MONSANTO COMPANY
ANNISTON PLANT

STANDARD OPERATING INSTRUCTIONS FOR AROCLORS

November 1969

DSW 334440

MONSANTO COMPANY
ANNISTON PLANT

STANDARD OPERATING INSTRUCTIONS

FOR

AROCLORS

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Revision Issued: November 1969

Copy No. 4

DSW 334442

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FOR
AROCLORS

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STANDARD OPERATING INSTRUCTIONS
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SYNOPSIS OF PROCESS

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STANDARD OPERATING INSTRUCTIONS
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A. SYNOPSIS OF PROCESS

General

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

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

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

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

1. Aroclor 4465

   Aroclor 4465 is a blend of 50% Aroclor 1262 and 50% Aroclor 5460 by weight.

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%.

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3. Aroclor 5042 and 5442

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

4. Aroclor 2565

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

Chlorinator Area

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

Batch operated liquid chlorinators are normally charged with 3,000 pounds of Biphenyl with 1-1/2 pounds of Ferric Chloride Catalyst. The chlorinators may be charged with Aroclor 1142 and chlorinated to a higher chlorinated Aroclor. Charges for the solid chlorinator vary dependent upon the Aroclor to be produced. Chlorine gas added through a distributor plate reacts with the raw material to release HCl and heat. The HCl gas goes to the Muriatic Acid Department. Heat is taken away by use of external air cooled heat exchangers. The specific gravity of the crude is checked after chlorine feed has been on for four hours, again when 80% chlorinated, as indicated by alarm, and as needed thereafter.

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

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

Still Area

Liquid Aroclors

Aerated Aroclors from a blowing tank or a feed tank are charged to a still, hydrated lime is added, a vacuum of 720 mm Hg (40 mm Hg absolute) is applied, the still furnace is fired, and the Aroclor is distilled into a receiver. The distillation is semi-continuous, since as many as ten (10) receivers are distilled prior to drawing bottoms or residue from the still. Every two receivers (or approximately 2,000 gallons) are treated with 40 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. In 1967, an experimental column was installed to treat part of the plant's production by passage through a bed of Bauxite. The column has proven superior to the present method of earth treatment and intentions are to treat all electrical Aroclors by the Bauxite column method in the near future.

Solid Aroclors

Solid Aroclors are distilled in a similar manner to Liquid Aroclors except for 1168. Aroclor 1168 is not air blown and is charged directly to the still from the chlorinator. A vacuum of 4 mm Hg absolute is applied for distillation. Solid Aroclors have 2, 3, or 4 receivers distilled prior to drawing bottoms in the still. This is dependent upon the particular Aroclor being produced.

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

SAFETY &
HOUSEKEEPING

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B. SAFETY AND HOUSEKEEPING

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

Cause and Action to Prevent

1. Chlorine Gas

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

Action to Prevent

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

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

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

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

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

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

Cut off chlorine from cars.

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Cause and Action to Prevent

2. Thermal Burns

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

Contact with uninsulated steam lines and open steam.

Contact with hot Aroclors from broken lines or leaks.

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

Action to Prevent

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

b. Know the first aid treatment for burns. Cold Water Treatment (See Appendix A - Emergency Section).

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

d. Report uninsulated lines for repair of insulation.

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

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

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

(2) Sampling the Solid Aroclor still receiver.

(3) Drawing bottoms on the Aroclor stills.

Cause and Action to Prevent

3. Explosion

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

Action to Prevent

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

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

c. Do not close valve in water discharge line from the chlorinator coil.

d. Observe temperature of the chlorinator periodically and be sure it is not too hot (180^{o}C. maximum).

4. Falls

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

Action to Prevent

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

Cause and Action to Prevent

4. Falls (Contd.)

b. The following items should be done:

(1) Return hose to rack after using.

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

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

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

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

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

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

5. Fires

Fires can occur by:

Biphenyl, Santowax R, or Santowax C ignition.

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

Furnace burner backfire.

Wood, rags, or paper on hot lines.

Sparks from welding apparatus of open flames.

Cause and Action to Prevent

5. Fires (Contd.)

Action to Prevent

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

b. Smoke only in areas so designated.

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

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

e. Fire fighting equipment includes:

(1) Two wheeled dry powder units.

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

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

(4) Two 3/4" water hoses.

(5) Hose connection north of Santowax.

(6) Scott Air Paks.

(7) Fire truck in fire house.

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

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

a. Chlorine Gas

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

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

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

b. Biphenyl

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

c. Santowax R

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

d. Santowax C

Same as Santowax R, since it is the crude material prior to distillation.

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6. (Continued)

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

HOUSEKEEPING

The Aroclor chlorinator and still operators are responsible for housekeeping during their shift. Good housekeeping is the mark of good operations, safety practices, quality, and costs.

Housekeeping duties are equal in importance with all other operating duties.

Poor Practices	Action to Prevent
1. Hoses, valve handles, dip sticks, rags, and other material on ground or floor.	a. Replace after use.
	b. Have place to store all necessary operating aids.
	c. Report needs to supervision.
2. Product Leaks.	a. Tighten valve packing glands and flange bolts.
	b. Report leaks to Chief Operator for maintenance alteration.
3. Trash and Crude Drums.	a. Contact Chief to have drums moved from area.
	b. Use trash skip in area.
4. Product spills or clean out messes.	a. Prevent necessity of clean-out by keeping tracing, insulation, or jacket in good repair by getting items turned in for maintenance work.
	b. Spills must be cleaned up when they are made. Clean up will continue through the following shifts to finish the job.

DETAILED INSTRUCTIONS

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PROCESS FUNCTION OUTLINE

C. 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 350 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 30 drums or approximately 1,650 gallons total are in the surge tank (Item 627).

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3.1 Aroclor 1242, as well as Aroclor 1248, can be charged into Therminol surge tank. When Aroclor 1242 is used it is charged into surge tank as follows:

A. Align valves in line from Aroclor 1242 storage tank to No. 9 chlorinator surge tank.

B. Check level gauge in surge tank.

C. Crack valve from circulating line at No. 9 surge tank to return line to Therminol surge tank. This allows Therminol to pump from No. 9 surge tank to Therminol surge tank.

D. Start Aroclor 1242 storage tank pump.

E. Observe level gauge in No. 9 surge tank to maintain constant level in tank while pumping in and out of tank.

F. Continue to pump from No. 9 surge tank to Therminol surge tank until you have 10" in Therminol surge tank.

G. Close valve from circulating line at No. 9 surge tank to return line to Therminol surge tank.

H. Observe level gauge in No. 9 surge tank.

I. When you have 40" in tank, stop Aroclor 1242 storage tank pump.

J. Close valves in line from storage tank to No. 9 surge tank.

3.2 Start-Up

A. Initial Start-Up

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

2. 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 350 GPM in "auto" position.

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

4. Open natural gas valves in line to furnace.

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

6. 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.

7. Set the temperature shutdown control point on Honey well coil outlet temperature indicator at 325°C. (617°F).

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

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 6 minutes. Green light on Protectoglo unit lights up indicating purge period is over.

13. 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. Pilot lights up indicated by 0-7 reading on micro amp meter.

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

15. Reset the two North American safety valves in the main gas line. Handle on both valves must be in UP position prior to opening either valve.

16. 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.

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 since you can cause shutdown of the furnace.

18. Shut steam valve to coil in the surge tank. Vent coil line to atmosphere.

19.. The furnace must be dried out prior to Step 20. Details will be provided.

20. Observe the furnace temperature at the coil outlet. Do not exceed 50°C. increase for first two 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.

    Check stack temperature and do not exceed 400°C on the multipoint temperature recorder point 10.

21. 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), 10" in sight glass.

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 350 GPM controller in "auto" position.

5. Adjust set point TRCA-629.12 at 126°-150°C. and controller in "auto" position.

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

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

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

9. Adjust manual valve in air line to burner until pressure is between 20-22 o.s.i.

10. Adjust TRCA-629.12 to temperature at outlet of coil and transfer instrument to "auto". Gradually raise the set point to 250°C.

11. 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 350 GPM.

B. PI-628.02 pump discharge pressure 85-95 psig.

C. PI-629.16 heater coil outlet pressure 55 psig.

D. PI-628.03 Therminol line pressure 30 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 pressure - above 15 o.s.i. less than 22 o.s.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 (0 o.s.i.).

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 6 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 main burner 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 0 - 7 microamperes on current meter. Meter gives an alternating off-on reading.

B. Check surge tank, Item 627, to be sure Therminol level is at least 10" in the sight glass.

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.

5. Close one or both of the North American safety valves in the gas line to the main burner.

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 150°C. then shut off the circulating pump.

6. Check surge tank level to be sure the tank does not overflow. It should have a level of 38-42" in the sight glass.

7. If a temperature of 100°C. is to be maintained in the 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 or below 10 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 350 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 6 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 main burner the air discharge pressure to the main burner must be below 1-1/2 o.s.i. for low fire start-up.

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 B.2. 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., Page 12 .

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. Normal sight glass level is 10" during operation and 40" with the pump stopped.

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.

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 10" in the sight glass. The level in the tank will vary, dependent on the operating temperature of the system and the Therminol usage.

F. Temperature of the Therminol system is maintained at 250°C. for production of all solid Aroclors except 1168. During operation to produce 1168, the temperature is raised to 300°C. The furnace high temperature shutdown alarm is kept at the same position of 325°C.

G. To get natural gas to the main burner the North American safety valves must be reset. Prior to opening the valves the handle of each valve must be in the up position. This sets the safety shutdown pressure switches.

H. Use care when opening the inner door to the field control panel at the furnace. The high temperature shutdown instrument pointer is free floating and can go above the shutdown pointer. The door must be opened slowly.

I. Gas to the venturi mixing chamber for the pilot light on the furnace should be at atmospheric pressure. Air pressure will be the blower discharge pressure (22 o.s.i.). The pilot light will not burn unless this pressure ratio is maintained to give the proper gas-air mixture.

J. In case of a power failure at the field panel for the Therminol Heater the reset button on the high temperature shutdown instrument must be pushed to restart the system. There is no apparent indication that this button has been pushed. The red no flame light will not light up and furnace can not be started.

STANDARD OPERATING INSTRUCTIONS
FOR
AROCLORS

PROCESS FUNCTION OUTLINE

C. I. WEIGH TANK, NO. 9 CHLORINATOR, AND NO. 2 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 is fed to the chlorinator from tank cars.

Aroclor 1168 is transferred directly from the chlorinator to the still because of its high hold point temperature (155-175°C).

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.

DSW 334471

B. Charge Therminol Cooling System for No. 9 Chlorinator

Charge Therminol (1248 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 7 drums or 385 gallons are in the surge tank.

C. Aroclor 1242, as well as Aroclor 1248, can be charged into the surge tank (Item 533). When Aroclor 1242 is used it is charged into surge tank as follows:

1. Align valves in line from Aroclor 1242 storage tank to surge tank.
2. Check level gauge at surge tank.
3. Start Aroclor 1242 storage tank pump.
4. Observe level gauge at surge tank and allow Aroclor 1242 to pump to surge tank until you have 40" in tank.
5. Stop storage tank pump.
6. Close valves in line from storage tank to surge tank.

TABLE I

BATCH CHLORINATOR OPERATING CONDITIONS - SOLID AROCLORS			
	1168	5042	5060
Chlorinator Charge:			
Biphenyl (lbs.)	9,550		
Santowax C			
Santowax R		11,000	11,000
Total Charge (lbs.)	9,550	11,000	11,000
Approximate Pounds 100% Chlorine Required to Produce Batch:	44,000	12,000	28,450
Totalizer Chlorine Settings (80% Cl_2, Assuming 10% Air) Lbs. Cl_2:	33,000	9,600	20,000
Chlorinator Temp.:			
Beginning	130°C.	160°C.	160°C.
Ending	200°C.	210°C.	250°C.
Hold Point	155-175°C.		
Softening Point		50-56°C.	105-115°C.
Weight of Crude Batch - Lbs.	22,000	14,050	22,800
Gallons	1,690		1,770

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

NOTE: Aroclor 1142 can be used to charge chlorinator for 1168 instead of Biphenyl. When this is done, Ferric Chloride is not added to charge.

D. 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). Tag lines closed.

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 160°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 Terminol 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 outlet 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.

E. 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.

   c. Pump pressure 55 psig.

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 350 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 170°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) - 20 to 25 psig water pressure.

8. Start the air blower (Item 530). Open the valve at the #2 blow tank 2 turns.

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).

F. Charge Weigh Tank (Charge Tank)

1. Refer to Table I, Page 15, 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 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, 5,220 lbs. of Biphenyl are added and then 3,480 lbs. of Santowax R are required. Place the scale set point at 8,700 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. Start the pump to charge the weigh tank. Santowax R is now entering the weigh tank.

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

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

i. Open the automatic valve and allow the line to drain. Then reclose the automatic valve.

j. 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.

k. Open manual valve on top of the weigh tank (Item 535) and add 5 pounds of Ferric Chlorine. Close the manual valve after adding the Ferric Chloride. Close the lid on the hopper.

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

G. 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-528.01 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 "manual". Set point at 1,500 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. Close pump discharge valve, open valve at bottom of weigh tank, start transfer pump (Item 536), and gradually open the pump discharge valve.

h. Stop pump when the weigh tank is empty. Close valve at bottom of weigh tank.

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

j. Start circulating pump (Item 506).

k. 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 <u>20-25 psig</u>. A low pressure alarm is set at <u>15 psig</u> - high pressure alarm at <u>35 psig</u>.

l. After chlorine feed levels off at 1,500 lbs. per hour - put FRCS-505.01 in automatic with set point at 1,500 lbs. per hour.

<u>Chlorine control valve should be open before manual valves are opened</u>.

m. After one hour, increase chlorine rate to <u>2,000 lbs. per hour</u> of chlorine feed.

n. 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 1248 system) - <u>300 GPM</u>.

(3) Chlorine flow on FRCS-505.01 - <u>1,500 lbs/hour</u>.

(4) Circulating pump discharge pressure on No. 9 chlorinator, PI-506.01 - <u>30-45 psig</u>.

o. 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 1248 system).

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

q. Increase temperature set points through the chlorination as is necessary to maintain the material liquid and fluid. End temperature point will be approximately <u>250°C</u>. Raise set point on TRCA-538.01 as necessary to achieve desired temperature.

r. Samples are taken at the discharge line of the circulating pump (Item 506) at the second level. Depending on the material being produced the softening point, or hold point is run on the 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.

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

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

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 dependent on Aroclor being produced - see Appendix I.

f. Adjust green set point knob on the Chlorine totalizer per the Table on Page 15 for measuring the chlorine flow.

. Set up flow-temperature 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 70°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 170°C. Controller in "auto".

h. Set valves to transfer charge from weigh tank to the No. 9 chlorinator.

i. Close pump discharge valve, open valve at bottom of weigh tank, start transfer pump (Item 536), and gradually open the pump discharge valve.

j. Stop the pump when the weigh tank is empty. Close valve at bottom of weigh tank.

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

l. Start circulating pump (Item 506).

m. Push the green reset pushbutton on the chlorinator panel for No. 9 chlorinator, (Item 505). This resets the chlorine totalizer and programmer and is the initiating signal for the start of the new batch. The Flexopulse time 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 totalizer, an alarm bell will ring to indicate 80% of the chlorine feed has been taken into the chlorinator.

n. 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.

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. After four 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.

p. 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 1248) system on FICA-535.02.

(4) Temperature points through the system on the No. 9 chlorinator and the Therminol cooling system (Aroclor 1248).

q. 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.

r. 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.

s. At completion of the chlorination (See Table I), shut off the chlorine feed valves to the distributors at the chlorinator, then push the green reset pushbutton on the chlorinator panel for the No. 9 chlorinator. This reduces the chlorine flow set point to 300 lbs./hour and stops the timer. No chlorine will be flowing.

t. Note the chlorine pressure on the main header as in "Manual Operation". Pressure controller alarm PIC-500.07 will indicate low pressure at 15 psig - high pressure at 35 psig.

u. Circulate the chlorinator for 10 minutes. Sample and check the hold point or softening point to be sure the chlorination has been completed. See Table I, Page 15.

If the chlorination is complete, prepare to pump to the No. 2 blow tank or directly to a still if Aroclor 1168 is being produced. See next section of Operating Instructions.

H. 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. Level indicator must read 0-5% before transfer.

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 are approximately 60%.

3.2 Rountine 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, 350 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-538.01. With the system in "cascade-auto", the temperature will be controlled by a pre-set program. Initial starting temperature of 130°C., completion temperature 250°C. dependent on Aroclor being produced - see Appendix I.

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 35-45 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 70°C. Low temperature alarm set at 60°C. - high temperature alarm set at 80°C.

   c. Surge tank Therminol level (Item 533) should be above the steam coils - 7-10" in sightglass.

   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 set point 170°C.

2. Level in the No. 2 blow tank will be indicated by LI-541.02. Normal level with a full charge is approximately 60%.

3. Water valve should be open to the S&K jet providing suction on the No. 2 blow tank - pressure 20-25 psig.

4. The air blower (Item 530) should be operating with a discharge pressure of 8-10 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 weigh alarm set at 15,000 pounds will sound for an overcharge.

NOTE: This interlock does not apply when Biphenyl is being charged to the weigh tank.

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 off-gas 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.

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 7"-11" in the sightglass.

G. 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.

H. A sight glass has been placed in the HCl off-gas 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 carry-over will cause plugging of the HCl off-gas line.

I. 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 <u>versus</u> pressure will be in the Operating Manual-see Appendix VI. A solid chlorinator batch could be completed using this pressure manometer if the need should arise.

J. 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.

K. 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 <u>80% bell</u> rings as preset by the chlorine flow totalizer. 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 <u>Shutdown</u>

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 automatic valve in Santowax line to weigh tank.

c. Close the valve at the bottom of the weigh tank.

d. Open discharge valve to transfer pump to vent transfer line.

e. Leave TIC-535.01 in "auto" with set point at $\underline{150^{o}C}$.

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

g. 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 automatic valve in Santowax line to weigh tank.

c. Close the valve at the bottom of the weigh tank.

d. Open discharge valve to transfer pump to vent transfer line.

e. Move the weigh tank temperature control TIC-535.01 set point to $\underline{0^{o}C}$. Close the manual valve in the steam supply line.

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

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

h. The tank may or may not be empty, dependent on the work to be done or the cause for shutdown. Under normal conditions the tank will be empty.

i. Note shutdown information on data sheet.

j. Drain the weigh tank if necessary for repair work.

k. Leave the system in this condition until needed.

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 chlorine feed to the other chlorinators. 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 10-12 psig. Discharge pressure on the vaporizer should be 70-100 psig. Chlorine header pressure normally 20-25 psig.

e. 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. The circulating pump will continue to run.

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

g. Leave the Therminol cooling system circulating.

h. Adjust control valve to TRCA-538.01 for No. 9 chlorinator to stop coolant flow on the heat exchanger.

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.

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, and the transfer lines into the vessel, will be tagged. 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 1.c. above.

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

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

g. 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 70°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 data 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. Vent pump discharge line into the blow tank.

c. Transfer pump will be shut off.

d. Adjust TIC-541.01 set point to 170°C. Leave in "auto".

e. The air blower will continue to run.

f. Water will remain on the S&K jet (Item 531), 20-25 psig.

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 blow tank. Vent the discharge valve of the transfer pump to the blow tank to eliminate expansion in the lines.

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

d. Adjust TIC-541.01 controller to $0^{o}C$. 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 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 Dept. if necessary.

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/hr. to the No. 9 chlorinator.

Immediately, shut off manual valves feeding this chlorinator in the field.

(2) Programmed Operation

Move chlorine controller FRCS-505.01 set points from "cascade" to set or move set points for flexopulse timer to zero.

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

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

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 Therminol cooling system circulating pump.

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 nine (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 five (5) minutes before the tank will overflow.

The interlock feature for the transfer pump does not apply when Biphenyl is being charged to the weigh tank.

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 in 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 totalizer 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 Flexopulse 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 Arôclor 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 Flexopulse Timer. After start of the program, the Flexopulse 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". This program, once set up, should not be distrubed without consulting supervision.

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 vaporizer 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 1248) in the surge tank (Item 533) at 70°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 60°C. - the high temperature alarm is set at 80°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 170°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.

This interlock does not apply when Biphenyl is being charged into the weigh tank.

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 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) When 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 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 1248) if the flow falls below 250 GPM. This alarm is on the chlorinator panel.

e. Abnormal exit temperatures on the Therminol (Aroclor 1248) cooling system from the cooler (Item 507) will sound an alarm. The low temperature alarm is set at 60°C. and the high temperature alarm at 80°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 shut-down 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 Thermon-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" in the sightglass. 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 turnings. Due to this change, it is absolutely necessary that (5) lbs. of Ferric Chloride be added to each chlorinator charge in the weigh tank.

G. Different time dials for the flexopulse timers are used for the different Solid Aroclors produced. This eliminates more complicated changes when products are changed. See Temperature - Chlorine Flow Programs - Appendix I.

*Ferric Chloride is not added when 1142 is used for an 1168 chlorinator charge.

APPENDIX I

SOLID AROCLORS PROGRAMMED CHLORINATION

TEMPERATURE & CHLORINE FLOW PROFILE

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

	AROCLORS		
Time	2565	5042	5060
1st hour @	1,000	1,000	1,500
2nd hour @	1,500	1,500	2,000
3rd & subsequent hrs. to end of batch @	1,700	1,500	2,500

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

	AROCLORS		
Time	2565	5042	5060
1st hour @	130	160	190
2nd two hours @	130	180	200
3rd two hours @	140	190	210
4th two hours @	140	200	220
5th two hours @	140	210	230
6th two hours @	150	210	240
7th two hours @	160	210	250
8th two hours @	180	210	255

Total Batch Time - Approximate hours - 10-1/2

APPENDIX I (Contd.)

3. CHLORINE TOTALIZER SETTINGS FOR 80% ALARM
(BASED ON 90% CHLORINE AND CHARGES INDICATED)

Aroclor Product	80% Cl_2 Setting	Total Charge Wt.
*1168	33,000	9,550
2565	26,800	9,000
5042	11,000	11,000
5060	20,000	11,000

4. CHLORINE TEMPERATURE PROFILE

AROCLOR 1168

Time	Chlorine Flow	Temperature
1st hour	1,000	130
2nd hour	1,500	130
3rd hour	1,700	140
5th hour	1,700	140
7th hour	1,700	140
9th hour	1,700	150
11th hour	1,700	160
13th hour	1,700	170
15th hour	1,700	180 to end of batch

*NOTE: Does not apply when 1142 is used for chlorinator charge rather than Biphenyl

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APPENDIX II

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

TANK CALIBRATION

Inches from Bottom of Sight Glass	Tank Capacity Gallons
Bottom of Sight Glass	163
1	169
2	176
3	183
4	190
5	197
6	204
7	211
8	218
9	224
10	231
11	238
12	245
13	252
14	259
15	266
16	273
17	279
18	286
19	293
20	300

APPENDIX III

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 out side 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 3.

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 IV

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 V

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 hole in the crossbar that holds sample.

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

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.

NO. 2 BLOW TANK

AROCLOR 5060

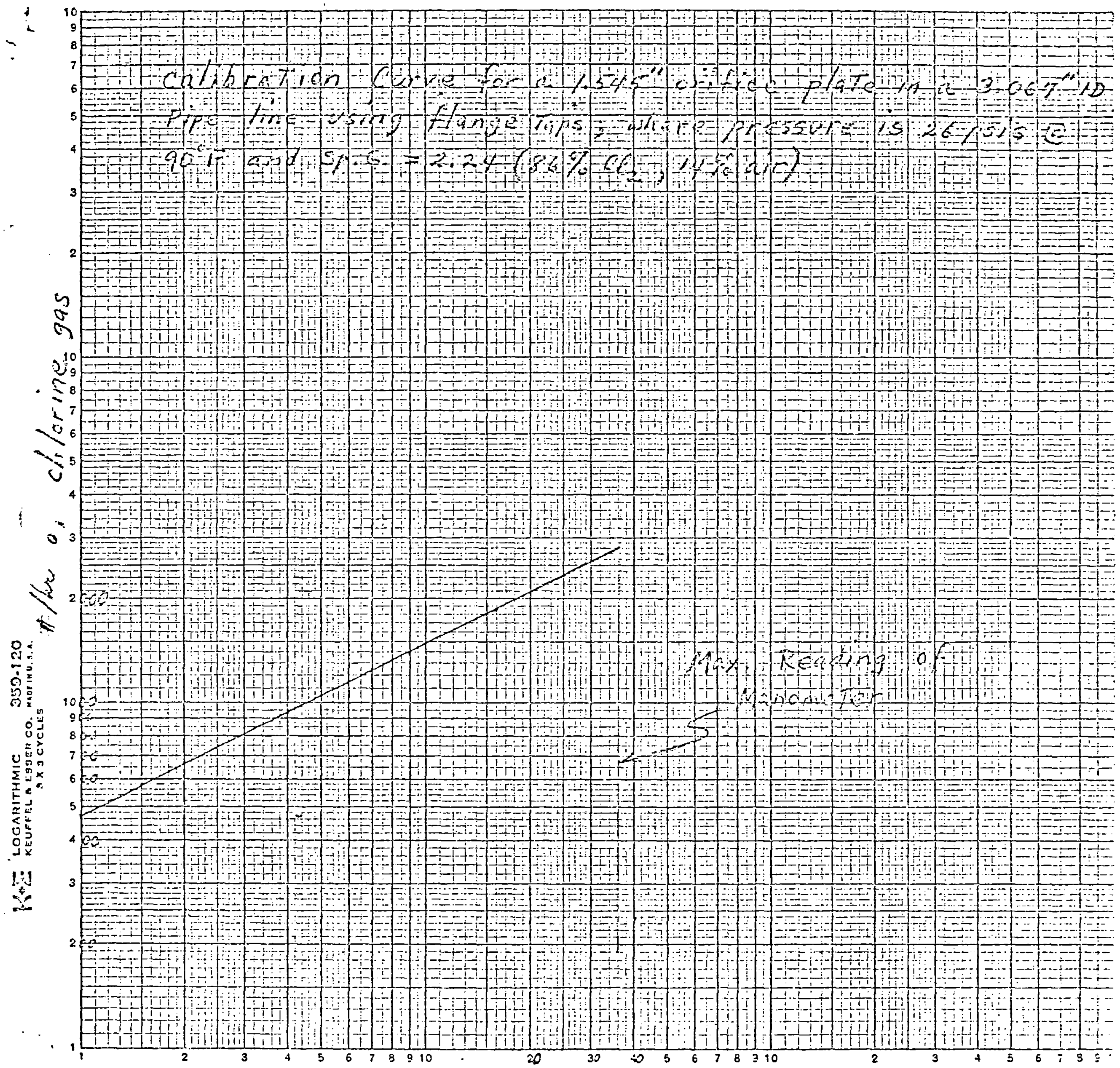
Innage Inches	% Full	Gallons	Innage Inches	% Full	Gallons	Innage Inches	% Full	Gallons
0	0.7	307	33	31.2	1,141	66	66.6	1,975
1	1.2	332	34	32.2	1,166	67	67.7	2,000
2	1.6	357	35	33.4	1,191	68	68.7	2,026
3	2.0	382	36	34.4	1,217	69	69.8	2,057
4	2.5	408	37	35.5	1,242	70	70.9	2,076
5	2.9	433	38	36.5	1,267	71	71.9	2,101
6	3.3	458	39	37.7	1,292	72	73.1	2,127
7	3.8	483	40	38.7	1,318	73	74.1	2,152
8	4.4	509	41	39.7	1,343	74	75.1	2,177
9	5.4	534	42	40.9	1,368	75	76.3	2,203
10	6.5	559	43	41.9	1,394	76	77.3	2,228
11	7.5	585	44	42.9	1,419	77	78.4	2,253
12	8.7	610	45	44.1	1,444	78	79.5	2,278
13	9.7	635	46	45.1	1,469	79	80.5	2,304
14	10.7	660	47	46.3	1,495	80	81.6	2,329
15	11.9	686	48	47.3	1,520	81	82.7	2,354
16	12.9	711	49	48.3	1,545	82	83.8	2,379
17	14.1	736	50	49.4	1,571	83	84.8	2,405
18	15.1	762	51	50.5	1,596	84	85.8	2,430
19	16.1	787	52	51.6	1,621	85	87.0	2,455
20	17.3	812	53	52.6	1,646	86	88.0	2,481
21	18.3	837	54	53.7	1,672	87	89.2	2,506
22	19.3	863	55	54.8	1,697	88	90.2	2,531
23	20.5	888	56	55.8	1,722	89	91.2	2,556
24	21.5	913	57	57.0	1,747	90	92.4	2,582
25	22.6	939	58	58.0	1,773	91	93.4	2,607
26	23.6	964	59	59.0	1,798	92	94.5	2,632
27	24.8	989	60	60.2	1,823	93	95.6	2,658
28	25.8	1,014	61	61.2	1,849	94	96.6	2,683
29	26.8	1,040	62	62.3	1,874	95	97.7	2,708
30	28.0	1,065	63	63.4	1,899	96	98.6	2,733
31	29.0	1,090	64	64.4	1,924			
32	30.2	1,115	65	65.5	1,950			

Data for Sheet based on filling tank with water during start-up, June 1964. Straight side 25.3 gals/in.

DSW 334504

1FO
#9 Chlorinator Controls

FI-505.01
EST. 1663 E.A. # 4-488
Richmond 1/27/65
sheet 10 of 10



inches of 60°Bé H_2SO_4

Sp.G. = 1.704 $\frac{20°C}{4°C}$

DSW 334505

STLCOPCB4080975

PROCESS FUNCTION OUTLINE

C. 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 is fed to the still tank. Hydrated lime is added to the crude Aroclor.

Vacuum is applied to the still and the Aroclor is circulated through the furnace coil and heated to the vaporization temperature. Vapors pass up an open column to the condenser. Distilled Aroclor is collected in a receiver. Quality of the distilled solid Aroclors is analyzed by the lab, and if in specification, it is transferred to the flaker hold tank for flaking or dumming into suitable containers.

Still residue or bottoms from each 2nd distillation (each Aroclor 1268 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. Thermінol 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.

NOTE: Aroclor 1242, as well as Aroclor 1248, can be charged into the surge tank. Same as charging No. 9 chlorinator surge tank - 6"-12" in sight glass.

The No. 4 still horizontal condenser was replaced with a vertical condenser in May 1968.

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 can be charged to the still without any problem. The still tank size is 2,500 gallons.

Aroclor 1168 is 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 (170°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 in the 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. This will be 6"-12" in the sight glass.

(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	5442	1268
Set Point, °C	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 or automatically.

(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 by-passing 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 250 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) Push pretemp "start" button to allow preheating the furnace before starting the circulating pump.

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

(6) 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 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.

(7) 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.

(8) The "green" light on the Protectoglo unit should come on within 6 minutes.

(9) 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.

(10) Put the set point on the natural gas flow controller FRC-618.06 to the solid still below 2.5 psig output. The switch will be in "auto".

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

(12) Increase gas flow to furnace burner. Observe stack temperature. Do not exceed 150°C.

(13) 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 50 GPM through the coil will cause the main burner to be shut off.

(14) Gradually raise the set point of the natural gas flow controller FRC-618.06 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 mades a sudden increase. Watch for this increase during initial heat-up of the furnace for the first time.

(15) 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 FRA-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) Prior to start-up, the still coil can be preheated before starting the circulating pump, if necessary. See Section e.(3), Page 49.

(2) Adjust natural gas flow controller to "auto" with the set point below 2.5 psig output pressure. 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 50 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 the Therminol heating system is off the vacuum line to the jets during operation.

(9) Check the Therminol cooling system on the 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 accomplish this. The temperature indicating alarm TIA-619.03 set at <u>100°C.</u> 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 automatically or manually.

(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 <u>150°C.</u> 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 55.

(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 <u>125 GPM</u>, an alarm will sound. The main gas burner to the furnace will shut off if flow drops below <u>50 GPM</u>. 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. <u>Operation of the Still During Distillation</u>

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 II - "Distillation Operating Conditions - Solid Aroclors" - Page 55)

TABLE II

DISTILLATION OPERATING CONDITIONS - SOLID AROCLORS				
	1268		5442	5460
Approximate Temperatures at which Various Aroclors Start Distilling @ 10 mm Vacuum. At Still:				
Column	225°C.	.	215°C.	260°C.
Coil Inlet	240°C.	.	240°C.	280°C.
Coil Outlet	245°C.	.	245°C.	285°C.
Approximate Finishing Temperature When Bottoms are not to be Drawn:				
Column		.		
Coil Inlet		.		
Coil Outlet		.		
Approximate Finishing Temperature After which Bottoms are to be Drawn:				
Column	285°C.	.	315°C.	355°C.
Coil Inlet	295°C.	.	340°C.	375°C.
Coil Outlet	330°C.	.	380°C.	400°C.
Finishing Hold Point	150-170°C.			
Finishing Softening Point		.	46-52°C.	98-105.5°C.

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.

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 transfer to the flaker hold tank.

e. When 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.

g. Start agitator in flaker hold tank.

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III. 3.1 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 170°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 stages. 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 below 2.5 psig output pressure.

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 Aroclor 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 250 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^{o}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 50 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 transfer material to the flaker hold tank. When material is to be transferred to the flaker hold tank, be sure the Therminol heating system is on the pump suction and discharge line. 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 900 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.

3.3 Safety Features

A. The Honeywell Protectoglo 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" in sight glass.

3.4 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).

3.5 Control Loops, Interlocks, and Alarms

A. Control Loops

There are nine (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 50 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. 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 50 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 assures the circulating pump has a positive suction and prevents surging in the heater coil. This will allow more uniform control of the temperature in the Therminol cooling system.

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" in the sight glass. 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 pressure of 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 end 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).

