3/29/74 RUN — Boucher

ON AROCLOR SCRUBBER

FACTOR 1.080864

HCL/DAY = 1,080,864 # H2O X .0661 HCL

= 71350 # HCL/DAY

= 2970 #/HR

		DCB	1109 (mono)
# PCB'S	100 MIN	3.44 PPM	.226 PPM
	140 "	3.27 PPM	.336 PPM
	180 MIN	3.04 PPM	.474 PPM
		3 | 9.75	3 | 1.034
	AVER.	3.25 PPB	.345
	TOTAL		3.60 PPB

PCB'S (ROUTINE) = 1080864 #/DAY X 3.25 X 10^{-6} PCB

= 3.53 #/DAY

MONO'S = 1080864 X .345 X 10^{-6} mono

= 0.375 #/DAY

TOTAL CHLORINATED BIPHENYL

3.53 PCB'S
.375 MONO

TOTAL: 3.905 #/DAY

ASSUME 10% AIR IN Cl_2

$\#Cl_2 = HCl \times \frac{35.5 \times 2}{36.5} = 2970\left(\frac{71}{36.5}\right) = 5800$ #

AIR = 5800 X .20 = 1160 # AIR/HR

TOTAL # GAS = 1160 + 2970 = 4130 #/HR

% MONO + % PCB'S = $\frac{3.905 \times 10^{-6}}{24}$ / 4130 .00393 %

% MONO = $\frac{.375}{24}$ / 4130 = .000378 % — 3.78 PPM

PCB-ARCH-EXT0375647

What has been accomplished?

1. We have demonstrated designs for scrubber efficiency, pressure drop, and rate.
2. We have demonstrated long scrubber liquor life
3. Demonstrated efficient chlorination of biphenyl and monochlorobiphenyl in the scrubber of liquor

Outline

Results
1. Less than 2.5 #/DAY PCB's in off gas
2. Scrubber liquor long life
3. No biphenyl in off gas due to some chlorination in scrubber
4. Process does not expect

Discussion
1. We would like to have less than 1 #/DAY
2. Allowed are (1) chlorination
(2) 1242.
(3) Temperature
3. Problem were [illegible]

Future Work
1. Test 1242
2. Measure chlorination rate & consider need for Cl_2 addition.

Benefits from scrubber

✓ 1. Less than 2.5 #/day PCB's
✓ 2. Essentially no Biphenyl losses
✓ 3. Scrubber liquor lasts >> 7-10 days
4. Little operator attention - record temp once/shift
5. Little or no build-up of liquor entrained for condenser off gas collection tank
6. Corrosion - little
7. Solid build-up in trays - none
8. Column pressure drop as predicted
9. Flow controller working well
10. New method developed to analyze scrubber liquor during start-up.
11. New method successfully used to analyze waste scrubber sample at considerable less cost proved to be good.
12. Costs within 10% of estimate
13. $FeCl_3$ build-up successfully to allow for chlorinate of low boiler in scrubber liquor
14. Apparent temperature effect on mass
15. Only 5 day downtime to tie-in final

Problems

1. Minor items not finished
2. Cost excess estimate
3. Circulation pump kicked-out on overload at
4. Flow indicator stuck
5. H_2 purge needed
6. Needed to understand about no water in system.
7. Possible loading/temp effect
8. Need to find better fluid to lower PCB's further
9. Need to determine chlorinates rate in scrubber

HI-LIGHTS

AROCLOR

1. To remove PCB's from the Aroclor chlorinator off-gas HCl the 15 tray steel column scrubber was installed and started-up on 2/27/74. On March the scrubber has successfully performed as designed. PCB's are effectively removed with distilled 1016 residue. And the distilled 1016 residue can last for periods considerably longer the one week because of the unexpected chlorination of low boilers in the scrubber liquor.

We still want to reduce the PCB's in the off-gas HCl even further. In April we plan to evaluate various ways to improve the scrubber efficiency.

