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Dept. 246 - Operating Instructions

Section III - Continuous Chlorinators

A. Continuous Chlorination

The continuous chlorinator operation consists of four cascade flow chlorinators in series where specific levels of chlorination occur. $FeCl_3$ catalyst suspended in molten biphenyl is fed into the first chlorinator along with molten biphenyl from the west storage tank. ~~where~~ The material is chlorinated and overflows to the second unit. This continues until the final unit where the finished Aroclor is pumped continuously to an intermediate storage tank.

B. Continuous Chlorination Equipment

1. Four Continuous Chlorinators
   a. #6 Chlorinator (Item 2-406)
   b. #7 Chlorinator (Item 2-410)
   c. #8 Chlorinator (Item 2-414)
   d. #9 Chlorinator (Item 2-418)

2. Four Chlorinator Circulating Pumps
   a. #6 Chlorinator Pump (Item 2-407)
   b. #7 Chlorinator Pump (Item 2-411)
   c. #8 Chlorinator Pump (Item 2-415)
   d. #9 Chlorinator Pump (Item 2-419)

3. Four Chlorinator Heat Exchangers (Air Coolers)
   a. #6 Chlorinator Heat Exchanger (Item 2-408)
   b. #7 Chlorinator Heat Exchanger (Item 2-412)
   c. #8 Chlorinator Heat Exchanger (Item 2-416)
   d. #9 Chlorinator Heat Exchanger (Item 2-420)

PCB-ARCH-EXT0374845

Section III (continued)

B. Continuous Chlorination Equipment (continued)

4. Four Brink Mist Eliminators

a. #6 Brink Mist Eliminator (Item 2-409)

b. #7 Brink Mist Eliminator (Item 2-413)

c. #8 Brink Mist Eliminator (Item 2-417)

d. #9 Brink Mist Eliminator (Item 2-421)

C. Chlorinator Equipment Function

1. The function of the four circulating pumps is to provide circulation from the chlorinator through the air cooler (heat exchanger) and back to the chlorinator to allow good mixing and temperature control.

2. The function of the four chlorinators is to provide facilities for the chlorination of the Bi$\emptyset$/$FeCl_3$ mixture to the desired level.

3. The function of the four air coolers (heat exchangers) is to provide temperature control for the process by cooling the crude Aroclor circulated from each chlorinator.

4. The function of the four Brink Mist Eliminators is to reduce carryover of material into the off-gas system.

D. Control Loops and Interlocks

1. There are eleven major control loops in this system.

a. Chlorinator control - TRCA-12, TRCA-13, TRCA-14, TRCA-15. The function of this loop is to provide temperature control for the chlorination batch in the chlorinator and to sound an alarm when the temperature leaving the air cooler is too low (120°C.). Annunciator window "Hi or Lo" Temperature Chlorinator #6, #7, #8, & #9" will light when the alarm sounds.

PCB-ARCH-EXT0374846

Section III (continued)

D. Control Loops and Interlocks (continued)

b. Chlorinator chlorine flow-FRC-8, FRC-9, FRC-10, FRC-11.

The function of this loop is to control the chlorine flow to the chlorinator and regulate the rate of chlorination. There is a Panel board indicator and a Field Mounted indicator.

c. Chlorinator Biphenyl feed control FRCA-7.

The function of this loop is to control the BiØ flow to chlorinator #6 and to sound an alarm if the flow is too low (2 gpm). When the alarm sounds annunciator window "Biphenyl addition sys. abnormal" will light. THERE ARE Two Field Mounted Flow Indicators, ONE on 2nd Level and ONE ON 3rd Level at #6 chlorinator.

d. Density control #9 Chlorinator - DRCA-39.

The function of this loop is to control the specific gravity of the material (1.350 @ 65°C set point) leaving #9 chlorinator and to sound an alarm when the Sp. Gr. is out of specification. When the alarm sounds, annunciator window "Hi or Lo Density chlorinator #9" will light. Hi density alarm sounds at 1.355; Lo density alarm sounds at 1.345.

e. #9 Chlorinator level Control - LCA16.