APPENDIX I

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

TANK CALIBRATIONS

Inches from Bottom of Sight Glass	Tank Capacity Gallons
Bottom of Sight Glass	87
1	92
2	97
3	103
4	108
5	113
6	118
7	123
8	128
9	133
10	139
11	144
12	149
13	154
14	159
15	164
16	169
17	174
18	180
19	185
20	190
21	195
22	200

APPENDIX II

ITEM 620: NO. 4 STILL RECEIVER

TANK CALIBRATIIONS

Level	Gallons	Level	Gallons	Level	Gallons
1"	224	3'-1"	1,031	6'-1"	1,839
2"	246	3'-2"	1,054	6'-2"	1,862
3"	269	3'-3"	1,076	6'-3"	1,884
4"	291	3'-4"	1,099	6'-4"	1,907
5"	314	3'-5"	1,121	6'-5"	1,929
6"	336	3'-6"	1,144	6'-6"	1,951
7"	358	3'-7"	1,166	6'-7"	1,974
8"	381	3'-8"	1,188	6'-8"	1,996
9"	403	3'-9"	1,211	6'-9"	2,019
10"	425	3'-10"	1,233	6'-10"	2,041
11"	448	3'-11"	1,256	6'-11"	2,064
1'-0"	470	4'-0"	1,278	7'-0"	2,086
1'-1"	493	4'-1"	1,301	7'-1"	2,108
1'-2"	515	4'-2"	1,323	7'-2"	2,131
1'-3"	538	4'-3"	1,346	7'-3"	2,153
1'-4"	560	4'-4"	1,368	7'-4"	2,176
1'-5"	583	4'-5"	1,390	7'-5"	2,198
1'-6"	605	4'-6"	1,413	7'-6"	2,221
1'-7"	627	4'-7"	1,435	7'-7"	2,243
1'-8"	650	4'-8"	1,458		
1'-9"	672	4'-9"	1,480		
1'-10"	695	4'-10"	1,503		
1'-11"	717	4'-11"	1,525		
2'-0"	740	5'-0"	1,547		
2'-1"	762	5'-1"	1,570		
2'-2"	785	5'-2"	1,592		
2'-3"	807	5'-3"	1,615		
2'-4"	829	5'-4"	1,637		
2'-5"	852	5'-5"	1,660		
2'-6"	874	5'-6"	1,682		
2'-7"	897	5'-7"	1,705		
2'-8"	919	5'-8"	1,727		
2'-9"	942	5'-9"	1,749		
2'-10"	964	5'-10"	1,772		
2'-11"	986	5'-11"	1,794		
3'-0"	1,009	6'-0"	1,817		

AROCLOR 5460
FLAKER HOLD TANK

% Scale	Gallons	Inches Aroclor (Innage)	% Scale	Gallons	Inches Aroclor (Innage)
0	87	11"	40	1,127	63.0"
1	113	12.3	41	1,153	64.3
2	139	13.6	42	1,179	65.6
3	165	14.9	43	1,205	66.9
4	191	16.2	44	1,231	68.2
5	217	17.5	45	1,257	69.5
6	243	18.8	46	1,283	70.8
7	269	20.1	47	1,309	72.1
8	295	21.4	48	1,335	73.4
9	321	22.7	49	1,361	74.7
10	347	24.0	50	1,387	76.0
11	373	25.3	51	1,413	77.3
12	399	26.6	52	1,439	78.6
13	425	27.9	53	1,465	79.9
14	451	29.2	54	1,491	81.2
15	477	30.5	55	1,517	82.5
16	503	31.8	56	1,543	83.8
17	529	33.1	57	1,569	85.1
18	555	34.4	58	1,595	86.4
19	581	35.7	59	1,621	87.7
20	607	37.0	60	1,647	89.0
21	633	38.3	61	1,673	90.3
22	659	39.6	62	1,699	91.6
23	685	40.9	63	1,725	92.9
24	711	42.2	64	1,751	94.2
25	737	43.5	65	1,777	95.5
26	763	44.8	66	1,803	96.8
27	789	46.1	67	1,829	98.1
28	815	47.4	68	1,855	99.4
29	841	48.7	69	1,881	100.7
30	867	50.0	70	1,907	102.0
31	893	51.3	71	1,933	103.3
32	919	52.6	72	1,959	104.6
33	945	53.9	73	1,985	105.9
34	971	55.2	74	2,011	107.2
35	997	56.5	75	2,037	108.5
36	1,023	57.8	76	2,063	109.8
37	1,049	59.1	77	2,089	111.1
38	1,075	60.4	78	2,115	112.4
39	1,101	61.7	79	2,141	113.7

Aroclor 5460
Sp. Gr. 1.544 @ 150°C
Temperature 150°C
Inst. Range - 0-200" H_2O
Inst. Scale - 0.100%

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PROCESS FUNCTION OUTLINE

C. I. CHARGE TANK, BATCH & CONTINUOUS LIQUID CHLORINATORS, & 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 chlorinator 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 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 68.

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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	1.577 1.587
@	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

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B. Fill 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 1, Page 68).

2. Set the valves to receive the charge from the Biphenyl Department. Biphenyl is obtained from 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.

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 is 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/hr.

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/hr. 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. 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 68 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 Flexopulse 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". 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. 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 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 alaım 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 chlorinators Nos. 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 Nos. 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 "atuo" 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.

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m. Samples will be caught and specific gravity run on chlorinators Nos. 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.

s. 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 by-passing 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 @ 65°C
Second	6	1.224 - 1.240 @ 65°C
Third	8	1.345 - 1.355 @ 65°C

*Note: Indicates No. 7 chlorinator out of system; however, any one of the four can be by-passed.

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 by-passed.

f. The chlorinator removed from service should be chlorinated to a finished Aroclor and 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 by-pass 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.

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 Flexopulse 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, Nos. 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 Accu Ray 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 set 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 1-1/2 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 off-gas 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 are 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.

F. A sight glass has been placed in the HCl off-gas 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 carry-over will cause plugging of the HCl off-gas 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 totalizer. This sample is to assure a batch is not over-chlorinated and sets up in the chlorinator, preventing its transfer to the blow tank.

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 vaporizing 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 vaporizer shell. This shut-off stops liquid chlorine feed to the vaporizer by closing a control valve.

2. Steam pressure to the chlorine vaporizer is regulated to 10-12 psig. A pressure relief valve is installed in the system to relieve any pressure above 12 psig.

3. Steam supply pressure to the chlorine vaporizer 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 thê 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 cut-back 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 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 10-12 psig. Discharge pressures on the vaporizer should be 1-2 psig greater than the pressure on the chlorine header (normally 20-25 psig).

   e. 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.

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

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

   h. 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. Leave the chlorine flow controller in "auto" with the set point at 0.

g. Leave the temperature recorder controller in "auto" with the set point at 150°C.

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

i. 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 Nos. 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. 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.

g. Shutdowns should be minimized. If the cause of the cut back can easily be remedied, start the continuous chlorination system up immediately.

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

i. 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 hours, 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.

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 Nos. 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 Nos. 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.e. 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 data 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) Open the bleed valve 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 from 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 vaporizer 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 (Nos. 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 sheet.

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 by-passed by directing flow from the catch tank to blow tanks Nos. 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. <u>Emergency Shutdown</u>

Ordinarily, 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. <u>From the Field</u>

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.

2. At the Panel

a. Stop chlorine feed to the chlorinators as follows:

(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.

Immediately 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. The remainder of the shutdown will have to be carried out from the field.

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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 amintain 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.

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 totalizer 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 Flexopulse 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-545.01

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 5 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. Nos. 1, 3, and 4 Blow Tank Level Indication

These loops measure the level of crude Aroclor in the Nos. 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, Page 94.

B. Interlocks

There are no interlocks in this system.

C. Alarms

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 mins. 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 off-gas pipe lines could cause extreme reactions which would generate excessive heat. The excessive heat will cause the chlorine to react and ignite with the steel pipe line. This would result in chlorine gas escaping to the atmosphere. Every effort possible should be made to operate the vaporizer with the control system provided.

2. Entrainment of Biphenyl or crude Aroclor into the HCl lines can occur when excessive chlorine rates occur. This can be checked by observing the off-gas from the chlorinators in the sight glasses on top of the Brink Demister on each chlorinator. Normal operation of the chlorinator should be to minimize this carryover. Abnormally high or low chlorine header pressures can cause operating 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 off-gas from an individual chlorinator or from the vent at the HCl absorber sewer box indicates problem operation in the Aroclor Department. It can be caused by inadequate reaction of the Biphenyl and might indicate formation of unstable Aroclor. If this situation occurs, it should be corrected immediately. Catch samples from the individual chlorinator off-gas 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 off-gas line. <u>In case this situation occurs and cannot be resolved, remove the chlorinator from operation. Contact department supervision immediately.</u>

   A badly worn distributor can also cause free chlorine in the off-gas line.

4. An agitator has been installed in the Biphenyl feed tank to keep Ferric Chloride in suspension. It is extremely important that the material be kept in suspension to allow production of stable Aroclors as well as eliminate production problems involving plugged lines with Ferric Chloride.

5. The continuous chlorinator catch tank has a high level alarm at <u>60%</u>. This alarm indicates there is approximately <u>30 mins.</u> before material will begin to back up in the continuous chlorinator system. Hold-up of material in the chlorinators can cause 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.

6. A low pressure instrument air alarm sounds at 70 psig. This alarm indicates the large instrument air compressor did not come back on 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.

7. Electricity to the two water supply pumps and the circulating fan, at the cooling tower north of the department, is provided through the motor control center at the Biphenyl Tubular Unit.

APPENDIX I

PROPOSED CHLORINE FLOW PROFILE

FOR PROGRAMMED BATCH CHLORINATION

I. CHLORINE INPUT — FLOW RECORDER CONTROLLER

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

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 @ 65°C.
2	6	1.170 - 1.196 @ 65°C.
3	7	1.254 - 1.280 @ 65°C.
4	8	1.336 - 1.362 @ 65°C.

II. THREE STAGE PRODUCTION

STAGE	CHLORINATOR*	SPECIFIC GRAVITY
1	5	1.108 - 1.124 @ 65°C.
2	6	1.224 - 1.240 @ 65°C.
3	8	1.345 - 1.355 @ 65°C.

*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 Chlor. 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

DSW 334567

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		

DSW 334568

APPENDIX IV (CONTINUED)

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.			X		X
Leave instrument in this position for "automatic-cascade" control from the external set point.					
Return system to "Automatic-Set".					
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	

DSW 334569

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, and analyzed sample is sent to the charge (melt) tank by gravity through a system of pipe lines from each chlorinator.

2. Take sample to the control room.

3. Allow water to run down out side 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 68.

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 VI

INSTRUMENT AIR COMPRESSORS

An instrument air compressor (No. 1) with a capacity of 105 cfm at 100 psig has been installed to supply dry, oil-free air for instrumentation. A stand-by air compressor is available in the old Joy instrument air compressor with a capacity of 50 cfm at 85 psig.

In case of failure of both of these compressors, an oil-type Ingersoll-Rand compressor is available. Capacity of this unit is 100 cfm at 100 psig.

Operation of the compressor system is as follows:

No. 1 compressor starts at low pressure of 85 psig. Compressor stops at 100 psig.

No. 2 compressor (old) starts at 68 psig; stops at 78 psig.

An instrument air failure alarm will sound at 70 psig. This will indicate failure of the No. 1 compressor to start up. The air compressor system should be checked immediately.

The No. 1 instrument air compressor will be in "auto" position for operation.

DSW 334571

APPENDIX VII

COOLING TOWER WATER SYSTEM

The water supply system for the Aroclor Department is as follows. At present, the cooling tower north of the department will supply the PNP Department, the old Biphenyl still system, the Aroclor Department, HB-40, and Santowax with cooling water. The supply pumps from the tower will feed water into the departments and return it back to the cooling tower. The new pumps for the system are located in the basin east of the cooling tower. Two pumps are installed for supply of water to the departments. Electricity to these pumps is provided through the motor control center at the Biphenyl tubular unit.

Operation of the pumps will be as follows:

(1) Place the electrical switches on both pumps in the "off" position.

(2) Open the valves in the discharge line from the pumps to the PNP Department and the Aroclor Department.

(3) Within the using departments, open the valves to allow water to return to the cooling tower.

(4) Turn on the circuit breakers for the cooling tower pumps and fan.

(5) Start one of the cooling tower pumps by placing the switch in the "hand" position. (This is for manual operation.)

(6) Place the other pump switch in the "auto" position.

(7) With the controls in this position, the pump in the manual or "hand" position will run unless failure occurs. In case of failure, the second pump in the "auto" control position will start up if the water discharge pressure drops below 60 psig.

Normal operating pressure for the pump discharge is 70 psig.

(8) The cooling tower temperature controls are set to start the circulating fan when the temperature drops to 75°F. and stops the circulating fan when the temperature rises to 85°F. To start up, turn on circuit breaker and place switch to "auto".

To operate the fan continuously, place the switch in "hand" or "manual".

The fan is on same circuit as the water supply pumps at the Biphenyl tubular unit.

NOS. 1, 3, & 4 BLOWING TANK CALIBRATIONS

1121 AROCLOR

% Scale	Gallons	% Scale	Gallons	% Scale	Gallons
0	185	20	1,196	40	2,206
1	236	21	1,246	41	2,256
2	286	22	1,297	42	2,307
3	337	23	1,347	43	2,357
4	388	24	1,398	44	2,408
5	438	25	1,448	45	2,458
6	489	26	1,499	46	2,509
7	539	27	1,549	47	2,559
8	590	28	1,600	48	2,610
9	640	29	1,650		
10	691	30	1,701		
11	741	31	1,751		
12	792	32	1,802		
13	842	33	1,852		
14	893	34	1,903		
15	943	35	1,953		
16	994	36	2,004		
17	1,044	37	2,054		
18	1,095	38	2,105		
19	1,145	39	2,155		

Aroclor 1121
Sp. Gr. - 1.070 @ 150°C (1.155 @ 65°C)
Instrument Scale - 0-100%
Instrument Range - 0-200" H_2O

DSW 334573

NOS. 1, 3, & 4 BLOW TANK CALIBRATIONS

1142 AROCLOR

% Scale	Gallons	% Scale	Gallons	% Scale	Gallons
0	185	20	1,039	39	1,850
1	228	21	1,082	40	1,893
2	270	22	1,124	41	1,936
3	313	23	1,167	42	1,978
4	356	24	1,210	43	2,021
5	399	25	1,253	44	2,064
6	441	26	1,295	45	2,107
7	484	27	1,338	46	2,149
8	527	28	1,381	47	2,192
9	569	29	1,423	48	2,235
10	612	30	1,466	49	2,277
11	655	31	1,509	50	2,320
12	697	32	1,551	51	2,363
13	740	33	1,594	52	2,405
14	783	34	1,637	53	2,448
15	826	35	1,680	54	2,491
16	868	36	1,722	55	2,534
17	911	37	1,765	56	2,576
18	954	38	1,808	57	2,619
19	996				

Aroclor 1142
Specific Gravity - 1.264 at 150°C (1.389 @ 25°C)
Instrument Scale - 0-100%
Instrument Range - 0-200" H_2O

DSW 334574

NOS. 1, 3, & 4 BLOWING TANK CALIBRATIONS

1148 AROCLOR

% Scale	Gallons	% Scale	Gallons	% Scale	Gallons
0	185	21	1,038	42	1,890
1	226	22	1,078	43	1,931
2	266	23	1,119	44	1,971
3	307	24	1,159	45	2,012
4	347	25	1,200	46	2,053
5	388	26	1,241	47	2,093
6	429	27	1,281	48	2,134
7	469	28	1,322	49	2,174
8	510	29	1,362	50	2,215
9	550	30	1,403	51	2,256
10	591	31	1,444	52	2,296
11	632	32	1,484	53	2,337
12	672	33	1,525	54	2,377
13	713	34	1,565	55	2,418
14	753	35	1,606	56	2,459
15	794	36	1,647	57	2,499
16	835	37	1,687	58	2,540
17	875	38	1,728	59	2,580
18	916	39	1,768	60	2,621
19	956	40	1,809		
20	997	41	1,850		

Aroclor 1148
Sp. Gr. - 1.330 @ 150°C (1.415 @ 65°C)
Instrument Scale - 0-100%
Instrument Range - 0-200" H_2O

DSW 334575

NOS. 1, 3, & 4 BLOWING TANK CALIBRATIONS

1154 AROCLOR

% Scale	Gallons	% Scale	Gallons	% Scale	Gallons
0	185	21	983	42	1,781
1	223	22	1,021	43	1,819
2	261	23	1,059	44	1,857
3	299	24	1,097	45	1,895
4	337	25	1,135	46	1,933
5	375	26	1,173	47	1,971
6	413	27	1,211	48	2,009
7	451	28	1,249	49	2,047
8	489	29	1,287	50	2,085
9	527	30	1,325	51	2,123
10	565	31	1,363	52	2,161
11	603	32	1,401	53	2,199
12	641	33	1,439	54	2,237
13	679	34	1,477	55	2,275
14	717	35	1,515	56	2,313
15	755	36	1,553	57	2,351
16	793	37	1,591	58	2,389
17	831	38	1,629	59	2,427
18	869	39	1,667	60	2,465
19	907	40	1,705	61	2,503
20	945	41	1,743	62	2,541
21				63	2,579
				64	2,617

Aroclor 1154
Sp. Gr. - 1.420 @ 150°C (1.505 @ 65°C)
Instrument Scale - 0-100%
Instrument Range - 0-200" H_2O

NOS. 1, 3, & 4 BLOWING TANK CALIBRATIONS

1160 AROCLOR

% Scale	Gallons	% Scale	Gallons	% Scale	Gallons
0	185	23	1,011	47	1,872
1	221	24	1,047	48	1,908
2	257	25	1,083	49	1,944
3	293	26	1,118	50	1,980
4	329	27	1,154	51	2,016
5	365	28	1,190	52	2,052
6	400	29	1,226	53	2,088
7	436	30	1,262	54	2,124
8	472	31	1,298	55	2,160
9	508	32	1,334	56	2,195
10	544	33	1,370	57	2,231
11	580	34	1,406	58	2,267
12	616	35	1,442	59	2,303
13	652	36	1,477	60	2,339
14	688	37	1,513	61	2,375
15	724	38	1,549	62	2,411
16	759	39	1,585	63	2,447
17	795	40	1,621	64	2,483
18	831	41	1,657	65	2,519
19	867	42	1,693	66	2,554
20	903	43	1,729	67	2,590
21	939	44	1,765	68	2,626
22	975	45	1,801		
		46	1,836		

Aroclor 1160
Sp.Gr. - 1.504 @ 150°C (1.564 @ 90°C)
Instrument Scale - 0-100%
Instrument Range- 0-200" H_2O

DSW 334577

NOS. 1, 3, & 4 BLOWING TANK CALIBRATIONS

1162 AROCLOR

% Scale	Gallons	% Scale	Gallons	% Scale	Gallons
0	185	23	1,002	45	1,783
1	221	24	1,037	46	1,818
2	256	25	1,073	47	1,854
3	292	26	1,108	48	1,889
4	327	27	1,144	49	1,925
5	363	28	1,179	50	1,960
6	398	29	1,215	51	1,996
7	434	30	1,250	52	2,031
8	469	31	1,286	53	2,067
9	505	32	1,321	54	2,102
10	540	33	1,357	55	2,138
11	576	34	1,392	56	2,173
12	611	35	1,428	57	2,209
13	647	36	1,463	58	2,244
14	682	37	1,499	59	2,280
15	718	38	1,534	60	2,315
16	753	39	1,570	61	2,351
17	789	40	1,605	62	2,386
18	824	41	1,641	63	2,422
19	860	42	1,676	64	2,457
20	895	43	1,712	65	2,493
21	931	44	1,747	66	2,528
22	966			67	2,564
				68	2,599
				69	2,635

Aroclor 1162
Sp. Gr. - 1.522 @ 150°C (1.582 @ 90°C)
Instrument Scale - 0-100%
Instrument Range - 0-200" H_2O

DSW 334578

NO. 1 ROOF TANK

AROCLOR 1142

% Scale	Inches	Gallons	% Scale	Inches	Gallons
0	6.0	296	40	69.3	8,815
1	7.6	420	41	70.9	9,032
2	9.2	553	42	72.5	9,259
3	10.8	707	43	74.0	9,431
4	12.3	856	44	75.6	9,637
5	13.9	1,015	45	77.2	9,839
6	15.5	1,183	46	78.8	10,037
7	17.1	1,352	47	80.4	10,207
8	18.7	1,548	48	82.0	10,376
9	20.2	1,738	49	83.5	10,526
10	21.8	1,944	50	85.1	10,686
11	23.4	2,125	51	86.7	10,839
12	25.0	2,354	52	88.3	10,971
13	26.6	2,572	53	89.9	11,097
14	28.2	2,758	54	91.4	11,205
15	29.7	2,993	55	93.0	11,296
16	31.3	3,221	56	94.6	11,354
17	32.9	3,446			
18	34.5	3,675			
19	36.1	3,905			
20	37.6	4,118			
21	39.2	4,361			
22	40.8	4,604			
23	42.4	4,839			
24	44.0	5,080			
25	45.6	5,307			
26	47.1	5,523			
27	48.7	5,839			
28	50.3	6,077			
29	51.9	6,307			
30	53.5	6,548			
31	55.1	6,781			
32	56.6	6,928			
33	58.2	7,148			
34	59.8	7,482			
35	61.4	7,711			
36	63.0	7,940			
37	64.6	8,166			
38	66.1	8,377			
39	67.7	8,626			

Aroclor 1142
Temperature 150°C
Sp. Gr. 1.264 @ 150°C
Sp. Gr. 1.389 @ 25°C
Inst. Range - 0-200" H_2O
Inst. Scale - 0-100%

90% full = 47% (10,219 gals.)

DSW 334579

#2 ROOF TANK

AROCLOR 1121

% Scale	Inches Aroclor	Gallons	% Scale	Inches Aroclor	Gallons
0	3.0	45	29	57.2	3,237
1	4.9	97	30	59.0	3,388
2	6.7	150	31	60.9	3,500
3	8.6	218	32	62.8	3,638
4	10.5	288	33	64.7	3,743
5	12.3	366	34	66.6	3,888
6	14.2	451	35	68.4	4,000
7	16.0	530	36	70.3	4,126
8	18.0	645	37	72.2	4,283
9	19.8	730	38	74.0	4,388
10	21.7	844	39	75.9	4,523
11	23.6	953	40	77.8	4,649
12	25.4	1,064	41	79.6	4,756
13	27.3	1,175	42	81.5	4,880
14	29.2	1,309	43	83.4	4,994
15	31.0	1,420	44	85.2	5,100
16	32.9	1,528	45	87.1	5,207
17	34.8	1,684	46	89.0	5,318
18	36.6	1,796	47	90.9	5,422
19	38.5	1,922	48	92.7	5,503
20	40.4	2,070	49	94.6	5,598
21	42.3	2,179	50	96.5	5,675
22	44.1	2,306	51	98.3	5,753
23	46.0	2,400	52	100.2	5,820
24	47.9	2,574	53	102.0	5,878
25	49.7	2,676	54	103.9	5,905
26	51.6	2,808	55	105.8	5,957
27	53.5	2,952	56	107.4	5,991
28	55.3	3,132			

Aroclor 1121
Sp. Gr. @ 150°C - 1.070 (1.155 @ 65°C)
Inst. Range - 0-200" H_2O
Inst. Scale - 0-100%

90% Full = 46%

DSW 334580

#2 ROOF TANK

AROCLOR 1142

% Scale	Inches Aroclor	Gallons	% Scale	Inches Aroclor	Gallons
0	3.0	45	33	55.2	3,124
1	4.6	90	34	56.8	3,213
2	6.2	134	35	58.4	3,340
3	7.8	188	36	60.0	3,426
4	9.3	243	37	61.5	3,558
5	10.9	306	38	63.1	3,652
6	12.5	373	39	64.7	3,743
7	14.1	446	40	66.3	3,874
8	15.7	520	41	67.9	3,953
9	17.2	593	42	69.5	4,086
10	18.8	681	43	71.0	4,168
11	20.4	767	44	72.6	4,296
12	22.0	860	45	74.2	4,405
13	23.6	953	46	75.8	4,517
14	25.2	1,052	47	77.4	4,618
15	26.7	1,139	48	79.0	4,708
16	28.3	1,244	49	80.5	4,820
17	29.9	1,340	50	82.1	4,914
18	31.5	1,450	51	83.7	5,014
19	33.0	1,533	52	85.3	5,106
20	34.6	1,668	53	86.9	5,195
21	36.2	1,753	54	88.4	5,288
22	37.8	1,888	55	90.0	5,363
23	39.4	1,986	56	91.6	5,446
24	41.0	2,100	57	93.2	5,524
25	42.6	2,210	58	94.8	5,608
26	44.1	2,306	59	96.4	5,670
27	45.7	2,389	60	98.0	5,743
28	47.3	2,525	61	99.5	5,794
29	48.9	2,616	62	101.1	5,851
30	50.5	2,745	63	102.7	5,880
31	52.0	2,820	64	104.3	5,916
32	53.6	2,962	65	105.8	5,957
			66	107.4	5,991

Aroclor 1142
Sp. Gr. 1.264 @ 150°C (1.389 @ 25°C)
Inst. Range -0-200" H_2O
Inst. Scale - 0 - 100%

90% Full = 55%

DSW 334581

#2 ROOF TANK

AROCLOR 1148

% Scale	Inches Aroclor	Gallons	% Scale	Inches Aroclor	Gallons
0	3.0	45	36	57.0	3,219
1	4.5	87	37	58.5	3,348
2	6.0	127	38	60.0	3,426
3	7.5	178	39	61.5	3,558
4	9.0	233	40	63.0	3,646
5	10.5	288	41	64.5	3,733
6	12.0	356	42	66.0	3,859
7	13.5	415	43	67.5	3,933
8	15.0	495	44	69.0	4,064
9	16.5	555	45	70.5	4,138
10	18.0	645	46	72.0	4,277
11	19.5	715	47	73.5	4,348
12	21.0	808	48	75.0	4,475
13	22.5	890	49	76.5	4,558
14	24.0	975	50	78.0	4,664
15	25.5	1,070	51	79.5	4,748
16	27.0	1,156	52	81.0	4,852
17	28.5	1,260	53	82.5	4,938
18	30.0	1,344	54	84.0	5,033
19	31.5	1,450	55	85.5	5,118
20	33.0	1,533	56	87.0	5,200
21	34.5	1,660	57	88.5	5,303
22	36.0	1,731	58	90.0	5,363
23	37.5	1,870	59	91.5	5,453
24	39.0	1,944	60	93.0	5,513
25	40.5	2,075	61	94.5	5,593
26	42.0	2,149	62	96.0	5,652
27	43.5	2,275	63	97.5	5,721
28	45.0	2,362	64	99.0	5,775
29	46.5	2,450	65	100.5	5,831
30	48.0	2,582	66	102.0	5,878
31	49.5	2,660	67	103.5	5,895
32	51.0	2,789	68	105.0	5,934
33	52.5	2,860	69	106.5	5,973
34	54.0	3,004			
35	55.5	3,148			

Aroclor 1148
Sp. Gr. 1.330 @ 150°C (1.415 @ 65°C)
Inst. Range - 0-200" H_2O
Inst. Scale - 0-100%

90% Full = 58%

DSW 334582

#2 ROOF TANK

AROCLOR 1154

% Scale	Inches Aroclor	Gallons	% Scale	Inches Aroclor	Gallons
0	3.0	45	37	55.1	3,116
1	4.4	84	38	56.5	3,204
2	5.8	122	39	57.9	3,299
3	7.2	167	40	59.3	3,399
4	8.6	218	41	60.7	3,483
5	10.0	265	42	62.2	3,616
6	11.5	333	43	63.6	3,683
7	12.9	387	44	65.0	3,758
8	14.3	457	45	66.4	3,879
9	15.7	520	46	67.8	3,948
10	17.0	580	47	69.2	4,073
11	18.5	668	48	70.6	4,144
12	19.9	735	49	72.0	4,277
13	21.3	824	50	73.4	4,340
14	22.7	902	51	74.8	4,458
15	24.1	982	52	76.2	4,540
16	25.5	1,070	53	77.6	4,634
17	27.0	1,156	54	79.0	4,708
18	28.4	1,252	55	80.5	4,820
19	29.8	1,335	56	81.9	4,902
20	31.2	1,432	57	83.3	4,988
21	32.6	1,512	58	84.7	5,072
22	34.0	1,620	59	86.0	5,148
23	35.4	1,712	60	87.5	5,234
24	36.8	1,818	61	88.9	5,313
25	38.2	1,909	62	90.3	5,383
26	39.6	2,008	63	91.7	5,463
27	41.0	2,100	64	93.0	5,513
28	42.4	2,189	65	94.5	5,593
29	43.8	2,290	66	96.0	5,652
30	45.3	2,373	67	97.4	5,716
31	46.7	2,470	68	98.8	5,769
32	48.1	2,586	69	100.2	5,820
33	49.5	2,660	70	101.6	5,866
34	50.9	2,780	71	103.0	5,881
35	52.3	2,824	72	104.4	5,918
36	53.7	2,973	73	105.8	5,957
			74	107.2	5,987

Aroclor 1154
Sp. Gr. 1.420 @ 150°C (1.505 @ 65°C)
Inst. Range - 0-200" H_2O
Inst. Scale - 0-100%

90% Full = 62%

DSW 334583

#2 ROOF TANK

AROCLOR 1160

% Scale	Inches Aroclor	Gallons	% Scale	Inches Aroclor	Gallons
0	3.0	45	39	54.9	3,098
1	4.3	82	40	56.2	3,194
2	5.7	119	41	57.5	3,264
3	7.0	160	42	58.9	3,380
4	8.3	206	43	60.2	3,442
5	9.6	252	44	61.5	3,558
6	11.0	310	45	62.8	3,638
7	12.3	366	46	64.2	3,718
8	13.6	420	47	65.5	3,809
9	15.0	495	48	66.8	3,898
10	16.3	545	49	68.2	3,979
11	17.6	619	50	69.5	4,086
12	19.0	690	51	70.8	4,156
13	20.3	760	52	72.1	4,280
14	21.6	839	53	73.5	4,348
15	23.0	920	54	74.8	4,458
16	24.3	995	55	76.1	4,534
17	25.6	1,076	56	77.5	4,626
18	26.9	1,150	57	78.8	4,699
19	28.3	1,244	58	80.1	4,794
20	29.6	1,326	59	81.5	4,880
21	30.9	1,412	60	82.8	4,956
22	32.3	1,496	61	84.1	5,039
23	33.6	1,585	62	85.4	5,112
24	34.9	1,692	63	86.8	5,190
25	36.2	1,753	64	88.1	5,273
26	37.6	1,876	65	89.4	5,336
27	38.9	1,940	66	90.8	5,415
28	40.2	2,060	67	92.1	5,482
29	41.6	2,129	68	93.4	5,535
30	42.9	2,240	69	94.8	5,608
31	44.2	2,312	70	96.1	5,657
32	45.6	2,385	71	97.4	5,716
33	46.9	2,490	72	98.7	5,765
34	48.2	2,590	73	100.1	5,817
35	49.5	2,660	74	101.4	5,860
36	50.9	2,780	75	102.7	5,880
37	52.2	2,836	76	104.1	5,911
38	53.5	2,952	77	105.4	5,946
			78	106.7	5,977

Aroclor 1160
Sp. Gr. @ 150°C - 1.504 (1.564 @ 90°C)
Inst. Range - 0-200" H_2O
Inst. Scale - 0-100%

90% Full = 65%

DSW 334584

STLCOPCB4081054

#2 ROOF TANK

AROCLOR 1162

% Scale	Inches Aroclor	Gallons
0	3.0	45
1	4.3	82
2	5.6	116
3	6.9	157
4	8.3	206
5	9.6	252
6	10.9	306
7	12.2	363
8	13.5	415
9	14.8	484
10	16.1	535
11	17.4	606
12	18.8	681
13	20.1	747
14	21.4	829
15	22.7	902
16	24.0	975
17	25.3	1,058
18	26.7	1,139
19	28.0	1,220
20	29.3	1,313
21	30.6	1,390
22	31.9	1,474
23	33.2	1,550
24	34.5	1,660
25	35.9	1,728
26	37.2	1,852
27	38.5	1,922
28	39.8	2,029
29	41.1	2,105
30	42.4	2,189
31	43.7	2,285
32	45.0	2,362
33	46.4	2,440
34	47.7	2,557
35	49.0	2,620
36	50.3	2,727
37	51.6	2,808
38	52.9	2,892
39	54.2	3,025

% Scale	Inches Aroclor	Gallons
40	55.6	3,156
41	56.9	3,216
42	58.2	3,324
43	59.5	3,407
44	60.8	3,492
45	62.1	3,612
46	63.4	3,671
47	64.8	3,748
48	66.0	3,859
49	67.4	3,928
50	68.7	4,032
51	70.0	4,108
52	71.3	4,201
53	72.6	4,296
54	74.0	4,388
55	75.3	4,491
56	76.6	4,564
57	78.0	4,664
58	79.2	4,724
59	80.5	4,820
60	81.8	4,897
61	83.2	4,981
62	84.5	5,061
63	85.8	5,136
64	87.0	5,200
65	88.4	5,288
66	89.7	5,350
67	91.0	5,428
68	92.4	5,492
69	93.7	5,552
70	95.0	5,618
71	96.3	5,666
72	97.6	5,725
73	98.9	5,772
74	100.2	5,820
75	101.6	5,866
76	102.9	5,881
77	104.2	5,913
78	105.5	5,949
79	106.8	5,979

Aroclor 1162
Sp. Gr. @ 150°C - 1.522 (1.582 @ 90°C)
Inst. Range - 0-200" H_2O
Inst. Scale - 0-100%

90% Full = 66%

DSW 334585

STLCOPCB4081055

LIQUIDS COLLECTION TANK
CALIBRATIONS
CRUDE AROCLOR TRAPPINGS

"Hg	Gallons	"Hg	Gallons	"Hg	Gallons
0	380	3.9	1,997	7.8	3,614
0.1	421	4.0	2,038	7.9	3,656
0.2	463	4.1	2,080	8.0	3,697
0.3	504	4.2	2,121	8.1	3,738
0.4	546	4.3	2,163	8.2	3,780
0.5	587	4.4	2,204	8.3	3,821
0.6	629	4.5	2,246	8.4	3,863
0.7	670	4.6	2,287	8.5	3,904
0.8	712	4.7	2,329	8.6	3,946
0.9	753	4.8	2,370	8.7	3,987
1.0	795	4.9	2,412	8.8	4,029
1.1	836	5.0	2,453	8.9	4,070
1.2	878	5.1	2,495	9.0	4,112
1.3	919	5.2	2,536	9.1	4,153
1.4	960	5.3	2,578	9.2	4,195
1.5	1,002	5.4	2,619	9.3	4,236
1.6	1,043	5.5	2,660	9.4	4,277
1.7	1,085	5.6	2,702	9.5	4,319
1.8	1,126	5.7	2,743	9.6	4,360
1.9	1,168	5.8	2,785	9.7	4,402
2.0	1,209	5.9	2,826	9.8	4,443
2.1	1,251	6.0	2,868	9.9	4,485
2.2	1,292	6.1	2,909	10.0	4,526
2.3	1,334	6.2	2,951	10.1	4,568
2.4	1,375	6.3	2,992	10.2	4,609
2.5	1,417	6.4	3,034	10.3	4,651
2.6	1,458	6.5	3,075	10.4	4,692
2.7	1,499	6.6	3,117	10.5	4,734
2.8	1,541	6.7	3,158	10.6	4,775
2.9	1,582	6.8	3,199	10.7	4,816
3.0	1,624	6.9	3,241	10.8	4,858
3.1	1,665	7.0	3,282	10.9	4,899
3.2	1,707	7.1	3,324	11.0	4,941
3.3	1,748	7.2	3,365	11.1	4,982
3.4	1,790	7.3	3,407	11.2	5,024
3.5	1,831	7.4	3,448	11.3	5,065
3.6	1,873	7.5	3,490		
3.7	1,914	7.6	3,531		
3.8	1,956	7.7	3,573		

Tank 573
Sp. Gr. 1.160 @ 50°C
Trappings Sample 10/4/65 - Before start-up of new clean-up system.

