200 GPM.

4. Temperature of the chlorinator can also be observed on the Multipoint temperature recorder.

5. The chlorine pressure on the main header can be observed on PIC-500.07, the pressure indicator controller from the chlorine vaporizer. Normal pressure will be 20-25 psig.

B. Continuous Chlorinators

1. Chlorine flow will be in "auto" control with the flow indicated on the flow recorder controller for the individual chlorinators, No. 5, 6, 7, and 8.

2. Temperature will be controlled by the temperature recorder controller for the individual chlorinators. Normally, the controller will be in "auto" with the set point at 150°C.

3. The chlorinator circulating pumps will be in operation with the discharge pressure at 35 psig. Normal flow of the pumps is 200 GPM.

4. The temperature of the individual chlorinators can be observed on the Multipoint temperature recorder.

5. Biphenyl feed to the first stage of the continuous chlorinators, (normally No. 5 chlorinator), can be observed on the Biphenyl feed control instrument. Normally, this instrument is in "auto" with the set point at 3.0 GPM.

6. The Accursy specific gravity instrument for the No. 8 chlorinator will be indicating the specific gravity for the material in the No. 8 chlorinator. The controller will be sat in "auto" with the control point at 1.350 specific gravity units.

7. The level in the Biphenyl mix and feed tanks will be indicated by the level indicators on the control panel. Normally, the mix tank will have a charge in it indicating 75% full. The feed tank level will vary from 25-85% full.

8. The level in the crude Aroclor catch tank will normally be 50%.

9. The level in the continuous blow tank will normally be 50%.

10. Air pressure to the continuous air blow tank will normally be 5.0 to 10 psig.

11. The HCl header off-gas pressure will normally be 1.5 to 3.0 psig.

C. Chlorine Vaporizer

1. Chlorine level in the vaporizer will be approximately 50%.

2. Steam to the chlorine vaporizer steam chest will be 10-12 psig.

3. Chlorine pressure from the tank car will normally be 60 psig.

4. The chlorine vaporizer temperature controller will be set at 65°C. Normally, the liquid chlorine will be well below this temperature which opens the steam control valve.

5. The chlorine pressure indicating controller PIC-500.07 will be set in "auto" with the controller at 20-25 psig.

D. Blow Tank

1. One of the air blowers will be operating with the discharge pressure at 5-7.5 psig.

2. Water at a pressure of 40 psig will be on the S&K scrubber jet, drowning the HCl fumes from the blow tank.

3.3 Safety Features

A. A level indication instrument is on the chlorinator control panel to indicate when a new charge is needed in the mix tank. A low level alarm is indicated at 25%.

B. A level indication instrument is located on the chlorinator control panel for the feed tank. A low level alarm will sound at 25% full to indicate a new charge is needed for the feed tank. Approximately 30 minutes operation time is available before the tank will be empty.

C. A level indicating controller is located in the crude Aroclor catch tank to control the level to 50%. A high alarm will sound at 60% level. This allows approximately 1½ hours prior to the tank being completely full.

D. A high temperature alarm is set at 190°C. on the individual chlorinators to prevent excessive carry-over of trappings into the HCl offgas header. Temperatures above this will cause excessive carry-over of Biphenyl or crude Aroclor. A low temperature alarm is also provided at 120°C. to prevent production of unstable Aroclors.

E. Chlorine flow stops will be placed on the chlorine flow control valves to the chlorinator set at 300 lbs./hour to prevent shutting off the chlorine feed in cases of air failure to the control valve. The control valve normally closes on air failure. This is for protection of Chlorine Plant personnel.

F. A sight glass has been placed in the HCl offgas line of each chlorinator to allow observation of the flow for possible entrainment. In case entrainment droplets are noticed being carried out of the HCl gas, the chlorine flow should be decreased slightly to reduce this entrainment. Excessive entrainment carryover will cause plugging of the HCl offgas line.

G. Normally, when the programmed flow control system is in operation on a batch chlorinator, a sample of the material being chlorinated will be taken after four hours of operation. This sample is taken to assure a short charge has not been made to the chlorinator. The sample should be checked for specific gravity. If the sample indicates a normal batch, the next sample should be taken when the 80% bell rings as preset by the chlorine flow totaliser. This sample is to assure a batch is not over-chlorinated and sets up in the chlorinator, preventing its transfer to the blow tank.

H. In case the chlorine flow control valve cannot be made to work, a rotameter is installed in each of the chlorine feed lines to the batch and continuous chlorinators. This rotameter will provide a reference to let the operator know what the chlorine flow is in cases of failure of the flow meter.

I. A chlorine pressure indicating controller has been installed to regulate the chlorine pressure to the main header. Chlorine pressure is regulated by feeding liquid chlorine from a tank car and vaporising it into the header. PIC-500.07 will be set for a normal chlorine header pressure of 20-25 psig, with a high alarm point at 35 psig and a low alarm point at 15 psig.

J. The chlorine vaporizer has several safety features and equipment items built into its design. They are:

1. A high level alarm shut-off in case the level should exceed 50% in the vaporiser shell. This shut-off stops liquid chlorine feed to the vaporiser by closing a control valve.

2. Steam pressure to the chlorine vaporizer is regulated to 10-15 psig. A pressure relief valve is installed in the system to relieve any pressure above 15 psig.

3. Steam supply pressure to the chlorine vaporiser is regulated by the temperature of the liquid chlorine feeding the vaporizer. Normally, the temperature indicator set point is above 40°C. Liquid chlorine from a tank car is normally 0°C. at 36 psig.

4. The chlorine header pressure is regulated to 20-25 psig by a pressure indicating controller which regulates a control valve on the discharge side of the chlorine vaporizer.

5. A rupture disc is installed on the chlorine vaporizer to relieve the pressure at 275 psig and a relief valve is installed on the discharge of the rupture disc to relieve at 300 psig.

3.4 Shutdown

Operations of the charge tank, the batch chlorinators, the continuous chlorinator system, and the blow tanks can occur which cause temporary or prolonged shutdowns. The following detailed information concerns individual shutdowns of each of the above items. If the entire system is to be shut down, the various items can be combined to achieve this objective.

A. Charge Tank

1. Temporary Shutdown

a. Close the manual valve in the Biphenyl feed line to the charge tank.

b. Close the valve at the bottom of the charge tank and at the discharge of the chlorinator charge pump.

c. Leave steam heat on the transfer lines to the charge tank.

d. Leave steam heat on the coil to the charge tank.

e. The agitator and charge tank pump will normally be shut down unless in use.

2. Prolonged Shutdown

a. Normally, the tank will have been emptied prior to a prolonged shutdown.

b. Close the manual valve on the Biphenyl feed line into the charge tank.

c. Drain the charge tank, if necessary, for repair work.

d. Close the valve at the bottom of the charge tank and at the discharge of the chlorinator charge tank pump.

e. Shut off the steam to the transfer lines to and from the charge tank.

f. The agitator and charge tank pump will be shut off.

g. Shut off the steam supply to the discharge line from the charge tank pump.

h. Leave the system in this condition until needed.

i. Note shutdown information on data sheet.

B. Batch Chlorinator

Operations can occur which will require a batch chlorinator to be cut back or temporarily shut down. Some of these items are failure of chlorine feed, a tank car emptying, or a cutback of the Chlorine Plant. Normally,

if a partial reduction of the chlorine feed occurs, the batch liquid chlorinators will be shut off and the continuous chlorinator system and the No. 9 chlorinator will continue to be operated.