The function of this loop is to control the level of material in #9 chlorinator and to activate an alarm if the level is too high or too low. When the alarm sounds, annunciator window "Hi or Lo level chlorinator #9" will light. Hi level alarm sounds at 10'-1½" above the bottom bend line of the chlorinator; Lo level alarm sounds at 7'-10½" above the bottom bend line. Normal control level set point is 9'-0" above the bottom bend line.

PCB-ARCH-EXT0374847

Section III (continued)

D. Control Loops and Interlocks (continued)

2. There are three interlocks in this control system.

a. If the temperature in the chlorinator at the spider sparger reaches 205°C., the chlorine control valve will close and an alarm will sound at 200°C. This alarm sounds from temperature points #2, #4, #6, #8 on the 24 pt. recorder (TR48). Annunciator window "Hi-Temp shutdown chlorinator #6, #7, #8, #9" will light when the alarm sounds. the reset button must be pushed before the chlorine value can be re-opened.

b. If the chlorinator circulating pump motor shuts off, the chlorine control valve will close and an alarm will sound. The annunciator window "Hi-Temp Shutdown Chlorinator #6, #7, #8 or #9" will light when the alarm sounds. the reset button must be pushed before the chlorine value can be re-opened.

c. If the air cooler exit temperature drops to 120°C. the cooler fan will shutdown and annunciator window "Hi or Lo Temperature Chlorinator #6, #7, #8 or #9" will light and an alarm will sound. the fan must be restarted manually.

3. Other alarms and instrumentation.

a. The chlorinator temperature just below the overflow line is recorded on points #3, #5, #7 and #9 on recorder (TR48). An alarm will sound if the temperature reaches 200°C. and annunciator window "Hi or Lo temperature chlorinator #6, #7, #8 or #9" will light.

PCB-ARCH-EXT0374848

Section III (continued)

D. Control Loops and Interlocks (continued)

3. Other alarms and instrumentation (continued

b) The temperature in the HCl off-gas header near the junction of the batch and continuous chlorinator off-gas lines is recorded on pt. #10 ~~or~~ on recorder TR-48. An alarm will sound and annunciator window "Hi Temp off-gas Header" will light when this temperature reaches 200°C.

c) The temperature of the crude Aroclor at the air cooler exit is indicated on points #2, #4, #6 and #8 on 36 pt. temperature indicator TI49.

d) If the biphenyl transfer pump in the west storage tank that feeds #6 chlorinator goes down an alarm will sound and annunciator window "Biphenyl Transfer Pump Shutdown" will light.

e) Pressure gauges are located at the following points in the chlorinator area.

1) Circulating pump discharge @ pumps.

2) Chlorine supply line at brink demisters on vaporizer.

3) HCl off-gas header at entrance to off-gas cooler.

f) The level in the catalyst mix tank is recorded on trend recorder XR-60 (blue ~~pen~~ pen). An alarm will sound at 20% and annunciator window "Biphenyl addition sys. abnormal" will light when only 45 minutes feed remains in the tank. This corresponds to 6" Above the bottom bend line of the tank.

PCB-ARCH-EXT0374849

#6 - 9503# - 914 gal 6% - INT 356.
#7 - 8107 - 780 gal 5%
8 - 6824 - 656 gal 4%
9 - 9137 - 879 gal 5.8%

Dept. 246 - Operating Instructions

Section III

~~E. Continuous Chlorinator Unit (4 Units)~~

E. Start-Up Operation

1. Chlorinators Empty - 4 UNITS

a. Close manual chlorine valve at the distributor on the chlorinator to be charged.

b. Close vents on the chlorinators to the blow tank.

c. Align off-gas valves to the muriatic acid area (Dept. 218).

d. Close manual valve on bottom of chlorinators. Also close block valve in Bi¢ feed line to #6 chlorinator. KEEP THIS VALVE CLOSED UNTIL READY TO START CIRCULATING PUMP.

e. Align valves at heat exchangers and pumps to circulate through the heat exchanger. Check that by-pass valves around heat exchanger and chlorinator pump away valves are closed. Check that heat exchanger fans are off. Selector switch should be in slow or fast positions.

f. Set the temperature controllers for chlorinators #6, #7 @ 150°C #8 @ 180°C and #9 @ 190°C at ~~150°C.~~ 165°C in the "Auto" position.

g. Set the chlorine flow controllers ~~in~~ on "Manual" with the set point ~~at 1295#/Hr.~~ as per Instructions. Open slowly.