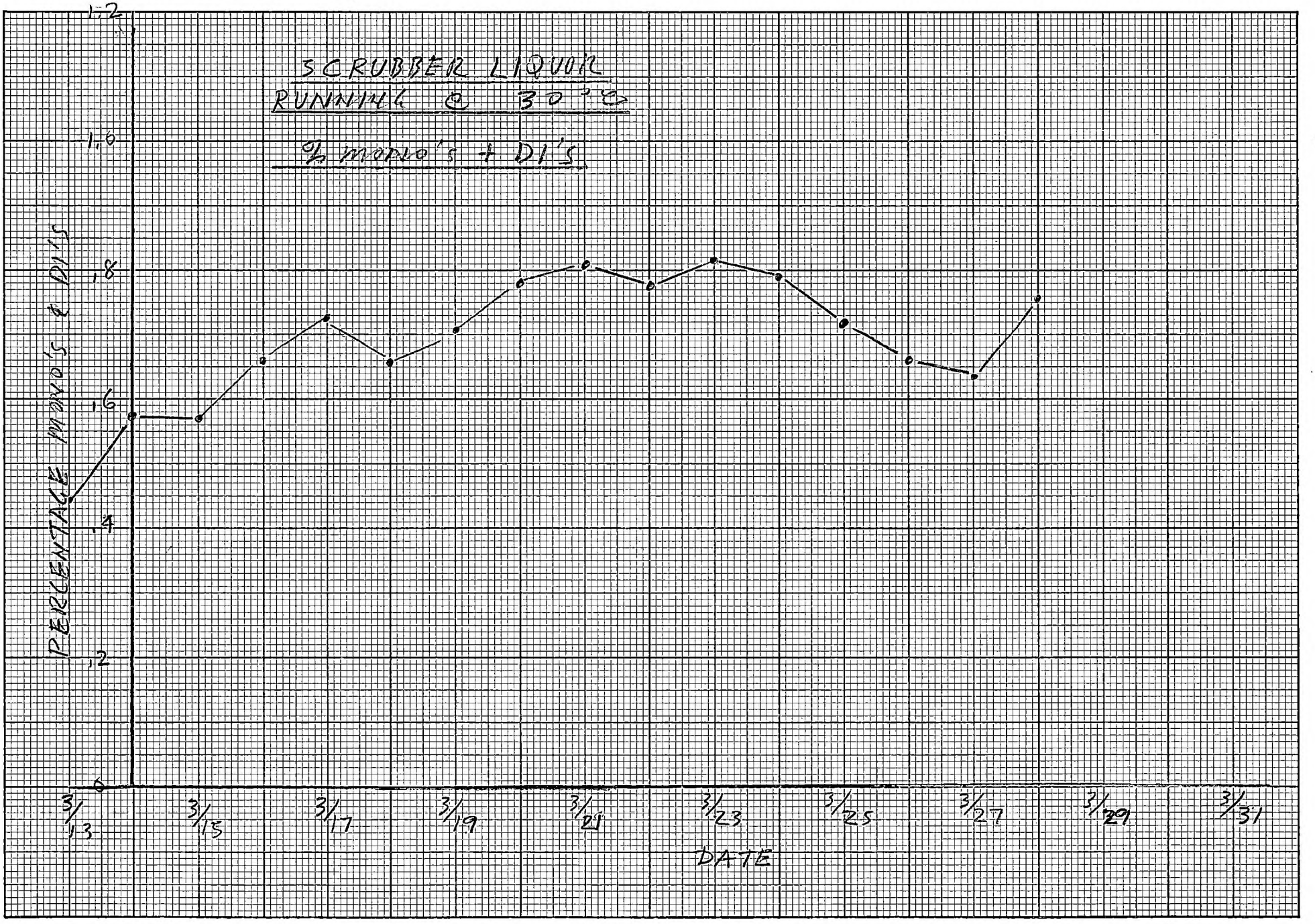
2. On 3/23/74 we resumed the burning of Aroclor at the Aroclor incinerator.

3 Our plans to demonstrate the manufacture of Monochlorobiphenyl in April has been delayed. Dow does not need any material until July 1974. This will give Research additional time to develop a means to dispose of the residue from the production of Monochlorobiphenyl.

4 Project design continues to provide residue handling facilities at the Aroclor incinerator, (Project 8020, $200,000 capital, $4000 expense) with an ECD of April 15, 1974 for the design package. Thermal stabilities studies of various plant waste residue mixtures have been completed.