1. Temporary Shutdown

   a. The circulating pump will normally be left in operation.

   b. Close the chlorine valve at the distributor of each chlorinator.

   c. Check the chlorine header pressure and rotameter feed and chlorine feed to the other chlorinators. The pressure should be 20-25 psig.

   d. Check to see that liquid chlorine is being fed to the vaporizer and that steam is on the vaporizer. Steam pressure should be 10-15 psig. Discharge pressures on the vaporizer should be 1-2 psig greater than the pressure on the chlorine header (normally 20-25 psig).

   e. Notify the Chlorine Plant of the problem and see if they have shut down or cut back.

   f. If the shutdown is to be longer than two hours, it may be necessary to put steam heat on the coil of the chlorinator to keep the temperature at 120°C. minimum. Normally, the circulating pump will be in operation.

   g. Shutdowns should be minimized. If the cause of the cut back can easily be remedied, start the chlorinator back immediately.

   h. Notify your chief operator or department supervision immediately in case of a problem.

   i. Note shutdown information on data sheet.

2. Prolonged Shutdown

a. Normally, when a chlorinator is to be left down for a period longer than a few hours, the chlorination will be completed and the batch pumped out prior to shutdown. If maintenance personnel are to work on the chlorinator, it may be necessary to vent the vessel and purge the chlorine lines and the chlorinator tank with CO_2.

NOTE: In case of a complete shutdown for maintenance work, the chlorine valves on the main header to the chlorinator will be tagged, the transfer lines into the vessel, and the steam valves to the chlorinator coils. The pump motor circuit breaker box switch will be tagged out.

b. Close chlorine valves at distributor on the chlorinator.

c. Empty chlorinator by pumping out, then shut off the circulating pump and drain the chlorinator.

d. Check chlorine header pressure as in item 1-c above.

e. Close the HCl vent valve on the chlorinator to the HCl header.

f. Notify the Chlorine Plant of the problem if this is to be a prolonged shutdown and it causes an increase in the chlorine header pressure.

g. Leave the chlorine flow controller in "auto" with the set point at 0.

h. Leave the temperature recorder controller in "auto" with the set point at 150°C.

i. Notify your chief operator or department supervision the vessel is shut down.

j. Note shutdown information on the data sheet.

C. Continuous Chlorinator System

1. Temporary Shutdown

a. The circulating pumps will normally be left in operation.

b. Close the valves to the chlorine distributor on chlorinators No. 5, 6, 7, and 8.

Adjust the chlorine feed control valves to 0 with the instrument still in "auto".

c. Close the automatic Biphenyl feed valve to the No. 5 chlorinator using the automatic controller; then shut the manual valve in this line to assure feed stops to the No. 5 chlorinator. Set valves to allow circulation back into the feed tank.

d. Proceed to check out the system to determine the reason for the cut back if you have not been informed.

e. Check the chlorine header pressure and chlorine feed to the other chlorinators. The header pressure should be 20-25 psig.

f. Notify the Chlorine Plant of the problem and see if they have shut down or cut back.

g. If the shutdown is to be longer than two hours, it may be necessary to put steam on the circulating lines or the coil of the chlorinator to maintain 120°C. minimum temperature.

h. Shutdowns should be minimized. If the cause of the cut back can easily be remedied, start the continuous chlorination system up immediately.

i. Notify your chief operator or department supervision immediately in case of a problem.

j. Note shutdown information on data sheets.

2. Prolonged Shutdown

a. Normally, when the continuous chlorinator system is to be shut down for a period longer than a few yours, the system is handled in the same manner as for a temporary shutdown except that steam may be cut off of some of the supply lines.

For a prolonged shutdown, this system would not be emptied except when the shutdown becomes greater than 48 hours. In that case, the chlorinators might be finished batchwise and then emptied.

Notify the Chlorine Plant if the shutdown will be prolonged and will cause an increase in the chlorine header pressure.

Normally, the chlorine vaporizer must be shut down when the continuous chlorinators are shut off.

b. Shut off the automatic Biphenyl feed valve to the No. 5 chlorinator using the automatic controller.

c. Shut off the chlorine feed to chlorinators No. 5, 6, 7, and 8, using the chlorine flow controllers in the control room.

d. Close the manual valves at the chlorine distributors on chlorinators No. 5, 6, 7, and 8.

e. Close the manual block valve at the automatic Biphenyl feed valve to assure no leakage occurs. Direct Biphenyl feed back into the feed tank.

f. The Biphenyl feed tank pump can be shut down if necessary.

Close the discharge valve in the line from the pump to No. 5 chlorinator. Stop the pump. Close the suction valve to the pump on the bottom of the Biphenyl feed tank.

g. Stop the agitator in the Biphenyl feed tank if necessary; otherwise, leave the agitator operating.

h. Stop the agitator in the Biphenyl mix tank if necessary; otherwise, leave this agitator operating.

i. When the crude Aroclor catch tank level is at 50%, stop the transfer pump. Close the valve in the discharge line to the continuous air blow tank.

j. Stop the continuous air blow tank transfer pump. Close the discharge valve in the line from this pump to the blow tank or the roof tank.

k. Shut off the air to the continuous air blow tank if necessary. There are four valves in the air header to the continuous air blow tank.

l. Check the chlorine header pressure as in item 1-c. above.

m. Close the HCl vent valves on the chlorinators to the HCl header.

n. Steam must be placed on the coil or the circulating lines of the chlorinators if the material is not pumped out. A minimum temperature of 120°C. must be maintained.

o. Notify your chief operator or department supervision the continuous chlorinator system is shut down.

p. Note the shutdown information on the data sheet.

D. Chlorine Vaporizer

1. Temporary Shutdown

a. Close block valve on each side of liquid chlorine control valve.

b. Allow steam to vaporize liquid chlorine in the vaporizer.

c. Shut off block valve in steam line into the vaporizer or close the steam control valve by adjusting the set point on the vaporizer temperature controller.

d. Close the automatic chlorine feed valve to the chlorine header by adjusting the chlorine pressure controller PIC-500.07 to 0. Leave the instrument in "auto". Close the block valve in the line to the chlorine header.

e. If there is a particular problem with the vaporizer, notify your chief operator or department supervision the vessel is shut down.

f. Note shutdown information on the date sheet.

2. Prolonged Shutdown

a. In case the chlorine vaporizer is to be shut down for a period greater than three days, the system should be completely empty of chlorine.

b. Disconnect the liquid chlorine car from the chlorine feed line to the vaporizer.

(1) Put on gas mask for use in connecting and disconnecting car.

(2) Close manual valve in 1" liquid chlorine line to vaporizer.

(3) Close angle valve on top of the chlorine tank car.

(4) Break the union on the pipe connection line. Slowly let the chlorine pressure bleed off. When the pressure is released, remove the piping.

c. Connect a CO_2 cylinder to the chlorine feed line to the vaporizer. Use pressure from the CO_2 cylinder to push the liquid chlorine to the vaporizer. Normally, 80-90 psig is all that will be required.

d. When the liquid chlorine has been pushed through the transfer line to the tank car to the vaporizer, close the block valve on each side of the liquid chlorine control valve to the vaporizer.

e. Allow steam to vaporize the liquid chlorine in the vaporizer.

f. Shut off block valve in steam line to the vaporizer.

g. Connect CO_2 to the vaporizer at the pressure gauge on the line to the vessel.