Note: The scale of the chlorine feed indicator is 0 to 100, a reading 100 is equal to 1700 lbs./hr. The set point will be ~~on 76.~~ as per supervision. No. 9 chlorine controller has a manual (local) and remote set point switch. Set this switch in local for the initial start-up.

h. Set the specific gravity controller for 1.350. The densitrol controller will adjust the chlorine feed automatically to #9 chlorinator to maintain the desired specific gravity when the #9 chlorine controller set point switch is in remote.

PCB-ARCH-EXT0374850

Dept. 246 - Operating Instructions

Section III

~~E. Continuous Chlorinator Unit (4 Units)~~

~~I~~E. Start-Up Operation (cont'd)

i ~~9~~. Set the Biphenyl feed controller in auto with the set point ~~at 4.25 gpm~~. as per instructions.

Note: The scale of the biphenyl feed indicator is 0 to 100. A reading of 100 is equal to ~~6.0~~ 10 gpm. the set point will ~~be on 7~~. depend on Rate Needed!

j ~~10~~. Align valves to overflow from #6 chlorinator to #7, from #7 to #8, from #8 to #9. By-pass valves should be closed.

k ~~11~~. Charge each of the four chlorinators with molten BiØ through the by-pass valve around the BiØ feed control valve. This is carried out by overflowing from #6 to #7, from #7 to #8 and #8 to #9. Close the by-pass valve around BiØ control valve when charging is complete. also close the overflow valves.

l ~~12~~. Add 4# $FeCl_3$ catalyst to ~~each~~ chlorinators #8 and #9 and 6# to #6 & #7 thru the spare nozzles on #6, #7, #8, & #9. ~~To add $FeCl_3$ to #6 you must go through the BiØ mix tank with the $FeCl_3$ in the BiØ.~~

m ~~13~~. Open manual valves on the bottom of the chlorinators and start the circulating pumps.

n ~~14~~. Open the valves in the chlorine supply lines to each chlorinator.

Note: The chlorine control valves will remain closed until the circulating pumps are started and the chlorine reset button is activated.

PCB-ARCH-EXT0374851

Dept. 246 - Operating Instructions

Section III

~~E. Continuous Chlorinator UNIT (4 Units)~~

E. Start-Up Operation (cont'd)

o. 6. Chlorinate to the following levels:

Stage	Chlorinator	Sp.Gr. at 65°C.
First	#6	1.078 - 1.104
Second	#7	1.170 - 1.196
Third	#8	1.254 - 1.280
Fourth	#9	1.336 - 1.362

p 6. Close manual valve on the chlorine distributor on each chlorinator when the correct Sp. Gr. level has been reached. Hold this chlorinator until all four are ready. When a chlorinator is down it may be necessary to put steam on the chlorinator to keep the temperature at 120°C. Min.

2. Chlorinators Full (4 UNITS Sp.GR. LEVELS IN EACH CHLORINATOR DESCRIBED IN #15 ABOVE)

a. Check the BiØ mix tank to be sure the mix tank has been charged, the agitator is running and the tank circulating.

b. Align valves at the BiØ mix tank to #6 chlorinator. Activate catalyst feed valve by putting selector switch in "On" position. Catalyst feed valve timers should be set ~~at open - 15 seconds, closed - 125 seconds~~. AS PER SUPERVISION.

c. Align manual valves at the west BiØ storage tank to #6 chlorinator. Activate feed by starting pump on west BiØ storage tank. Controller should be set ~~on 71.~~ AS PER SUPERVISION.

PCB-ARCH-EXT0374852

Dept. 246 Operating Instructions

Section III

~~E. Continuous Chlorinator Unit (4 Units)~~

E. Start-Up Operation (continued)

d. Start the chlorine feed to each chlorinator ~~(set to)~~ by opening the manual valves at each chlorinator distributor. Chlorine feed is adjusted at the automatic flow controllers in the control room to maintain the required Sp. Gr. level. Normally, chlorine feed to #6 is lower than the other three chlorinators. This is to keep BiØ carryover into the HCL line at a low level. When density controller set point for #9 chlorinator control valve is nearly the same as the local setting change the set point switch to remote.

e. Line up the valves in pump away line from #9 chlorinator to the intermediate storage tank after checking level of intermediate storage tank! Open overflow valves between the chlorinators. Check That water is ON scrubber.

f. Samples will be taken and Sp. Gr. run on each chlorinator every two hours OR as per INSTRUCTIONS.

g. The following items should be checked during operations.