DSW 334586

STANDARD OPERATING INSTRUCTIONS
FOR
AROCLORS

PROCESS FUNCTION OUTLINE

C. I. LIQUID STILL SYSTEM

1.1 Scope

This covers the charging, start-up, shutdown, and normal operation of the Liquid Aroclor Still System (Stills No. 1, 2, and 3).

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 vaporization temperature. Vapors pass up an open column to the condenser. Distilled Aroclor is collected in a receiver and then transferred into a blending tank.

Distilled Aroclors are treated with Attapulgus Earth in the blending tank, filtered, analyzed, and packaged or held in storage. Part of the production is treated in a porocel column.

Still residue or bottoms are sold as Montars or discarded.

II. PROCESS DIAGRAM

Attached

III. DESCRIPTION OF PROCESS

3.1 Charging and Start-Up

A. Charges for Various Aroclors

1. Under normal conditions Crude Liquid Aroclors are charged continuously to the still from a blowing tank or roof tank to a 55" outage. This level is maintained by an automatic level controller. Occasionally, Liquid Aroclors are charged batch-wise. When this is done, the crude is charged to a 25" outage.

2. Prepare blowing tank for transfer of charge:

   a. Check to be sure steam is on the pump and charging lines. Material to be pumped must be hot or it will damage the mechanical seals on #3 and #4 blowing tank pumps.

   b. Check temperature of material in blowing tank to be sure it is hot enough to transfer (120-140°C).

   c. Check with chlorinator operator to be sure Crude Aroclor has been blown with air for a minimum of one hour.

3. Prepare Still to receive Charge:

   a. Close valve in bottom line under the still.

   b. Open vent valve on the still.

   c. Remove vent cap on measuring nipple on the still.

   d. Open valve on charging line at the still.

   e. Set valves in charging line to pump from the desired blowing tank to the correct still.

   f. Close main valve in vacuum line to the still just above the receiver. Start steam to the vacuum jets. Adjust water to intercondenser on middle stage. The jets on stills should pull down to 20-30 mm Hg absolute on the receiver.

4. Charging the Still and Start-Up:

   a. Set valves in line to the still.

   b. Start the blowing tank pump.

   c. Observe material entering the still.

   d. Insert rod in measuring nipple on the still and check amount of material in the still. As soon as 10-15 inches of material is in the still, start the circulating pump.

   e. When complete charge is in the still stop the charging pump. Allow lines to drain and close valve in charging line at the still.

   f. Close valve under blowing tank.

g. Add hydrated lime through the measuring nipple using funnel provided for this purpose. Add 250 pounds of lime for each five (5) still receiver batches of liquid Aroclor.

h. Replace cap on nipple over still.

i. Light gas burners on furnace and set gas pressure at 5 psig on each burner. Accomplish this as follows:

   (1) Check all gas valves at furnace to be sure they are closed.

   (2) Open valve in main gas supply line to furnace.

   (3) Put on face shield.

   (4) Open valve in pilot line.

   (5) Raise cover over peephole over pilot light and insert torch to light pilot.

   (6) When pilot is burning, open valve to one main burner, the one directly in front of pilot light, to light this main burner.

   (7) When one main burner is on, open valves to other main burners, one at a time, until all burners have been lighted.

j. Check temperature recording instrument to be sure it is operating correctly.

k. In case temperature chart does not indicate a rise in temperature, check for plugged lines or instrument problems.

l. Turn the pump off and on a couple of times. It may be necessary to pull a vacuum through the coil. Check the still pump ammeter to be sure the pump is pulling a load. Have the electrician check the instrument if the temperature does not rise.

m. Adjust the gas burners to give maximum rate of temperature rise without overheating. A spread of 10-15°C. between the coil inlet and outlet is normal. Gas pressure is normally as follows on the stills when maximum rate is achieved.

Still No.	Gas Burner Pressure
1	20 psig.
2	20 psig.
3	30 psig.

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n. Open valve in main vacuum line to the vacuum jets above the receiver. Vacuum should be 20-30 mm Hg absolute on receiver.

o. Start water on condenser as material starts to come over. Adjust water to keep from plugging up the condenser.

p. Gas pressure on the burners is adjusted until the coil temperatures reach a point about 20°C. below the expected distillation temperature. Normally a 10°C. temperature spread is obtained on the inlet and outlet of the coil.

q. Batch data sheets are filled out during each distillation. Information includes still lot number, material being distilled, start time, finish time, temperature spread on the still coils, end time for the distillation, etc.--- (See distillation sheet, Page 106).

5. Operation of Still during Distillation:

a. Regulate the gas pressure at the burners to give maximum distillation rate consistent with a good color of the product. (See Item 4. m. Page 104)

b. The lower the vacuum, the faster the distillation rate. (See Table I, Page 106)

c. Coil Temperature Spread:

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. If the coil outlet temperature jumps suddenly and the inlet temperature stays the same or falls, circulation has nearly stopped. In this case, cut the burners off quickly and suck the coil. If the coil cannot be sucked, it is plugged and will have to be replaced.

Observation of the ammeters on the still circulating pump motors will also indicate when the pump has stopped circulation. Normally, the pump motor will pull 20 to 40 amps during a distillation. A sudden increase in the amp load indicates the coil is probably plugging. A sudden decrease indicates the pump load has dropped off and the coil is plugged.

d. Transfer of Receiver to Bland Tank:

(1) Observe level of material in the still receiver. When material is 8" to 12" from the sightglass the receiver of material is transferred to a blend tank.

(2) Check to be sure steam heat is on the transfer lines and the pump.

TABLE I

DISTILLATION OPERATING CONDITIONS

Approximate Temperatures at which various Aroclors start distilling 35-40 mm Vac.	LIQUID AROCLORS					
	1221	1242	1248	1254	1260	1262
Column	155°C	165°C	170°C	190°C	195°C	235°C
Coil Inlet	165	170	180	200	210	245
Coil Outlet	170	175	190	220	225	255
Approximate Finishing temperature when bottoms are not to be drawn.						
Column	180	205	230	240	265	275
Coil Inlet	185	210	240	245	270	280
Coil Outlet	190	220	250	255	280	290
Approximate Finishing temperature after which bottoms are to be drawn						
Column	215	230	250	280	315	320
Coil Inlet	225	240	255	290	325	335
Coil Outlet	240	250	265	310	340	345
Finishing Specific Gravity	1.182-1.192 @ 25°C	1.381-1.392 @ 25°C	1.405-1.415 @ 65°C	1.495-1.505 @ 65°C	1.555-1.566 @ 90°C	1.572-1.583 @ 90°C

NOTE: Aroclor 1232 is a blend of Aroclors 1221 and 1242.

(3) Set valves in line to the blend tank desired.

(4) Start transfer pump under the receiver.

(5) Allow material to pump until the receiver is empty. Do not let the still lose vacuum. This entire transfer can be made while the still is operating.

(6) Check the blend tank to be sure the material is being transferred.

(7) Close the valves and stop the pump when the transfer is complete.

B. Stopping the Distillation

1. General Operation:

a. Run down the stills. Stop feed to still and distill off material in the still tank until an outage of 82" to 84" is reached.

b. Reduce gas pressure on the burners to 5 psig.

c. Close valve in vacuum line above the receiver.

d. Reduce water flow to the condenser as the distillation stops.

2. Operation Dependent on Aroclor being Distilled:

Aroclors 1221, 1242, 1248, 1254, 1260, and 1262.

a. Stop circulating pump after 15-20 minutes.

b. Release vacuum through the vent valve on the coil. Suck the coil clean for one to three minutes.

c. Remove cap from the measuring nipple on the still.

d. Measure bottoms in the still and record in the log book.

e. Prepare to draw bottoms and then recharge the still to start another distillation.

C. Drawing Bottoms

1. Schedule for Drawing Bottoms:

a. Aroclors 1221, 1242, 1248, 1254, 1260, and 1262: Draw bottoms after every 10th distillation on No. 1 and No. 2 stills and every 6th distillation on No. 3 still.

2. Operation for Drawing Bottoms into Drums:

   a. Check to be sure that Therminol heat is on the draw-out line.

   b. Place necessary drum near draw-out station.

   c. Set valves in line to draw-out station.

   d. Check to be sure the exhaust fan is running.

   e. Obtain assistance to draw bottoms.

      NOTE: Fumes from this operation are toxic. If the exhaust fan should stop, discontinue drawing out and notify the Chief Operator.

      The material to be drawn into drums is hot. Have the person filling the drums to put on face shield.

   f. Place drum under valve at draw-out station. Open valve under still. Close draw-out valve.

   g. If the bottoms being drawn out are to be packaged for shipment, open the valve at draw-out station and allow approximately <u>25 to 30 gallons</u> of material to flow through the line into the drum to flush out the line.

   h. If the bottoms being drawn out are not to be packaged for shipment, flush out of line is not necessary.

   i. Continue drawing out until the still is empty. Fill drums to within 6"-8" of top and place cover on drum. As the drums are filled move them on conveyor to east platform.

   j. Close the valve under the still. Leave the valve at draw-out station open.

      NOTE: If bottoms are packaged for shipment, take a one pint sample of the material and send to the laboratory for analysis.. Stencil Montar number and lot number on each drum. (See Appendix I for identification.)

   k. Allow drums to set on conveyor until they have cooled 6-10 hours, then palletize the drums to be transferred to warehouse. Drums to be discarded will be transferred to the dump by plant stake truck.

D. Earth Treatment of Aroclors

Liquid Aroclors 1221, 1242, 1248, 1254, 1260, and 1262 are treated with Attapulgus Earth for three hours per the following procedure:

1. Collect two receiver distillations from No. 1 and 2 stills in a blend tank. Collect one receiver distillation from No. 3 still in a blend tank.

2. Prepare Attapulgus earth which is to be added to the blend tank. This earth must be dried in an oven for a minimum of four hours at a temperature of 210-250°C.

3. Start the agitator in the blending tank and add 40 lbs. of dried earth for two receiver distillation batches from No. 1 or 2 stills. Add 40 lbs. to one receiver distillation batch from No. 3 still.

4. Agitate the mixture of earth and Aroclor for 3 hours at the following temperatures:

Aroclor 1221	60 - 70°C
1242	70 - 80°C
1248	80 - 90°C
1254	90 - 100°C
1260	100 - 110°C
1262	110 - 120°C

E. Filtration of Aroclors

1. Prepare filter for filtration of Aroclor by cleaning the earth from the previous filtrations from the press and installing new filter paper.

   a. Run tightening screw back to permit removal of papers.

   b. Separate and clean frames and remove used papers. Be sure no earth is left on the surfaces of the plates and frames. Discard earth and paper in a 55 gallon trash drum.

   c. Install new papers and tighten the press. Use two papers between each plate.

2. Starting Filtration:

   a. After the Aroclor has been earth treated for three hours, start filtration.

   b. Set valves in the system to pump the treated Aroclor from the blend tank, through the filter press, and back to the blend tank. Recycle this material until no earth is visible in a sample from the filter.

   c. Set valves to direct material to the Filtrate Receiver when the material has cleaned up.

   d. Catch a sample of the filtrate. Check specific gravity and observe color. Record data in log book.

F. <u>Transfer to Storage Tank</u>

1. Measure outage of material in the filtrate tank and record in the log book.

2. Set valves in the line so the Aroclor will be pumped to the desired storage tank.

3. Check to be sure steam is on the transfer pump and the transfer lines.

4. Start the pump under the filtrate receiver.

5. Close the valve under the filtrate receiver and stop the transfer pump when the Aroclor has been pumped out.

6. Measure innage in the storage tank and record in the log book.

G. <u>Aroclor Treatment Columns</u>

1. <u>Start-Up from Complete Shutdown</u>

   a. <u>Charging Column(s) with Porocel</u>

      a-1) Check bottom nozzle valves to insure that they are closed.

      a-2) Remove manhole on top of column. Insure that bauxite discharge manhole at bottom of column is securely bolted closed.

      a-3) Inspect inside of column through top to insure that bottom support is not damaged and that interior of column is not dirty or rusted.

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a-4) Obtain about 12 drums of porocel from storage (400 lb. drums - 20-60 mesh).

a-5) Place one drum in drum hoist and lift to top of column.

a-6) Leave drum in hoist, remove cover lid and pour porocel into the column.

a-7) Lower empty drum to ground and repeat a-5, a-6, and a-7 until column is filled.

a-8) Actuate the column vibrators to pack the porocel bed.

a-9) Have manhole cover reinstalled on top of column.

b. Aroclor Porocel Columns Therminol System

b-1) Check out lines from Therminol header to column jacket to Therminol tank.

b-2) Close all manual valves on column jackets except the valves on column jacket inlet and outlet of column which is to be dried and the Therminol tank fill valve after exiting the column jacket.

b-3) Open the by-pass valve around the Therminol temperature control valve (TCV-691.1) to allow Therminol to fill the Therminol tank.

b-4) Close by-pass valve when Therminol tank is 75% full.

b-5) Open the Therminol valves to and from the plate coil jacket of the Therminol tank.

b-6) The Therminol heating system is now ready to use to dry the porocel bed in the specific column in question.

c. Drying the Aroclor Treating Column Porocel Bed

c-1) Close all inlet and outlet product valves on Aroclor column to be dried.

c-2) Line up nitrogen supply line leaving the valve nearest the column closed.

c-3) Close column vent valve on top of column.

c-4) Slowly open nitrogen purge valve. Do not bump porocel bed. Leave valve wide open.

c-5) Open slowly vent valve on top of column. Nitrogen is now flowing through porocel bed.

c-6) Line up valves to allow Therminol to flow from Therminol tank, through pump, through column jacket, and back to Therminol tank.

c-7) Start Therminol circulating pump.

c-8) Set Therminol temperature controller (TIC-691.2) at top of scale.

c-9) Open block valves around Therminol temperature control valve (TCV 691.1). Close by-pass valve.

c-10) Hot therminol should now be circulating through the column jacket and nitrogen should be blowing through the porocel bed. After four (4) hours of drying, close nitrogen supply valve.

c-11) Sample the porocel by dipping glass rod through the vent valve on top of column.

c-12) Send porocel sample to Lab for moisture analysis. Resume nitrogen purging while waiting for analysis.

c-13) Sample the porocel bed every four (4) hours as above until the moisture analysis is 1,000 ppm or below.

c-14) When the moisture is in spec, close the nitrogen supply valve and column vent valve in that order. Do not leave nitrogen pressure on the column.

c-15) Therminol is left circulating on column after drying. If it is going through the jacket of a 1242 column, reset Therminol temperature control to 65°C. If going through a 1254 or 1260 column, reset temperature to 100°C. When it becomes necessary to dry a different column, divert the Therminol flow to the fresh column by opening inlet and then outlet Therminol valves on the fresh column and then closing inlet and outlet Therminol valves on the previous column.

d. <u>Initial Aroclor Conditioning of New Porocel Column Beds</u>

d-1) After one still batch of 1242, 1254, or 1260 has been pumped to the blend tank, line up to flow from the blend tank to the Viking pump, to the appropriate product heat exchanger, to the appropriate column, on through the filter and then to the No. 3 filtrate receiver. Close vent valve on top of column.

d-2) Set the flow controller at the blend tank (FIC 913.2, 914.2, or 915.2) at 3 gpm.

d-3) Set the product temperature controller(s) at the column(s) to control as follows:

1242	-	65°C.
1254	-	100°C.
1260	-	125°C.

If the blend tank temperature is above this temperature, manually set cooling water to go through the heat exchanger. If the temperature of blend tank is below the desired temperature, set up valves to put steam into the exchanger.

d-4) Start the positive displacement Viking pump under the appropriate blend tank and pump the blend tank dry through the column.

d-5) When the batch of Aroclor has all been put through the column to the No. 3 receiver, sample the receiver and have checked for resistivity.

d-6) If the resistivity is within spec, pump out receiver to appropriate storage tank.

d-7) If resistivity is below spec, pump back to blend tank and rework through column until resistivity spec is met.

2. Routine Operations of Aroclor Treating Columns

Following are pertinent comments on conditions which will exist on the porocel treatment systems during normal operations.

a. Therminol Heating System

a-1) Therminol tank will be 75% full.

a-2) Therminol temperature controller (TIC 691.2) will be set at 65°C. if the Therminol is going through a 1242 column jacket. If it is going through a 1254 or a 1260 column jacket, set-point of controller should be at 100°C.

a-3) Temperature of Therminol entering and leaving the jacket of a column can be read on the temperature recorder in the control room (L&N).

b. <u>Porocel Column</u>

b-1) The Viking feed pumps under each blend tank will be pumping Aroclor from the blend tanks through the appropriate heat exchanger located near each column on the second level, through the individual columns, polishing filters, and on to storage.

b-2) The flow recorder controllers at each blend tank can be set from 0-10 gpm of Aroclor going to the columns. Object is to adjust flow such that there will be a continuous feed to each column when stills are running normally. Flows of around 3 gpm should be normal. In practice, adjust flow rate so that blend tanks are <u>almost</u> empty in time to receive another batch from still receivers. This will involve close watching of still receiver and blend tank levels.

b-3) Each column has a heat exchanger to bring temperature of product going to the columns to desired temperatures. These temperatures are as follows:

Aroclor 1242	-	65°C.
Aroclor 1254	-	100°C.
Aroclor 1260	-	125°C.

These temperatures are automatically controlled with one manual stipulation. If the temperature of product from the blend tank is above these temperatures, cooling water is put on the exchanger manually to bring the temperature down. If the temperature from the blend tank is below the desired temperature, steam is put on the exchanger to bring temperature up. Once the inlet temperature is determined to be above or below the desired temperature and the temperature control medium is manually selected, the temperature recorder controller will maintain desired temperature to column.

b-4) A selector valve and timer makes it possible to put a side stream from any one of the columns through the power factor instrument at the old column. This power factor reading is remoted into the control room. When selecting a stream - allow about one-half hour before taking reading.

b-5) Temperatures into and out of each column are read on temperature recorder in control room (L&N). This same temperature recorder also records temperature of product stream out of power factor instrument.

c. Data Collection

Data to be taken and recorded on data sheet at indicated times is as follows:

c-1) Flow rate through column.

c-2) Blend tank level.

c-3) Still receiver level.

c-4) Temperature of Aroclor entering column.

c-5) Temperature of Aroclor out of column.

c-6) Power factor.

c-7) Therminol temperature.

d. Sampling

During routine operations, quality will be monitored mainly by in-line power factor measurements of product from the columns. On start-ups of the column, initial production will be sampled and lab tested for resistivity to determine whether rework is necessary. Operator will measure and record specific gravity of each batch.

3. Dumping Porocel Beds

a. Porocel in individual columns will be dumped when:

a-1) Resistivity of treated Aroclor drops below 10,000.

a-2) When pressure drop through column becomes so great as to restrict flow to such an extent that it is bottlenecking stills.

a-3) If it becomes necessary to treat a different Aroclor other than the one for which the column is earmarked.

b. Stop column feed pump.

c. Close inlet and outlet valves to column.

d. Position Dempster-Dumpster under manhole near bottom of column.

e. Have top of column opened.

f. Have manhole near bottom of column opened.

g. Rake out porocel - Aroclor mixture from bottom manhole into Dumpster.

h. Have bottom manhole cover replaced when column is empty and refill column as per instructions above.

4. Shutdowns

a. Temporary Shutdown

a-1) Stop column feed pump under blend tank.

a-2) Close inlet valve to pump.

a-3) Leave Therminol system as is.

a-4) Start-up when ready as per above instructions.

b. Complete Shutdown

b-1) Stop column feed pump.

b-2) Close inlet valve to pump.

b-3) Stop Therminol circulating pump.

b-4) Close inlet and outlet valves of Therminol circulatinh pump.

b-5) Close inlet block valve to TCV 691.1 - Therminol temperature control valve.

b-6) Slowly blow out lines and column with nitrogen at blend tank connection.

b-7) Close block valve on column product outlet valve.

b-8) Shut off steam or cooling water valves to product heat exchanger.

b-9) Open vent valve on top of column.

5. Control Loops

a. Aroclor Flow Control FIC 913.2, 914.2, and 915.2

The function of these instrument loops is to control the flow of Aroclor from each blend tank to each porocel column. This is done by setting the desired flow on the flow indicator controller located at the blend tank, measuring the flow stream to a column with an orifice and regulating this forward stream by automatically throttling of a control valve on a recycle line which recycles the excess Aroclor back to the blend tank. The range of these instruments are 0-10 gpm.

b. Therminol Temperature Controller TIC 691.2

The function of this loop is to maintain a constant Therminol temperature to dry out a fresh porocel charge in any one of the four Aroclor treatment columns. It does this by regulating the flow of hot Therminol from the main header to the plate coil jacket on the Therminol tank. Control valve TCV 691.1 is throttled by TIC 691.2 as needed to maintain the Therminol temperature at the desired set point in the surge tank.

c. Aroclor Product Temperature Controller TIC 913.1, 914.1, and 915.1

The function of these loops is to control the temperature of Aroclor going into each column. The TIC's throttle either a cooling water control valve or a steam control valve to maintain a set temperature. The choice of water or steam is made and set up by the operator depending on if temperature of Aroclor from blend tank is above or below desired temperature. Range of instruments are 50-150°C.

6. Comments on Process

a. Column Feed Pumps (Items 910, 911, 912)

The column feed pumps are Viking positive displacement pumps with internal relief valves to prevent over-pressurizing the system. The relief valves are set for 80 psi.

b. Column Pressure Relief

Each column is equipped with a 2-inch rupture disc to prevent damage from over-pressurizing columns. The discs are rated at a bursting pressure of 95 psig and a bursting temperature of 205°C.

c. Product Changeover

In normal operations, each column will be earmarked for a specific Aroclor. If it should become necessary to put a different Aroclor through a particular column other than its normal product, this column will have to be dumped and recharged with fresh bauxite to avoid contamination of the Aroclors. Only electrical grade Aroclors (1242, 1254, 1260) will be column treated.

G-a. TCB AND TTCB TREATMENT COLUMNS

1. Start-up From Complete Shutdown

a. Charging columns with Porocel

Follow instructions as for charging the Aroclor columns except you will only need nine (9) drums or porocel rather than twelve (12).

b. Drying the Porocel Beds

b-1) Follow instructions c-1 through c-5 of section dealing with drying of Aroclor column Porocel beds.

b-2) There is no Therminol system servicing these two columns. Instead, introduce steam flow into the jackets of these columns for heating by manipulating appropriate valves.

b-3) Follow instructions c-10 through c-15 of section dealing with drying of Aroclor column porocel beds.

b-4) When porocel is dried, discontinue steam flow to column jackets.

c. Routine Operation of Columns

The TCB or TTCB will be unloaded directly from the tank cars or trucks through the porocel columns, through the polishing filter, and then to storage. The flow from the unloading pump will be split to go through both columns in order to unload in a reasonable length of time.

c-1) Set up car, pump and unloading line for unloading material.

c-2) Open inlet product valves to both columns. Insure that the by-pass valve enabling by-passing of material around columns is closed.

c-3) Open discharge valves on product lines out of column.

c-4) Open valve to either TCB or TTCB storage tanks depending on which product is to be unloaded. Be sure correct valve to correct tank is opened.

c-5) Start unloading pump and pump all material out of car to storage tank.

c-6) When all material is unloaded, stop pump and disconnect and secure car.

c-7) Blow out line from unloading dock, through columns and to storage tank to rid the lines and treatment system of material.

c-8) Close valves on storage tank and on porocel columns.

c-9) There are no automatic flow or temperature control loops on these columns. Local pressure and temperature gauges allow for trouble-shooting and monitoring the unloading procedures.

d. Dumping Porocel Beds

Follow procedure c through f of instructions for dumping Aroclor column beds.

H. Trouble Shooting Aroclor Stills, Earth Treatment, and Storage Operation

Problem	Possible Cause & Action
1. Still Vacuum Problems	a. Jet not operating properly.
	Action: Close valve on receiver and be sure the jet will pull down. Check steam pressure to the jet, check vacuum lines for leaks, or plugs, and check the jet for pluggage. Notify chief operator repairs are necessary.
	b. Plugged condenser.
	Action: Put steam or flame heat on the condenser to unplug.
	c. Leaks in the system.
	Action: Apply full vacuum to the jet. Check out the piping system, the still, still pump, and the receiver for leaks.

Problem	Possible Cause & Action
1. Still Vacuum (Contd.)	d. Minor jet problems Action: Water to the intercondenser must be adjusted properly. Steam to the jet must be constant. Nozzles in the jet must be in good condition.
2. Holes or plugs of still coils	a. Coils occasionally wear until a hole comes in the coil from heating and age. Black smoke in the furnace, or out the furnace stack indicates Aroclor is burning. Action: If the leak is minor continue operation until the still is finished. Notify the chief operator repairs are necessary. b. Running down in the still at the end of a distillation, failure of the pump, or excess heating of a coil can cause a coil to plug. Action: Check the pump ammeter to see how many amps are required. (Normal 25-30 amps). A higher reading would indicate the coil is plugging. Cut the fire off of the furnace immediately, check the inlet and outlet coil temperature to determine if coil has overheated. Notify the chief operator if the coil must be changed out.
3. Plugged Lines	a. The still residue will plug lines, still coils, and pumps when it is not kept hot. Action: Check to be sure steam or hot Aroclor is on the pipe line. If not put steam on and give it time to heat up the line. Check pipe lines and valves for exposed areas not steam traced or insulated. Use CO_2 and try to blow the line out. Use a gas torch flame to heat the valve or pipe line.

Problem	Possible Cause & Action
4. Off-Color Aroclor on a Still	a. Rapid or too fast a heat-up on a still. Action: Decrease fire and stop distillate, then increase temperature slowly to give good color Aroclor (normally 10 on 1242). b. Rapid surges in the vacuum system can cause material to burp over. Action: Check vacuum control - adjust to give good control. Notify chief operator if repairs are necessary. c. Rundown on a still can cause carry-over of high color material at end of a distillation. Action: Watch temperature spread on rundown. Do not exceed final temperature on a distillation. Do not let temperature spread exceed 15°C.
5. High Moisture in Aroclor	a. Moisture above 50 ppm is too high in finished Aroclors. Normally material must be 20 to 25 ppm to be loaded in specification, since moisture is picked up during loading. Action: Start sampling to determine where the moisture is being obtained. It may be necessary to run a pressure test on tank coils to determine the problem. Notify the chief operator as soon as material out of specification is found.
6. Bad Electrical Property Problem in Aroclor	a. Resistivity and stability of the Aroclors are very critical in this quality product. Material must be loaded at a 500 resistivity minimum to be in specification. Since the electrical property drops during loading, it should be 700-800 when loaded. If material is low in the storage tank it is transferred back to the blending tank for earth treatment, laboratory check, and then loaded to a car.

Problem	Possible Cause & Action
7. Still Receiver Transfer Pump Problems	a. Transfer pump will not pump the receiver out under vacuum. Action: Check the lines to be sure the valves are set correctly. Check lines at bottom of the receiver to be sure they are not plugged. If necessary to pump out, shut off vacuum on the still and transfer the receiver. Notify the chief operator that the pump, relief valve, or the pipe lines need work.

IV. COMMENTS ON PROCESS

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, water adjustment on intercondenser on jets, changes in steam pressure to the jets, or problems in the jet nozzles. Flashing can be stopped by adjusting the cooling water on the condenser or operation of the still at a slower rate. Vacuum trouble must be traced systematically from the jet, to the receiver, and then to the still.

Export Quality & Quantity

At present, Export grade 1242 and 1254 have tighter specs resistivity and Biphenyl content. The resistivity target is 10,000 giga ohm cms in drums which means a department spec of at least 15,000 will be needed to assure this spec.

Although demand for export grade 1242 and 1254 has increased over 1966, it is still a small portion of the overall sales. This means the Porocel column will be operated on a part time basis to meet the demand.

Interference with Normal Still Operation

The necessity of using No. 3 Filtrate tank as an intermediate storage tank will cause problems with the normal operation of the No. 2 still. Export grade Aroclor will be drummed from the No. 3 Filtrate tank whenever No. 5 storage tank contains regular electrical grade 1242 (No. 6 storage tank applies to 1254). With two Filtrate Receivers servicing three stills the Filtrate Receivers will be the bottleneck and will cause downtime on the three stills.

Column Feed Pump - Item 693

The column feed pump is a Viking positive displacement pump. To prevent over-pressurizing the lines and equipment, the pump is equipped with an internal pressure relief system. It is set at ________psig.

Porocel Column Pressure Relief

The Porocel column is provided with a rupture disc to prevent damage from over-pressurization. The disc rating is _______ psig, at _____°F.

Changing Product

Whenever a product change from 1242 to 1254 or vice versa is needed, the Porocel bed must be dumped to prevent product contamination.