Purge the chlorine vaporizer with CO_2. Do not exceed 40 psig.

h. Close the automatic chlorine feed valve to the chlorine header. Adjust the chlorine pressure controller PIC-500.07 to 0 with the controller in "auto". Close the block valve in the line to the header.

i. Notify your chief operator or department supervision the chlorine vaporiser has been shut down.

j. Note shutdown information on the data sheet.

E. Blow Tanks and HCl Drowning Facilities

1. Temporary Shutdown

This temporary shutdown applies to a single blow tank. It can apply to all blow tanks.

a. Close the valve at the bottom of the blow tank.

b. Close the discharge valve on the blow tank transfer pump.

c. Shut off the transfer pump.

d. Leave the air blower running.

e. Water will remain on the S&K jet.

f. The system can be left in this condition until needed. Actually, the blow tanks are still being air blown.

2. Prolonged Shutdown

This procedure applies to a single blow tank; however, it can apply to all blow tanks by merely extending the work to the other vessels.

a. Normally, if the vessel is to be shut down for any length of time, the material in the tank will be emptied.

b. Shut off the blow tank pump.

c. Drain the blow tank. Close the valve at the bottom of the blow tank and at the discharge of the transfer pump.

d. Close the steam supply valve to the coil on the blow tank.

e. Shut off the steam on the transfer lines to the blow tank and from the blow tank.

f. Shut off the air blower or blowers.

g. Shut off water to the S&K jet.

h. When air is shut off the air blowers if the continuous chlorinator system is to continue to be operated, the crude Aroclor being produced must be re-directed from the roof tank to an individual blow tank (No. 1, 3, or 4).

i. Leave the system in this condition until needed.

j. Notify your chief operator or department supervision the system is shut down.

k. Note shutdown information on the department data sheets.

F. Continuous Chlorinator Air Blow Tank

1. Temporary Shutdown

a. In case the continuous air blow tank is to be shut down for a lack of air on a temporary basis, crude Aroclor from the Aroclor catch tank must be directed from the roof tank to an individual blow tank.

b. Close air valves to distributor header on the continuous air blow tank. Crude Aroclor can still be allowed to flow through the tank and it will not be used as an air blow tank.

c. Notify your chief operator or department supervision this tank is temporarily shut down.

d. Determine the nature of the problem. If possible, start the system back up.

e. Note the downtime for this vessel on the department data sheet.

2. Prolonged Shutdown

a. In case the continuous air blow tank is to be shut down for a long period of time, this vessel may be bypassed by directing flow from the catch tank to blow tank No. 1, 3, or 4.

b. Close the air valves to the distributor on the continuous air blow tank.

c. Start the circulating pump on the continuous air blow tank.

d. Close the discharge valve from the continuous air blow tank pump to the roof tank.

e. Close the valve in the line from the crude Aroclor catch tank to the continuous air blow tank.

f. Notify department supervision the vessel has been shut down.

g. If necessary, the tank can be drained through a bottom outlet. Normally, the tank cannot be pumped empty due to the baffles in the tank.

h. The system can be left in this condition until needed.

i. Note shutdown information on department data sheet.

G. Emergency Shutdown

Normally, an emergency shutdown does not occur concerning the charge tank or the blow tanks; however, emergencies can occur which make it necessary to shut down the batch chlorinators and the continuous chlorinators as fast as possible. The following methods can normally be used:

1. From the Field

   a. Close the manual chlorine valves to the distributors on the individual chlorinators.

   b. Close the manual valve in the Biphenyl feed line to the continuous chlorinator system.

   c. Shut off the chlorine vaporizer. Stop liquid chlorine feed.

   d. Stop the circulating pumps if necessary. Normally, these pumps would be left operating.

   e. Shut the valves in the HCl pipeline to the Muriatic Acid Department if necessary.

   f. Stop the flow of crude Aroclor from the catch tank to the continuous air blow tank to the roof tank if necessary.

   g. Dependent on the emergency situation which has occurred, continue to shut the system down systematically by normal procedures for both the batch and continuous chlorinator systems.

      Notify the Chlorine Plant if they have not already been informed.

2. At the Panel

   a. Stop chlorine feed to the chlorinators as follows, dependent on operation:

(1) Close chlorine automatic valves by adjusting flow controllers to 0. This reduces chlorine flow to 300 lbs/hour on each of these chlorinators.

Immediately go into the field and shut off manual valves feeding these chlorinators.

b. Stop Biphenyl feed to the continuous chlorinator system using the automatic Biphenyl feed control instrument. Adjust set point to 0.

Immadiately go into the field and shut off the block valve to the No. 5 chlorinator.

c. Continue shutdown of this unit as is necessary to handle the emergency which has occurred. Normally, the remainder of the shutdown will have to be carried out from the field.

Notify the Chlorine Plant if they have not already been informed.

3.5 Control Loops, Interlocks, and Alarms

A. Control Loops

There are 14 major control loops in this system.

1. Chlorinator Temperature Controls - TRCA-508.01

The function of this loop is to provide temperature control for the chlorination batch in the chlorinator. This is accomplished by measurement of the temperature in the crude Aroclor circulating line at the discharge of the external heat exchanger and controlling the position of the dampers at the cooler and automatically turning the fan for the cooler on and off by temperature. The temperature controls for the fans can be operated manually. The control instruments can be operated manually or automatically. The temperature system has a low temperature alarm at 120°C. and a high alarm at 190°C.

Each chlorinator has the same control system.

a. Manual Control

The temperature controller will be in "manual". Adjustment of the louvers on the air cooler can be controlled manually by adjusting the control valve with the TRCA instrument set point. The fan can either be in "auto" or "manual". Adjust until the desired temperature is acquired. The fan can be stopped or started as desired.

b. Automatic Control

The temperature controller is in "auto" with the set point at 150°C. The cooler fan will be in "auto". The controller will automatically adjust the louvers on the cooler and the fan to maintain the temperature of the set point.

2. Chlorine Header Pressure Control - PIC-500.07

The function of this loop is to maintain the chlorine header pressure within a narrow range. This is accomplished by measuring the chlorine header pressure and throttling a control valve at the discharge of the chlorine vaporizer. This system will only control the pressure assuming you are using more chlorine than the Chlorine Plant is producing. Normal operation of the system is with the controller in "auto" and the set point at 20-25 psig. A low pressure alarm will sound at 15 psig and a high alarm at 35 psig.

3. Batch Chlorinator Chlorine Flow Control - FRCS-551.01

The function of this loop is to control the chlorine flow to the batch chlorinators and regulate the chlorine chlorination rate. This is accomplished by measurement of the chlorine flow with an orifice and controlling this flow with a control valve in the chlorine feed line. This system can be operated manually, automatically, on chlorine feed control, or by a preset programmed chlorine feed control.

Each batch chlorinator has this same system.

a. Manual Control

The chlorine flow controller is positioned in "manual-set". The set point is regulated to give the desired chlorine flow to the chlorinator.

b. Automatic Flow Control

The chlorinator chlorine flow controller is positioned in "auto-set". The chlorine feed desired is set on the controller which will maintain this chlorine feed by adjusting the control valve as required.

c. Programmed Flow Control

The chlorine flow controller has the set points in "auto-cascade". The chlorine integrator set point is adjusted for the desired chlorine alarm level, dependent on the product being produced. The dial reads 0-225 and has a multiplier of 100. The range represents 0 - 22,500 lbs. of chlorine. When the desired quantity of chlorine has entered the chlorinator, an alarm bell will ring and an annunciator light will flash indicating "Chlorinator, 80% Chlorinated". The totaliser can be used with automatic flow control above if the controller is not in "cascade". It must be reset by pushing the green set button. When the controller is in "cascade", the Taylor Flexipulse Timer will, by predetermined program (See Appendix I), change the chlorine flow rate to the chlorinator. The chlorine flow program is set by turning the knob on each flow profile set point. This program, once set up, should not be disturbed without consulting supervision.