1) Temperature on the individual chlorinators on the automatic temperature controllers and at ~~local~~ Panel TI 49 on ~~heat exchanger~~ Panel Board.

2) Chlorine flow on the chlorine flow controller.

3) Discharge pressure of the circulating pumps for each chlorinator (65 psig.)

4) Temperature on the multipoint temperature recorder for chlorinator batch temperature for each unit!

PCB-ARCH-EXT0374853

Dept. 246 Operating Instructions

Section III

~~E. Continuous Chlorinator Unit (4 Units)~~

E. Start-Up Operation (continued)

g. 5) Specific gravity of #9 chlorinator on the density controller ~~and record every hour~~.

6) HCl off-gas pressure at header on top level (3-5# psig).

7) Check the sight glass in the HCL off-gas line of each chlorinator for entrainment.

~~8) Level in the catalyst mix tank should drop about 4-5% each hour.~~

8) Catalyst concentration in each chlorinator checked once a shift - ~~should be 0.05% and 0.10%~~.

PCB-ARCH-EXT0374854

Dept. 246 Operating Instructions

Section III OPERATION (continued)

E. ~~START-UP~~ THREE (3) OPERATION

3. ~~Continuous~~ Chlorinator ~~Unit (3 Units)~~

a. Switch manual valves on the overflow, BiØ feed, catalyst mix feed and pump away lines from one chlorinator to another to allow by-passing a particular chlorinator.

b. Shut-off the BiØ and catalyst mix feeds to the first stage chlorinator and chlorinate the material to the following levels:

Stage	Chlorinator	Sp.Gr. at 65°C.
First	#6 or #7	1.108 - 1.124
Second	#7 or #8	1.124 - 1.240
Third	#8 or #9	1.345 - 1.355

Note: (1) When #9 chlorinator is down the lines on the densitrol Sp. Gr. instrument must be hooked to the densitrol taps on #8 chlorinator. In addition the level-trol must be re-located to the nozzles on the east side (second level) of #8 chlorinator.

(2) When #6 chlorinator is down piping modifications are required to allow BiØ and catalyst mix to be fed to #7 chlorinator.

c. Start chlorine, catalyst mix and BiØ feeds in the same manner as for four stage operation.

d. The chlorinator removed from service should be chlorinated to a finished Aroclor and pumped out through #9 chlorinator circulating line.

PCB-ARCH-EXT0374855

Dept. 246 Operating Instructions

Section III

F. ~~A~~. Emergency Shutdown

1. Shut off BiØ mix tank feed using automatic controller and BiØ feed to the chlorinators, close block valves in these two lines. and shut down Feed pump.

2. Close block valves to the chlorine distributors at Chlorinators #6, #7, #8 and #9. Reset chlorine feed control valves to 0 with instrument in "Auto".

3. Shutdown Cooler Fans.

4. In event of a prolonged shutdown, greater than two hours, put steam on circulating lines or tracing around the chlorinators to maintain 120°C. minimum temperature.

G. ~~A~~. Critical Control Points and Expected Readings

1. Temperature of each chlorinator - check at ~~TRC~~ TIC on panel also on multipoint recorder (~~Set 150°C. or 195°C.~~). #6 @ 150°C, #7 @ 165°C #8 @ 180°C #9 @ 195°C

2. Chlorine flow-check at FIC on panel (~~#6 Set~~ unit)

3. Specific Gravity on #9 unit - check at panel (1.350 Set point)

4. HCl off gas pressure - check at pressure gauge (3-5#).

PCB-ARCH-EXT0374856

TYPICAL OPERATING DIFFICULTIES (Chlorinators)