APPENDIX I

Montar No. 1	-	Aroclor 1242 Still Bottoms
Montar No. 2	-	Aroclor 1248 Still Bottoms
Montar No. 3	-	Aroclor 1254 Still Bottoms
Montar No. 4	-	Aroclor 1260 Still Bottoms
Montar No. 5	-	Aroclor 5460 Still Bottoms
Montar No. 6	-	Aroclor 4465 Still Bottoms
Montar No. 7	-	Aroclor 1268 Still Bottoms
Montar No. 9	-	Santowax Still Bottoms
Montar No. 10	-	50% Montar 5, 50% Montar 9

There is no Montar numbered 8

NO. 1, 2 & 3 AROCLOR STILLS

AROCLOR 1121

% Scale	Gallons	Outage (Ins.)	% Scale	Gallons	Outage (Ins.)
0	202	78.0	32	729	48.1
1	219	77.1	33	745	47.1
2	235	76.1	34	762	46.2
3	251	75.2	35	778	45.3
4	268	74.3	36	795	44.3
5	284	73.3	37	811	43.4
6	301	72.4	38	827	42.5
7	317	71.5	39	844	41.5
8	334	70.5	40	860	40.6
9	350	69.6	41	877	39.7
10	367	68.7	42	893	38.7
11	383	67.7	43	910	37.8
12	400	66.8	44	926	36.9
13	416	65.8	45	943	35.9
14	432	64.9	46	959	35.0
15	449	64.0	47	976	34.1
16	465	63.0	48	992	33.1
17	482	62.1	49	1,008	32.2
18	498	61.2	50	1,025	31.3
19	515	60.2	51	1,041	30.3
20	531	59.3	52	1,058	29.4
21	548	58.4	53	1,074	28.4
22	564	57.4	54	1,091	27.5
23	581	56.5	55	1,107	26.6
24	597	55.6	56	1,124	25.6
25	614	54.6	57	1,140	24.7
26	630	53.7	58	1,157	23.8
27	646	52.8	59	1,173	22.8
28	663	51.8	60	1,190	21.9
29	679	50.9	61	1,206	21.0
30	696	50.0	62	1,223	20.0
31	712	49.0	63	1,239	19.1

Aroclor 1121
Sp. Gr. 1.070 @ 150°C (1.155 @ 65°C)
Inst. Range - 0-100" H_2O
Inst. Scale - 0-100%

NO. 1, 2 & 3 AROCLOR STILLS

AROCLOR 1142

% Scale	Gallons	Outage (Inches)
0	202	78.0
1	216	77.2
2	230	76.4
3	244	75.6
4	258	74.8
5	272	74.0
6	285	73.2
7	299	72.4
8	313	71.6
9	327	70.8
10	341	70.0
11	355	69.2
12	369	68.4
13	383	67.6
14	397	66.8
15	411	66.0
16	424	65.2
17	438	64.4
18	452	63.6
19	466	62.8
20	480	62.0
21	494	61.2
22	508	60.4
23	522	59.6
24	536	58.8
25	550	58.0
26	563	57.2
27	577	56.4
28	591	55.6
29	605	54.8
30	619	54.0
31	633	53.2
32	647	52.4
33	661	51.6
34	675	50.8
35	689	50.0
36	702	49.2
37	716	48.4
38	730	47.6
39	744	46.8
40	758	46.0
41	772	45.2
42	786	44.4
43	800	43.6
44	814	42.8
45	828	42.0
46	841	41.2
47	855	40.4
48	869	39.6
49	883	38.8
50	897	38.0
51	911	37.2
52	925	36.4
53	939	35.6
54	953	34.8
55	967	34.0
56	980	33.2
57	994	32.4
58	1,008	31.6
59	1,022	30.8
60	1,036	30.0
61	1,050	29.2
62	1,064	28.4
63	1,078	27.6
64	1,092	26.8
65	1,106	26.0
66	1,119	25.2
67	1,133	24.4
68	1,147	23.6
69	1,161	22.8
70	1,175	22.0
71	1,189	21.2
72	1,203	20.4
73	1,217	19.6
74	1,231	19.0

Aroclor 1142
Sp.Gr. 1.264 @ 150^{o}C (1.389 @ 25^{o}C)
Inst. Range 0-100" H_2O
Inst. Scale 0-100%

NO. 1, 2 & 3 AROCLOR STILLS

AROCLOR 1148

% Scale	Gallons	Outage (Inches)	% Scale	Gallons	Outage (Inches)
0	202	78.0	40	730	48.0
1	215	77.3	41	743	47.3
2	228	76.5	42	756	46.5
3	242	75.8	43	770	45.8
4	255	75.0	44	783	45.0
5	268	74.3	45	796	44.3
6	281	73.5	46	809	43.5
7	294	72.8	47	822	42.8
8	308	72.0	48	836	42.0
9	321	71.3	49	849	41.3
10	334	70.5	50	862	40.5
11	347	69.8	51	875	39.8
12	360	69.0	52	888	39.0
13	374	68.3	53	902	38.3
14	387	67.5	54	915	37.5
15	400	66.8	55	928	36.8
16	413	66.0	56	941	36.0
17	426	65.3	57	954	35.3
18	440	64.5	58	968	34.5
19	453	63.8	59	981	33.8
20	466	63.0	60	994	33.0
21	479	62.3	61	1,007	32.3
22	492	61.5	62	1,020	31.5
23	506	60.8	63	1,034	30.8
24	519	60.0	64	1,047	30.0
25	532	59.3	65	1,060	29.3
26	545	58.5	66	1,073	28.5
27	558	57.8	67	1,086	27.8
28	572	57.0	68	1,100	27.0
29	585	56.3	69	1,113	26.3
30	598	55.5	70	1,126	25.5
31	611	54.8	71	1,139	24.8
32	624	54.0	72	1,152	24.0
33	638	53.3	73	1,166	23.3
34	651	52.5	74	1,179	22.5
35	664	51.8	75	1,192	21.8
36	672	51.0	76	1,205	21.0
37	690	50.3	77	1,218	20.3
38	704	49.5	78	1,232	19.5
39	717	48.8			

Aroclor 1148
Sp.Gr. 1.330 @ 150°C (1.415 @ 65°C)
Inst. Range 0-100" H_2O
Inst. Scale 0-100%

DSW 334613

STLCOPCB4081083

NO. 1, 2 & 3 AROCLOR STILLS

AROCLOR 1154

% Scale	Gallons	Outage (Inches)	% Scale	Gallons	Outage (Inches)
0	202	78.0	43	735	47.9
1	214	77.3	44	748	47.2
2	227	76.6	45	760	46.5
3	239	75.9	46	772	45.8
4	252	75.2	47	785	45.1
5	264	74.5	48	797	44.4
6	276	73.8	49	810	43.7
7	289	73.1	50	822	43.0
8	301	72.4	51	834	42.3
9	314	71.7	52	847	41.6
10	326	71.0	53	859	40.9
11	338	70.3	54	872	40.2
12	351	69.6	55	884	39.5
13	363	68.9	56	896	38.8
14	376	68.2	57	909	38.1
15	388	67.5	58	921	37.4
16	400	66.8	59	934	36.7
17	413	66.1	60	946	36.0
18	425	65.4	61	958	35.3
19	438	64.7	62	971	34.6
20	450	64.0	63	983	33.9
21	462	63.3	64	996	33.2
22	475	62.6	65	1,008	32.5
23	487	61.9	66	1,020	31.8
24	500	61.2	67	1,033	31.1
25	512	60.5	68	1,045	30.4
26	524	59.8	69	1,058	29.7
27	537	59.1	70	1,070	29.0
28	549	58.4	71	1,082	28.3
29	562	57.7	72	1,095	27.6
30	574	57.0	73	1,107	26.9
31	586	56.3	74	1,120	26.2
32	599	55.6	75	1,132	25.5
33	611	54.9	76	1,144	24.8
34	624	54.2	77	1,157	24.1
35	636	53.5	78	1,169	23.4
36	648	52.8	79	1,182	22.7
37	661	52.1	80	1,194	22.0
38	673	51.4	81	1,206	21.3
39	686	50.7	82	1,219	20.6
40	698	50.0	83	1,231	19.9
41	710	49.3			
42	723	48.6			

Aroclor 1154
Sp. Gr. 1.415 @ 150°C (1.505 @ 65°C)
Inst. Range - 0-100" H_2O
Inst. Scale - 0-100%

NO. 1, 2 & 3 AROCLOR STILL

AROCLOR 1160

% Scale	Gallons	Outage (Inches)	% Scale	Gallons	Outage (Inches)
0	202	78.0	47	719	48.7
1	213	77.4	48	730	48.1
2	224	76.8	49	741	47.5
3	235	76.1	50	752	46.9
4	246	75.5	51	763	46.2
5	257	74.9	52	774	45.6
6	268	74.3	53	785	45.0
7	279	73.6	54	796	44.4
8	290	73.0	55	807	43.7
9	301	72.4	56	818	43.1
10	312	71.8	57	829	42.5
11	323	71.4	58	840	41.9
12	334	70.5	59	851	42.2
13	345	69.9	60	862	40.6
14	356	69.3	61	873	40.0
15	367	68.7	62	884	39.4
16	378	68.0	63	895	38.8
17	389	67.4	64	906	38.1
18	400	66.8	65	917	37.5
19	411	66.2	66	928	36.9
20	422	65.5	67	939	36.3
21	433	64.9	68	950	35.6
22	444	64.3	69	961	35.0
23	455	63.7	70	972	34.4
24	466	63.0	71	983	33.8
25	477	62.4	72	994	33.1
26	488	61.8	73	1,005	32.5
27	499	61.2	74	1,016	31.9
28	510	60.6	75	1,027	31.3
29	521	59.9	76	1,038	30.7
30	532	59.3	77	1,049	30.0
31	543	58.7	78	1,060	29.4
32	554	58.1	79	1,071	28.8
33	565	57.4	80	1,082	28.2
34	576	56.8	81	1,093	27.5
35	587	56.2	82	1,104	26.9
36	598	55.6	83	1,115	26.3
37	609	54.9	84	1,126	25.7
38	620	54.3	85	1,137	25.0
39	631	53.7	86	1,148	24.4
40	642	53.1	87	1,159	23.8
41	653	52.5	88	1,170	23.2
42	664	51.8	89	1,181	22.6
43	675	51.2	90	1,192	21.9
44	686	50.6	91	1,203	21.3
45	697	50.0	92	1,214	20.7
46	708	49.3	93	1,225	20.1
			94	1,236	19.4

Aroclor 1160
Sp.Gr. 1.504 @ 150°C (1.564 @ 90°C)
Inst. Range - 0-100" H_2O
Inst. Scale - 0-100%

NO. 1, 2 & 3 AROCLOR STILLS

AROCLOR 1162

% Scale	Gallons	Outage Inches	% Scale	Gallons	Outage Inches	% Scale	Gallons	Outage Inches
0	202	78.0	31	560	57.6	62	919	37.3
1	214	77.3	32	572	57.0	63	930	36.6
2	225	76.7	33	584	56.3	64	942	36.0
3	237	76.0	34	595	55.7	65	953	35.3
4	248	75.4	35	607	55.0	66	965	34.6
5	260	74.7	36	618	54.3	67	976	34.0
6	271	74.1	37	630	53.7	68	988	33.3
7	283	73.4	38	641	53.0	69	1,000	32.7
8	294	72.7	39	653	52.4	70	1,011	32.0
9	306	72.1	40	664	51.7	71	1,023	31.4
10	318	71.4	41	676	51.1	72	1,034	30.7
11	329	70.8	42	688	50.4	73	1,046	30.0
12	341	70.1	43	699	49.7	74	1,057	29.4
13	352	69.5	44	711	49.1	75	1,069	28.7
14	364	68.8	45	722	48.4	76	1,081	28.1
15	375	68.1	46	734	47.8	77	1,092	27.4
16	387	67.5	47	745	47.1	78	1,104	26.8
17	398	66.8	48	757	46.5	79	1,115	26.1
18	410	66.2	49	768	45.8	80	1,127	25.4
19	422	65.5	50	780	45.2	81	1,138	24.8
20	433	64.9	51	792	44.5	82	1,150	24.1
21	445	54.2	52	803	43.8	83	1,161	23.5
22	456	63.5	53	815	43.2	84	1,173	22.8
23	468	62.9	54	826	42.5	85	1,185	22.2
24	479	62.2	55	838	41.9	86	1,196	21.5
25	491	61.6	56	849	41.2	87	1,208	20.8
26	503	60.9	57	861	40.6	88	1,219	20.2
27	514	60.3	58	872	39.9	89	1,231	19.5
28	526	59.6	59	884	39.2			
29	537	59.0	60	896	38.6			
30	549	58.3	61	907	37.9			

Aroclor 1162
Sp. Gr. 1.522 @ 150°C (1.582 @ 90°C)
Inst. Range - 0-100" H_2O
Inst. Scale - 0-100%

BLENDING TANK & FILTRATE RECEIVER

AROCLOR 1221

% Scale	Gallons	Outage (Ins.)	% Scale	Gallons	Outage (Ins.)
0	189	94.0	22	1,183	52.6
1	234	92.1	23	1,229	50.7
2	279	90.2	24	1,274	48.8
3	325	88.4	25	1,319	46.9
4	370	86.5	26	1,364	45.0
5	415	84.6	27	1,409	43.2
6	460	82.7	28	1,455	41.3
7	505	80.8	29	1,500	39.4
8	551	78.9	30	1,545	37.5
9	596	77.1	31	1,590	35.6
10	641	75.2	32	1,635	33.7
11	686	73.3	33	1,680	31.9
12	731	71.4	34	1,726	30.0
13	777	69.5	35	1,771	28.1
14	822	67.6	36	1,816	26.2
15	867	65.8	37	1,861	24.3
16	912	63.9	38	1,906	22.4
17	957	62.0	39	1,952	20.6
18	1,003	60.1	40	1,997	18.7
19	1,048	58.2	41	2,042	16.8
20	1,093	56.3	42	2,087	14.9
21	1,138	54.5	43	2,132	13.0

Aroclor 1221
Sp. Gr. 1.062 @ 150^{o}C (1.187 @ 25oC)
Inst. Range - 0-200" H_2O
Inst. Scale - 0-100%

DSW 334617

STLCOPCB4081087

BLENDING TANK & FILTRATE RECEIVER

AROCLOR 1242

% Scale	Gallons	Outage (Ins.)	% Scale	Gallons	Outage (Ins.)
0	189	94.0	25	1,140	54.4
1	227	92.4	26	1,178	52.8
2	265	90.8	27	1,216	51.2
3	303	89.2	28	1,254	49.6
4	341	87.7	29	1,292	48.0
5	379	86.1	30	1,330	46.5
6	417	84.5	31	1,368	44.9
7	455	82.9	32	1,406	43.3
8	493	81.3	33	1,444	41.7
9	531	79.7	34	1,482	40.1
10	569	78.2	35	1,520	38.5
11	607	76.6	36	1,558	36.9
12	645	75.0	37	1,596	35.4
13	684	73.4	38	1,634	33.8
14	722	71.8	39	1,672	32.2
15	760	70.2	40	1,710	30.6
16	798	68.6	41	1,748	29.0
17	836	67.1	42	1,786	27.4
18	874	65.5	43	1,825	25.9
19	912	63.9	44	1,863	24.3
20	950	62.3	45	1,901	22.7
21	988	60.7	46	1,939	21.1
22	1,026	59.1	47	1,977	19.5
23	1,064	57.5	48	2,015	17.9
24	1,102	56.0	49	2,053	16.3
			50	2,091	14.8
			51	2,129	13.2

Aroclor 1242
Sp. Gr. 1.262 @ 150°C (1.387 @ 25°C)
Inst. Range - 0-200" H_2O
Inst. Scale - 0-100%

DSW 334618

BLENDING TANK & FILTRATE RECEIVER

AROCLOR 1248

% Scale	Gallons	Outage (Ins.)	% Scale	Gallons	Outage (Ins.)
0	189	94.0	28	1,203	51.7
1	225	92.5	29	1,240	50.2
2	262	91.0	30	1,276	48.7
3	298	89.5	31	1,312	47.2
4	334	88.0	32	1,348	45.7
5	370	86.5	33	1,384	44.2
6	406	84.9	34	1,421	42.7
7	443	83.4	35	1,457	41.2
8	479	81.9	36	1,493	39.7
9	515	80.4	37	1,529	38.2
10	551	78.9	38	1,566	36.6
11	587	77.4	39	1,602	35.1
12	624	75.9	40	1,638	33.6
13	660	74.4	41	1,674	32.1
14	696	72.9	42	1,710	30.6
15	732	71.4	43	1,747	29.1
16	769	69.8	44	1,783	27.6
17	805	68.3	45	1,819	26.1
18	841	66.8	46	1,855	24.6
19	877	65.3	47	1,892	23.1
20	914	63.8	48	1,928	21.6
21	950	62.3	49	1,964	20.0
22	986	60.8	50	2,000	18.5
23	1,022	59.3	51	2,037	17.0
24	1,058	57.8	52	2,073	15.5
25	1,095	56.3	53	2,109	14.0
26	1,131	54.8	54	2,145	12.5
27	1,167	53.3			

Aroclor 1248
Sp. Gr. 1.325 @ 150°C (1.410 @ 65°C)
Inst. Range - 0-200" H_2O
Inst. Range - 0-100%

DSW 334619

BLENDING TANK & FILTRATE RECEIVER

AROCLOR 1254

% Scale	Gallons	Outage (Ins.)
0	189	94.0
1	223	92.6
2	257	91.2
3	291	89.8
4	325	88.3
5	359	86.9
6	393	85.5
7	427	84.1
8	460	82.7
9	494	81.3
10	528	79.9
11	562	78.5
12	596	77.0
13	630	75.6
14	664	74.2
15	698	72.8
16	732	71.4
17	766	70.0
18	800	68.6
19	834	67.1
20	867	65.7
21	901	64.3
22	935	62.9
23	969	61.5
24	1,003	60.1
25	1,037	58.7
26	1,071	57.3
27	1,105	55.8
28	1,139	54.4
29	1,173	53.0
30	1,207	51.6
31	1,241	50.2
32	1,275	48.8
33	1,308	47.4
34	1,342	45.9
35	1,376	44.5
36	1,410	43.1
37	1,444	41.7
38	1,478	40.3
39	1,512	38.9
40	1,546	37.5
41	1,580	36.1
42	1,614	34.6
43	1,648	33.2
44	1,682	31.8
45	1,716	30.4
46	1,749	29.0
47	1,783	27.6
48	1,817	26.2
49	1,851	24.7
50	1,885	23.3
51	1,919	21.9
52	1,953	20.5
53	1,987	19.1
54	2,021	17.7
55	2,055	16.3
56	2,089	14.8
57	2,122	13.4
58	2,156	12.0

Aroclor 1254
Sp. Gr. 1.415 @ 150°C (1.500 @ 65°C)
Inst. Range - 0-200" H_2O
Inst. Scale - 0-100%

DSW 334620

BLENDING TANK & FILTRATE RECEIVER

AROCLOR 1260

% Scale	Gallons	Outage (Ins.)	% Scale	Gallons	Outage (Ins.)
0	189	94.0	32	1,212	51.4
1	221	92.7	33	1,244	50.0
2	253	91.3	34	1,276	48.7
3	285	90.0	35	1,308	47.4
4	317	88.7	36	1,340	46.0
5	349	87.3	37	1,372	44.7
6	381	86.0	38	1,404	43.4
7	413	84.7	39	1,436	42.0
8	445	83.3	40	1,468	40.7
9	477	82.0	41	1,500	39.4
10	509	80.7	42	1,532	38.0
11	541	79.3	43	1,564	36.7
12	573	78.0	44	1,596	35.4
13	605	76.7	45	1,628	34.0
14	637	75.3	46	1,660	32.7
15	669	74.0	47	1,692	31.4
16	701	72.7	48	1,724	30.0
17	733	71.3	49	1,756	28.7
18	765	70.0	50	1,788	27.4
19	797	68.7	51	1,820	26.0
20	829	67.4	52	1,852	24.7
21	861	66.0	53	1,884	23.4
22	893	64.7	54	1,916	22.1
23	925	63.4	55	1,948	20.7
24	957	62.0	56	1,980	19.4
25	989	60.7	57	2,012	18.1
26	1,020	59.4	58	2,044	16.7
27	1,052	58.0	59	2,076	15.4
28	1,084	56.7	60	2,108	14.1
29	1,116	55.4	61	2,140	12.7
30	1,148	54.0			
31	1,180	52.7			

Aroclor 1260
Sp. Gr. 1.501 @ 150°C (1.561 @ 90°C)
Inst. Range - 0-200" H_2O
Inst. Scale - 0-100%

BLENDING TANK & FILTRATE RECEIVERS

AROCLOR 1262

% Scale	Gallons	Outage (Ins.)	% Scale	Gallons	Outage (Ins.)
0	189	94.0	33	1,233	50.5
1	221	92.7	34	1,264	49.2
2	252	91.4	35	1,296	47.9
3	284	90.0	36	1,327	46.6
4	316	88.7	37	1,359	45.3
5	347	87.4	38	1,391	43.9
6	379	86.1	39	1,422	42.6
7	410	84.8	40	1,454	41.3
8	442	83.5	41	1,485	40.0
9	474	82.1	42	1,517	38.7
10	505	80.8	43	1,549	37.4
11	537	79.5	44	1,580	36.0
12	568	78.2	45	1,612	34.7
13	601	76.8	46	1,644	33.4
14	632	75.6	47	1,675	32.1
15	663	74.2	48	1,707	30.8
16	695	72.9	49	1,738	29.4
17	727	71.6	50	1,770	28.1
18	758	70.3	51	1,802	26.8
19	790	69.0	52	1,833	25.5
20	821	67.7	53	1,865	24.2
21	853	66.3	54	1,896	22.9
22	885	65.0	55	1,928	21.5
23	916	63.7	56	1,960	20.2
24	948	62.4	57	1,991	18.9
25	980	61.1	58	2,023	17.6
26	1,011	59.7	59	2,055	16.3
27	1,042	58.4	60	2,086	15.0
28	1,074	57.1	61	2,118	13.6
29	1,106	55.8	62	2,149	12.3
30	1,138	54.5			
31	1,169	53.2			
32	1,201	51.8			

Aroclor 1262
Sp.Gr. 1.518 @ 150°C (1.578 @ 90°C)
Inst. Range - 0-200" H_2O
Inst. Scale - 0-100%

PROCESS FUNCTION OUTLINE

C. I. SOLID HCl OFF-GAS CLEAN-UP

1.1 Scope

This covers the start-up, shutdown, and normal operation of the Solid HCl Off-Gas Clean-Up System involving No. 9 Chlorinator.

1.2 Description of Process

HCl gas produced on the No. 9 chlorinator system passes through a Solids off-gas condenser which cools the gas to knock out the Santowax and Solid Aroclor vapors. The gas then flows through a catch tank, combines with the gas from the Liquid system and flows to the Muriatic Acid absorber.

A Therminol (1248 Aroclor) cooling system is circulated through the tube side of the off-gas condenser to cool the HCl gases. Material collected in the catch tank is returned to the weigh tank for other chlorinator charges.

II. PROCESS DIAGRAM

Attached.

III. OPERATION OF PROCESS

3.1 Start-Up

1. Open valves in heated air purge system and the pressure indicating instruments on the Solids knock-out tank and the HCl gas line to the Muriatic Acid absorber.

2. Open the valves in the heated air purge for the level instrument in the Solids knock-out tank.

3. Set the therminol temperature recording controller in automatic with the set point at 80°C.

4. Set the Solids knock-out tank temperature indicating controller in automatic with the set point at 110°C.

5. Set valves to allow circulation of the therminol system from the therminol surge tank to the circulating pump through the tube side of the Solids off-gas condenser, through the air cooled off-gas condenser, and back to the therminol surge tank.

6. Open manual valves to allow circulation of therminol heat through the jacket on the Solids knock-out tank.

7. Check to be sure the valves on bottom of the Solids knock-out tank are closed.

8. Set manual valves to allow HCl gas to flow through the Solids off-gas condenser, through the Solids knock-out tank, and to the Muriatic Acid absorber.

9. This system should now be in automatic control. Checking of the pressure across the condenser will indicate plugging if it should occur.

10. When approximately 3" is showing on level gauge, open manual valves at the bottom of the Solids knock-out tank before pumping a charge to weigh tank, to allow collected material to drain into the weigh tank. Material accumulated in the Solids knock-out tank will be recycled through the chlorinator system for re-use. (The knock-out tank should be drained when approximately 3" is showing on the level gauge.)

3.2 Shutdown

1. Open manual valve to direct HCl gas to the drowning jet at the Muriatic Acid Department.

2. Close the manual valve to isolate the HCl gas clean-up system.

   It is possible to by-pass the off-gas condenser in the HCl clean-up system and still have the HCl gas pass through the Solids knock-out tank.

3. The therminol heat system on the tube side of the off-gas condenser can be shut down by stopping the circulating pump.

4. The system is now shut down and can be worked on if necessary.

   It may be necessary to shut down No. 9 chlorinator, dependent upon repairs to be made.

3.3 Instruments

1. Therminol Circulating System Temperature Control - TRC 577.01

The temperature in the therminol circulating system for the off-gas condenser in the Solids clean-up system is controlled by sensing the temperature in the surge tank and controlling the louvers on the air cooled off-gas condenser and the control valve in the line from the coil in the surge tank. The instrument will be in automatic with the set point at 80°C.

2. Solids Knock-Out Tank Temperature Controller - TIC 581.01

The temperature in the Solids knock-out tank is controlled by sensing the temperature of the material in the tank and throttling the control valve on the discharge line from the tank jacket. The controller is in automatic with the set point at 110°C.

3. Solids Knock-Out Tank Level Indicator - LI 581.06

The Solids knock-out tank has a level indicator with a range of 0-30" Hg indicating the level in the tank.

IV. COMMENTS

1. Plugging of the Solids off-gas condenser in the Solids clean-up system can occur. To unplug the off-gas condenser the temperature of the therminol system will be elevated as required. It will probably require a temperature of 160 - 170°C. During this time, the off-gas condenser will be by-passed.

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

3. Any material collected in the Solids knock-out tank from Aroclor produced while using Biphenyl is discarded.

PROCESS FUNCTION OUTLINE

C. I. LIQUID HCl OFF-GAS CLEAN-UP

1.1 Scope

This covers the start-up, shutdown, and normal operation of the Liquid HCl Off-Gas Clean-Up System.

1.2 Description of Process

HCl gas from the Liquid chlorinators is directed through the off-gas condenser into the Liquids collection tank, out the demister, combines with gas from the Solids system, and flows to the Muriatic Acid absorber. The gas is cooled to knock out Aroclor and Biphenyl vapors. It passes through the Liquids collection tank and a demister which returns collected liquid to the Liquids collection tank as the gas flows on to the Muriatic Acid absorber.

The HCl gas can also be turned into the drowning jet in the Muriatic Acid area without passing through the clean-up system.

II. PROCESS DIAGRAM

Attached.

III. OPERATION OF PROCESS

3.1 Start-Up

1. Start air purges flowing on the pressure recording alarm to the off-gas condenser, the level indicator on the Liquids collection tank, and the pressure recording instruments across the demister.

2. Open the steam valves to the coil in the Liquids collection tank and set the temperature indicating controller TIC-573.01 in automatic with the set point at 50°C.

3. Set the tempered water controller in automatic with the set point at 40°C.

4. Open all tower water valves to flood the circulating water system on the tube side of the off-gas condenser.

5. Start the tempered water circulating pump.

6. Open the manual steam valve to the water mixer.

7. Open all plug valves to permit water circulation through the off-gas condenser and to the water return system.

8. Open manual valves to direct HCl gas from the chlorinator headers into the off-gas condenser, to the Liquids collection tank, and out the demister to the Muriatic Acid absorber.

   The HCl gas leaving the clean-up system should be 99% free of Biphenyl and Aroclor vapors.

9. Trappings accumulated in the Liquids collection tank will be used in the batch chlorinators #1 through #4 to make Aroclor 1148 or 1162 only. The material can be pumped from the Liquid collection tank to the existing Biphenyl charge tank (melt tank) by setting the manual valves and starting the pump.

   Material collected in the Liquids collection tank can also be pumped to drums or a Dempster-Dumpster skip for discarding if the tank should become too full. This will only be done as a last resort.

3.2 Shutdown

1. Open manual valves to direct HCl gas to the drowning jet system.

2. Close manual valves to isolate HCl clean-up system from routine flow.

3. Stop the tempered water circulating pump.

4. If necessary for a complete shutdown, close the manual valves for water and steam to the off-gas condenser.

5. Drain the water out of the off-gas condenser to prevent freezing during cold weather.

3.3 Instruments

1. Tempered Water System - TRC 549.01

   This control loop maintains the temperature of the water circulating through the HCl off-gas condenser at 40°C. This is accomplished by sensing the temperature in the tempered water circulating pump discharge line and regulating the control valves in the steam and water supply lines to the pump suction.

2. Liquid Collection Tank Level Instrument - LI 573.04

The level in the Liquids collection tank is indicated by a bubbler differential pressure indicator. Range of the instrument is 0-30" Hg indicating the level in the tank. This system has a heated air purge to keep the dip lines open.

3. Demister Differential Pressure - PR 576.01

Pressure recorders indicate the pressure drop across the demister. This is a recording pressure instrument to indicate plugging of the demister.

4. Liquids Collection Tank Temperature Control - TIC 573.01

Temperature in the Liquids collection tank is controlled by a sensing element in the tank operating the control valve in the steam line to the coil in the tank.

5. Liquids Collection Tank Relief System - RD 573.05

An emergency relief system is provided on the Liquids collection tank to relieve excessive pressure through a rupture disc at 20 psig.

6. HCl High Pressure Alarm - PRA 549.05

HCl gas pressure to the off-gas condenser is sensed by a purged dp cell. It will record the HCl feed pressure to the off-gas condenser and sound an alarm at 5 psig.

IV. COMMENTS

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

B. The demister on top of the Liquids collection tank is used as a final knock-out for Aroclor and Biphenyl entrained droplets in the HCl gas system. Usually this system will be operating with the steam tracing around the outer shell shut off. When the steam tracing is turned on it will allow vapors to be carried through the demister to the Muriatic Acid absorber. The sight glass on the discharge of the demister can be checked to determine if entrained droplets are being carried over.

The steam is installed for use to unplug the demister in case this should occur.

C. At the present, the trappings from this clean-up system will be used to produce Aroclor 1148 and 1162 only. The reason for this is to be sure that we do not produce any unstable electrical grade Aroclors.

The Liquids collection tank will hold 5,000 gallons of trappings which should last 15-30 days.

D. In case the problems with the clean-up system, HCl gas must be directed to the drowning tower. This can be done in case the off-gas condenser or demister should become plugged. The pressure recording instruments across the demister should indicate an increase in HCl gas pressure if this occurs.

The HCl gas pressure to the off-gas condenser will sound an alarm at 5 psig to indicate an excessive pressure in the system.

PROCESS FUNCTION OUTLINE

C. I. LOADING OF REFINED AROCLORS

1.1 Scope

This covers loading of Refined Aroclors into tank cars and trucks and packaging of cans, drums, and bags.

1.2 Description of Process

Refined Liquid Aroclors are collected in storage tanks or filtrate tanks. A representative sample of all Aroclors from storage tank or filtrate tank is analyzed by the laboratory prior to packaging. A final sample of the packaged material is analyzed by the laboratory prior to shipment or storage.

Refined Solid Aroclors are collected in the flaker hold tank for packaging or they may be drawn directly from the still receiver or a blow tank into appropriate drums. All Solid Aroclors are also analyzed by the laboratory prior to shipment.

Some Solid Aroclors and Montars (Aroclor Still Residue) are crushed, screened, or milled prior to packing for shipment.

II. PROCESS DIAGRAM

Does not apply.

III. DESCRIPTION OF PROCESS

3.1 Loading of Liquid Aroclor Cars or Trucks

Aroclors are shipped in 4,000, 7,000, and 8,000 gallon tank cars; and 3,000 or 4,000 gallon tank trucks to customers.

A. Spotting Tank Cars

Normally the railroad switch crew will spot cars at the Aroclor loading dock. Occasionally, it will be necessary to move a car. When this is necessary, use the track mobile to put the car into position.

1. Obtain help to move car.

2. Get track mobile from storage area, normally old hydrogen compressor room and place on railroad track near car to be spotted.

3. Move chocks from car wheels.

4. Release the brakes on the car.

5. Connect track mobile to car to be moved.

6. Move car to desired location.

7. Put brakes on car.

8. Put wheel chocks in place.

9. Disconnect track mobile from car.

10. Remove track mobile to storage area.

B. <u>Filling Tank Cars or Trucks</u>

Aroclors are shipped in lined vessels to protect the electrical properties from contamination. Most vessels are lined with aluminum or a zinc-tin lining.

1. Inspection of car or truck for loading:

   a. Enter each car or truck for inspection prior to loading. If necessary clean out the vessel.

      All material in the tank should be removed. Car should be wiped out using lint-free rags. Damaged lining areas should be cleaned of any rust particles. Report damaged areas or comments on inspection form.

   b. Use an approved tank entering and fire permit when entering a car or truck. Observe safety rules for each permit.

   c. A fellow worker must be on top of the car or truck holding the rope harness. Wear the safety belt harness, an air mask, gas test the car, and use a low voltage, explosion-proof light when entering a tank car or truck.

C. Preparation for Loading of Car or Truck

1. Fill out tank inspection form.

2. Put steam on the car or truck after it is clean.

3. Check to be sure there is enough material in storage tank to load a car or truck as required. (See Appendix III for storage tank calibrations)

4. Circulate the material in the storage tank for two (2) hours, sample the tank, and have the sample checked for loading by the laboratory. If material is in specification, proceed with loading of the tank.

5. Install diaper cloth sock in the filter in the loading line and place a sock over the end of the loading line extension.

6. Attach extension to the loading line at the dock and place sock end into the dome of the car.

7. Connect ground wire to the car.

8. Set valves in the loading line from the storage tank to the loading dock. Do not open valve in the line at the car.

NOTE: Care should be taken to see that the correct valves are set so only the desired Aroclor enters the loading line.

D. Loading of Car or Truck

1. Start pump at the storage tank.

2. Open valve in drain line at the loading dock and allow one drum of Aroclor to flow through the line to flush out the loading line.

3. Close valve in the drain line and open valve in the line to the car or truck. Approximately 2-1/2 hours is required to load a car. (1-1/2 hours to load a truck.)

4. When the car or truck is loaded, stop the pump and close the valve to the loading line. Fill car or truck one to two feet into the dome.

5. Remove loading line from the car or truck.

6. Take samples from the car or truck and send to the laboratory for final analysis. (See Appendix II for samples required.)

7. Close and tighten lid on car or truck.

8. Seal car or truck and record seal number and car or truck number in the Aroclor still log book.

3.2 Filling Drums

A. Preparation for Filling Liquid Aroclor Drums

Liquid Aroclor can be drummed from the storage tank or a filtrate receiver.

1. Send a representative sample (1/2 gallon) of the material to the laboratory to be checked for drumming. If the material to be drummed is in a storage tank it should be circulated for two (2) hours prior to sampling. Material in a filtrate tank need not be circulated, since it is mixed in the blend tank. If the material is in specification proceed with drumming preparation.

2. Check the scales to be used. Set the scales for the weight specified for each drum (See Appendix I).

3. Inspect each drum to be filled for rust and water.

4. Install diaper cloth sock on end of the drum-out line.

B. Filling Liquid Aroclor Drums

1. Start the pump.

2. Open the valve in the drum-out line and allow approximately 5 to 30 gallons of material to flow through the line into a drum to flush out the line. Drumming from a filtrate tank should take 5 gallons of material to flush the line. Drumming from a storage tank should take 30 gallons to flush the line.

3. Fill 5 or 6 drums of material to the specified weight; stencil each drum showing the name of product, lot number, net weight of drum, and the initials of the person doing the drumming. (See Appendix I for drum weights)

4. Sample these drums with a thief for final lot samples. (See Appendix II for samples required.)

5. Continue drumming the Aroclor when the laboratory gives the final OK that material is in specifications.

6. Be sure to tighten bungs on all drums.

7. Drum material until you have the required quantity of drums. Filled drums are palletized and moved to the loading platform for transfer to the warehouse.

C. Preparation For Filling Solid Aroclor Drums

Solid Aroclor (5442) is drawn from the Aroclor flaker hold tank into steel drums. Solid Aroclor 2565 (undistilled) is drawn from blow tank into steel drums.