4. Continuous Chlorinator Chlorine Flow Control - FRCS-558.01

The function of this loop is to control the chlorine flow to the continuous chlorinator system chlorinators and regulate the chlorination rate. This is accomplished by measurement of the chlorine flow with an orifice and controlling this flow with a control

valve in the chlorine feed line. This system can be operated manually or automatically on chlorine feed control.

Each of the chlorinators in the continuous system has the same controls.

a. Manual Control

The chlorine flow controller is positioned in "manual". The set point is regulated to give the desired chlorine flow to the chlorinator. The output pressure of the controller can be observed by looking at the top of the control instrument.

b. Automatic Flow Control

The chlorinator chlorine flow controller is in "auto". The chlorine feed desired is set on the feed controller which will maintain this chlorine feed by adjusting the control valve as required.

5. Biphenyl Mix Tank Level Indication - LIA-520.01

This loop measures the level of Biphenyl in the mix tank. This is accomplished by a bubbler differential pressure level indication instrument. A 0-100% dial indicates the tank level in the field and on the control panel. A low level alarm is set at 25% and a high level alarm at 75%.

6. Biphenyl Feed Tank Level Indication - FIA-520.01

This loop measures the level of Biphenyl in the feed tank for the continuous chlorinator system. This is accomplished by use of a bubbler differential pressure level indication instrument. A 0-100% dial indicates the tank level in the field and on the control panel. A low level alarm will sound at 25% and a high level alarm at 80%.

7. Crude Aroclor Catch Tank Level Control - LICA-543.01

This loop measures the level of crude Aroclor in the catch tank for the continuous Aroclor chlorinator system and maintains a constant level of 50% in the tank. This is accomplished by measurement of the level in the tank by a bubbler differential pressure level indication instrument and throttling a control valve in the discharge of the crude Aroclor catch tank pump line. A high alarm will sound if the tank reaches 60% level.

8. Continuous Blow Tank Level Control - LICA-529.01

Function of this loop is to maintain a constant level in the continuous air blow tank. This is accomplished by measuring the level with a bubbler differential pressure level indication instrument and throttling a control valve in the discharge line from the continuous blow tank pump to the roof tank or a blow tank. The level in the system is normally 50%. A low level alarm is set at 40% and a high level alarm at 60%.

9. HCl Pressure Alarm - PRA-702.02

The purpose of this loop is to measure the HCl header pressure to the HCl absorber, record this pressure and give an alarm in case of excessive high pressure. This is accomplished by measurement of the pressure with a pressure transmitter and sounding an alarm at a high pressure of 8 psig.

10. Continuous Chlorinator Biphenyl Feed Control

The function of this loop is to control the Biphenyl feed to the continuous chlorinator system. This is accomplished by measurement of the Biphenyl flow with an orifice and throttling a control valve in the Biphenyl line. This system can be operated by a controller on manual or automatic operation.

A flow range from 0-5 GPM of Biphenyl is possible with this controller. A low flow alarm is set at 1 GPM and a high flow alarm at 4 GPM. The recorder read-out has a multiplier of 2.

11. No. 1, 3, and 4 Blow Tank Level Indication

These loops measure the level of crude Aroclor in the No. 1, 3, and 4 blow tanks. This is accomplished by use of a bubbler differential pressure level indication instrument. A 0-100% dial indicates the tank level in the field.

12. Biphenyl Charge Tank Level Indication

This loop measures the level of Biphenyl in the charge tank for the chlorinators. This is accomplished by use of a bubbler differential pressure level indication instrument. A 0-100% dial indicates the tank level in the field.

13. No. 1 and 2 Aroclor Roof Tank Level Indication

This loop measures the level of crude Aroclor in the No. 1 and 2 Aroclor roof tanks. This is accomplished by use of a bubbler differential pressure level indication instrument. A 0-100% dial indicates the tank level in the field.

14. Chlorine Vaporizer Control Loops

There are several control loops on the chlorine vaporizer system to insure safe operation. The control loops consist of a steam pressure regulation valve, high liquid level control, and steam supply temperature control. These controls are accomplished by the following:

a. Steam Control

A temperature indicating controller senses the liquid chlorine feed to the vaporizer and throttles a steam valve in the main steam feed line to the vaporizer.

b. Liquid Level Control

The liquid level control in the vaporizer is measured by a ball float level instrument which is actuated on high level and closes a control valve in the liquid chlorine feed line to the vaporizer. This high level also sounds an alarm in the control room.

c. Steam Supply Temperature Alarm

The temperature of the steam supply to the vaporizer is measured by a Fenwall temperature element and sounds an alarm when the steam temperature drops below 100°C. This failure indicates the vaporizer may fill with liquid chlorine. Normally, this indicates steam failure.

d. Chlorine Pressure Control

A pressure control loop PIC-500.07 is installed for controlling the discharge pressure from the vaporizer. It is described under 3.5-A-2 above.

B. Interlocks

There are no interlocks in this system.

C. Alarms

The following alarms exist through the system:

1. Biphenyl Mix Tank

A low level alarm sounds at 25% full and a high level alarm sounds at 75% full. These alarms are on the chlorinator annunciator panel. The high alarm horn indicates there is approximately 5 minutes before the tank will overflow.

2. Biphenyl Feed Tank

A low level alarm will sound when the tank is 25% full and a high level alarm when the tank is 80% full. The low level alarm indicates there is approximately 30 minutes time before the tank will run empty.

3. Batch Chlorinators

a. Chlorine Flow Alarm

If the chlorine totalizer is being used, an alarm bell will ring when the batch is 80%

chlorinated. The chlorine set point for the totalizer depends on the crude Aroclor being produced.

b. Temperature Alarm

Abnormal temperature alarms are set for a low chlorination temperature of 120°C. and a high temperature of 190°C.

4. Continuous Chlorinators

Abnormal temperature alarms are set for a low chlorination temperature of 120°C. and a high temperature of 190°C.

5. Chlorine Header Pressure Alarm

The chlorine header pressure will sound an alarm at a low pressure of 15 psig and a high pressure of 35 psig. This will actuate an annunciator on the chlorinator panel indicating "high/low" chlorine header pressure.

6. Instrument Air Low Pressure Alarm

An annunciator will sound in case the instrument air pressure drops to 70 psig.

7. Continuous Chlorinator Biphenyl Feed Alarm

Biphenyl feed alarms are provided for a low flow of 1.0 GPM and a high flow of 4.0 GPM.

8. Chlorine Vaporizer High Level

A high level above 50% will sound an alarm for the chlorine vaporizer.

IV. COMMENTS ON PROCESS

1. Problems with the chlorine vaporizer can occur which would allow liquid chlorine to be fed to the chlorinators. In case this should happen, slugs of liquid chlorine would be fed into the chlorinator possibly causing excessive reaction or excessive loss and venting of chlorine to the atmosphere. Chlorine

in the HCl offgas 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.

2. Entrainment of Biphenyl or crude Aroclor into the HCl lines can occur when excessive chlorine rates occur. This same situation can occur in case the Chlorine Plant is blowing too much air. This can be checked by observing the offgas 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 carryover. 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 flow-back into the chlorine header. In small pipe lines where there is no heat removal from the reaction, problems can occur as stated in Item 1 above.