	Symptom	Problem	Cause	Possible Solutions
Chlorinator #6	1. Cl_2 Flow Dropping	1. Low Supply pressure 2. High off-gas pressure back 3. Under chlorination or over chlorination.	1. Trouble at Nash pumps. 2. ~~Failure~~ Plugged in off-gas system. 3. a) Low Cl_2 flow. b) Material not carrying thru to next chlor.	1. Call Cl_2 dept. Operator. 2. Check off-gas system. Sewer gas to allow chlor. to run. 3. a) Reduce BiØ feed rate. b) Check Sp. Gr. and adjust.
	2. Low Catalyst Flow	1. Inadequate catalyst supply to #6.	1. a) System pluggage b) Circulating pump failure. c) Steam heating failure d) Mix tank empty e) Catalyst timer valve failure. f) Agitator failure on BiØ mix tank. Freeze @ off gas condenser	1. a) Thaw or clean out line. b) Check pump. c) Check heating system d) Charge BiØ mix tank. e) Check out valve, if needed call Shop. f) Check out agitator. G) Take H_2O off condenser unit. I Thawed out
	3. Low BiØ ~~flow.~~ feed.	1. Inadequate BiØ flow to #6.	1. a) BiØ feed pump failure b) Line pluggage c) Flow controller failure. d) West BiØ storage empty e) Rate of charging BiØ mix tanks or batch heat too high.	1. a) Check out pump b) Thaw or clean out line. c) Check out control loop and control valve. d) Charge BiØ tank e) Cut charging rate back to allow proper flow to #6.
	4. Hi or low temperature of chlorinator	1. Inadequate temperature control.	1. a) Circulating pump failure. b) Temperature controller failure. c) Circulating line pluggage. d) Air cooled heat exchanger. Fan speed too fast or too slow. e) Too many or too few louvres attached to controller. f) By-pass open around cooler. g) Cooler plugged	1. a) Check out pump. b) Check out ~~Local~~ Loop TI against controller. Check out loop. c) Thaw or clean out line. d) Check fan speed. e) Hook up or take off louvres as needed. f) Close the by-pass valve. g) Put steam (by hose) under cooler with circ. pump Running and by-pass open. Keep fan off.

PCB-ARCH-EXT0374857

TYPICAL OPERATIN_ _IFFICULTIES (Chlorinators)

	Symptom	Problem	Cause	Possible Solutions
Chlorinator #6 (continued)	5. High or low level in #6.	1. Sp Gr. out of specs. 2. No flow from #9 or too much flow.	1. Low or high level in #9 chlor. 2. a) Leveltrol failure b) Line pluggage c) Control valve failure.	1. Adjust level & Cl_2 feed. 2. a) Check leveltrol setting and control loop. b) Thaw or clean line c) Check control valve actio
5.	6. High Tempy off-gas.	1. High carry over in off-gas sight glass 2. Free Cl_2 in off-gas	1. a) Over charged b) Mist eliminator failure 2. Reaction dead.	1. a) Stop Cl_2 flow. b) Check level in chlor. 2. Follow EMERGENCY INSTRUCTIONS Contact supervision.
6.	7. Cl_2 shut-down.	1. High temperature. 2. Circ. Pump Failure.	1. Over chlorination 2. Pump failure	1. Pump from another chlor. Dissolve over chlorinated material - check Sp.Gr. and contact supervision. 2. Check out pump.
Chlorinator #7 & #8	1. Cl_2 Flow dropping.	1. Low supply pressure. 2. High off-gas back pressure. 3. Under chlorination or over chlorination.	1. Trouble at Chlorine Dept. 2. Failure off-gas system. 3. a) Low Cl_2 flow. b) Material not carrying thru to next chlorinator.	1. Call Cl_2 dept. 2. Check off-gas system. Sewer gas to allow chlor. to run. 3. a) Reduce BiØ Feed Rate b) Check Sp.Gr. & Adjust.
	2. Hi or low temperature in chlorinator.	1. Inadequate temperature control.	1. a) Circulating pump failure b) Temperature controller failure c) Circulating line pluggage. d) Air cooled heat exchanger fan speed too fast or too slow e) Too many or too few louvres attached to controller. f) By-pass open around cooler. g) Cooler plugged.	1. a) Check out pump. b) Check PANEL TI against controller. Check out Loop. c) Thaw or clean out line. d) Check fan speed. e) Hook up or take off louvres as needed. f) Close by pass valve. g) Put steam (by hose) under cooler with circ. pump running to thaw out cooler. Have by-pass valve open and fan off.