1. Send a representative sample (1 pt. can) of the material to the laboratory to be checked for drumming. If the material to be drummed is in the receiver it should be circulated for 10 to 15 minutes prior to sampling. If the material is in the blow tank it should be air blown for 30 minutes prior to sampling. If the material is in specification the sample will be given a lot number. Proceed with drumming preparations.

2. Check the scales to be used. Set the scales for the weight specified for each drum (See Appendix I).

3. Inspect each drum to be filled for rust and water.

4. Install screen on end of the drum-out line.

D. Filling Solid Aroclor Drums

1. Open valve on bottom of tank.

2. Open valve in the drum-out line and allow approximately 20 gallons of material to flow through the line into a drum to flush out the line.

3. Stencil each drum showing the name of product, lot number, net weight of drum, and initials of the person doing the drumming. (See Appendix I for drum weights.)

4. Be sure to tighten lids on all drums.

5. Drum material until tank is empty. Filled drums are palletized and moved to the loading platform for transfer to the warehouse.

3.3 Flaking Aroclors (Bldg. 27 Flaker - 5060 and 1268)

Aroclor 5060 is flaked on a drum flaker and bagged in 50 lbs. or 100 lbs. bags. Aroclor 1268 is flaked and packaged in fibre drums at 200 lbs. net.

A representative sample of Aroclor 1268 is taken from the receiver and sent to the laboratory to be checked for flaking.

A representative sample of Aroclor 5060 is taken from the blow tank and sent to the laboratory to be checked for flaking.

NOTE: Aroclor 5060 must be free of acid before bagging.

A. Preparation For Flaking

1. Place Therminol heat on the pipe lines, valves, and flaker hold tank. Observe temperature of the Therminol heater system on the recorder controller on the still control panel - should be 250°C. When producing 1268, this temperature is increased to 280°C.

2. Pump Aroclor to be flaked into the flaker hold tank.

   Aroclor 5060 is pumped from the No. 2 Blow Tank to the flaker.

   Aroclor 1268 and 5460 are flaked from the Flaker Hold Tank.

3. Check level indicator after transfer.

4. Start agitator and continue to agitate until the temperature of the hold tank reaches 220-230°C.

B. Start-Up of Flaker System

1. Turn on electrical heat in the flaker pan about 20 to 30 minutes before start-up.

2. Open valve in water line feed to the flaker drum.

3. Start the flaker drum. Start breaker at discharge of flaker.

4. Open valve at sight glass to start Aroclor feed into the flaker pan. Observe flow in sight glass. Adjust valve to maintain the level in the flaker pan about one inch from the top of the pan.

5. Observe operation to be sure the drum is picking up the material.

6. After the flaker has run 15 to 20 minutes, notify the chief operator material is in the hopper to be bagged.

7. Continue to flake until the flaker hold tank is empty.

C. Shutdown of Flaker

1. Normally the flaker will be run until the hold tank is empty or below 2% on level instrument.

2. Allow the drum to pick up material from the pan until it will no longer contact the hot liquid product.

3. Stop the flaker drum and the breakers.

4. Turn off the electrical heat to the flaker pan.

5. Close the valve in the water line to the flaker drum.

6. Close the valve at the sight glass feed to the pan.

D. Bagging Solid Aroclors

1. Check to be sure flaked material is in the hopper under the flaker.

2. Get bags ready for use and stack near the bagging machine.

3. Get a stencil for the bags with name of the product, lot number, net weight of each bag, and the initials of the person doing the bagging.

4. Set up an empty pallet at the bagger for stacking filled bags.

5. Check the scales to be used. Set the scales for the weight specified for each bag.

6. Open the slide gate valve above the bagger.

7. Stencil each bag per (3) above. Insert the bag on the bagger nozzle. Clamp the bag in position. Be sure the bag support is at the right height.

8. Start the bagger. Fill the bag until is is nearly full. Stop the bagger.

9. Start collecting a 1-qt. composite sample of the flaked material.

10. Check the weight of each bag to be sure it is correct. Add material or take out as is necessary to get correct weight. Place bags on the pallet and move to the loading platform for transfer to the warehouse.

11. Continue to operate the bagger until all the material in the hopper is in bags. When complete, stop the bagger and put up all items left.

12. Send the composite sample of the flaked material to the laboratory for inspection.

13. Flaked material may hang up in the hopper. Turn on the electric vibrator for about one minute if this occurs. It may be necessary to remove the plate over the chute from the hopper to the bagger and poke the material into the bagging machine.

14. Occasionally flaked material hangs up in the screw in the bagger and becomes molten. When this occurs stop the bagger and let it cool for 10 minutes and try again.

    At times the screw must be removed from the bagger and cleaned as follows:

    a. Tag out the electrical switch.

    b. Close the slide gate valve above the bagger.

    c. Remove the back cover on the bagger.

    d. Remove the bolts on the screw drive pulley.

    e. Pull the screw out. Clean all molten material off the screw and out of the screw chamber.

    f. Replace the screw in the bagger. Put the bolts on the drive pulley and replace the back cover on the machine.

    g. Throw the switch on the electrical starter box and remove the tag-out card.

    h. Open the slide gate valve above the bagger.

    i. Start the bagger into operation.

3.4 Crushing Aroclors

Several of the Montars (Aroclor still bottoms or residue) are crushed and repackaged in drums for shipment.

A. Preparation For Crushing

1. Select drums of material to be crushed.

2. Break the material in the drum by hitting the side of the drum with a hammer.

3. Place new empty drum under the crusher to collect the crushed material.

4. Check scales to be used.

B. Operation of Crusher

1. Start the crusher.

2. Feed the material from the drum into the crusher by use of a hand scoop.

3. Start collecting a 1-quart composite sample.

4. Fill the drum to the desired weight (See Appendix I).

5. Stencil the drum with the name of the product, lot number, net weight of each drum, and the initials of the person doing the work.

6. Continue this operation until the required number of drums have been filled.

7. Stop the crusher and clean up the scales, crusher, and surrounding area.

8. Send the composite sample to the laboratory for lot number.

9. All drums filled are palletized and moved to the loading platform for transfer to the warehouse.

3.5 Milling Aroclors

Aroclor 1268 is the only Aroclor which is sold as a milled product. The material must first be flaked.

A. Preparation For Milling

1. Select the drums or bags of material to be milled.

2. Check the scales to be used.

3. Place a new drum under the milling machine to collect the ground material.

4. Crush the dry ice to be used during milling. This keeps the machine cool and the Aroclor 1268 from clogging up the machine.

B. Operation of Mill

1. Start the mill and auger.

2. Fill the bucket with flaked 1268.

3. Blend dry ice with the 1268 and feed it into the hopper over the mill. Use approximately five pounds of dry ice to each 100 pounds of Aroclor 1268 that is milled.

4. Start collecting a composite sample of the ground material.

5. Fill the drums to the specified weight (normally 200 lbs. net).

6. Stencil the drums with the name of the product, lot number, net weight of each drum, and the initials of the person doing the work.

7. Continue this operation until the required number of drums are filled.

8. Stop the milling machine and clean up the scales, the milling machine and the milling area.

9. Send the composite sample to the laboratory for screen test.

10. All drums filled are palletized and moved to the loading platform for transfer to the warehouse.

IV. COMMENTS ON PROCESS

A. All Refined Liquid Aroclors are stored in aluminum, zinc, or tin lined tanks.

B. Tank cars, trucks, and all cans and drums used for Aroclors must be carefully inspected for rust, water, and foreign particles prior to filling.

C. Every precaution must be taken when collecting Aroclor samples to prevent any contamination of the material.

D. To keep lot numbers correct for the products, be sure to note the date and lot number in the book for this purpose.

APPENDIX I

AROCLOR FINISHED GOODS

CONTAINER WEIGHTS

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

DSW 334641

APPENDIX I

AROCLOR FINISHED GOODS

CONTAINER WEIGHTS

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

APPENDIX II

AROCLOR AND PYRANOL LOT SAMPLES

Aroclor	Tank Cars - Trucks or Drums
1221	2 x 1/2 Gallon
1232	2 x 1/2 Gallon
1242	3 x 1/3 Gallon & 1 x 5 pint
1248	2 x 1/2 Gallon
1254	3 x 1/3 Gallon & 1 x 5 pint
1260	3 x 1/3 Gallon
1262	2 x 1/2 Gallon
1262 - 10% Toluene	1 x 1/2 Gallon - From Mix Tank
1262 - 10% Xylene	1 x 1/2 Gallon - From Mix Tank
1260 - 10% Toluene	1 x 1/2 Gallon - From Mix Tank
A13B3B	3 x 1/2 Gallon
Inerteen PPO	3 x 1/2 Gallon
Inerteen 54201-KA	1 x 1/2 Gallon - From Mix Tank

1242 STORAGE TANKS

ITEMS 704, 705, & 707

% Scale	Gallons	Ins.Aroclor (Innage)	% Scale	Gallons	Ins.Aroclor (Innage)	% Scale	Gallons	Ins.Aroclor (Innage)
0	493	6	34	9724	118	68	18,955	230
1	765	9	35	9996	122	69	19,227	234
2	1036	13	36	10,267	125	70	19,498	237
3	1308	16	37	10,537	128	71	19,770	240
4	1579	19	38	10,810	131	72	20,041	244
5	----	22	39	11,082	135	73	20,313	247
6	2122	26	40	11,353	138	74	20,584	250
7	2393	29	41	11,625	141	75	20,856	254
8	2665	32	42	11,896	145	76	21,127	257
9	2937	36	43	12,168	148	77	21,399	260
10	3208	39	44	12,439	151	78	21,670	263
11	3480	42	45	12,711	154	79	21,942	267
12	3751	46	46	12,982	158	80	22,213	270
13	4023	49	47	13,254	161	81	22,485	273
14	4294	52	48	13,525	164	82	22,756	277
15	4566	56	49	13,797	168	83	23,028	280
16	4837	59	50	14,068	171	84	23,299	283
17	5109	62	51	14,340	174	85	23,571	286
18	5380	65	52	14,611	178	86	23,842	290
19	5652	69	53	14,883	181	87	24,114	293
20	5923	72	54	15,154	184	88	24,385	296
21	6195	75	55	15,426	188	89	24,657	300
22	6466	79	56	15,697	191	90	24,928	303
23	6738	82	57	15,969	194	91	25,200	306
24	7009	85	58	16,240	197	92	25,471	310
25	7281	88	59	16,512	201	93	25,743	313
26	7552	92	60	16,783	204	94	26,014	316
27	7824	95	61	17,055	207	95	26,286	320
28	8095	98	62	17,326	211	96	26,557	323
29	8367	102	63	17,598	214	97	26,829	326
30	8638	105	64	17,869	217	98	27,100	329
31	8910	108	65	18,141	220	99	27,372	333
32	9181	112	66	18,412	224	100	27,643	336
33	9453	115	67	18,684	227			

Aroclor 1242
Temperature - 140°C.
Sp. Gr. - 1.272 @ 140°C.
Inst. Range - 0-425" H_2O
Inst. Scale - 0-100%

DSW 334644

STLCOPCB4081114

AROCLOR 1254

ITEMS 707, 708

% Scale	Gallons	Ins.Aroclor	% Scale	Gallons	Ins.Aroclor	% Scale	Gallons	Ins.Aroclor
0	493	6	34	8619	106	68	16,745	206
1	732	9	35	8858	109	69	16,984	209
2	971	12	36	9097	112	70	17,223	212
3	1210	15	37	9336	115	71	17,462	215
4	1449	18	38	9575	118	72	17,701	218
5	1688	21	39	9814	121	73	17,940	221
6	1927	24	40	10,053	124	74	18,179	224
7	2166	27	41	10,292	127	75	18,418	226
8	2405	30	42	10,531	129	76	18,657	229
9	2644	32	43	10,770	132	77	18,896	232
10	2883	35	44	11,009	135	78	19,135	235
11	3122	38	45	11,248	138	79	19,374	238
12	3361	41	46	11,487	141	80	19,613	241
13	3600	44	47	11,726	144	81	19,852	244
14	3839	47	48	11,965	147	82	20,091	247
15	4078	50	49	12,204	150	83	20,330	250
16	4317	53	50	12,443	153	84	20,569	253
17	4556	56	51	12,682	156	85	20,808	256
18	4795	59	52	12,921	159	86	21,047	259
19	5034	62	53	13,160	162	87	21,286	262
20	5273	65	54	13,399	165	88	21,525	265
21	5512	68	55	13,638	168	89	21,764	268
22	5751	71	56	13,877	171	90	22,003	271
23	5990	74	57	14,116	174	91	22,242	274
24	6229	77	58	14,355	177	92	22,481	276
25	6468	80	59	14,594	180	93	22,720	279
26	6707	82	60	14,833	182	94	22,959	282
27	6946	85	61	15,072	185	95	23,198	285
28	7185	88	62	15,311	188	96	23,437	288
29	7424	91	63	15,550	191	97	23,676	291
30	7663	94	64	15,789	194	98	23,915	294
31	7902	97	65	16,028	197	99	24,154	297
32	8141	101	66	16,267	200	100	24,393	300
33	8380	103	67	16,506	203			

Aroclor 1254
Temperature - 140°C.
Sp. Gr. 1.425 @ 140°C.
Inst. Range - 0-428" H_2O
Inst. Scale - 0-100%

DSW 334645

STLCOPCB4081115

1248 STORAGE TANK

ITEM 709

% Scale	Gallons	Ins.Aroclor (Innage)	% Scale	Gallons	Ins.Aroclor (Innage)	% Scale	Gallons	Ins.Aroclor (Innage)
0	420	6	34	6574	94	68	12,728	181
1	601	9	35	6755	96	69	12,909	184
2	782	11	36	6936	99	70	13,090	187
3	963	14	37	7117	101	71	13,271	189
4	1144	16	38	7298	104	72	13,452	192
5	1325	19	39	7479	107	73	13,633	194
6	1506	21	40	7660	109	74	13,814	197
7	1687	24	41	7841	112	75	13,995	199
8	1868	27	42	8022	114	76	14,176	202
9	2049	29	43	8203	117	77	14,357	205
10	2230	32	44	8384	120	78	14,538	207
11	2411	34	45	8565	122	79	14,719	210
12	2592	37	46	8746	125	80	14,900	212
13	2773	40	47	8927	127	81	15,081	215
14	2954	42	48	9108	130	82	15,262	218
15	3135	45	49	9289	132	83	15,443	220
16	3316	47	50	9470	135	84	15,624	223
17	3497	50	51	9651	138	85	15,805	225
18	3678	52	52	9832	140	86	15,986	228
19	3859	55	53	10,013	143	87	16,167	230
20	4040	58	54	10,194	145	88	16,348	233
21	4221	60	55	10,375	148	89	16,529	236
22	4402	63	56	10,556	150	90	16,710	238
23	4583	65	57	10,737	153	91	16,891	241
24	4764	68	58	10,918	156	92	17,072	243
25	4945	70	59	11,099	158	93	17,253	246
26	5126	73	60	11,280	161	94	17,434	249
27	5307	76	61	11,461	163	95	17,615	251
28	5488	78	62	11,642	166	96	17,796	254
29	5669	81	63	11,823	169	97	17,977	256
30	5850	83	64	12,004	171	98	18,158	259
31	6031	86	65	12,185	174	99	18,339	261
32	6212	89	66	12,366	176	100	18,520	264
33	6393	91	67	12,547	179			

Aroclor 1248
Temperature - 140°C.
Sp. Gr. - 1.335 @ 140°C.
Inst. Range - 0-352" H_2O
Inst. Scale - 0-100%

AROCLOR 1221 STORAGE TANK

ITEM 710

% Scale	Gallons	Ins.Aroclor (Innage)	% Scale	Gallons	Ins.Aroclor (Innage)	% Scale	Gallons	Ins.Aroclor (Innage)
0	420	6	34	6574	94	68	12,728	181
1	601	9	35	6755	96	69	12,909	184
2	782	11	36	6936	99	70	13,090	187
3	963	14	37	7117	101	71	13,271	189
4	1144	16	38	7298	104	72	13,452	192
5	1325	19	39	7479	107	73	13,633	194
6	1506	21	40	7660	109	74	13,814	197
7	1687	24	41	7841	112	75	13,995	199
8	1868	27	42	8022	114	76	14,176	202
9	2049	29	43	8203	117	77	14,357	205
10	2230	32	44	8384	120	78	14,538	207
11	2411	34	45	8565	122	79	14,719	210
12	2592	37	46	8746	125	80	14,900	212
13	2773	40	47	8927	127	81	15,081	215
14	2954	42	48	9108	130	82	15,262	218
15	3135	45	49	9289	132	83	15,443	220
16	3316	47	50	9470	135	84	15,624	223
17	3497	50	51	9651	138	85	15,805	225
18	3678	52	52	9832	140	86	15,986	228
19	3859	55	53	10,013	143	87	16,167	230
20	4040	58	54	10,194	145	88	16,348	233
21	4221	60	55	10,375	148	89	16,529	236
22	4402	63	56	10,556	150	90	16,710	238
23	4583	65	57	10,737	153	91	16,891	241
24	4764	68	58	10,918	156	92	17,072	243
25	4945	70	59	11,099	158	93	17,253	246
26	5126	73	60	11,280	161	94	17,434	249
27	5307	76	61	11,461	163	95	17,615	251
28	5488	78	62	11,642	166	96	17,796	254
29	5669	81	63	11,823	169	97	17,977	256
30	5850	83	64	12,004	171	98	18,158	259
31	6031	86	65	12,185	174	99	18,339	261
32	6212	89	66	12,366	176	100	18,520	264
33	6393	91	67	12,547	179			

Aroclor 1221
Temperature 140°C.
Sp. Gr. - 1.072 @ 140°C.
Inst. Range - 0-273" H_2O
Inst. Scale - 0-100%

AROCLOR 1232

ITEM 710

% Scale	Gallons	Ins.Aroclor	% Scale	Gallons	Ins.Aroclor	% Scale	Gallons	Ins.Aroclor
0	420	6	34	5928	85	68	11,436	163
1	582	8	35	6090	87	69	11,598	165
2	744	11	36	6252	89	70	11,760	168
3	906	13	37	6414	91	71	11,922	170
4	1068	15	38	6576	94	72	12,084	172
5	1230	18	39	6738	96	73	12,246	175
6	1392	20	40	6900	98	74	12,408	177
7	1554	22	41	7062	101	75	12,570	179
8	1716	24	42	7224	103	76	12,732	182
9	1878	27	43	7386	105	77	12,894	184
10	2040	30	44	7548	108	78	13,056	186
11	2202	31	45	7710	110	79	13,218	188
12	2364	34	46	7872	112	80	13,380	191
13	2526	36	47	8034	115	81	13,542	193
14	2688	38	48	8196	117	82	13,704	194
15	2850	41	49	8358	119	83	13,566	198
16	3012	43	50	8520	121	84	14,028	200
17	3174	45	51	8682	124	85	14,190	202
18	3336	48	52	8844	126	86	14,352	205
19	3498	50	53	9006	128	87	14,514	207
20	3660	52	54	9168	131	88	14,676	209
21	3822	55	55	9330	133	89	14,838	212
22	3984	57	56	9492	135	90	15,000	214
23	4146	59	57	9654	138	91	15,162	216
24	4308	61	58	9816	140	92	15,324	219
25	4470	64	59	9978	142	93	15,486	221
26	4632	65	60	10,140	145	94	15,648	223
27	4794	68	61	10,302	147	95	15,810	225
28	4956	71	62	10,464	149	96	15,972	228
29	5118	73	63	10,626	152	97	16,134	230
30	5280	75	64	10,788	154	98	16,296	232
31	5442	78	65	10,950	156	99	16,458	235
32	5604	80	66	11,112	158	100	16,620	237
33	5766	82	67	11,274	161			

Aroclor 1232
Temperature 140°C.
Sp. Gr. - 1.160 @ 140°C.
Inst. Range - 0-278" H_2O
Inst. Scale - 0-100%

AROCLOR 1260 STORAGE TANK

ITEM 711

% Scale	Gallons	Ins.Aroclor (Innage)	% Scale	Gallons	Ins.Aroclor (Innage)	% Scale	Gallons	Ins.Aroclor (Innage)
0	420	6	34	6574	94	68	12,728	181
1	601	9	35	6755	96	69	12,909	184
2	782	11	36	6936	99	70	13,090	187
3	963	14	37	7117	101	71	13,271	189
4	1144	16	38	7298	104	72	13,452	192
5	1325	19	39	7479	107	73	13,633	194
6	1506	21	40	7660	109	74	13,814	197
7	1687	24	41	7841	112	75	13,995	199
8	1868	27	42	8022	114	76	14,176	202
9	2049	29	43	8203	117	77	14,357	205
10	2230	32	44	8384	120	78	14,538	207
11	2411	34	45	8565	122	79	14,719	210
12	2592	37	46	8746	125	80	14,900	212
13	2773	40	47	8927	127	81	15,081	215
14	2954	42	48	9108	130	82	15,262	218
15	3135	45	49	9289	132	83	15,443	220
16	3316	47	50	9470	135	84	15,624	223
17	3497	50	51	9651	138	85	15,805	225
18	3678	52	52	9832	140	86	15,986	228
19	3859	55	53	10,013	143	87	16,167	230
20	4040	58	54	10,194	145	88	16,348	233
21	4221	60	55	10,375	148	89	16,529	236
22	4402	63	56	10,556	150	90	16,710	238
23	4583	65	57	10,737	153	91	16,891	241
24	4764	68	58	10,918	156	92	17,072	243
25	4945	70	59	11,099	158	93	17,253	246
26	5126	73	60	11,280	161	94	17,434	249
27	5307	76	61	11,461	163	95	17,615	251
28	5488	78	62	11,642	166	96	17,796	254
29	5669	81	63	11,823	169	97	17,977	256
30	5850	83	64	12,004	171	98	18,158	259
31	6031	86	65	12,185	174	99	18,339	261
32	6212	89	66	12,366	176	100	18,520	264
33	6393	91	67	12,547	179			

Aroclor 1260
Temperature - 140° C.
Sp. Gr. - 1.511 @ 140°C.
Inst. Range - 0-394" H_2O
Inst. Scale - 0-100%

DSW 334649

STLCOPCB4081119

AROCLOR 1262 STORAGE TANK

ITEM 712

% Scale	Gallons	Ins.Aroclor (Innage)	% Scale	Gallons	Ins.Aroclor (Innage)	% Scale	Gallons	Ins.Aroclor (Innage)
0	420	6	34	6574	94	68	12,728	181
1	601	9	35	6755	96	69	12,909	184
2	782	11	36	6936	99	70	13,090	187
3	963	14	37	7117	101	71	13,271	189
4	1144	16	38	7298	104	72	13,452	192
5	1325	19	39	7479	107	73	13,633	194
6	1506	21	40	7660	109	74	13,814	197
7	1687	24	41	7841	112	75	13,995	199
8	1868	27	42	8022	114	76	14,176	202
9	2049	29	43	8203	117	77	14,357	205
10	2230	32	44	8384	120	78	14,538	207
11	2411	34	45	8565	122	79	14,719	210
12	2592	37	46	8746	125	80	14,900	212
13	2773	40	47	8927	127	81	15,081	215
14	2954	42	48	9108	130	82	15,262	218
15	3135	45	49	9289	132	83	15,443	220
16	3316	47	50	9470	135	84	15,624	223
17	3497	50	51	9651	138	85	15,805	225
18	3678	52	52	9832	140	86	15,986	228
19	3859	55	53	10,013	143	87	16,167	230
20	4040	58	54	10,194	145	88	16,348	233
21	4221	60	55	10,375	148	89	16,529	236
22	4402	63	56	10,556	150	90	16,710	238
23	4583	65	57	10,737	153	91	16,891	241
24	4764	68	58	10,918	156	92	17,072	243
25	4945	70	59	11,099	158	93	17,253	246
26	5126	73	60	11,280	161	94	17,434	249
27	5307	76	61	11,461	163	95	17,615	251
28	5488	78	62	11,642	166	96	17,796	254
29	5669	81	63	11,823	169	97	17,977	256
30	5850	83	64	12,004	171	98	18,158	259
31	6031	86	65	12,185	174	99	18,339	261
32	6212	89	66	12,366	176	100	18,520	264
33	6393	91	67	12,547	179			

Aroclor 1262
Temperature - 140°C.
Sp. Gr. - 1.528 @ 140°C.
Inst. Range - 0-402 " H_2O
Inst. Scale - 0-100%

MIX TANK

ITEM 725 (15° SLOPE BOTTOM)

% Scale	Gallons	Ins. Blends	% Scale	Gallons	Ins. Blends	% Scale	Gallons	Ins. Blends
0	15	6	34	3530	77	68	7746	149
1	34	8	35	3654	80	69	7870	151
2	60	10	36	3778	82	70	7994	153
3	94	12	37	3902	84	71	8118	155
4	136	14	38	4026	86	72	8242	157
5	184	16	39	4150	88	73	8366	159
6	250	18	40	4274	90	74	8490	161
7	320	20	41	4398	92	75	8614	163
8	400	23	42	4522	94	76	8738	166
9	500	25	43	4646	96	77	8862	168
10	600	27	44	4770	98	78	8986	170
11	700	29	45	4894	100	79	9110	173
12	800	31	46	5018	103	80	9234	174
13	925	33	47	5142	105	81	9358	176
14	1050	35	48	5266	107	82	9482	178
15	1174	37	49	5390	110	83	9606	180
16	1298	40	50	5514	111	84	9730	182
17	1422	42	51	5638	113	85	9854	184
18	1546	44	52	5762	115	86	9978	187
19	1670	46	53	5886	117	87	10102	189
20	1794	48	54	6010	119	88	10226	191
21	1918	50	55	6134	121	89	10350	194
22	2042	52	56	6258	124	90	10474	195
23	2169	54	57	6382	126	91	10598	197
24	2290	56	58	6506	128	92	10722	199
25	2414	58	59	6630	131	93	10846	201
26	2538	61	60	6754	132	94	10970	203
27	2662	63	61	6878	134	95	11094	205
28	2786	65	62	7002	136	96	11218	208
29	2910	67	63	7126	138	97	11342	210
30	3034	69	64	7250	140	98	11466	212
31	3158	71	65	7374	142	99	11590	214
32	3286	73	66	7498	145	100	11714	216
33	3406	75	67	7622	147			

Mix Tank
Temperature - 140°C
Sp. Gr. - 1.375 @ 140°C
Inst. Range - 0-297" H_2O
Inst. Scale - 0-100%

CM BLEND STORAGE TANK

ITEM 726

% Scale	Gallons	Ins. Aroclor (Innage)	% Scale	Gallons	Ins. Aroclor (Innage)	% Scale	Gallons	Ins. Aroclor (Innage)
0	420	6	34	6574	94	68	12728	181
1	601	9	35	6755	96	69	12909	184
2	782	11	36	6936	99	70	13090	187
3	963	14	37	7117	101	71	13271	189
4	1144	16	38	7298	104	72	13452	192
5	1325	19	39	7479	107	73	13633	194
6	1506	21	40	7660	109	74	13814	197
7	1687	24	41	7841	112	75	13995	199
8	1868	27	42	8022	114	76	14176	202
9	2049	29	43	8203	117	77	14357	205
10	2230	32	44	8384	120	78	14538	207
11	2411	34	45	8565	122	79	14719	210
12	2592	37	46	8746	125	80	14900	212
13	2773	40	47	8927	127	81	15081	215
14	2954	42	48	9108	130	82	15262	218
15	3135	45	49	9289	132	83	15443	220
16	3316	47	50	9470	135	84	15624	223
17	3497	50	51	9651	138	85	15805	225
18	3678	52	52	9832	140	86	15986	228
19	3859	55	53	10013	143	87	16167	230
20	4040	58	54	10194	145	88	16348	233
21	4221	60	55	10375	148	89	16529	236
22	4402	63	56	10556	150	90	16710	238
23	4583	65	57	10737	153	91	16891	241
24	4764	68	58	10918	156	92	17072	243
25	4945	70	59	11099	158	93	17253	246
26	5126	73	60	11280	161	94	17434	249
27	5307	76	61	11461	163	95	17615	251
28	5488	78	62	11642	166	96	17796	254
29	5669	81	63	11823	169	97	17977	256
30	5850	83	64	12004	171	98	18158	259
31	6031	86	65	12185	174	99	18339	261
32	6212	89	66	12366	176	100	18520	264
33	6393	91	67	12547	179			

CM Blend
Temperature - 140°C
Sp. Gr. - 1.265 @ 140°C
Inst. Range - 0-334" H_2O
Inst. Scale - 0-100%

DSW 334652

TCB STORAGE TANK

ITEM 733

% Scale	Gallons	Inches TCB	% Scale	Gallons	Inches TCB	% Scale	Gallons	Inches TCB
0	354	6	34	4570	77	68	8786	149
1	478	8	35	4694	80	69	8910	151
2	602	10	36	4818	82	70	9034	153
3	726	12	37	4942	84	71	9158	155
4	850	14	38	5066	86	72	9282	157
5	974	16	39	5190	88	73	9406	159
6	1098	19	40	5314	90	74	9530	161
7	1222	21	41	5430	92	75	9654	163
8	1346	23	42	5562	94	76	9778	166
9	1470	25	43	5686	96	77	9902	168
10	1594	27	44	5810	98	78	10026	170
11	1718	29	45	5934	100	79	10150	172
12	1842	31	46	6058	102	80	10274	174
13	1966	33	47	6182	105	81	10398	176
14	2090	35	48	6306	107	82	10522	178
15	2214	37	49	6430	109	83	10646	180
16	2338	40	50	6554	111	84	10770	182
17	2462	42	51	6678	113	85	10894	184
18	2586	44	52	6802	115	86	11018	187
19	2710	46	53	6926	117	87	11142	189
20	2834	48	54	7050	119	88	11266	191
21	2958	50	55	7174	121	89	11390	193
22	3082	52	56	7298	124	90	11514	195
23	3206	54	57	7422	126	91	11638	197
24	3330	56	58	7546	128	92	11762	199
25	3454	58	59	7670	130	93	11886	201
26	3578	61	60	7794	132	94	12070	203
27	3702	63	61	7918	134	95	12134	205
28	3826	65	62	8042	136	96	12258	208
29	3950	67	63	8166	138	97	12382	210
30	4074	70	64	8290	140	98	12506	212
31	4198	71	65	8414	142	99	12630	214
32	4322	73	66	8538	145	100	12754	216
33	4446	75	67	8662	147			

TCB
Temperature - 140°C
Sp. Gr. - 1.303 @ 140°C
Inst. Range - 0-281" H_2O
Inst. Scale - 0-100%

TTCB STORAGE TANK

ITEM 734

% Scale	Gallons	Inches TTCB	% Scale	Gallons	Inches TTCB	% Scale	Gallons	Inches TTCB
0	354	6	34	4570	77	68	8786	149
1	478	8	35	4694	80	69	8910	151
2	602	10	36	4818	82	70	9034	153
3	726	12	37	4942	84	71	9158	155
4	850	14	38	5066	86	72	9282	157
5	974	16	39	5190	88	73	9406	159
6	1098	19	40	5314	90	74	9530	161
7	1222	21	41	5430	92	75	9654	163
8	1346	23	42	5562	94	76	9778	166
9	1470	25	43	5686	96	77	9902	168
10	1594	27	44	5810	98	78	10026	170
11	1718	29	45	5934	100	79	10150	172
12	1842	31	46	6058	102	80	10274	174
13	1966	33	47	6182	105	81	10398	176
14	2090	35	48	6306	107	82	10522	178
15	2214	37	49	6430	109	83	10646	180
16	2338	40	50	6554	111	84	10770	182
17	2462	42	51	6678	113	85	10894	184
18	2586	44	52	6802	115	86	11018	187
19	2710	46	53	6926	117	87	11142	189
20	2834	48	54	7050	119	88	11266	191
21	2958	50	55	7174	121	89	11390	193
22	3082	52	56	7298	124	90	11514	195
23	3206	54	57	7422	126	91	11638	197
24	3330	56	58	7546	128	92	11762	199
25	3454	58	59	7670	130	93	11886	201
26	3578	61	60	7794	132	94	12070	203
27	3702	63	61	7918	134	95	12134	205
28	3826	65	62	8042	136	96	12258	208
29	3950	67	63	8166	138	97	12382	210
30	4074	70	64	8290	140	98	12506	212
31	4198	71	65	8414	142	99	12630	214
32	4322	73	66	8538	145	100	12754	216
33	4446	75	67	8662	147			

TTCB
Temperature - 140°C
Sp. Gr. - 1.357 @ 140°C
Inst. Range - 0-293" H_2O
Inst. Scale - 0-100%

NOS. 5 & 6 STORAGE TANKS

1232 AROCLOR

% Scale	Gallons	% Scale	Gallons	% Scale	Gallons
0	538	24	4,618	48	8,698
1	708	25	4,788	49	8,868
2	878	26	4,958	50	9,038
3	1,048	27	5,128	51	9,208
4	1,218	28	5,298	52	9,378
5	1,388	29	5,468	53	9,548
6	1,558	30	5,638	54	9,718
7	1,728	31	5,808	55	9,888
8	1,898	32	5,978	56	10,058
9	2,068	33	6,148	57	10,228
10	2,238	34	6,318	58	10,398
11	2,408	35	6,488	59	10,568
12	2,578	36	6,658	60	10,738
13	2,748	37	6,828	61	10,908
14	2,918	38	6,998	62	11,078
15	3,088	39	7,168	63	11,248
16	3,258	40	7,338	64	11,418
17	3,428	41	7,508	65	11,588
18	3,598	42	7,678		
19	3,768	43	7,848		
20	3,938	44	8,018		
21	4,108	45	8,188		
22	4,278	46	8,358		
23	4,448	47	8,528		