3. Free chlorine in the offgas 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. Catch samples from the individual chlorinator offgas and have them analyzed for free chlorine by the lab. 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 offgas line. <u>In case this situation occurs and cannot be resolved, remove the chlorinator from operation. Contact department supervision immediately.</u>

4. An agitator has been installed in the Biphenyl feed tank to keep Ferric Chlorids in suspension. It is extremely important that the material be kept in suspension to allow production of stabla Aroclors as well as eliminate production problems involving plugged lines with Ferric Chloride.

5. In the PFO outline for the batch chlorinators, it is suggested that the batch chlorinators will be charged and pumped out while venting to the HCl header. This is to try and eliminate fumes in the chlorinator system which presently causa excessive corrosion around the upper level of the chlorinators. This operation will be tried when the new system is installed and it is no longer necessary to blow out the Biphenyl charge line to the individual chlorinators. Blowing of this line will be eliminated due to the fact Santowax is not being charged to the batch chlorinators.

6. The continuous chlorinator catch tank has a high level alarm at 60%. This alarm indicates there is approximately 30 minutes before material will begin to back up in the continuous chlorinator system. Hold-up of material in the chlorinators can causa production of off-grade specification material. In case a high level alarm occurs, the problem should be solved immediately or the system shut down rather than produce off-grade material.

7. A low prassure instrument air alarm sounds at 70 psig. This alarm indicates the large instrument air compressor did not come back on at its normal 85 psig. In this case the small instrument air compressor will start up at 68 psig. The large compressor should be checked immediately to determine the problem since the small compressor will not normally handle the entire air requirements for this department.

APPENDIX I

PROPOSED CHLORINE FLOW PROFILE

FOR PROGRAMMED BATCH CHLORINATION

I. CHLORINE INPUT	FLOW RECORDER CONTROLLER
First Hour	400 LBS./HOUR
Second Hour	600 LBS./HOUR
Third Hour	800 LBS./HOUR
Fourth Hour To End Of Batch	1,000 LBS./HOUR
End of Batch (Control Valve Closed)	300 LBS./HOUR

II. TEMPERATURE CONTROL	RECORDER CONTROLLER
Entire Batch	150°C.

III. CHLORINE INTEGRATOR SETTINGS FOR 80% OF CALCULATED INPUT BASED ON 100% CHLORINE AND 90% CHLORINE

Aroclor Product	100% Chlorine	90% Chlorine
1121	1280	1420
1142	2660	3000
1148	4450	4940
1154	5630	6250
1160	7220	8020
1162	7580	8420

IV. CHLORINE INTEGRATOR SETTINGS FOR 80% OF CALCULATED INPUT BASED ON USING 1142 TO CHARGE CHLORINATOR

Aroclor Product	100% Chlorine	90% Chlorine
1148	1790	1990
1154	2970	3300
1160	4560	5070
1162	4920	5470

APPENDIX II

CONTINUOUS CHLORINATOR SPECIFIC GRAVITY LEVELS FOR 1142 PRODUCTION

I. FOUR STAGE PRODUCTION

STAGE	CHLORINATOR	SPECIFIC GRAVITY
1	5	1.078 - 1.104
2	6	1.170 - 1.196
3	7	1.254 - 1.280
4	8	1.336 - 1.362

II. THREE STAGE PRODUCTION

STAGE	CHLORINATOR*	SPECIFIC GRAVITY
1	5	1.108 - 1.124
2	6	1.224 - 1.240
3	8	1.345 - 1.355

*NOTE: THIS INDICATES NO. 7 CHLORINATOR OUT OF SYSTEM. ANY ONE OF THE FOUR CAN BE BYPASSED.

APPENDIX III

FOUR CHLORINATOR BIPHENYL-CHLORINE FEED RATE CHART:

BIPHENYL FEED GPM	CHLORINE RATE AT EACH CHLORINATOR			
	100% CHLORINE		90% CHLORINE	
	Total Chlorinators Lbs./Hr.	Each Chlor. Lbs./Hr.	Total Chlor. Lbs./Hr.	Each Chlor. Lbs./Hr.
2.1	1,400	350	1,560	390
2.4	1,600	400	1,760	440
2.7	1,800	450	2,000	500
3.0	2,000	500	2,200	550
3.3	2,200	550	2,440	610
3.6	2,400	600	2,680	670
3.9	2,600	650	2,880	720
4.2	2,800	700	3,120	780
4.5	3,000	750	3,320	830
4.8	3,200	800	3,560	890
5.1	3,400	850	3,760	940

MONS 093116

APPENDIX IV

OPERATION OF AUTOMATIC CONTROLLERS

1. Automatic Control

This procedure starts with the controller set at manual and gives set-wise changes to automatic and back to manual. This assumes a flow recorder controller (FRC) is used.

Example: Chlorine Flow Control

Operation Manual to Automatic	Switching FRC Manual	 Seal	 Automatic
1. FRC on manual. Set point moved to give desired flow as indicated on recording sheet. Flow indicated by recording pen.	X		
2. Transfer FRC to seal. Place set pointer (Red) opposite flow recording pen (Red).		X	
3. Transfer FRC from seal to automatic. Adjust FRC set pointer until flow levels out if any fluctuations occur. Leave instrument in this position for automatic control as the set point is adjusted.			X
Return system to manual.			
4. Note FRC output air signal. Transfer from automatic to seal. Adjust FRC set pointer (Red) to the same output air.		X	
5. Transfer from seal to manual. Adjust set point if fluctuations occur.	X		

2. Cascade Control

For a controller to operate in cascade, it must first be in automatic. The manual set position is overriding and will not let cascade signals control.

Use the same procedure as above to transfer from manual to automatic.

Operation "Automatic-Set" to "Automatic-Cascade"	Switching FRC				
	Manual	Seal	Automatic	Set	Cascade
1. FRC on automatic. Set point (Red) moved for desired flow.			X	X	
2. Adjust external set point (Orange) to line up with the (Red) set point.			X	X	
3. Move the controller from "set" position to "Cascade". Adjust the FRC set pointer until flow levels out if fluctuations occur. Leave instrument in this position for "automatic-cascade" control from the external set point. Return system to "Automatic-Set".			X		X
4. Adjust the (Red) set point to line up with the (Orange) set point.			X		X
5. Transfer from "Cascade" to set. Adjust (Red) set pointer if fluctuations occur.			X	X	

APPENDIX V

METHOD OF RUNNING SPECIFIC GRAVITIES

1. Catch representative sample of material in metal cylinder provided for this purpose. On the chlorinators, the sample point is at the discharge of the circulating pump. Excess material is returned to the suction of the pump through a special pipeline.

2. Take sample to the control room.

3. Allow water to run down outside of the cylinder while stirring sample vigorously until the sample is 10°C. above the temperature at which the sample is run. See Table I, Page 2.

4. Cut off the water when the sample is 10°C. above the desired temperature. Keep stirring until the sample is 1°C. above the temperature which the sample is to be run. Stop stirring. Allow the hydrometer which has been thoroughly cleaned to sink into the sample until it reaches equilibrium.

5. Observe reading on the hydrometer. Record hydrometer reading on the operating data sheet, along with the time the sample was taken.

6. In case the temperature was off 1° or 2° when the reading was taken, a correction can be applied. It is 0.001 specific gravity units per °C. If the sample was 2°C. high, add 0.002 specific gravity units to the reading. If the sample was 2°C. low, subtract 0.002 specific gravity units from the reading.