PCB-ARCH-EXT0374858

TYPICAL OPERATING DIFFICULTIES (Chlorinators)

	Symptom	Problem	Cause	Possible Solutions
Chlorinator #7 & #8 (continued)	~~3. High Level~~ ?	~~1. Sp.Gr. out spec.~~ ~~2. No flow from #9 or too much flow.~~	~~1. High or low level in #9 chlor.~~ ~~2. a) Leveltrol failure~~ ~~b) Line pluggage~~ ~~c) Control Valve Failure~~	~~1. Adjust level and Cl_2 Feed.~~ ~~2. a) Check leveltrol setting and control loop.~~ ~~b) Thaw or clean line~~ ~~c) Check control valve action.~~
3	4. High Temp. off-gas	1. High carry-over in off-gas sight glass.	1. Chlor. overcharged 2. Mist Eliminator Failure	1. a) Stop Cl_2 Flow b) Check level in chlor. 2. Contact supervision
4	5. Cl_2 Shut-down.	1. High temperature. 2. Circ. pump failure.	1. Over chlorination 2. Pump failure	1. Pump from another chlor. to dissolve over chlorinated material. Check sp. gr. and contact supervision. 2. Check out pump
Chlorinator #9	1. Cl_2 Flow dropping.	1. Low supply pressure. 2. High off-gas header pressure 3. Under or over chlorination. 4. Sp.Gr. out of spec.	1. Trouble at Nash pumps. 2. ~~Failure~~ Pluggage off-gas sys. 3. a) Low Cl_2 flow. b) Too much or too little Material ~~not carrying~~ pumped ~~through~~ to ~~next chlor.~~ Int. Sp. Gr. 4. Densitrol failure.	1. Call Cl_2 dept. 2. Check off-gas system. Sewer gas to allow chlor. to run. 3. a) Reduce BiØ feed rate. b) Check Sp.Gr. and adjust. 4. Measure & control Sp. Gr. manually.
	2. Hi or Low temperature of chlorinator.	1. Inadequate temperature control.	1. a) Circulating pump failure. b) Temperature controller failure. c) Circulating line pluggage. d) Air cooled heat exchanger fan speed too fast or too slow. e) Too many or too few louvres attached to controller. f) By-pass open around cooler. g) Cooler Plugged	1. a) Check out pump. b) Check out ~~Local~~ Panel TI against controller. Check out loop. c) Thaw or clean out line. d) Check fan speed. e) Hook up or take off louvres as needed. f) Close the by-pass valve. g) Put steam (by hose) under cooler with Circ. pump running to thaw out cooler, have by-pass valve open and fan off.

PCB-ARCH-EXT0374859

TYPICAL OPERATING DIFFICULTIES (Chlorinators)

	Symptom	Problem	Cause	Possible Solutions
Chlorinator #9 (continued)	3. Hi or Low Level.	1. Sp.Gr. out spec. 2. No flow or too much flow from chlorinator.	1. Densitrol failure. 2. a) Leveltrol failure. b) Line Pluggage c) Control valve failure.	1. Adjust Level and Cl_2 feed. 2. a) Check Leveltrol setting and control loop. b) Thaw or clean line c) Check control valve action. d) Manually control level.
	4. High Temp off-gas	1. High carry-over in off-gas sight glass.	1. Chlor. overcharged. 2. Mist elimination failure.	1. a) Stop Cl_2 flow b) Check Level in Chlor. 2. Contact Supervision.
	5. Cl_2 Shut-down.	1. High temperature. 2. Circ. pump failure.	1. Over chlorination 2. Pump failure	1. Pump from another chlor. to dissolve over chlorinated material. Check sp. gr. and contact supervision. 2. Check out pump.
	6. Material out of spec.	1. Unstable product 2. Crude 1142 out of spec. on Sp.Gr.	1. a) Catalyst doesn't carry thru chlor. b) Inadequate feed (catalyst) #6 Chlor. c) Chlorination temp. too low. d) High bromine content in chg. supply. e) Circ. pump failure. 2. a) Chlorine feed too high or too low. b) Density control failure.	1. a) Contact supervision. Add $FeCl_3$ by hand. b) Check catalyst feed sys. c) Check fan speed & adjust to proper temp. open by-pass. d) Contact Cl_2 dept. and supervision. e) Check out pump. 2. a) Adjust Cl_2 feed manually. b) Check Sp. Gr. manually.

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