Aroclor 1232
Sp.Gr. 1.150 @ 150°C
Sp.Gr. 1.275 @ 25°C
Inst. Range - 0-400" H_2O
Inst. Scale - 0-100%

NOS. 5 & 6 STORAGE TANKS

1242 AROCLOR

% Scale	Gallons	% Scale	Gallons	% Scale	Gallons
0	538	24	4,258	49	8,133
1	693	25	4,413	50	8,288
2	848	26	4,568	51	8,443
3	1,003	27	4,723	52	8,598
4	1,158	28	4,878	53	8,753
5	1,313	29	5,033	54	8,908
6	1,468	30	5,188	55	9,063
7	1,623	31	5,343	56	9,218
8	1,778	32	5,498	57	9,373
9	1,933	33	5,653	58	9,528
10	2,088	34	5,808	59	9,683
11	2,243	35	5,963	60	9,838
12	2,398	36	6,118	61	9,993
13	2,553	37	6,273	62	10,148
14	2,708	38	6,428	63	10,303
15	2,863	39	6,583	64	10,458
16	3,018	40	6,738	65	10,613
17	3,173	41	6,893	66	10,768
18	3,328	42	7,048	67	10,923
19	3,483	43	7,203	68	11,078
20	3,638	44	7,358	69	11,233
21	3,793	45	7,513	70	11,388
22	3,948	46	7,668	71	11,543
23	4,103	47	7,823	72	11,698
		48	7,978	73	11,853

Aroclor 1242
Sp. Gr. 1.262 @ 150°C (1.387 @ 25°C)
Inst Range - 0-400" H_2O
Inst Scale - 0-100%

DSW 334656

NOS. 5 & 6 STORAGE TANKS

1248 AROCLOR

% Scale	Gallons	% Scale	Gallons	% Scale	Gallons
0	538	24	4,090	50	7,938
1	686	25	4,238	51	8,086
2	834	26	4,386	52	8,234
3	982	27	4,534	53	8,382
4	1,130	28	4,682	54	8,530
5	1,278	29	4,830	55	8,678
6	1,426	30	4,978	56	8,826
7	1,574	31	5,126	57	8,974
8	1,722	32	5,274	58	9,122
9	1,870	33	5,422	59	9,270
10	2,018	34	5,570	60	9,418
11	2,166	35	5,718	61	9,566
12	2,314	36	5,866	62	9,714
13	2,462	37	6,014	63	9,862
14	2,610	38	6,162	64	10,010
15	2,758	39	6,310	65	10,158
16	2,906	40	6,458	66	10,306
17	3,054	41	6,606	67	10,454
18	3,202	42	6,754	68	10,602
19	3,350	43	6,902	69	10,750
20	3,498	44	7,050	70	10,898
21	3,646	45	7,198	71	11,046
22	3,794	46	7,346	72	11,194
23	3,942	47	7,494	73	11,342
		48	7,642	74	11,490
		49	7,790	75	11,638

Aroclor 1248
Sp.Gr. 1.325 @ 150°C
(1.410 @ 65°C)
Inst. Range - 0-400" H_2O
Inst. Scale - 0-100%

DSW 334657

STLCOPCB4081127

NOS. 5 & 6 STORAGE TANKS

1254 AROCLOR

% Scale	Gallons	% Scale	Gallons	% Scale	Gallons
0	538	25	3,988	52	7,714
1	676	26	4,126	53	7,852
2	814	27	4,264	54	7,990
3	952	28	4,402	55	8,128
4	1,090	29	4,540	56	8,266
5	1,228	30	4,678	57	8,404
6	1,366	31	4,816	58	8,542
7	1,504	32	4,954	59	8,680
8	1,642	33	5,092	60	8,818
9	1,780	34	5,230	61	8,956
10	1,918	35	5,368	62	9,094
11	2,056	36	5,506	63	9,232
12	2,194	37	5,644	64	9,370
13	2,332	38	5,782	65	9,508
14	2,470	39	5,920	66	9,646
15	2,608	40	6,058	67	9,784
16	2,746	41	6,196	68	9,922
17	2,884	42	6,334	69	10,060
18	3,022	43	6,472	70	10,198
19	3,160	44	6,610	71	10,336
20	3,298	45	6,748	72	10,474
21	3,436	46	6,886	73	10,612
22	3,574	47	7,024	74	10,750
23	3,712	48	7,162	75	10,888
24	3,850	49	7,300	76	11,026
				77	11,164
		50	7,438	78	11,302
				79	11,440
		51	7,576	80	11,578
				81	11,716

Aroclor 1254
Sp. Gr. 1.415 @ 150°C
Sp. Gr. 1.500 @ 65°C
Inst. Range 0-400" H_2O
Inst. Scale 0-100%

NOS. 5 & 6 STORAGE TANKS

1260 AROCLOR

% Scale	Gallons
0	538
1	668
2	798
3	928
4	1,058
5	1,188
6	1,318
7	1,448
8	1,578
9	1,708
10	1,838
11	1,968
12	2,098
13	2,228
14	2,358
15	2,488
16	2,618
17	2,748
18	2,878
19	3,008
20	3,138
21	3,268
22	3,398
23	3,528
24	3,658
25	3,788

% Scale	Gallons
26	3,918
27	4,048
28	4,178
29	4,308
30	4,438
31	4,568
32	4,698
33	4,828
34	4,958
35	5,088
36	5,218
37	5,348
38	5,478
39	5,608
40	5,738
41	5,868
42	5,998
43	6,128
44	6,258
45	6,388
46	6,518
47	6,648
48	6,778
49	6,908
50	7,038
51	7,168
52	7,298
53	7,428

% Scale	Gallons
54	7,558
55	7,688
56	7,818
57	7,948
58	8,078
59	8,208
60	8,338
61	8,468
62	8,598
63	8,728
64	8,858
65	8,988
66	9,118
67	9,248
68	9,378
69	9,508
70	9,638
71	9,768
72	9,898
73	10,028
74	10,158
75	10,288
76	10,418
77	10,548
78	10,678
79	10,808
80	10,938
81	11,068
82	11,198
83	11,328
84	11,458
85	11,588
86	11,718

Sp.Gr. 1.501 @ 150°C
1.561 @ 90°C

Inst. Range - 0-400" H_2O
Inst. Scale - 0-100%

NOS. 5 & 6 STORAGE TANKS
1262 AROCLOR

% Scale	Gallons	% Scale	Gallons	% Scale	Gallons	% Scale	Gallons
0	538	23	3,505	46	6,472	69	9,439
1	667	24	3,634	47	6,601	70	9,568
2	796	25	3,763	48	6,730	71	9,697
3	925	26	3,892	49	6,859	72	9,826
4	1,054	27	4,021	50	6,988	73	9,955
5	1,183	28	4,150	51	7,117	74	10,084
6	1,312	29	4,279	52	7,246	75	10,213
7	1,441	30	4,408	53	7,375	76	10,342
8	1,570	31	4,537	54	7,504	77	10,471
9	1,699	32	4,666	55	7,633	78	10,600
10	1,828	33	4,795	56	7,762	79	10,729
11	1,957	34	4,924	57	7,891	80	10,858
12	2,086	35	5,053	58	8,020	81	10,987
13	2,215	36	5,182	59	8,149	82	11,116
14	2,344	37	5,311	60	8,278	83	11,245
15	2,473	38	5,440	61	8,407	84	11,374
16	2,602	39	5,569	62	8,536	85	11,503
17	2,731	40	5,698	63	8,665	86	11,632
18	2,860	41	5,827	64	8,794		
19	2,989	42	5,956	65	8,923		
20	3,118	43	6,085	66	9,052		
21	3,247	44	6,214	67	9,181		
22	3,376	45	6,343	68	9,310		

Aroclor 1262
Sp.Gr. 1.518 @ 150°C (1.578 @ 90°C)
Inst. Range - 0-400" H_2O
Inst. Scale - 0-100%

STANDARD OPERATING INSTRUCTIONS
FOR
SOLID AROCLORS
(1970 EXPANSION)

A. Synopsis of Process

The Solid Aroclor equipment installed in 1970 was designed for a nominal 20 M pounds per year production rate. These facilities are intended for the production of Santowax based Solid Aroclors (Aroclors 5060, 5460, 5442) exclusively while the old facilities are retained to produce Biphenyl based Aroclor 1268 and also the Santowax based Solid Aroclors as total product demand dictates. Total production capability of the combined systems is a nominal 30 M pounds per year.

General operation of the newer system is as follows:

Santowax R from the Biphenyl-Santowax department is pumped into a terphenyl feed tank (weigh tank) until a pre-determined weight is collected in the tank. Ferric chloride is introduced into the Santowax and the mixture is agitated. From the weigh tank, the charge is pumped into one of two identical chlorinators.

The Santowax in the chlorinator is circulated through a two-pass, therminol cooled shell and tube heat exchanger through the tube side and back to the chlorinator. Chlorine is fed into the circulating mass at a controlled rate over approximately an 11 hour period. The heat of reaction is removed in the therminol cooled exchanger under programmed temperature conditions.

Both the chlorine feed and temperature of the mass are controlled and stepped up at predetermined intervals during the length of the chlorination period. The control for determining when the reaction is complete is softening point. HCl gas is liberated throughout the chlorination and is sent to the muriatic acid plant for processing into acid.

After the chlorination is completed, the crude Aroclor is pumped to a blow tank where residual HCl is removed by air sparging. A slight vacuum is drawn on the tank by a water scrubber to remove the HCl fumes. The blow tank will hold material from both chlorinators (2 chlorinator batches).

From the blow tank, the material is transferred to a still pot. Again, two chorinator batches constitute a still charge. Lime is added to the still and the still buttoned up. Vacuum is then drawn on the system by a four-stage steam ejector. The mass is circulated through a gas fired furnace which provides the heat for distillation.

DSW 334661

STLCOPCB4081131

A. Synopsis of Process (Cont'd)

The vapors from the still pass upward through a cyclone separator to remove entrainment and then on through a therminol cooled condenser where they are liquefied. From the condenser the molten Aroclor is collected in the still receiver. The distillation takes place over approximately an 11 hour period.

After distillation is completed (as determined by the softening point of the Aroclor), the material in the receiver is pumped out to a hold tank and then on to the flaking area to be packaged in 50 pound bags. In the case of Aroclor 5442, it is either drummed from the receiver or pumped to storage for tank car shipments. The Montar (still bottoms) is drawn out in drums from the still pot after every second run.

STANDARD OPERATING INSTRUCTIONS
FOR
SOLID AROCLOR 5460

PROCESS FUNCTION OUTLINE

III. C. I. MAIN THERMINOL HEATER SYSTEM

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) or FR-1 (Aroclor 1242) is circulated through a pipe system in the Aroclor Department. This heating system is used to heat up tanks, transfer lines, and material involved in producing solid Aroclors.

There are three separate circulating systems drawing off the same surge tank (Item 149). They should not be confused with the Therminol cooling systems other places in the process. The first system circulates 400 GPM through the furnace to heat the Aroclor to 250°C. The second system can circulate 1,000 GPM through the old system (existing users). The third system can circulate 300 GPM through the new Solid Aroclor Expansion area (CEA 2080 users). The pumps are equipped with a seal guard system.

II. PROCESS DIAGRAM

Attached.

III. OPERATION OF PROCESS

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

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

2. Position 55 gallon drum next to 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 flow is steady.

7. Continue to fill the tank until 72 drums or approximately 3,950 gallons total are in the surge tank (Item 149).

C. III. 3.1 b. Therminol 1242 can be charged directly to the surge tank (Item 149) by the following procedure:

1. Align valves from storage tank No. 5 to surge tank (Item 149). Care must be taken to ensure that all valves to the other surge tanks are closed. They are also filled from this storage tank line.

2. Check level gauge at surge tank.

3. Start storage tank pump.

4. Observe the level gauge at surge tank and shut off pump when you have 3,950 Gals.

5. Close valves in line from storage tank to surge tank.

3.2 Start-Up

A. Initial Start-Up

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

2. Place TRCA-629.12 in "Manual" with the output pressure at 15 psig. Blower air control valve is air to open.

3. Check to be sure Therminol is in the surge tank (Item 149). Temperature should be 100°C. minimum.

4. There is no flow control through the heater. The old FIC instrument will be used as a flow indicator, FIA-159-1. An alarm will sound if the pump stops and furnace shutdown will occur below 200 GPM.

5. Open natural gas valves in line to furnace.

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

7. 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.

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

9. Start Therminol circulating pump (Item 159).

C. III. 3.2 A. 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 6 minutes. Green light on Protectoglo unit lights up indicating purge period is over.

13. 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. Pilot lights up indicated by 0-7 reading on micro amp meter.

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

15. Reset the two North American safety valves in the main gas line. Handle on both valves must be in UP position prior to opening either valve.

16. 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.

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, since you can cause shutdown of the furnace.

18. Shut steam valve to coil in the surge tank. Vent coil line to atmosphere.

19. The furnace has been dried out and is ready for use.

20. Observe the furnace temperature at the coil outlet. Do not exceed 50°C. increase for first two hours. Set TRCA-629.12 in automatic and raise the temperature 50°C. per hour until you reach 280°C.

Open the manual air valve slowly to raise the temperature.

Place TRCA-629.12 in "Auto" position and put set point at 280°C. System will circulate until needed.

Check stack temperature and do not exceed 400°C. on the multipoint temperature recorder.

C. III. 3.2 A. 21. The therminol will continue to circulate from surge tank to heater and back to surge tank until the pumps for the other two systems are turned on. (Items 150 (existing users) and 158 (CEA 2080 users)).

22. To put the therminol through these two systems, fill the lines one at a time. Open each branch valve at feed and discharge to drive out air.

B. Start-Up Following Temporary Shutdown

Assume circulating pump is running (FIA-159-1) and the pilot light is burning.

1. Check to be sure Therminol is in the surge tank (Item 149).

2. Check temperature in surge tank (Item 149), TI-149-2. It should be 100°C.

   Turn on steam to tank coil if necessary.

3. Adjust set point TRCA-629.12 at 126° - 150°C. and controller in "Auto" position.

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

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

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

7. Adjust manual valve in air line to burner until pressure is between 20-22 o.s.i.

8. Adjust TRCA-629.12 to temperature at outlet of coil and transfer instrument to "Auto". Gradually raise the set point to 280°C.

9. Start circulating pumps to both areas (existing old system and 2080 system). Fill lines one at a time, opening discharge and feed line at each feeder.

C. III. 3.3 Routine Operations

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

A. FIA-159-1 will indicate 415 GPM.

B. PI-159 pump discharge pressure 44 psig.

C. PI-150 (existing users) pump discharge pressure 43 psig.

D. PI-158 (CEA 2080 users) pump discharge pressure 44 psig.

E. PI-629.16 heater coil outlet pressure 5-10 psig .

F. TRCA-629.12 heater coil outlet temperature set at 280°C.

G. Honeywell coil outlet temperature indicator at 280°C. Shutdown alarm set at 325°C.

H. TI-149-2 surge tank temperature is around 250°C.

I. Air blower reduced discharge pressure - above 15 o.s.i. less than 22 o.s.i.

J. Main natural gas pressure 40 psig.

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

L. Natural gas feed to burner atmospheric pressure (0 o.s.i.).

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 6 minute timed purge before next step of start-up can proceed.

C. III. 3.4 A. 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 main burner 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 0-7 microamperes on current meter. Meter gives an alternating off-on reading.

B. Check surge tank, Item 149, to be sure therminol level is adequate. There should be 24 inches in the bottom sight glass during normal operation.

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.

5. Close one or both of the North American safety valves in the gas line to the main burner.

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.

C. III. 3.5 B. 5. Allow circulating pump to continue pumping until furnace coil outlet has cooled to 150°C. then shut off the circulating pump.

6. Check surge tank level (Item 149) to be sure the tank does not overflow.

7. If a temperature of 100°C. is to be maintained in the 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, 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 near the surge tank (Item 149) beside the pump (Item 159).

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.

C. III. 3.5 C. 2. At the Still Panel

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

3. At Motor Control Center

a. Shut off circulating pump circuit breaker. This method is least preferred.

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 or below 10 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 loops in this system.

1. Circulating Pump Flow Indication - FIA-159-1

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 280°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 325°C. will be actuated at too low or too high a temperature.

C. III. 3.6 A. 3. Therminol Heater Furnace Control - 629A

The function of this loop is to provide a source of heat for the Therminol 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 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 6 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 main burner the air discharge pressure to the main burner must be below 1-1/2 o.s.i. for low fire start-up.

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. III. 3.6 B. 2. 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 B.2. above.

2. Therminol heater coil outlet low temperature below 220°C.

3. Therminol heater coil outlet high temperature above 325°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., below.

IV. COMMENTS ON PROCESS

A. It is very important to be sure the coil in the surge tank (Item 149) 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. FIA-159-1 flow indicator will shut the system down if the flow is less than 200 GPM.

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.

C. IV. 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 149) too full during normal operation. This can cause the tank to run over when the circulating pump is stopped. Normal level will be about 24 inches in the sight glass. The level in the tank will vary, dependent on the operating temperature of the system and the Therminol usage.

F. The control valve formally controlled by FIC-159-1 must be kept closed at all times. This is accomplished by setting the red arrow at zero flow. If this valve is open the hot Therminol does not go through the branch lines to return to the surge tank, since the large supply and return lines are connected at this point.

G. To get natural gas to the main burner the North Americal safety valves must be reset. Prior to opening the valves the handle of each valve must be in the UP position. This sets the safety shutdown pressure switches.

H. Use care when opening the inner door to the field control panel at the furnace. The high temperature shutdown instrument pointer is free floating and can go above the shutdown pointer. The door must be opened slowly.

I. Gas to the venturi mixing chamber for the pilot light on the furnace should be at atmospheric pressure. Air pressure will be the blower discharge pressure (22 o.s.i.). The pilot light will not burn unless this pressure ratio is maintained to give the proper gas-air mixture.

J. In case of a power failure at the field panel for the Therminol heater the reset button on the high temperature shutdown instrument must be pushed to restart the system. There is no apparent indication that this button has been pushed. The red no flame light will not light up and furnace can not be started.

APPENDIX I

Item 149, Main Therminol Surge Tank

90" OD X 134" Long
Dished Heads

Depth (In.)	Contents (Gal.)	Depth (In.)	Contents (Gal.)
0	0	46	2148.3
1	7.4	47	2210.0
2	21.7	48	2271.7
3	39.4	49	2332.3
4	60.4	50	2392.8
5	84.1	51	2452.1
6	111.1	52	2512.3
7	139.7	53	2572.3
8	170.7	54	2631.0
9	203.1	55	2689.5
10	248.1	56	2747.8
11	273.9	57	2805.7
12	312.0	58	2862.3
13	348.0	59	2918.5
14	385.1	60	2975.4
15	433.3	61	2030.8
16	472.5	62	2085.7
17	512.7	63	3141.2
18	568.6	64	3195.1
19	610.8	65	3248.5
20	652.4	66	3300.3
21	712.0	67	3340.5
22	763.3	68	3397.9
23	815.2	69	3445.5
24	865.7	70	3494.7
25	922.9	71	3530.9
26	970.7	72	3592.3
27	1024.8	73	3637.8
28	1079.6	74	3682.3
29	1135.9	75	3724.8
30	1191.4	76	3765.2
31	1248.5	77	3804.5
32	1306.0	78	3843.5
33	1363.9	79	3880.3
34	1422.0	80	3915.6
35	1480.5	81	3948.4
36	1541.0	82	3979.7
37	1600.1	83	4010.1
38	1659.2	84	4036.6
39	1719.5	85	4059.9
40	1709.9	86	4081.7
41	1840.5	87	4100.7
42	1901.2	88	4115.1
43	1962.9	89	4125.6
44	2024.7		
45	2086.5		

STANDARD OPERATING INSTRUCTIONS
FOR
SOLID AROCLOR 5460

PROCESS FUNCTION OUTLINE

III. C. I. NO. 2 WEIGH TANK, NO. 10 & 11 CHLORINATORS, AND NO. 5 BLOW TANK

1.1 Scope

This covers the charging, start-up, shutdown, normal operation, and emergency situations involving the No. 2 Weigh (charge) Tank, No. 10 & 11 Chlorinators, and the No. 5 Blow Tank for production of 5460 Solid Aroclor. To avoid confusion, the instructions for the chlorinators will be written for No. 10 with the corresponding item number, controller number, etc., for No. 11 appearing in parenthesis.

1.2 Description of Process

Crude 5460 (5060 Aroclor) is produced by the batch chlorination of a weighed quantity of Santowax R 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. The 5060 produced in batch chlorination is transferred to a blowing tank when the chlorination is completed. Chlorine gas is fed to the chlorinator from tank cars.

II. PROCESS DIAGRAM

Attached.

III. DESCRIPTION OF PROCESS

3.1 Start-Up

A. Charge Therminol Cooling System for the No. 10 (11) Chlorinator

Both chlorinator cooling systems use the same surge tank (Item 114). Therminol 1242 can be charged directly to the surge tank by the following procedure:

1. Align valves in line from storage tank No. 5 to surge tank (Item 114). Care must be taken to ensure that all valves to the other surge tanks are closed. They are also filled from this storage tank line.

2. Check level gauge at surge tank and start the storage tank pump.

C. III. 3.1 A. 3. Observe the level gauge at surge tank and shut off pump when you have 700 Gals. or 3-1/2 ft. in the sight glass. Once circulation is established Therminol should be added to bring the sight glass level to 12" (approximately 150 gallons more).

4. Close valves in line from storage tank to surge tank.

B. Charge Therminol Cooling System for No. 10 (11) Chlorinator

Charge Therminol (1248 Aroclor) into the surge tank (Item 114) by the following procedure:

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

2. Position 55 gal. 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 114).

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 16 drums or 850 gallons are in the surge tank.

C. Start-Up Therminol Cooling System for No. 10 (11) Chlorinator

1. Set valves in the system to flow through the No. 10 (11) chlorinator heat exchanger (Item 106 (119)) and through the tube side of the therminol cooler (Item 116 (123)).

2. Close drain valve on the suction of the circulating pump (Item 115 (122)).

3. Close valves to put Therminol from the furnace system on the No. 10 (11) Aroclor chlorinator heat exchanger (Item 106 (119). Tag lines closed.

4. Open steam valve to coil on the surge tank (Item 114). Both chlorinator cooling systems use the same surge tank (Item 114). There is no temperature controller on this tank. The steam valve should be set to bring the temperature in this tank to 45°C. Once in operation, the valve can be closed. It will be reopened upon shutdown of both chlorinators or if required to maintain an adequate temperature.

C. III. 3.1 C. 5. Check level in the surge tank (Item 114). Should have an adequate level in the tank.

6. Set TRCA-106-1 (119-1) 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-115-1 (122-1) 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 115 (122).

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

   a. Pump discharge pressure should be 45 psig on the local gauge.

   b. Flow through Therminol system should be 300 GPM. Check FICA-115-1 (122-1).

   c. Check action of control valve to the No. 10 (11) Aroclor heat exchanger. See TRCA-106-1 (119-1). Valve should be closed.

10. Set TICA-116-1 (123-1) on the Therminol cooler to 70°C. Low temperature alarm is set at 50°C. - high temperature alarm is set at 90°C.

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

   a. Pump discharge temperature, No. 10 (11) chlorinator heat exchanger outlet temperature, and the outlet temperature of the water-cooled heat exchanger for the therminol system (See TRCA-116-1 (123-1)).

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

D. Initial Equipment Check for Start-Up

Open valves on steam lines to the Santowax supply to the weigh tank (Item 101). Open valves in the steam lines to the coil on the weigh tank.

1. Set temperature controller on the No. 2 weigh tank, TIC-101-1, at 150°C. The controller has no provision for manual operation.

C. III. 3.1 D. 2. Check Therminol cooling system.

a. Therminol cooler controller TICA-116-1 (123-1) is set in "Auto." with a set point at 70°C.

b. Flow controller FICA-115-1 (122-1) in "Auto." with the set point at 300 GPM.

c. Pump pressure 45 psig.

3. The No. 5 blow tank temperature controller TIC-125-1 should be in "Auto." with the set point at 240°C.

4. Make sure the main Aroclor therminol heater system is in operation and is circulating at 250°C. This system provides the heat for high temperature line tracing and for the No. 5 blow tank coil.

5. Open therminol feeder lines to heat the following equipment:

a. Transfer lines from weigh tank (Item 101) to the transfer pump and to No. 10 (11) chlorinator (Item 104 (117).

b. Circulating line on No. 10 (11) chlorinator.

c. Sample line on No. 10 (11) chlorinator.

d. Transfer line at No. 10 (11) chlorinator to the No. 5 blow tank (Item 125).

e. Plate coils on No. 5 blow tank (Item 125).

f. Transfer line from No. 5 blow tank to the pump (Item 126).

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.

6. Open steam valve on mist eliminator (Item 107 (120)) tracing.

7. Open water valve to S&K jet (Item 127) - 20 psig water pressure. This unit stays in continuous operation.

C. III. 3.1 D. 8. Start the air blower (Item 124). Open the valve at the No. 5 blow tank two turns.

9. Check the suction on the No. 5 blow tank (Item 125) to be sure it is adequate for operation.

10. Open the manual valves in the water system to the Aroclor cooler (Item 116 (123)).

E. Charge and Operating Temperatures for Crude 5460 Solid Aroclor

The charge and operating temperatures for the chlorinators are shown in Table I.

F. Charge No. 2 Weigh Tank (Charge Tank)

1. Charge 11,200 lbs. of Santowax R in the following manner:

a. Set the valves to receive the charge from the Santowax Department. Santowax R is obtained from the Santowax storage tank.

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

c. Depress the pushbutton near the scale to open the automatic valve. This will put the annunciator window light out which is marked "Charge Complete Terphenyl Feed Tank".

d. Start the pump to charge the weigh tank. Santowax R is now entering the weigh tank.

e. When the measured weight reaches the set point, the automatic Santowax R control valve will close and annunciator window marked "Charge Complete Terphenyl Feed Tank" will be actuated.

f. If the charge valve does not close at 11,200 lbs. another switch will attempt to close it at 15,000 lbs. and also sound an alarm.

g. Close the manual valve in the Santowax R line. Turn off pump.

h. Open the automatic valve and allow the line to drain, then reclose the automatic valve.

i. Obtain a Santowax R sample before adding catalyst.

j. Open wing nut lid on top of the weigh tank (Item 101) and add 5 pounds of Ferric Chlorine. Close the lid after adding the Ferric Chloride.

TABLE I

BATCH CHLORINATOR OPERATING CONDITIONS - 5060 AROCLOR	
Chlorinator Charge:(Lbs.)	
Santowax R	11,200
Approximate Pounds 100% Chlorine Required to Produce Batch:	30,500
Totalizer Chlorine Settings	
Lbs. Cl_2 @ 80%	24,400
Chlorinator Temperature:	
Beginning	190°C.
Ending	250°C.
Softening Point	105 - 115°C
Weight of Crude Batch - Lbs.:	24,200
Gallons	2,000

NOTE: ADD 15 POUNDS OF FERRIC CHLORIDE TO EACH BATCH CHLORINATOR CHARGE.

C. III. 3.1 F. 1. k. 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.

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

G. Charge No. 10 (11) Chlorinator and Start Chlorination

1. Programmed Chlorinator Operation

a. Close manual chlorine valves at distributors on No. 10 (11) chlorinator.

b. Close vent valve on chlorinator.

c. Open HCl valve to off-gas condenser and on the Muriatic Acid area.

d. Set the chlorine flow controller FRC-104-1 (117-1) in "Manual-Cascade". The controller set point is automatically altered in three steps - 1,500 lbs/hr. for first hour; 2,000 lbs/hr. for the second hour; and 3,000 lbs/hr. for each of nine subsequent hours. The last set point on the flow controller will stay on until the programmer is jogged back to step 0.

e. Set the temperature controller TRCA 106-1 (119-1) in "Manual-Cascade" with the manual set point at zero. The last set point on the temperature controller will stay on until the programmer is jogged back to step 0. The cascade set points are as follows:

1st Hour	190°C
2nd Hour	200
3rd Hour	210
4th Hour	220
5th Hour	230
6 - 7th Hour	240
8 - 9th Hour	250
10 - 11th Hour	250

f. Check the following control instruments:

(1) #2 weigh tank temperature - TIC-101-1 set at 150°C.

(2) Therminol cooling temperature - TICA-116-1 (123-1) set at 70°C.

(3) Therminol cooling flow - FICA-115-1 (122-1) at 300 GPM, controller in "Auto".

(4) No. 5 blow tank temperature - TIC-125-1 set at 240°C.

C. III. 3.1 G. 1. g. Set valves to transfer charge from #2 weigh tank to the No. 10 (11) chlorinator. Special care must be taken to close the charge valve to the other chlorinator, since it is possible to pump to the wrong one. Be sure transfer line to blow tank is closed off.

h. Start transfer pump (Item 103). The pump discharge valve and the valve at the bottom of the weigh tank have been left open. This is to allow for the thermal expansion of the 150°C Santowax R remaining in the transfer line that is being heated to 250°C by the hot therminol. In this way the pump's seal and the valve's packing are protected from a build up in pressure.

i. As pump-out proceeds and weight falls to 100#, a switch actuates to close down the pump (Item 103). An alarm sounds and the pump "Run Light" will go out.

j. The transfer pump (Item 103) cannot be started if the charge valve is open and vice versa.

k. Close the charge valve on top of the chlorinator. Set valves to circulate the No. 10 (11) chlorinator batch through the heat exchanger (Item 106 (119)) and back to the chlorinator. Once again check line to blow tank.

l. Start the circulating pump (Item 105 (118)) when about one-third of the batch is transferred.

m. After circulation has been established the chlorination is started by pressing the start button on programmer XC1-CP1 (XC1-CP2). This injects both a flow and temperature set point into the respective controllers. Change the temperature controller TRCA-106-1 (119-1) from manual to automatic. The chlorine flow is started in Manual. Set the instrument output pressure at 6 psig then open the manual valves on the distributor. Manually raise the chlorine flow rate until it matches the yellow arrow of the programmer set point. Then change the controller FRC-104-1 (117-1) from manual to automatic. The batch chlorine flow and temperature will now be controlled according to the preset program. Now a flow integrator with two dials is used to read out 80% and total pounds of chlorine. When integrated flow equals the preset 80% mark, one dial stops counting, an alarm bell rings and "Chlorinator #10 (11) 80% Chlorination" lights up. The second dial continues indicating total flow until chlorine flow is shut off.

C. III. 3.1 G. 1. n. 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. After four hours, take a sample of the Aroclor and check for softening point. Samples are taken off the circulating line. 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.

p. Check the following items during operation:

(1) Circulation temperature on TRCA-106-1 (119-1).

(2) Chlorine flow on FRC-104-1 (117-1).

(3) Therminol cooling system flow through FICA-115-1 (122-1) - 300 GPM.

(4) Therminol temperature on TICA-116-1 (123-1) - 70°C.

(5) Chlorinator body temperature on the multipoint #1 (7).

q. High chlorinator temperature or failure of the circulating pump will sound an alarm. This high chlorinator body temperature alarm set at 275°C. is in addition to the high alarm of TRCA-106-1 (119-1).

r. 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 has reached and the additional chlorine to add.

s. Continue the chlorination until complete. It may be necessary to run the softening point more often during the last one or two hours of the chlorination. A density measurement system DRC-104-4 (117-4) is installed to determine the correlation between density and final softening point. This might in the future eliminate the time consuming softening point determination. For the present it will just record the density.

t. Upon completion of the chlorination (softening point 105-112°C.), shut off the manual chlorine feed valves on the distributors, circulate for 10 min., take a final sample and pump to the No. 5 blow tank.

C. III. 3.1 G. 1. u. As previously stated the final set points will remain on the controllers until the programmer is advanced to Step 0. If there is any delay in transferring, TRCA-106-1 (119-1) may remain in "Automatic-Cascade" as long as Step 0 does not appear on the programmer. At Step 0 the temperature controller must be put in manual with a set point of zero; otherwise, cooling will start and will continue until the circulation cooler is plugged.

2. Manual Operation

Complete manual operation is possible but is not recommended because the function of the programmer is to relieve the operator of the duty of keeping time and manually dialing in set points. The operation is very similar to the automatic programmed operation except for the following:

a. Place the chlorine flow controller FRC-104-1 (117-1) in "Automatic-Set". Then place the arrow at 1,500 lbs/hr. After one hour move it to 2,000 lbs/hr. and then one hour later to 3,000 lbs/hr. The controller can also be placed in "Manual" and the control valve positioned manually. The integrator digit counters will continue to totalize and will sound at the 80% point.

b. Place the circulating temperature controller TIC-106-1 (119-1) in "Automatic-Set" and increase the set point in a number of steps which will simulate the programmer action. If the process is to be operated in "Manual" then this can also be done by manually positioning the control valve and observing the temperature on the controller.

c. Samples should be taken more often towards the end to ensure against over chlorination.

H. Transfer to No. 5 Blow Tank and Air Blow

1. Set transfer lines to pump to the No. 5 blow tank (Item 125). Be sure Therminol heat is on jacketed lines and that the temperature controller TIC-125-1 is set at 240°C.

The chlorinator is still vented to the off-gas storage tank.

C. III. 3.1 H. 2. Check the level indication instrument, LIA-125-2.1 to be sure there is enough room to transfer into the blow tank (Item 125). The tank is sized to hold two chlorinator batches. There is a high level alarm - LIA-125-2.

3. Change final valve in the transfer line and allow material to pump from the No. 10 (11) chlorinator to the No. 5 blow tank. Observe transfer and note level increase in the No. 5 blow tank by LIA-125-2.1. Make sure the complete batch has been transferred. At the completion of the transfer, close the valve in the circulating system and shut off the circulating pump (Item 105 (118) on the No. 10 (11) 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.

3.2 Routine Operations

During normal operations of the #2 weigh tank, No. 10 (11) chlorinator, and No. 5 blow tank system, the following conditions will exist in the process.