7. Carefully clean the hydrometer and thermometer. Place them in the rack provided for this purpose. Dump sample in the return line to the chlorinator pump.

SECTION IV

OVERALL PLAN AND OUTLINE

AROCLOR TRAINING SCHEDULE

Training will be organized by shift groups from the existing Aroclor operating personnel. The training sessions will cover areas of interest for the combined shift and also smaller functioning groups covering the areas of particular interest for one or two operators.

Classroom sessions consisting of lecture and discussion, field trips, personal study, problem solving or utilizing classroom problems and field problems will be involved in all training sessions. Discussion periods and demonstrations led by manufacturers' representatives and trained technicians will also be utilized in the case of new and unfamiliar types of equipment. Charts, flow diagrams, drawings, slides, models and other visual aids will be utilized wherever applicable.

Each participant will be provided with an outline of the material covered. Copies of applicable visual aids and material for taking notes in a binder or binders will also be available to aid in organization and retention of the material by the operating personnel.

Instructors will include, but not be limited, to the following personnel:

W. F. Taffee
R. S. Yates
J. W. Molloy
M. J. Williams
R. N. Harris
V. R. Haupt
N. K. Madison

Areas to be covered during these training sessions will include the following general topics:

a. Chemical process.

b. Process control and general instrumentation.

c. Instrument panel and hardware trouble-shooting and maintenance.

d. Physical processing item by item.

e. Operating and maintenance of auxiliary equipment.

f. Electrical supply, substation and motor control center.

Overall Plan and Outline

Department personnel will be trained on a scheduled basis normally for an eight hour period of time. The training will follow the pattern outlined below:

Time	Description
8:00 - 9:00 AM	Review of previous day's material.
9:00 - 10:00	New material, classroom presentation.
10:00 - 10:15	Break
10:15 - 11:30	New material, classroom discussion.
11:30 - 12:00 Noon	Lunch
12:00 - 2:00 PM	Field work or demonstration with class participation related to new material covered in morning session.
2:00 - 4:00	Group discussion, question and answer period in small groups.
4:00 - 4:30	Group leader summary of day's activities and general introduction to topic for next day.

The techniques and time distributions above will be varied to fit the subject matter in groups, but in no case will a solid eight hours of classroom lecture be employed.

The following is a general outline of the training for all personnel involved in the start-up of Aroclor-Muriatic Acid operations. A detailed daily training program will be issued immediately.

Personnel to be trained: Chief Operators
Operators
Foreman
Supervisor
Shift Supervisors

MONS 093122

Overall Plan and Outline

Training Instructors:

Plant	Division Engineering & Research
Start-up Superintendent	Project Engineer
Department Supervisor	Instrument Technician
Department Foreman	Research Group Leader
Shift Supervisor	

Each training session will be repeated four times to cover four separate shifts of operating personnel consisting of 3-4 men per shift. This is necessary to allow continued operation of the department during the training program.

Program Outline by Topics:

Week Beginning:

March 29, 1965 - (Train 4 shift crews - 8 hours)

Indoctrination -	Training Schedule
Process Flow -	Equipment for: Therminol Heater Weigh Tank No. 9 Chlorinator No. 2 Blow Tank No. 4 Still & Receiver
Safety -	
Operating Procedures -	Therminol Heater Weigh Tank No. 9 Chlorinator No. 2 Blow Tank No. 4 Still & Receiver
Plant Tours -	Solid Aroclor Facilities Motor Control Center Control Panel Air Compressor

April 5, 1965 - (Train 3 shift crews - 16 hours)

Review Process Flow from Week of March 29, 1965

Overall Plan and Outline

April 5, 1965 (Continued)

Operating Procedures - Therminol Heater
Weigh Tank
No. 9 Chlorinator
No. 2 Blow Tank
No. 4 Still & Receiver

Control Room Panel -

Review changing from temporary control rooms to new control room.

April 12, 1965 - (Train 4 shift crews - 16 hours)

Complete April 5th Training Schedule -

(Train 4 shift crews - 8 hours)

Review April 5th Training -

Control Room Panel -

Review changing from temporary control rooms to new control room.

Tower Water System Alterations -

Review Alterations to HCl Drowning Facilities -

April 19, 1965 - (Train 4 shift crews - 8 hours)

Review Operating Procedures for:
Therminol Heater
Weigh Tank
No. 9 Chlorinator
No. 2 Blow Tank
No. 4 Still & Receiver

Operating Procedures for Instrumentation Changes on:
Existing Chlorinators
Chlorine Flow Control
Temperature Control
Programmed Chlorination Step

April 23, 1965 - (Train 4 shift crews - 8 hours)

Review Operating Procedures for:
Therminol Heater
Weigh Tank
No. 9 Chlorinator
No. 2 Blow Tank

Overall Plan and Outline

April 23, 1965 (Continued)

Review Operating Procedures for:
No. 4 Still & Receiver
Instrumentation Changes
on Existing Chlorinators

April 28, 1965 - (Train 4 shift crews - 8 hours)

Equipment Check-Out and Testing -

Process Simulation -

Review Operating Procedures for:
Solid Aroclor Equipment
Instrumentation Changes on
Existing Chlorinators

Emergency Training -

Process Simulation and Equipment Check-Out in field -

Start-up Therminol Heater -

Begin start-up of instrumentation for chlorinators No. 1 through No. 8 -

May 5, 1965

Charge Solid Aroclor Facilities and carry first batch through stepwise.

May 24, 1965 - (Train 4 shift crews - 8 hours)

Continue start-up of new instrumentation facilities for Chlorinators No. 1 through No. 8.

June 7, 1965 - (Train 4 shift crews - 8 hours)

Review instrumentation alterations to chlorinators No. 1 through No. 8. Start programmed batch chlorinator training. Chlorine flow control and totalizing temperature control.

Process flow, Equipment, and Operating Procedures for Continuous Chlorinator feed and continuous blow tank systems.

Review alterations to chlorinators No. 1, 2, & 3.

Overall Plan and Outline

Week Beginning:

June 14, 1965 - (Train 4 Shift Crews - 4 hours)

Review batch chlorinator training for programmed batch control.

Review alterations to No. 3 Aroclor Still.

June 28, 1965 - (Train 2 Shift Crews - 16 hours)

Process Flow - Equipment for:
Muriatic Acid Facilities

Operating Procedures -

Control Panel Instruments -

Safety -

Field Tours -

July 5, 1965 - (Train 2 Shift Crews - 16 hours)

Identical to training week of June 28, 1965.

July 12, 1965

Start Muriatic Acid Process Simulation or Field Check-out.

Charge system with chemicals July 15, 1965.

August 23, 1965 - (Train 4 Shift Crews - 4 hours)

Process Flow, Equipment, and Operating Instructions for:
HCl Clean-up Facilities

Safety -

Plant Field Tours -

Instrumentation Controls -

August 30, 1965

Equipment field check-out by production.

Charge system with chemicals September 1, 1965.

SAMPLE LESSON

OUTLINE OF TYPICAL TRAINING PROGRAM

FOR WEEK OF APRIL 5, 1965

FIRST AND SECOND DAY

I. Process Flow Review

A. Therminol Heater

B. Weigh Tank

C. No. 9 Chlorinator

D. No. 2 Blow Tank

E. No. 4 Still, Still Heater, and No. 4 Still Receiver

F. Therminol Cooling System Auxilieries for No. 9 Chlorinator and No. 4 Still

II. Detailed Operating Instructions

A. Therminol Heater System

1. General Flow

2. Heater Start-Up

3. Instrumentation Details and Controls

4. Safety Features for Heater System

B. Weigh Tank, No. 9 Chlorinator, and No. 2 Blow Tank

1. General Flow and Start-Up

2. Normal Operations in Automatic Control

3. Normal Operations in Programmed Flow Control for Chlorinator System

4. Shutdown

5. Instrumentation Details and Controls

6. Special Comments on Operation Details and Changes from Present System

C. No. 4 Still and Receiver System

1. General Flow and Start-Up

2. Normal Operations

3. Shutdown

4. Instrumentation Details and Controls

5. Comments on Special Changes from Present System

III. Plant Tours During the Day

A. Detailed Therminol Heater Review for Start-Up and Shutdown

B. Detailed Weigh Tank, No. 9 Chlorinator, and No. 2 Blow Tank System Review

C. No. 4 Still System Review

D. Control Room Instrument Review

IV. Group Discussion with Question and Answer Period

AROCLOR START-UP TRAINING PROGRAM

WEEK OF MARCH 29, 1965

Typical 1 Day Training Program
Four Shift Crews to be Trained

Time	Topic	Instructor
7:00 - 7:30 a.m.	General Information a. Training Schedule b. Reason for Plant c. Capacity Expected	Taffee
7:30 - 9:00	Process Flow a. Flow Sheets in Detail b. General Instrumentation c. Safety d. Motor Control Center e. Air Compressor f. Control Panel	Molloy or Haupt
9:00 - 9:15	Break	
9:15 - 9:30	Introduction	McClain
9:30 - 11:00	Plant Tour Flow & New Motor Control Center Control Room	Williams & Haupt
11:00 - 11:30	Lunch	
11:30 - 12:00	Reactions	Haupt or Molloy
12:00 - 1:15 p.m.	Operating Procedures Therminol Heater Safety Features	Molloy
1:15 - 1:30	Break	

Week of March 29, 1965

Time	Topic	Instructor
1:30 - 2:30	Operating Procedures Weigh Tank No. 9 Chlorinator No. 2 Blow Tank	Molloy
2:30 - 3:30	Plant Tour Therminol Heater	Molloy & Williams

AROCLOR START-UP TRAINING PROGRAM

WEEK OF APRIL 5, 1965

Typical 2 Day Training Program
Three Shift Crews to be Trained

FIRST DAY:

Time	Topic	Instructor
7:00 - 8:00 a.m.	Process Flow Review	Williams
8:00 - 9:00	Operating Procedures: Therminol Heater Safety Features	Haupt
9:00 - 9:15	Break	
9:15 - 11:00	Operating Procedures: Weigh Tank No. 9 Chlorinator No. 2 Blow Tank	Molloy
11:00 - 11:30	Lunch	
11:30 - 12:30	Operating Procedures: No. 4 Still & Receiver	Molloy
12:30 - 1:30 p.m.	Plant Tour For items covered above	Williams & Haupt
1:30 - 1:45	Break	
1:45 - 2:45	Plant Tour Detailed Instructions	Williams & Haupt
2:45 - 3:30	Group Discussion & Questions	Molloy

Week of April 5, 1965

SECOND DAY:

Time	Topic	Instructor
7:00 - 8:00 a.m.	Review of Previous day's training	Molloy
8:00 - 9:00	Operating Instructions: Weigh Tank No. 9 Chlorinator & Auxiliaries No. 2 Blow Tank Safety Features	Haupt
9:00 - 9:15	Break	
9:15 - 11:00	Continue Instructions	Haupt
11:00 - 11:30	Lunch	
11:30 - 12:30 p.m.	Plant Tour Emphasis on Operating Instructions for morning session	Molloy & Williams
12:30 - 1:30	Operating Instructions: No. 4 Still, Reciver, & Auxiliaries Safety Features	Molloy
1:30 - 1:45	Break	
1:45 - 3:00	Plant Tour Emphasis on Operating Instructions for No. 4 Still & Receiver	Molloy & Williams
3:00 - 4:00	Classroom Review & Questions - Changes to New Control Room	Molloy

AROCLOR START-UP TRAINING PROGRAM

WEEK OF APRIL 12, 1965

COMPLETE TRAINING OF FOURTH SHIFT CREW
ON OUTLINED PROGRAM FOR WEEK OF 4/5/65

Typical 1 Day Training Program
Four Shift Crews to be Trained

Time	Topic	Instructor
7:00 - 8:00 a.m.	Review Previous Week's Training Chlorinator System	Madison - Haupt
8:00 - 9:00	New Control Instruments	
9:00 - 9:15	Break	
9:15 - 11:00	Operating Instructions: No. 4 Still System	Haupt
11:00 - 11:30	Lunch	
11:30 - 1:00 p.m.	Plant Tour Chlorinator & Still Systems	Molloy
1:00 - 1:45	Review Water System Changes & HCl Drowning Facilities	Molloy
1:45 - 2:00	Break	
2:00 - 2:30	Review Changing to New Control Room	Molloy
2:30 - 4:00	Plant Tour Review Operating Instructions Chlorinator & Still Systems	Molloy - Williams

AROCLOR START-UP TRAINING PROGRAM

WEEK OF APRIL 19, 1965

FIRST FOUR DAYS

Typical 1 Day Training Program
Four Shift Crews to be Trained

Time	Topic	Instructor
7:00 - 9:45 a.m.	General Review Operator Individual Training on: Weigh Tank No. 9 Chlorinator No. 2 Blow Tank No. 4 Still & Receiver	Haupt
9:45 - 10:00	Break	
10:00 - 11:00	Plant Tour Operators Instructed on Details of Start-up and Operation Group Discussion	Madison & Williams
11:00 - 11:30	Lunch	
11:30 - 1:30 p.m.	Instrumentation & Equipment Changes on Existing Chlorinators	Molloy
1:30 - 1:45	Break	
1:45 - 2:45	Plant Tour Therminol Heater Operating Instructions	Williams & Madison
2:45 - 3:30	Plant Tour Review Instruments in Field	Molloy & Williams

AROCLOR START-UP TRAINING PROGRAM

WEEK OF APRIL 26, 1965

FOUR-DAY TRAINING PROGRAM

Typical 1 Day Training Program
Four Shift Crews to be Trained

Time	Topic	Instructor
7:00 - 8:00 a.m.	Equipment Check-Out Review & Process Simulation	Molloy
8:00 - 9:00	Plant Tour Detailed Individual Operator Training - Operator Review of Start-Up and Normal Operations - Use Water in Vessels - Solid Aroclor Equipment	Haupt & Williams
9:00 - 9:15	Break	
9:15 - 11:00	Continue Plant Tour and Water Processing in Each Vessel as for 8:00 - 9:00 a.m.	
11:00 - 11:30	Lunch	
11:30 - 4:00 p.m.	Start-Up Therminol Heater & Check-Out Safety Features	Madison, Williams, Haupt, and Molloy
	Start-Up Circulating Therminol Systems for No. 9 Chlorinator and No. 4 Still Condenser Systems	
	Start Equipment Check-Out: Therminol Heater System Weigh Tank No. 9 Chlorinator No. 2 Blow Tank No. 4 Still and Receiver	