A. Main Therminol Heater

1. Flow through the main therminol heater system will be indicated on FIC-628.1, 415 GPM normal.

2. TRCA-629.12 controls the temperature of the main therminol heating system. Set point normally at 280°C. Low temperature alarm set at 220°C. - high temperature alarm set at 325°C.

B. No. 2 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 "charge complete terphenyl feed tank".

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

3. TIC-101-1 will be controlling the temperature in the weigh tank at 150°C.

4. Temperature on the Multipoint Indicator will indicate 150°C.

C. III. 3.2 B. 5. The agitator will be running to keep the Ferric Chloride in suspension.

6. The transfer pump will be shut off.

C. No. 10 (11) Chlorinator

1. Chlorine flow will be indicated on FRC-104-1 (117-1). If in "cascade-auto" control, the Taylor Timer will be controlling the flow by program system.

2. Temperature will be controlled by TRCA-106-1 (119-1). With the system in "cascade-auto", the temperature will be controlled by a preset program. Initial starting temperature set point of 190°C., completion temperature 250°C.

3. No. 10 (11) chlorinator circulating pump will be in operation.

4. The Therminol chlorinator cooling system should have the following checks:

   a. Flow will be indicated by FICA-115-1 (122-1). Normal set point 300 GPM. Low flow alarm set at 250 GPM.

   b. Temperature in the circulating system is indicated by TIC-116-1 (123-1). Normal indication is 70°C. Low temperature alarm set at 50°C. - high temperature alarm set at 90°C.

   c. Surge tank Therminol level (Item 114) is 12 inches in the sight glass.

   d. The Therminol cooling system pump discharge pressure should be 45 psig.

5. Temperature of the No. 10 (11) chlorinator can also be observed on the Multipoint temperature recorder point 1(7). There should be no more than a 10°C temp. spread between the body temp. and the circulating temperature.

D. No. 5 Blow Tank

1. Temperature will be indicated by TIC-125-1. Normal set point 240°C.

2. Level in the No. 5 blow tank will be indicated by LIA-125-2.1.

3. Water valve should be open to the S&K jet providing suction on the No. 5 blow tank - pressure 20 psig.

4. The air blower (Item 124) should be operating with a discharge pressure of 8-10 psig.

C. III. 3.2 E. Data Sheets

A Solid Aroclor system data sheet is available for the #2 weigh tank, No. 10 (11) chlorinator, and the #5 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 101) has an interlock system which will not allow starting the transfer pump (Item 103) 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. 10 (11) chlorinator. A high weigh alarm set at 15,000 pounds will sound for an overcharge.

B. A high temperature alarm is set at 275°C. on the body of No. 10 (11) chlorinator (Item 104 (117)). A low temperature alarm is provided at 120°C. to prevent production of unstable Aroclors.

C. The main therminol heating circulation system has several safety features which can be found in the PFO for this heater system.

D. Check the level in the therminol cooling system surge tank (Item 114) to be sure the therminol level is 12 inches in the sight glass.

E. The valves in the main therminol heating system used to put heat on the No. 10 (11) chlorinator heat exchanger (Item 106 (119)) 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.

F. 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.

G. Normally, when the programmed flow control system is in operation, 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 No. 10 (11) chlorinator. The sample should be checked for softening point. If this sample indicates a normal batch, the next sample would be taken when the 80% bell rings as preset by the chlorine flow totalizer. This sample is to assure a batch is not over-chlorinated and does not set up in the chlorinator preventing its transfer to the #5 blow tank.

C. III. 3.4 Shutdown

Operations of the No. 2 weigh tank, the No. 10 (11) chlorinator, and the No. 5 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 isolate the system from the main therminol heating system to make the system safe. This must be considered, depending on the situation.

A. No. 3 Weigh Tank (Item 101)

1. Temporary Shutdown

a. Close the manual valves in the Santowax supply line to the weigh tank.

b. Close automatic valve in Santowax line to weigh tank.

c. Leave TIC-101-1 in "Auto" with set point at 150°C.

d. Leave therminol heat on the transfer lines to the No. 10 (11) chlorinator.

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

2. Prolonged Shutdown

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

b. Close automatic valve in Santowax line to weigh tank.

c. Close the valve at the bottom of the weight tank if necessary.

d. Leave the discharge valve on transfer pump open.

e. Move the weigh tank temperature control TIC-101-1 set point to 0°C. Close the manual valve in the steam supply line.

C. III. 3.4 A. 2. f. The agitator and transfer pump will be shut off.

g. Close the valves in the main therminol heating system lines for the weigh tank transfer lines. Close valves in steam supply to Biphenyl lines.

h. The tank may or may not be empty, dependent on the work to be done or the cause for shutdown. Under normal conditions the tank will be empty.

i. Note shutdown information on data sheet.

j. Drain the weigh tank if necessary for repair work.

k. Leave the system in this condition until needed.

B. <u>No. 10 (11) Chlorinator (Item 104 (117))</u>

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, or a tank car emptying. Normally, if a partial reduction in the chlorine feed occurs, the batch liquid chlorinators will be shut off and the No. 10 (11) chlorinator will continue to be operated.

1. <u>Temporary Shutdown</u>

a. The circulating pump (Item 105 (118) will normally be left in operation.

b. Close the chlorine valves at the distributor on the No. 10 (11) chlorinator.

c. Check the chlorine header pressure and chlorine feed to the other chlorinators. Pressure should be <u>20-25 psig</u>.

d. Check to see that liquid chlorine is being fed to the vaporizer and that steam is on the vaporizer. Steam pressure should be <u>15 psig</u>. Discharge pressure on the vaporizer should be <u>70-100 psig</u>. Chlorine header pressure normally <u>20-25 psig</u>.

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

f. Leave the therminol cooling system circulating.

C. III. 3.4 B. 1. g. Ensure the cooling therminol does not flow through the circulation cooler. As long as the programmer is in a step other than 0, it is taken care of automatically. If the programmer is in Step 0 then TRCÁ-106-1 (119-1) should be placed in manual with the set point at zero.

h. Leave the main therminol heating system circulating on the jacketed lines.

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

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, and the transfer lines into the vessel, will be tagged. 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 and pump suction line.

c. Close chlorine valves at distributor on No. 10 (11) chlorinator.

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

e. Close the HCl vent valve on the chlorinator to the off-gas storage tank.

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

C. III. 3.4 B. 2. g. Shut down the therminol cooling system by:

(1) Shutting off circulating pump (Item 115 (122)).

(2) Leave FICA 115-1 (122-1) in "Auto" with set point at <u>300 GPM</u>.

(3) TICA-116-1 (123-1) will be in "Auto" with the set point at <u>70°C</u>.

(4) Turn on the steam to the surge tank (Item 114). 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) Shut off water to the cooler (Item 116 (123)), if necessary.

(c) Tag out the circulating pump (Item 115 (122)) circuit breaker; and

(d) Tag out the therminol heating valves to the No. 10 (11) chlorinator heat exchanger system.

h. Note shutdown information on the data sheet.

C. <u>No. 5 Blow Tank (Item 125)</u>

1. <u>Temporary Shutdown</u>

a. Close the valve at the bottom of the No. 5 blow tank (Item 125).

b. Vent pump discharge line into the blow tank.

c. Transfer pump will be shut off.

d. Leave TIC-125-1 set point at <u>240°C</u>. Leave in "Auto".

e. The air blower will continue to run.

f. Water will remain on the S&K jet (Item 127), <u>20 psig</u>.

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

C. III. 3.4 C. 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 blow tank.

c. Shut off the transfer pump (Item 126).

d. Adjust TIC-125-1 controller to 0°C. Close the manual valve in the therminol heating system to the coils on the No. 5 blow tank and tag out valves.

e. Shut off the air blower (Item 124).

f. Shut off water to the S&K jet (Item 127).

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 101) or the No. 5 blow tank (Item 125). However, emergencies can occur which make it necessary to shut down the No. 10 (11) chlorinator as fast as possible. The following methods can 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. 10 (11) chlorinator.

b. Shut valve in HCl pipe line to the Muriatic Acid Dept. if necessary.

c. Stop circulating pump (Item 105 (118)) 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. 10 (11) chlorinator. This will be done as follows, dependent on operation:

C. III. 3.4 D. 2. a. (1) Manual Operation

Controller FRC-104-1 (117-1) in "Manual". Adjust chlorine flow controller set point to zero.

Immediately shut off manual valves feeding this chlorinator in the field.

(2) Programmed Operation

Move chlorine controller FRC-104-1 (117-1) from "automatic" to "Manual" and adjust set point on chlorine feed controller to zero. Proceed as in Item (1) above.

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

c. Stop the circulating pump (Item 105 (118) 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. 10 (11) Chlorinator

a. Stop therminol cooling system circulating pump.

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 nine (9) major control loops in this system.

1. No. 2 Weigh Tank Scale Loop - 101

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 "charge complete terphenyl feed tank". During charging of the weigh tank, the transfer pump (Item 103) cannot be started. In case the weigh tank is overcharged, an alarm horn will sound at 15,000 lbs. and will again attempt to close the charging valve.

C. III. 3.5 A. 1. As pump-out proceeds and weight falls to 100 lbs., the pump (Item 103) is shut down. An alarm sounds and "terphenyl feed pump shutdown" is indicated. The pump running light will also go out.

2. Weigh Tank Temperature Control - TIC-101-1

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 in the weigh tank.

3. No. 9 Chlorinator Chlorine Flow Control - FRC-104-1 (117-1)

The function of this loop is to control the chlorine flow to the No. 10 (11) 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, or by a preset programmed chlorine feed control.

a. Manual Control

The chlorine flow controller FRC-104-1 (117-1) is positioned in "Manual". The instrument pressure is regulated to give the desired chlorine flow to the No. 10 (11) chlorinator.

b. Automatic Flow Control

The No. 10 (11) chlorinator chlorine flow controller FRC-104-1 (117-1) 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 first chlorine integrator set point is adjusted on a digit counter for the desired chlorine alarm level. When the desired quantity of chlorine has entered the chlorinator, an alarm bell will ring and an annunciator light will flash indicating "No. 10 (11) chlorinator, 80% chlorination". A second digit counter will continue to totalize the flow. The integrator readout (X2) is total pounds of chlorine. The totalizer settings can be used with the automatic flow control above if the controller is not in "cascade". When the controller is in "Auto-cascade", the predetermined program will change the

C. III. 3.5 A. 3. c. chlorine flow rate to the No. 10 (11) 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. It is: 1,500 #/hr. for one hour; 2,000 #/hr. for one hour; and 3,000 #/hr. for the remaining time.

4. No. 10 (11) Chlorinator Temperature Control - TRCA-106-1 (119-1)

The function of this loop is to provide temperature control of the chlorination batch in the No. 10 (11) 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 106 (119). 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-106-1 (119-1) will be in "manual". Circulating of the therminol cooling system across the No. 10 (11) chlorinator heat exchanger can be controlled manually by adjusting the control valve with TRCA-106-1 (119-1). Adjust until the desired temperature is acquired.

b. Automatic Control

The temperature controller TRCA-106-1 (119-1) 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.

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 Timer. After start of the program, the Timer will automatically advance through the temperature profile as set up by the program. These set points will be directed by the programmer only if TRCA-106-1 (119-1) is in "auto-cascade". This program, once set up, should not be disturbed without consulting supervision.

C. III. 3.5 A. 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 vaporizer 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-115-1 (122-1)

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 flow with an orifice flow meter and adjusting a control valve to by-pass the No. 10 (11) chlorinator heat exchanger (Item 106 (119). Flow through the No. 10 (11) heat exchanger is regulated by the temperature control TRCA-106-1 (119-1). As the chlorinator heat exchanger needs more cooling fluid the control valve reduces the by-pass quantity. 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-116-1 (123-1)

The function of this loop is to control the temperature of the cooling therminol system at 70°C. This is accomplished by measurement of the discharge temperature from the therminol water cooler (Item 116 (123) and automatically throttling the water flow on the shell side of the cooler. The low temperature alarm on this system is set at 50°C. - the high temperature alarm is set at 90°C. Experience has shown that a temperature controller is not needed on the surge tank (Item 114).

8. No. 5 Blow Tank Temperature Control - TIC-541.01

The function of this loop is to maintain a constant temperature of 240°C. in the No. 5 blow tank. This is accomplished by measuring the temperature in the blow tank and throttling the control valve in the Therminol heating system to the coils in the No. 5 blow tank. There are no alarms in this system.

C. III. 3.5 A. 9. No. 2 Blow Tank Level Indication - LIA-125-2.1

This loop measures the level of crude Aroclor in the No. 5 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 103) 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. Conversely the charge valve cannot be opened if the pump is running.

C. Alarms

The following alarms exist through this system.

1. Weigh Tank (Item 101)

a. When the measured or preset weight approaches the set point on the scales, an alarm bell will sound indicating "charge complete terphenyl feed tank".

b. A high weight alarm will sound if the weigh tank is filled above 15,000 lbs. Immediate action should be taken to stop the filling by stopping the charge pump and/or closing the manual valve.

c. An alarm will sound upon completion of pump-out. The pump is shut off automatically.

2. No. 10 (11) Chlorinator System (Item 106 (117))

a. Chlorine Flow Alarm

(1) When the chlorine totalizer is being used, an alarm bell will ring when the batch is 80% chlorinated.

b. Temperature Alarms

Abnormal temperature alarms are set on the cooler for a low circulation temperature of 120°C. and a high temperature of 275°C. In addition to the high-low temperature alarm of the circulation, high-low alarms will sound at 275°C. and 120°C. for the chlorinator body temperature.

C. III. 3.5 C. 2. 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 for the Therminol cooling system if the flow falls below 250 GPM.

e. Abnormal exit temperatures on the therminol cooling system from the cooler (Item 116 (123)) will sound an alarm. The low temperature alarm is set at 50^{o}C. and the high temperature alarm at 90^{o}C.

f. An alarm will sound upon circulation pump shutdown (Item 105 (118)).

C. IV. COMMENTS ON PROCESS

A. Special flexible piping joints have been made to the weigh tank (Item 101) since this tank is placed on scales. 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 weighting 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 incoming 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 up to the No. 5 still. Then steam is used in the transfer lines to the flaker hold tank.

C. The transfer pump (Item 103) for the weigh tank has steam on 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.

E. Care must be taken not to fill the therminol cooling system surge tank (Item 114) too full during normal operation. This can cause the tank to run over when the circulating pump is stopped.

F. The programmer has been set up to hold the last temperature and chlorine flow set points for a total chlorination cycle time of 20 hrs. This is to prevent the chlorine flow from automatically being shut off at the end of a batch before the manual distributor valves can be closed. It also allows for the chlorination cycle to be increased from the designed 11 hrs. without changing the programmer itself.

APPENDIX I

SOLID AROCLORS PROGRAMMED CHLORINATION

TEMPERATURE & CHLORINE FLOW PROFILE

1. CHLORINE FLOW - FLOW RECORDER CONTROLLER (FRC-104-1 (117-1)

Time	Aroclor 5060
1st hour @	1,500 Lbs/hr.
2nd Hour @	2,000 Lbs/hr.
3rd & subsequent hours to end of batch @	3,000 Lbs/hr.

2. TEMPERATURE CONTROL - TEMPERATURE RECORDER CONTROLLER (TRCA-106-1 (119-1)

Time	Aroclor 5060
1st hour @	190
2nd hour @	200
3rd hour @	210
4th hour @	220
5th hour @	230
6 - 7th hour @	240
8 - 9th hour @	250
10 -11th hour @	250

Total Batch Time - Approximate hours - 10 - 12

APPENDIX II

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 <u>under 80°C</u>.

   b. Use glycerin when expected softening point is <u>over 80°C</u>.

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 hole in the crossbar that holds sample.

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

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

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

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

APPENDIX III

ITEM 114: THERMINOL SURGE TANK
5'-0" OD X 5'-3" HIGH - DISHED ENDS

Level	Gallons	Level	Gallons	Level	Gallons
0"	78 (Dish)	2'-5"	433	4'-10"	788
1	90	-6	445	-11"	800
2	102	-7	457	5'- 0"	813
3	114	-8	470	- 1"	825
4	127	-9	482	- 2"	837
5	139	-10	494	- 3"	849
6	151	-11	506		
7	163	3'- 0"	519		
8	176	- 1	531		
9	188	- 2	543		
10	200	- 3	555		
11	212	- 4	568		
1'- 0"	225	- 5	580		
- 1	237	- 6	592		
- 2	249	- 7	604		
- 3	261	- 8	617		
- 4	274	- 9	629		
- 5	286	-10	641		
- 6	298	-11	653		
- 7	310	4'- 0"	666		
- 8	323	- 1	678		
- 9	335	- 2	690		
- 10	347	- 3	702		
- 11	359	- 4	715		
2'- 0"	372	- 5	727		
- 1	384	- 6	739		
- 2	396	- 7	751		
- 3	408	- 8	764		
- 4	421	- 9	776		

ITEM 125: BLOWING TANK
10'-0" OD X 10'-0" HIGH
DISHED HEADS

% Scale	Gallons	Innage(")		% Scale	Gallons	Innage(")
0	611 (dish)	0	(16.3")	52	3,644	62.4"
2	728	2.4		54	3,760	64.8
4	844	4.8		56	3,877	67.2
6	961	7.2		58	3,994	69.6
8	1,078	9.6		60	4,110	72.0
10	1,194	12.0		62	4,227	74.4
12	1,311	14.4		64	4,343	76.8
14	1,427	16.8		66	4,460	79.2
16	1,544	19.2		68	4,577	81.6
18	1,661	21.6		70	4,693	84.0
20	1,777	24.0		72	4,810	86.4
22	1,894	26.4		74	4,927	88.8
24	2,011	28.8		76	5,043	91.2
26	2,127	31.2		78	5,160	93.6
28	2,244	33.6		80	5,277	96.0
30	2,361	36.0		82	5,393	98.4
32	2,477	38.4		84	5,511	100.8
34	2,594	40.8		86	5,627	103.2
36	2,711	43.2		88	5,743	105.6
38	2,827	45.6		*90	5,860	108.0
40	2,944	48.0		92	5,976	110.4
42	3,060	50.4		94	6,093	112.8
44	3,177	52.8		96	6,210	115.2
46	3,294	55.2		98	6,326	117.6
48	3,410	57.6		100	6,443	120.0
50	3,527	60.0				

Sp.Gr.: 1.5
Inst. Range: 0-180" H_2O
Inst. Scale: 0-100% Linear

*Alarm Point %

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STANDARD OPERATING INSTRUCTIONS
FOR
SOLID AROCLOR 5460

PROCESS FUNCTION OUTLINE

III. C. I. NO. 5 STILL SYSTEM

1.1 Scope

This covers the charging, start-up, shutdown, normal operation, and emergency situations involving the No. 5 Aroclor Still System.

1.2 Description of Process

Aerated crude Aroclor from a blowing 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 vaporization temperature. Vapors pass up an open column through a cyclone separator 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 transferred to the flaker hold tank for flaking or drumming into suitable containers.

Still residue or bottoms from two distillations (four chlorinator batches) 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. Thermínol Cooling System for No. 5 Still Condenser

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

(1) Use temporarily relocated Pyranol pump to charge Therminol surge tank (Item 139).

(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.

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C. III. 3.1 A. 1. a. (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 six drums or approximately 325 gallons total are in the surge tank (Item 139).

b. Therminol 1242 can be charged directly to the surge tank (Item 139) by the following procedure:

(1) Align valves in line from storage tank to surge tank (Item 139). Care must be taken to ensure that all valves to the other surge tanks are closed. They are also filled from this storage tank line.

(2) Check level gauge at surge tank.

(3) Start storage tank pump.

(4) Observe this level gauge at the surge tank and shut off pump when you have 275 gallons or 32 inches in the sight glass. Once circulation is established add therminol to bring the sight glass level to 12".

(5) Close valves in line from storage tank to surge tank.

2. Still and Furnace Start-Up

a. Charge to the No. 5 Still

Under normal conditions, crude Aroclor is charged to the No. 5 still with the charge measured by the level indication (LIA-125-2) on the No. 5 blow tank. The blow tank (Item 125) holds two chlorinator batches of 2,160 gals/batch. Two chlorinator batches are charged to the No. 5 still to make up one still batch.

b. Prepare No. 5 Blow Tank (Item 125) for transfer of charge:

(1) Check to be sure the steam heating system is on the transfer pump (Item 126) and the therminol on the charging lines. Material to be pumped must be hot. Cold lines can also cause plug-ups and failure to transfer material.

C. III. 3.1 A. 2. b. (2) Check temperature of material in blowing tank to be sure it is hot enough to transfer - above 200°C. See TIC-125-1.

(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 129).

(2) Set valves from the No. 5 blow tank to the No. 5 still. Be sure the therminol heating system is on all transfer lines.

(3) Close the main valve in the vacuum line to the still just above the receiver. Start steam to the vacuum jets. Put steam on stage 4, stage 3, stage 2, and stage 1, in that order. Stage 1 is the closest to the receiver. Adjust water to the after condensers on the last three stages. The jet on the No. 5 still should pull down to 2-3 mm Hg absolute on the receiver (Item 132). The steam to the jet on the No.5 still should have a minimum of 90 psig supply pressure - operate at 110 psig. Normally, this unit will stay in continuous operation.

(4) Open vent valve on the still receiver.

d. Start up the Therminol Cooling System for the No. 5 Still Condenser (Item 131):

(1) Set TICA-141-1 at 60°C.

(2) The set points for the therminol high and low temperature alarms are at 70°C and 30°C.respectively.

(3) Set the valves in the therminol cooling system for the No. 5 still condenser (Item 131) to allow circulation from the surge tank through the condenser and back into the surge tank. Therminol only goes through the tower water cooler on demand. When needed, the small stream of 60°F therminol is mixed with the hot circulating therminol to maintain the desired 145°C.

(4) Open the steam heating valve to the surge tank (Item 139). Wait until the temperature of the therminol cooling system is 70°C., then start the circulating pump (Item 140).

C. III. 3.1 A. 2. d. (5) Check the level in the surge tank (Item 139). There should be 12 inches in the sight glass.

(6) Set the temperature controller TRC-131-1 for the therminol going to the condenser at 145°C.

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

(a) Therminol cooling system circulating pump (Item 140) discharge pressure should be 45 psig. Flow rate should be 200 GPM.

(b) TICA-131-1 (circulating therminol temperature) should be set at 145°C.

(c) TIC-141-1 (cooled therm. from therm. cooler) should be set at 60°C.

e. Charging the No. 5 Still and Start-up:

(1) Set valves in transfer line from No. 5 blow tank to the still.

(2) Start the blowing tank pump (Item 126) and transfer a full charge into the still tank. This is done by observing the before and after level in the blow tank (Item 125).

(3) Stop the No. 5 blow tank transfer pump when the charge is complete as noted on the No. 5 blow tank level gauge.

(4) Close the valve on the transfer line located on top of the blow tank.

(5) Set valves in the No. 5 still circulating line through the heater coil (Item 128) and back into the still tank. These valves stay in the correct position during normal operation.

(6) Start up preheat of the No. 5 still furnace (Item 128). (See the following page)

(7) Start the circulating pump (Item 134) after the furnace stack temperature has reached 200°C.

C. III. 3.1 A. 2. e. (8) Add hydrated lime through the chute provided for this purpose on the No. 5 still. Add 400 pounds (8 bags) of lime for each still batch.

(9) Swing the chute away and button down the wing nuts.

f. Furnace Start-Up for the First Time:

(1) Preliminary Procedure

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

(b) Open damper on the furnace stack.

(c) Turn on circuit No. 9 at the still panel and the breaker switch on the outside of the field control box to "ON". The "RED" light at the Honeywell Protectoglo unit will light up.

(d) Put fuel gas flow controller FRCA-128-1 in manual with output at 1 psig.

(e) Set high temperature switch at 425°C. (800°F).

(f) At this stage the "RED" light on the "Protectoglo Relay" is on. The heater shutdown alarm is sounding and must be acknowledged.

(2) Start-Up Procedure

(a) Move red safety switch inside the "Protectoglo" unit in the field control box to the right to reset. You must wait 10 seconds before the switch can be reset in case it has to be redone.

(b) At end of purge period (there is no air blower and hence no purge but purge timer introduces a time delay and natural convection will cause an upward draught) the green "pre-purge complete" light will light.

(c) Carry out a "sniff" test through the small side door of the furnace. If the test shows dangerous, stop and correct the cause of trouble before lighting 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. If satisfactory, proceed.

C. III. 3.1 A. 2. f. (2) (d) Depress the ignition start button inside 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" and "red" lights will go out. When this occurs, pull your finger away. The pilot is now properly lit. Pilot flame is detected by "purple peeper" and a steady audible clicking of checking relay will be heard.

(e) Manually open the two reset safety valves in the main gas line prior to the flow valve. The heater is now ready for operation. These safety valves will not stay open if the signal to the gas flow control valve is above 3 psig.

(f) The main burner will not yet be lit because the fuel gas flow control valve FV-128-1 is closed. See f.(1)(d) previous page.

(g) The still furnace coil can be preheated by using the pushbutton on the still control panel. This will allow by-passing the furnace no flow interlock to start gas into the furnace without starting the still pump.

It is desirable to fire the furnace for the purpose of either drying out the brickwork or to temper the coils before circulation begins when the unit is cold. Preheating is necessary to prevent plugging. For this reason, a tempering button is installed on the burner control panel which is mounted in the field. This button energizes a relay for ten (10) minutes only. It may be necessary to use this temper button several times.

(h) When preheating is required the tempering button is pushed and with the gas flow controller FRCA-128-1 in "manual", slowly open the control valve and monitor stack temperature when the main burner has lit. Observe the temperature at point #8 on the multipoint recorder. Do not exceed 200°C. but this temperature should be maintained until circulation is established. If preheating is not necessary, skip this step.

C. III. 3.1 A. 2. f. (2) (i) Start up the solid still circulating pump (Item 134). The circulating flow meter FIA-128-2 will now indicate a flow around 290 GPM. Flow below 125 GPM will cause the main burner to be shut off.

(j) Leave the gas flow controller, FRCA-128-1 on manual. If there was no preheat the gas flow will be a zero. Gradually increase the set point to 3,000 SCFH. Press the "acknowledge" button on main control panel. Alarm "Still #5 Fuel Gas Low Flow" should go out. If the stack outlet temperature is higher than 550°C. the set point should be lowered. Switch the controller to automatic operation.

Observe the coil outlet temperature on the multipoint temperature recorder. The distillation or "boiling" is considered to be started when the vapor temperature makes a sudden increase. Observe point #14 on the digital indicator for this indication. After the initial heat up to around 290°C. the fuel gas must be cut back to 2,300 SCFH to maintain vacuum around 12-15 mm Hg in the still.

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

1) Natural gas flow to the furnace on FRCA-128-1.

2) No. 5 still circulating pump flow FIA-128-2.

3) Therminol cooling system temperature on TRCA 131-1.

4) Check the coil temperature differential on the inlet and outlet of the furnace (Item 128). There should be an 8°C. spread.

g. Start-Up of Furnace after Temporary Shutdown:

(1) Prior to start-up, the still coil can be preheated before starting the circulating pump, if necessary. See Section f.(2)(g).

(2) Adjust natural gas flow controller in "manual" to a set point of 1 psig output pressure. This is FRCA-128-1.

C. III. 3.1 A. 2. g. (3) Start up the solid still circulating pump (Item 134). The Aroclor circulating flow meter FIA-128-2 should now indicate a flow in excess of 290 GPM. Shutdown will occur at a flow below 125 GPM.

(4) Check that the vacuum is 1 mm Hg on the line above the catch tank (Item 135). Open the main valve in the vacuum line from the jets to the receiver. Vacuum at the still receiver should be approximately 2-3 mm Hg. The vacuum on the still will be 12-15 mm Hg. during operation.

(5) Gradually raise the set point of the natural gas flow controller FRCA-128-1 to 3,000 SCFH for the initial heat up. (See (j) previous page)

3. Operation of the Still During Distillation

a. Check the multipoint temperature recording instrument for the temperature rise across the coil in the heater furnace points #8 and #9. 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.

b. A spread of 8°C. between the coil inlet and outlet is normal. A 12°C. temperature spread is the maximum difference allowable.

c. Be sure the steam heating system is off the vacuum line to the jets during operation.

d. Check the therminol cooling system on the No. 5 still condenser (Item 131) to be sure the condenser does not plug up. If plugging begins to occur, raise the temperature in the therminol cooling circulation system. Use TRC -131-1 to accomplish this. There is no alarm on this controller, so it must be watched closely.

e. Vacuum problems on the stills are usually due to flashing of product over plugging vacuum lines, leaks in the still system, leaks at pump packing, or therminol flow problems on the condenser, water adjustment on the jets, 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. 5 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:

C. III. 3.1 A. 3. e. (1) On top of the trap in front of the jet (Item 135).

(2) On the cyclone separator off-gas line (Item 130).

(3) On the still (Item 129).

(4) On the receiver (Item 132).

f. The still receiver temperature indicating controller TIC-132-1 is set at 150°C.

g. A level indication gauge has been installed in the still receiver (Item 132) to allow indication of the level of material being distilled over. The level instrument is LI-132-2.1. This level indication can be used to help determine when the distillation is near completion. Normally the receiver gauge will be indicating 80-90% at the end.

h. As the distillation nears completion, the vacuum will start to come down lower and the flow through the coil will start to drop. If the flow drops below 125 GPM, an alarm will sound and the main gas burner to the furnace will shut off. Normally the flow will not drop below 240 GPM.

i. The distillation temperature should normally be carried no higher than 370°C. on the coil outlet. At this point the batch is checked for color and softening point. Be sure the receiver has been circulating for at least 30 minutes before a sample is taken. If it is in specification, cut the fuel gas flow to zero, transfer the receiver to the day tank (Item 810), and prepare to charge the still again. For the second run, the fuel gas should be cut back to 1400-1500 SCFH to maintain the circulating Montar 5 around 360°C. This is to prevent it from cooling down before they are drawn. Be careful to shut off the furnace before the coil is sucked.

j. Close the main valve in the vacuum line on top of the receiver (Item 132). This is to isolate the jet from the still system and eliminate plugging of the jet.

k. Vent the furnace coil and allow it to suck dry after the second run.

l. 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.

C. III. 3.1 A. 3. 1. 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 and suck the coil. If the coil cannot be sucked, it is plugged and will have to be replaced.

m. 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.

n. The distillation operating conditions are show in Table II.

4. Pump Out Still Receiver

a. Transfer material from the still receiver (Item 132) to the day hold tank (Item 810) or the flaker hold tank (Item 811).

b. Observe level of material in the still receiver by use of LI-132-2.1.

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

d. Set valves in the line to transfer to the desired hold tank.

e. When material is to be transferred, start the transfer pump (Item 133) 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-132-2.1.

5. Operation for Drawing Bottoms into Drums:

a. Check to be sure that Therminol heat is on the draw-out line.

b. Place necessary drum near draw-out station approximately 30-35 drums.

c. Set valves in line to draw-out station.

TABLE II

DISTILLATION OPERATING CONDITIONS-SOLID 5460 AROCLOR	
Approximate Temperature at which 5460 Aroclor starts distilling @ 10 mm Vacuum. At Still:	
Coil Inlet	280°C
Coil Outlet	290°C
Approximate Finishing Temperature:	
Still Pot	360°C
Coil Inlet	360°C
Coil Outlet	370°C
Finishing Softening Point	98-105°C

C. III. 3.1 A. 5. d. Check to be sure the exhaust fan is running.

e. Obtain assistance to draw bottoms.

NOTE: Fumes from this operation are toxic. If the exhaust fan should stop, discontinue drawing out and notify the Chief Operator.

The material to be drawn into drums is hot. Have the person filling the drums to put on face shield and gloves.

f. Place drum under valve at draw-out station. Open valve under still. Close draw-out valve.

g. If the bottoms being drawn out are for shipment, open the valve at draw-out station and allow approximately 25 to 30 gallons of material to flow through the line into the drum to flush out the line.

h. If the bottoms being drawn out are not for shipment, flush out of line is not necessary.

i. Continue drawing out until the still is empty. Fill drums to within 6" - 8" of top and place cover on drum. As the drums are filled move them on conveyor to east platform.

j. Close the valve under the still. Leave the valve at draw-out station open.

k. Allow drums to set on conveyor and labor will palletize the drums. Drums to be discarded will be transferred to the dump by plant stake truck.

C. III. 3.1 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. 5 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 at least 200°C.

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

   d. The No. 5 still vacuum system should be operating with the valve just above the No. 5 still receiver closed. Water should be on the condensers and steam on the jet stages. Vacuum on the trap (Item 135) in the vacuum pipe line should be indicating 1-3 mm Hg.

2. The No. 5 still receiver temperature controller TIC-132-1 should have the set point at 150°C.

3. The therminol cooling system should be circulating through the No. 5 still condenser and back to the surge tank. The temperature controller TRC-131-1 should be in "auto" with the set point at 145°C. Tower water should be on the therminol water cooled heat exchanger.

4. The natural gas flow controller FRCA-128-1 will be in "manual" with the set point below 2.5 psig output pressure.

5. The pilot flame for the No. 5 still furnace (Item 128) will be on as indicated by the Honeywell Protectoglo unit in the field panel. The "white" light on the Protectoglo unit will be on.

6. Set valves in the transfer line from the No. 5 blow tank to the No. 5 still.

7. Open the vent valve on the No. 5 receiver.

8. Start the No. 5 blow tank transfer pump and charge the No. 5 still. Observe level indication gauge in the No. 5 blow tank to measure the still charge.

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C. III. 3.1 B. 9. The solid still circulating pump will already be circulating.

10. Stop the No. 5 blow tank transfer pump as soon as the blow tank is empty. Close the valve on the transfer line.

11. Add 400 lbs. of lime to the still charge.

12. Close the vent valve on the No. 5 receiver. Open the vacuum valve on the No. 5 still receiver and start the vacuum on the system.

13. Gradually raise the set point of the natural gas flow controller FRCA-128-1 to 3,000 SCFH. Watch the temperature rise across the furnace coil inlet and outlet as the temperature is raised. Normally, an $8^{o}C.$ spread will be obtained across the furnace coil.

14. 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 FIA-128-2.

    c. Level indication in the No. 5 still receiver. See LI-132-2.1.

    d. Natural gas flow control to the No. 5 still furnace. See FRCA-128-1.

    e. Temperature control on the No. 5 still condenser therminol circulating system. See TRC-131-1.

    f. Temperature control in the No. 5 still receiver. See TIC-132-1.

15. At the end of the distillation the batch is checked for color and softening point.

C. III. 3.1 B. 16. Shut off the natural gas when the distillation is finished, and bottoms are ready to be drawn. Clear the coil by doing the following:

a. Close the vacuum valve on top of the No. 5 still receiver in the line to the jet.

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

17. Set lines to transfer material to the desired hold tank. Set the valves in the transfer line and start transfer pump to the hold tank. When the No. 5 still receiver is empty, stop the circulating pump and close the valves in the transfer lines.

3.2 Routine Operations

When the No. 5 still system is operating normally, the following conditions will exist in the process:

A. No. 5 still pressure will be around 12-15 mm Hg.

B. No. 5 still circulatin pump flow indicated on FIA-128-2 with flow above 125 GPM.

C. No. 5 still condenser temperature control TRC-131-1 set at 145°C.

D. Natural gas feed to the still furnace controller FKCA-128-1 set to give desired coil outlet temperature (about 2300 scfh).

E. Furnace high temperature alarm instrument set at 425°C.

F. Therminol cooling system temperature controller TICA-141-1 set at 60°C.

G. No. 5 still receiver temperature control TIC-132-1 set at 150°C.

H. No. 5 still receiver level indication gauge LI-132-2.1 will indicate level.

I. Main natural gas pressure 40 psig.

J. Natural gas reduced pressure 4 psig.

C. III. 3.3 Safety Features

A. The Honeywell Protectoglo unit has the following safety features for the No. 5 still furnace (Item 128):

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

2. Heater coil high temperature outlet shutdown set at 425°C.

3. Natural gas high reduced pressure shutdown set at 25 psig.

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

5. Pilot flame must be burning to start up the unit. This is indicated by 4 microamperes on the field control panel.

3.4 Shutdown

A. Temporary Shutdown

Main gas burner is off with the pilot light on. The No. 5 still circulating pump running and the vacuum system on.

1. Adjust FRCA-128-1. Set point to 0. Instrument in "manual".

2. The vacuum may be cut off by closing the manual valve above the No. 5 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. Still circulating pump off. The vacuum shut down and the Therminol cooling system shut off.

1. Push ignition stop button inside the field control panel for the furnace control system. Hold it until the red lamp comes on.

C. III. 3.4 B. 2. After the furnace has cooled slightly, push the stop button for the No. 5 still circulating pump (Item 134).

3. Close manual valve above the No. 5 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 condensers on the No. 5 still jet.

6. Stop the Therminol cooling system circulating pump (Item 140). An alarm will sound.

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

8. Adjust [illegible] TRC-131-1, and TIC-132-2 controller set point to <u>0</u>.

9. Turn off the tower cooling water to the Therminol cooler (Item 141).

3.5 <u>Control Loops, Interlocks, and Alarms</u>

A. <u>Control Loops</u>

There are nine (9) major control loops in this system.

1. <u>No. 5 Still Circulating Pump Low Flow Shutdown-FIA-128-2</u>

The function of this loop is to measure the flow through the furnace heater coil on the No. 5 still. This is accomplished by measurement with a Ramapo Mark 5 Flow Meter that indicates the flow to a panel. Normal flow will be <u>290 GPM</u>. A low flow alarm shutdown for the furnace (Item 128) main gas system will be actuated if the flow drops below <u>125 GPM</u>. Complete shutdown of fuel gas to the main burner occurs.

2. <u>Heater Fuel Gas Flow Control - FRCA-128-1</u>

The function of this loop is to control the gas input to the No. 5 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 until the desired setting is obtained.

C. III. 3.5 A. 3. No. 5 Still Furnace Controls - Item 128

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 425°C.

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

c. High reduced natural gas pressure 25 psig.

d. Failure of circuit No. 9 at the rear of the still panelboard, or electrical failure.

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

f. Low circulating of crude Aroclor flow below 125 GPM.

When any one of the six conditions occurs an alarm sounds in the main control room indicating furnace shutdown. If the shutdown is caused by a. or f. separate alarms also sound. If neither of these alarms sound then the cause of shutdown must be elimirated between b., c., d., or e.

4. No. 5 Still Receiver Temperature Control - TIC-132-1

The function of this loop is to control the temperature in the No. 5 still receiver to 150°C. This is accomplished by measuring the temperature in the receiver and throttling a control valve on the 200# steam inlet line to the heating coil.

5. No. 5 Still Receiver Level Indication - LI-132-2.1

The function of this loop is to indicate the level of distilled product in the No. 5 still receiver. This is accomplished by a float level instrument which indicates the Aroclor level in the control room and in the field.

6. No. 5 Still Condensate Temperature - TRC-131-1

The function of this loop is to control the temperature of the cooling therminol going into the No. 5 still condenser. It does this by mixing therminol cooled to 60°C. in the tower water cooler (Item 141) with the hot circulating therminol to maintain a temperature of 145°C.

C. III. 3.5 A. 7. Therminol Cooling System Flow Control - FICA-140-1

The function of this loop is to maintain a constant flow of 200 GPM. through the still condenser. This is accomplished by measurement of flow with an orifice flow meter and adjusting a control valve. When TRC-131-1 calls for cooled therminol to maintain 145°C. in the circulating system, FICA-140-1 closed down in proportion to maintain a 200 GPM total flow. Normal operation of the system is with the controller in "Auto" and the set point at 200 GPM. A low flow alarm will sound at 160 GPM.

8. Therminol Cooling System Temperature Control-TICA-141-1

The function of this loop is to control the temperature of the therminol going through the cooler at 60°C. This therminol is needed by TRC-131-1 to maintain 145°C in the condenser during distillation. This is accomplished by measurement of the discharge temperature from the therminol water cooler (Item 141) and automatically throttling the water flow on the shell side of the cooler. The low temperature alarm on this system is set at 30°C. The tower water valve TV-141-1 has a stop to ensure water is always flowing through the cooler thus preventing boiling. The high temperature alarm is set at 70°C. There is no temperature controller on the surge tank (Item 139).

9. Still No. 5 Level System - LS-129-3 & 4

The function of this loop is to only give visual and audible indication of low level. High level will shut down the blow tank pump (Item 126). These will prevent over charging the still pot and alert operators that batch distillation has continued to a point that endangers the N.P.S.H. requirements of the still circulating pump. The level switches are both gamma type radiation detectors. The high level actuates when radiation is decreased and the low level when radiation increases sufficiently.

B. Interlocks

Interlocks in this system are as follows:

1. Start-Up of No. 5 Still Furnace (Item 128)

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. Before the ignition "start" button at the Protectoglo unit is pushed the red safety switch is moved to reset. It has a 3 minute purge delay. This is to allow for natural convection to purge the furnace before it lights up.

C. III. 3.5 B. 1. c. The two safety valves in the main fuel gas line will not stay on unless the signal to the gas control valve is below 3 psig.

d. Complete shutdown of fuel gas to the main burner occurs if the circulating flow through the furnace drops below 125 GPM.

e. As stated in "A" Section (Control Loops), the furnace will shut down from six safety features. See Section "A".

2. Automatic No. 5 Still Furnace Shutdown with Alarms (Pilot and Main Gas Burner Off)

a. High furnace coil outlet temperature above 425°C.

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

c. High reduced natural gas pressure 25 psig.

d. Low coil flow below 125 GPM. (Pilot light stays on)

e. Failure of circuit No. 9 at the rear of the still panel.

f. Failure of the switch inside 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. 5 still circulating pump low flow alarm below 125 GPM.

3. Therminol cooling system TICA-141-1 has a low temperature alarm at 30°C. and a high temperature alarm at 70°C.

4. There is a high-low temperature alarm on the No. 5 still pot that is detected by the multipoint recorder. It is set at 430°C. for the high alarm and at 200°C. for the low alarm.

IV. COMMENTS ON THE PROCESS

A. It is very important to be sure there is adequate fluid in the Therminol cooling system surge tank (Item 139). This assures the circulating pump has a positive suction. This will allow more uniform control of the temperature in the Therminol cooling system.

C. IV. B. Care must be taken not to fill the surge tank (Item 139) too full during normal operation. This can cause the tank to run over when the circulating pump is stopped.

C. 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 128).

D. 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 carry-over. The vacuum line from the No. 5 still receiver (Item 132) has steam heat on the tracers of the pipe line up to the suction line on the jet (Item 136). The trap tank (Item 135) in the vacuum line has steam heat on the coils in the tank. It is very important that the steam heating system be cut off the tracer lines and the coils in the trap tank during normal operation. If these lines are kept hot during normal operation, it will cause carry-over into the jet nozzles and cause more rapid plugging than in the past. When using the steam heating system to clean out the lines or drain the trap tank, the jet should be isolated from the No. 5 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.

E. The still pot No. 5 level system LS-129-3 & 4 requires special attention. There is a lock that maintains a safety shutter on the radiation source holder which must be unlocked to operate. The law requires the source holder will be periodically wipe tested by an approved representative to ensure that leakage of the radioactive source has occurred.

Aroclor -
PFO

APPENDIX

ITEM 111 and 139: Therminol Surge Tank
3'-6" OD X 4'-3" High
Dished Ends

Level	Gallons	Level	Gallons
0"	24 (Dish)	2'-6"	204
1"	30	2'-7"	210
2"	36	2'-8"	216
3"	42	2'-9"	222
4"	48	2'-10"	228
5"	54	2'-11"	234
6"	60	3'-0"	240
7"	66	3'-1"	246
8"	72	3'-2"	252
9"	78	3'-3"	258
10"	84	3'-4"	264
11"	90	3'-5"	270
1'-0"	96	3'-6"	276
1'-1"	102	3'-7"	282
1'-2"	108	3'-8"	288
1'-3"	114	3'-9"	294
1'-4"	120	3'-10"	300
1'-5"	126	3'-11"	306
1'-6"	132	4'-0"	312
1'-7"	138	4'-1"	318
1'-8"	144	4'-2"	324
1'-9"	150	4'-3"	330
1'-10"	156		
1'-11"	162		
2'-0"	168		
2'-1"	174		
2'-2"	180		
2'-3"	186		
2'-4"	192		
2'-5"	198		

APPENDIX

ITEM 132: No. 5 STILL BATCH RECEIVER
8'-0" OD x 10'-0" HIGH - DISHED HEADS

% Scale	Gallons	Innage(")	% Scale	Gallons	Innage(")
0	310	0 (13")			
1	347	1.2	51	2,212	61.2
2	385	2.4	52	2,250	62.4
3	422	3.6	53	2,287	63.6
4	459	4.8	54	2,325	64.8
5	496	6.0	55	2,362	66.0
6	534	7.2	56	2,399	67.2
7	571	8.4	57	2,435	68.4
8	608	9.6	58	2,472	69.6
9	646	10.8	59	2,510	70.8
10	683	12.0" (1 ft.)	60	2,547	72.0 (6 ft.)
11	720	13.2	61	2,584	73.2
12	757	14.4	62	2,522	74.4
13	795	15.6	63	2,660	75.6
14	832	16.8	64	2,698	76.8
15	869	18.0	65	2,732	78.0
16	907	19.2	66	2,770	79.2
17	943	20.4	67	2,808	80.4
18	981	21.6	68	2,847	81.6
19	1,018	22.8	69	2,883	82.8
20	1,056	24.0 (2 ft.)	70	2,920	84.0 (7 ft.)
21	1,093	25.2	71	2,957	85.2
22	1,131	26.4	72	2,995	86.4
23	1,168	27.6	73	3,031	87.6
24	1,205	28.8	74	3,070	88.8
25	1,243	30.0	75	3,108	90.0
26	1,280	31.2	76	3,145	91.2
27	1,317	32.4	77	3,182	92.4
28	1,354	33.6	78	3,218	93.6
29	1,391	34.8	79	3,256	94.8
30	1,428	36.0 (3 ft.)	80	3,292	96.0 (8 ft.)
31	1,466	37.2	81	3,330	97.2
32	1,503	38.4	82	3,368	98.4
33	1,540	39.6	83	3,405	99.6
34	1,578	40.8	84	3,442	100.8
35	1,615	42.0	85	3,480	102.0
36	1,652	43.2	86	3,517	103.2
37	1,689	44.4	87	3,553	104.4
38	1,727	45.6	88	3,590	105.6
39	1,763	46.8	89	3,628	106.8
40	1,801	48.0 (4 ft.)	90	3,667	108.0 (9 ft.)
41	1,838	49.2	91	3,702	109.2
42	1,877	50.4	92	3,740	110.4
43	1,913	51.6	93	3,777	111.6
44	1,950	52.8	94	3,815	112.8
45	1,988	54.0	95	3,853	114.0
46	2,027	55.2	96	3,890	115.2
47	2,062	56.4	97	3,928	116.4
48	2,100	57.6	98	3,964	117.6
49	2,137	58.8	99	4,000	118.8
50	2,173	60.0 (5 ft.)	100	4,040	120.0 (10 ft.)

Aroclor 5460
Sp.Gr.: 1.5 @ 150°C
Temperature: 150°C

Inst. Range: 0-10 ft.
Inst. Scale: 0-100% Linear

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AROCLOR 5460

ITEM 810

% Scale	Gal.	Inch.	% Scale	Gal.	Inch.	% Scale	Gal.	Inch.
0	480	9	35	1889	49	70	3298	90
1	520	10	36	1929	50	71	3338	91
2	561	11	37	1969	52	72	3378	92
3	601	12	38	2010	53	73	3418	93
4	641	14	39	2050	54	74	3459	94
5	681	15	40	2090	55	75	3499	95
6	722	16	41	2130	56	76	3539	96
7	762	17	42	2171	57	77	3579	98
8	802	18	43	2211	58	78	3620	99
9	842	19	44	2251	60	79	3660	100
10	883	21	45	2291	61	80	3700	101
11	923	22	46	2332	62	81	3740	102
12	963	23	47	2372	63	82	3781	103
13	1003	24	48	2412	64	83	3821	104
14	1044	25	49	2452	65	84	3861	106
15	1084	26	50	2493	67	85	3901	107
16	1124	27	51	2533	68	86	3942	108
17	1164	29	52	2573	69	87	3982	109
18	1205	30	53	2613	70	88	4022	110
19	1245	31	54	2654	71	89	4062	111
20	1285	32	55	2694	72	90	4103	113
21	1325	33	56	2734	73	91	4143	114
22	1366	34	57	2774	75	92	4183	115
23	1406	35	58	2815	76	93	4223	116
24	1446	37	59	2855	77	94	4264	117
25	1486	38	60	2895	78	95	4304	118
26	1527	39	61	2935	79	96	4344	119
27	1567	40	62	2976	80	97	4384	121
28	1607	41	63	3016	81	98	4425	122
29	1647	42	64	3056	83	99	4465	123
30	1688	44	65	3096	84	100	4505	124
31	1728	45	66	3137	85			
32	1768	46	67	3177	86			
33	1808	47	68	3217	87			
34	1849	48	69	3257	88			

Range - 0-172" W.C.

Sp.Gr. 1.49
For 5460 @ 240°C

SOLID AROCLOR FLAKER FEED TANK

ITEM 811

Inches	Gallons	Inches	Gallons	Inches	Gallons
1	8	36	1715	71	4138
2	23	37	1783	72	4196
3	40	38	1853	73	4260
4	64	39	1928	74	4323
5	90	40	1994	75	4385
6	119	41	2060	76	4444
7	152	42	2128	77	4502
8	187	43	2198	78	4563
9	223	44	2266	79	4620
10	262	45	2342	80	4678
11	302	46	2408	81	4734
12	345	47	2478	82	4789
13	389	48	2545	83	4841
14	433	49	2621	84	4894
15	480	50	2695	85	4945
16	528	51	2762	86	4995
17	578	52	2829	87	5043
18	629	53	2903	88	5090
19	682	54	2979	89	5134
20	735	55	3046	90	5178
21	790	56	3116	91	5221
22	846	57	3182	92	5261
23	904	58	3258	93	5300
24	961	59	3326		
25	1022	60	3396		
26	1080	61	3464		
27	1139	62	3530		
28	1201	63	3596		
29	1264	64	3671		
30	1328	65	3741		
31	1386	66	3809		
32	1454	67	3874		
33	1521	68	3938		
34	1586	69	4003		
35	1650	70	4070		

Sp. Gr. 1.49

For 5460 @ 240^{o}C

DSW 334727

STLCOPCB4081197

STANDARD OPERATING INSTRUCTIONS
FOR
SOLID AROCLOR 5460

PROCESS FUNCTION OUTLINE

III. C. I. SOLID HCl OFF-GAS CLEAN-UP

1.1 Scope

This covers the start-up, shutdown, and normal operation of the HCl Off-Gas Clean-Up System involving No. 10 (11) Chlorinator.

1.2 Description of Process

HCl gas produced on the No. 10 (11) chlorinator system passes through an off-gas condenser which cools the gas to knock out the Santowax and Aroclor vapors. The gas then flows through a catch tank, combines with the gas from the Liquid system and flows to the Muriatic Acid absorber.

A Therminol (1242 Aroclor) cooling system is circulated through the tube side of the off-gas condenser to cool the HCl gases. Material collected in the catch tank is returned to the weigh tank for other chlorinator charges.

II. PROCESS DIAGRAM

Attached.

III. OPERATION OF PROCESS

3.1 Charge Therminol Cooling System Surge Tank (Item 111)

A. Therminol 1242 can be charged directly to the surge tank by the following procedure:

1. Align valves in line from storage tank to surge tank. Care must be taken to ensure that all valves to the other surge tanks are closed. They are also filled from this storage tank line.

2. Check level gauge at surge tank.

3. Start storage tank pump.

4. Observe the level gauge at surge tank and shut off pump when you have 275 gals. or 32 inches in the level gauge.

5. Close valves in line from storage tank to surge tank.

C. III. 3.1 B. Charge System with Therminol FR-2 (Aroclor 1248)

1. Use temporary relocated Pyranol pump to charge surge tank (Item 139).

2. Position 55 gal. 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 pump into the tank.

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

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

7. Continue to fill the surge tank until five (5) drums or approximately 275 gallons total are in the surge tank (Item 111).

3.2 Start-Up

1. Set the panel mounted therminol temperature controller TIC-111-1 in automatic with the set point at 120°C.

2. Set the off-gas storage tank (Item 109) locally mounted temperature indicating controller, TIC 109-1, in automatic with the set point at 120°C.

3. Set valves to allow circulation of the therminol system from the therminol surge tank (Item 111) to the circulating pump (Item 112), through the tube side of the off-gas condenser (Item 108), through the air therminol cooler (Item 113), and back to the therminol surge tank.

4. Open manual valves to allow circulation of steam heat through the jacket on the off-gas storage tank (Item 109).

5. Check to be sure the valve on bottom of the off-gas storage tank is closed.

6. Set manual valves to allow HCl gas to flow through the off-gas condenser (Item 108) through the off-gas storage tank (Item 109) and to the Muriatic Acid absorber.

C. III. 3.2 7. This system should now be in automatic control. Checking of the pressure across the condenser will indicate plugging if if should occur.

8. Material accumulated in the off-gas storage tank will be recycled through the chlorinator system for reuse. A locally mounted gauge indicates the tank level.

3.3 Shutdown

1. It is necessary to shut down the No. 10 (11) chlorinator if work is to be done on the condenser (Item 108) or the off-gas storage tank (Item 109).

2. Close manual valve from the chlorinator and on the exit line after the storage tank.

3. The therminol heat system on the tube side of the off-gas condenser can be shut down by stopping the circulating pump (Item 112).

4. The system is now shut down and can be worked on if necessary.

3.4 Instruments

1. Therminol Circulating System Temperature Control-TIC-111-1

The temperature in the therminol circulating system for the off-gas condenser in the clean-up system is controlled by sensing the temperature in the surge tank and controlling the louvers on the air cooled therminol cooler and the control valve on the line to the coil in the surge tank. At 3 psig, the louvers are open giving maximum cooling; at 9 psig, the louvers are closed and the second positioner (which has been inoperative up to 9 psig) applies a 3 psig signal to the steam control valve on the coils causing it to open. At 15 psig., input into this positioner will cause a 15 psig signal to the valve to open it fully. The instrument will be in automatic with the set point at 120°C.

2. Off-Gas Storage Tank Temperature Controller - TIC-109-1

The temperature in the off-gas storage tank (Item 109) is controlled by sensing the temperature of the material in the tank and throttling the control valve on the input line on the tank's jacket. The controller is in automatic with the set point at 120°C.

C. III. 3.4 3. Solids Knock-Out Tank Level Indicator - LI-109-2

The off-gas storage tank has a sight feed bubbler system sensed by a D/P cell and is transmitted to a gauge graduated 0-100%. The signal is directly proportional to tank level. It is field mounted.

IV. COMMENTS

1. Plugging of the off-gas condenser in the clean-up system can occur. To unplug the off-gas condenser the temperature of the therminol system will be elevated as required. It will probably require a temperature of 160 - 170°C.

2. Even with the louvers shut the steam coil does not transfer enough heat to the Therminol to overcome the cooling effect of the fan in cold weather. During winter months it will be necessary to operate with the fan off and only turning it on as needed to keep the off-gas condenser temperature below 130°C.

ITEM 109: OFF-GAS SURGE TANK
6'-6" OD X 7'-9" HIGH
DISHED HEADS

% Scale	Gallons	Innage (")	% Scale	Gallons	Innage(")
0	170(Dish)	0 (14")	52	1,140	48.5"
2	208	1.9	54	1,176	50.3
4	246	3.8	56	1,214	52.2
6	282	5.6	58	1,252	54.1
8	320	7.5	60	1,290	56.0
10	356	9.3	62	1,326	57.8
12	394	11.2	64	1,364	59.7
14	432	13.1	66	1,400	61.5
16	470	15.0	68	1,438	63.4
18	506	16.8	70	1,474	65.2
20	544	18.7	72	1,512	67.1
22	580	20.5	74	1,550	69.0
24	618	22.4	76	1,586	70.8
26	654	24.2	78	1,624	72.7
28	692	26.1	80	1,662	74.6
30	730	28.0	82	1,698	76.4
32	766	29.8	84	1,736	78.3
34	804	31.7	86	1,774	80.2
36	842	33.6	88	1,810	82.0
38	878	35.4	90	1,848	83.9
40	916	37.3	92	1,886	85.8
42	954	39.2	94	1,924	87.7
44	990	41.0	96	1,960	89.5
46	1,028	42.9	98	1,996	91.3
48	1,066	44.8	100	2,034	93.2
50	1,102	46.6			

Sp.Gr.: 1.2
Inst. Range: 0-112" H_2O
Inst. Scale: 0-100% Linear

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Aroclor -
PFO

APPENDIX

ITEM 111 and 139: Therminol Surge Tank
3'-6" OD X 4'-3" High
Dished Ends

Level	Gallons	Level	Gallons
0"	24 (Dish)	2'-6"	204
1"	30	2'-7"	210
2"	36	2'-8"	216
3"	42	2'-9"	222
4"	48	2'-10"	228
5"	54	2'-11"	234
6"	60	3'-0"	240
7"	66	3'-1"	246
8"	72	3'-2"	252
9"	78	3'-3"	258
10"	84	3'-4"	264
11"	90	3'-5"	270
1'-0"	96	3'-6"	276
1'-1"	102	3'-7"	282
1'-2"	108	3'-8"	288
1'-3"	114	3'-9"	294
1'-4"	120	3'-10"	300
1'-5"	126	3'-11"	306
1'-6"	132	4'-0"	312
1'-7"	138	4'-1"	318
1'-8"	144	4'-2"	324
1'-9"	150	4'-3"	330
1'-10"	156		
1'-11"	162		
2'-0"	168		
2'-1"	174		
2'-2"	180		
2'-3"	186		
2'-4"	192		
2'-5"	198		

EMERGENCY PROCEDURE

AROCLOR DEPARTMENT
OPERATING INSTRUCTIONS

D. EMERGENCY PROCEDURES

This is the plan for departmental action in the event a hazardous situation or injuries warrant emergency action either in the Aroclor Department or within the Anniston Plant.

1. Hazardous Situations which might occur are:

   a. Operational Accidents or difficulties, such as explosions, fires, release of toxic fumes, etc.

   b. Forces of Nature - hurricanes, tornadoes, floods, lightning, etc.

   c. Deliberate Damage - malicious actions, sabotage, direct enemy action.

2. The Primary considerations in the event of a disaster are:

   a. The care of injured individuals and evacuation of personnel to safe areas.

   b. Measures to prevent any, or further, property or equipment damage.

   c. Measures to provide accurate and thorough information so that other plant personnel and the community can be informed, if necessary.

   d. Prompt restoration of affected facilities and resumption of uninterrupted operations.

3. Responsibility

   The areas of responsibility and overall department organization for disaster control are as follows:

   a. Chief Operator:

      Responsible for continuing or closing down production facilities as conditions permit; for directing fire fighting and damage control activities in the department area; keeping department supervision fully informed of conditions within the department.

   b. Operators:

      Responsible for evacuation of all personnel from danger area; for directing and assisting in first aid and rescue missions; reporting to and keeping Chief Operator informed of conditions within his area of responsibility.

      NOTE: All actions of the Fire Brigade are coordinated with the Chief Operator.

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4. Detail of Plan:

a. In the event of an emergency, personnel must be accounted for. The first assembly area for the department is the open area south of the HB-40 plant near the ladder rack, the second or alternate assembly area is east of the Aroclor-Biphenyl building in the road.

It is very important to know where people are in an emergency or before action is taken to correct an emergency. If the alternate area has to be used, take whatever safety equipment you can from the department to the assembly area.

b. If assistance is needed, pertinent phone numbers of plant personnel to be contacted are as follows:

T. E. Lackey	358-4284 Munford
M. J. Williams	237-1952
R. A. Haydel	831-4924
H. L. Williams	236-3835
G. L. Jessee	237-5328
H. Schulte	238-1222
J. C. Landwehr	237-0546
J. G. Thorne	237-7652
T. D. Tucker	237-3927
P. K. Ward	831-4189
Dr. J. C. Francis	237-5612 (Home)
Main Gate	236-2961 (308 or 317)

c. In the event of a plant disaster, the Main Conference Room is the Control Center. The alternate Control Center is the Guard Room at the Service Building. The Medical Center is the Plant Dispensary. The alternate Medical Center is the Service Building.

d. If the emergency or disaster occurs before or after the day shift, or on a weekend, the department Chief Operator shall notify the Guard on duty and the Guard will be responsible for notifying plant supervision.

e. Immediately upon discovering a fire, or a current or imminent disaster condition, turn in an alarm. Dial 7-111 and leave the phone off the hook until the alarm has sounded five times. Use another phone to call operator.

f. On day shift, Monday through Friday, Dial operator - state location and type emergency and need for outside help.

g. On "off-shifts", contact Guard (317).

4. Detail of Plan (Continued)

h. If the Guard cannot be contacted and the local Fire Department is needed, call them at 237-3541, giving them location, material burning, size of area involved, etc. Then call the department supervision.

NOTE: Chief Operator may designate this job to one of the operators.

i. The Plant Primary Assembly Area, should the emergency be so widespread that the major portion of the plant is affected, is West of HCl Neutralization Pit (Secondary is Guard Gate No. 4 West of Niran).

j. The Off-Side Primary Assembly Area, should complete plant evacuation be necessary, is REA Terminal, Highway 202 (Secondary is Rescue Squad Headquarters, 1313 Walnut Avenue, South side of Building). To signify complete evacuation, the plant fire alarm will be activated and the sound repeated two-second blasts at one-second intervals - for several minutes. At this signal, leave the plant by the most expedious means and route available and reassemble at the off-site assembly point and report to the Personnel Superintendent for head count.

5. Emergency Situations:

The following emergencies are possible at the Aroclor Department:

Emergency	Action
a. Fire Handling Biphenyl	a. Turn in alarm - Dial 7-111. b. Remove injured from fire area - take care of them. c. Proceed under Chief Operator to extinguish the fire: (1) Dry powder extinguisher. (2) Fire truck, dry powder, and water. (3) Water. d. Pull power on all motors. e. Cut off gas to Aroclor and Biphenyl stills at main cut-off at northwest corner of blowing tank area. f. Shut down Department.

Emergency Situations (Continued)

Emergency	Action
b. Chlorine Release Tank Car	a. Obtain help and turn in alarm if necessary- Notify Chief Operator. b. Obtain gas mask or Scott Air Pak. c. Shut off source of Chlorine. d. Disconnect Cl_2 connection at car if necessary. e. If vaporizer is full of liquid chlorine, vent to the chlorine car, then shut off car. f. Notify Department Supervision as soon as possible.
c. HCl Release	a. Obtain help and turn in alarm if necessary-Notify Chief Operator. b. Obtain gas mask or Scott Air Pak. c. Shut off source of HCl gas. d. Notify Department Supervision as soon as possible.
d. Fire or explosion at HB-40, Santowax, or Biphenyl Depts.	a. Turn in alarm, shut down Aroclor Department. Obtain gas mask, go to an assembly point, be prepared to assist in stopping the fire as directed by Chief Operator.
e. Emergency in the Plant	a. Prepare to shut down on orders.
f. Equipment failure creating hazard.	a. Notify Chief Operator or Department Supervision. b. Take appropriate action.

Emergency Situations (Contd.)

f. Injuries and Treatment

a. Obtain help.

b. Prevent further injuries to person involved.

c. Make comfortable.

d. Know your first aid:

(1) Mouth-to-mouth resuscitation.

(2) How to use a resuscitator.

(3) How to remove from electrical contact.

(4) Action for a heat stroke.

(5) Chest massage for heart failure.

(6) Emergency action in case of burns.

(7) Location of stretcher, blanket, oxygen.

(8) Know equipment available from the dispensary.

e. Contact Plant Physician as soon as possible, if necessary. Make contact through Plant Guard or Department Supervision.

AROCLOR DEPARTMENT
EMERGENCY PROCEDURE

ALARM METHODS

To Activate Plant Disaster System

1. Dial 7-111 - This alarms only and the phone must be left off the hook. Use another phone for contacting personnel.

2. On-Shifts - Dial "0" - State location and type emergency and need for outside aid.

   Off-Shifts - Dial 317 - State location and type emergency and need for outside aid.

3. If 317 does not answer - get outside aid directly.

Signal for Complete Plant Evacuation of "Off-Site" Assembly Area

Dial 7-555 - Evacuation will sound automatically

ASSEMBLY AREAS

1. Department

   a. Primary - Open area South of HB-40 Plant.

   b. Secondary - Road East of Biphenyl-Aroclor Building.

2. Plant

   a. Primary - West of HCl Neutralization Pit.

   b. Secondary - Guard Gate No. 4 (West of Niran).

3. Off-Site

   a. Primary - REA Terminal - Highway 202.

   b. Secondary - Rescue Squad Hdq., 1313 Walnut Avenue (South side of Bldg.).

PRIORITY OF ACTIONS

1. Care for injured.

2. Account for all personnel.

3. Property Safety.

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LOCATION OF EMERGENCY EQUIPMENT:

1. Stretcher - In Biphenyl-Aroclor Building North of old Biphenyl Control Room.

2. Blankets - In Tubular Unit Control Room.

3. Burn Treatment Equipment - Box north of old Santowax R Plant.

4. Gas Masks - East and West wall outside Aroclor Control Room.

5. Scott Air Paks - South of Air Blowers in Aroclor and old Biphenyl Control Room.

6. Emerson Resuscitator - In Dispensary.

7. Emergency Oxygen - In old Biphenyl Control Room.

APPENDIX A
EMERGENCY PROCEDURE

COLD WATER TREATMENT OF BURNS
(Thermal & Chemical)

Thermal Burn - The type of burn you would get by:

1. Direct exposure to flame.
2. Skin-make contact with hot surface.
3. Hot materials, such as molten Santowax, solidify when it touches the skin, thereby holding the heat in the skin.

Chemical Burn - The type of burn you would get by:

1. Contact with Muriatic or Sulfuric Acid.
2. Contact with Potassium or Sodium Hydroxide.
3. Contact with any acid or strong alkali material.

Treatment - Thermal Burns

If possible, submerge burn area in container of cold water (50°F). The container may be a drum, water pail, wash basin - anything that will hold the water. Follow these steps:

1. Put water in container to desired depth.
2. Try to obtain a water temperature of 50°F. by adding ice cubes.
3. Submerge burn area below the surface of the water.
4. Transport injured person to the doctor, keeping burned surface submerged in water.

If burn is in area that cannot be submerged in water, it is a good practice to take the cleanest cloth or toweling that you can obtain, soak it in cold water (wringing out excess water), and place on the burned area. This would be an area such as the back, shoulders, or stomach. UNDER NO CIRCUMSTANCES SHOULD A PERSON SUFFERING FROM THERMAL BURNS BE PLACED UNDER RUNNING WATER. There is a danger of the small droplets of water striking the burned area, causing pain to such an extent as to result in shock.

Treatment - Chemical Burns

1. Place injured person under safety shower or some other method of washing with large amounts of water.
2. Remove contaminated clothing while under the shower.
3. If goggles are worn, keep in place until all the chemical has been washed from the body.

General

In our dispensary, we have an ointment labeled Sulfathizole. This material is used in the treatment of burns, both thermal and chemical. It allows an injury to heal from the inside out, which is usually the situation with a burn injury.