AROCLOR START-UP TRAINING PROGRAM

WEEK OF APRIL 28, 1965

FOUR DAY TRAINING PROGRAM

Typical 1 Day Training Program
Four Shift Crews to be Trained

Time	Topic	Instructor
7:00 - 8:00 a.m.	General Review Operating Instructions	Williams
8:00 - 9:00	Equipment Check-Out Review & Process Simulation	Molloy
9:00 - 9:15	Break	
9:15 - 11:00	Plant Tour Detailed Individual Operator Training - Operator Review of Start-Up & Normal Operations - Solid Aroclor Equipment	Molloy & Williams
11:00 - 11:30	Lunch	
11:30 - 12:30 p.m.	Emergency Training	Molloy
12:30 - 4:00	Start-Up Therminol Heater & Check-Out Safety Features	Molloy, Williams & Haupt
	Start-Up Circulating Therminol Systems for No. 9 Chlorinator, & No. 4 Still Condenser Systems	
	Start Equipment Check-Out: Therminol Heater System Weigh Tank No. 9 Chlorinator No. 2 Blow Tank No. 4 Still & Receiver	

AROCLOR START-UP TRAINING PROGRAM

WEEK OF MAY 5, 1965

WEDNESDAY

Time	Topic	Shift Supervision
7:00 - 9:00 a.m.	Final Check-out of Equipment Systems as follows: Therminol Heater Raise Temperature	Lackay - Haupt Molloy - Williams Madison
9:00 - 10:00	Continue Check-out of: Weigh Tank No. 9 Chlorinator & Aux. No. 2 Blow Tank No. 4 Still System & Aux. Control Panel Instruments	Schedule to be determined later
10:00 - 11:00	Start-Up Therminol Systems: No. 9 Chlorinator No. 4 Still Start-Up S&K Drowning Jet System for No. 2 Blow Tank	
11:00 - 1:00 p.m.	Charge Weigh Tank with 1/2 size Santowax Batch for 5060	
1:00 - 2:00	Transfer Santowax to No. 9 Chlorinator-Start Chlorination Batch No. AE-1 - Take off-gas samples - Fill out Data Sheet	
2:00 - 11:00 p.m.	Complete Chlorination Complete Data Sheet	
11:00 - 12:00 midnight	Transfer to Blow Tank	
12:00 - 1:00 a.m.	Air Blow Crude 5060	
1:00 - 2:00	Charge No. 4 Still with Lot AE-1	
2:00 - 7:00 a.m.	Start-Up No. 4 Still and begin Distillation Lot AE-1 Fill out Data Sheet	

Week of May 5, 1965

THURSDAY

Time	Topic	Shift Supervision
7:00 - 12:00 noon	Complete Distillation No. 4 Still Lot AE-1 Complete Data Sheet	
12:00 - 2:00 p.m.	Lab Analyze 1st Distillation Quality	
2:00 - 3:00	Transfer to Flaker Hold Tank	
3:00 - 4:00	Start-up Flaker & Sample to check Quality	
4:00 - 5:00	Charge Weigh Tank with full size Santowax Charge for next Chlorination Batch Fill out Data Sheet	
5:00 - 6:00	Charge No. 9 Chlorinator & Start Chlorination Batch AE-2 Take off-gas Samples Fill out Data Sheet	
6:00 - 7:00	Continue Chlorination Batch AE-2	

Week of May 5, 1965

FRIDAY

Time	Topic	Shift Supervision
7:00 - 12:00 noon	Complete Chlorination Batch AE-2	
12:00 - 1:00 p.m.	Transfer Batch to No. 2 Blow Tank	
1:00 - 2:00	Air Blow Batch No. AE-2	
2:00 - 3:00	Charge No. 4 Still with Lot AE-2 Begin Distillation Fill out Data Sheet	
3:00 - 1:00 a.m.	Complete Distillation Lot AE-1 Complete Data Sheet	
1:00 - 3:00	Lab Analyze 2nd Distillation Quality	
3:00 - 4:00	Transfer to Flaker Hold Tank	
4:00 - 5:00	Start-up Flaker & Sample to Check Quality	
5:00 - 6:00	Charge Weigh Tank with full size Santowax Charge for next Chlorination Batch	
6:00 - 7:00 a.m.	Charge No. 9 Chlorinator and Hold for Start-up at 7:30 a.m.	

Week of May 5, 1965

SATURDAY

Time	Topic	Shift Supervision
7:00 - 1:00 a.m.	Start Chlorination Batch No. AE-3 Begin programmed batch operation Take off-gas samples Fill out Data Sheet	
	Continue operations as before. Start continued operation as soon as one batch is complete. Start next batch for Chlorination and distillation.	

SUNDAY-MONDAY-TUESDAY

Continue shift coverage on operation as noted before.
If operation is acceptable at this stage, shift coverage will be stopped on May 24, 1965.

AROCLOR START-UP TRAINING PROGRAM

WEEK OF MAY 24, 1965

MONDAY

Time	Topic	Shift Supervisor
7:00 a.m.-3:00 p.m.	Start operation of Control Instruments on Chlorinators No. 1 through 8. Start programmed batch chlorination if operators developed to this stage. If necessary delay until after review training week of June 7, 1965.	Haupt Madison Molloy Williams

AROCLOR START-UP TRAINING PROGRAM

WEEK OF JUNE 7, 1965

Typical 1 Day Training Program
Four Shift Crews to be Trained

Time	Topic	Instructor
7:00 - 7:30 a.m.	Review Alterations to Chlorinators Nos. 1, 2, & 3, and Start-up	Williams
7:30 - 9:00	Review Instrumentation Alterations to Chlorinators No. 1 thru 8 Train on Batch Program System with Taylor Flexi-pulse Timer Chlorine Flow Control, & Temperature Control	Molloy
9:00 - 9:15	Break	
9:15 - 11:30	Field Tour Review Training above Detailed Operator Review & Discussion	Molloy & Williams
11:30 - 12:00	Lunch	
12:00 - 1:00 p.m.	Process Flow, Equipment & Operating Procedures for Continuous Chlorinator & Continuous Blow Tank System	Haupt
1:00 - 2:00	Field Tour Review Continuous System Operation	Haupt & Williams
2:00 - 2:15	Break	
2:15 - 3:00	Group Discussion & Review	Williams

AROCLOR START-UP TRAINING PROGRAM

WEEK OF JUNE 14, 1965

Typical 4 Hour Training Program
Four Shift Crews to be Trained

Time	Topic	Instructor
12:00 - 1:00 p.m.	Review Batch Chlorinator Programmed Control System	Williams
1:00 - 2:00	Field Tour Detailed Operator Training	Haupt & Williams
2:00 - 2:15	Break	
2:15 - 3:30	Group Discussion of System	Molloy
3:30 - 4:00	Review Alterations to No. 3 Aroclor Still	Molloy

MURIATIC ACID START-UP TRAINING PROGRAM

WEEK OF JUNE 28, & JULY 5, 1965

Typical 2 Day Training Program
Four Shift Crews to be Trained

FIRST DAY

Time	Topic	Instructor
7:00 - 8:00 a.m.	Process Flow Review New Absorber Carbon Towers Filter Storage Tanks	Haupt
8:00 - 9:00	Questions & Answer Discussion Period	Haupt
9:00 - 9:15	Break	
9:15 - 11:00	Field Tour HCl Facilities	Haupt & Williams
11:00 - 11:30	Lunch	
11:30 - 12:30 p.m.	Operating Procedures & Detailed Instrument Instructions	Molloy
12:30 - 1:30	Questions - Group Discussion	Williams
1:30 - 1:45	Break	
1:45 - 2:45	Field Tour - Detailed Operator Review of Operating Instructions	Molloy & Williams
2:45 - 3:30	Group Review of Operating Details	Williams