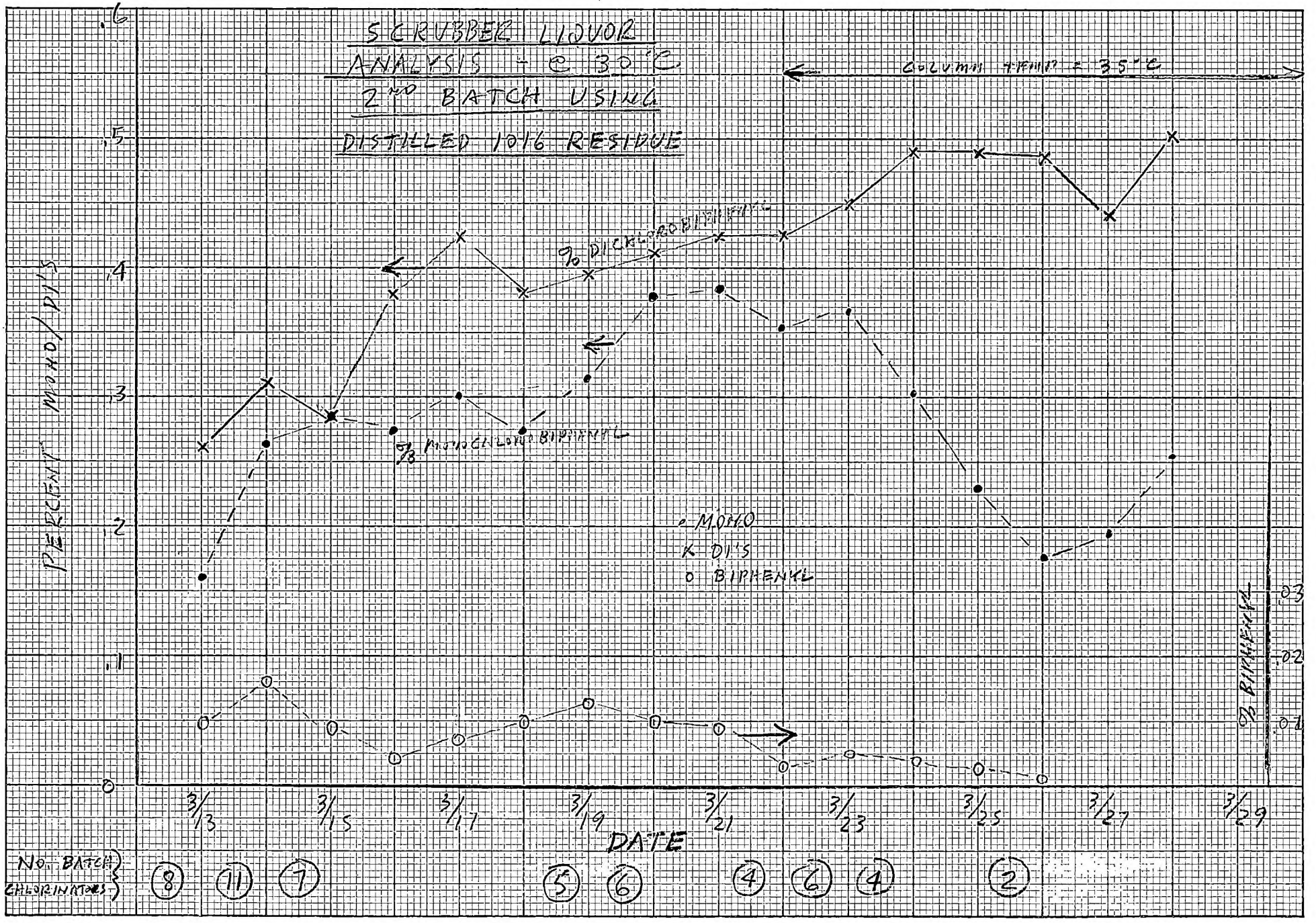
PCB-ARCH-EXT0375650

K+E 20 X 20 TO THE INCH 46 1240
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.



PCB-ARCH-EXT0375651

K+E 20 X 20 TO THE INCH 46 1240
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.



PCB-ARCH-EXT0375652

Monsanto

COMPANY CONFIDENTIAL

FROM (NAME & LOCATION) K. L. Schutzenhofer - WGK

DATE March 25, 1974

CC L. H. Horcher
C. F. Buckley
G. A. Hippe
H. J. Horner

SUBJECT PCB Analysis of Water Scrubber Samples

REFERENCE

TO : K. E. Baucher

The following results were obtained on the analysis of the samples, as listed, for PCB content.

Bottle No.	Sample Time	PCB's (ppm)
1	3/20/74, 12.25 pm, 0 min.	44.6
4	' , 12.45 pm, 20 min.	8.92
6	' , 1.05 pm, 40 min.	3.73
7	' , 1.25 pm, 60 min.	2.75
9	' , 1.45 pm, 80 min.	3.11
10	' , 1.45 pm, 80 min.	20.2
11	' , 2.05 pm, 100 min.	3.87
14	' , 2.25 pm, 120 min.	2.96
16	' , 2.45 pm, 140 min.	1.73
17	' , 3.05 pm, 160 min.	3.05
19	' , 3.25 pm, 180 min.	1.61

The above results were obtained by WGK Method No. S-005, utilizing the Cary Spectrophotometer, and do not include 1109 aroclor content.

Reference. WGK Laboratory Notebook, pp.17871-72.

K. L. Schutzenhofer

K. L. Schutzenhofer

dy

PCB-ARCH-EXT0375653

FORM 7411-5 U.S.A.

Ba.	Date	Unit	Time Started	End	Aroclor
670	3/8	#3	6 PM	7 PM	1154
669	3/8	#2	3 PM	4 PM	1154
668	3/8	#3	1 PM	2 PM	1154
677	3/7	#2	11 30 AM	12 30 PM	1154
676	3/7	#3	10 30 PM	11 30 PM	1154
671	3/8	#2	8 45 PM	9 45 PM	1154
672	3/8	#3	10 45 PM	11 45 PM	1154
673	3/11	#2	8 20 PM	9 15 PM	1154
673	3/11	#3	9 25 PM	10 25 PM	1154
674	3/11	#2	10 40 PM	11 40 PM	1154
675	3/11	#3	10:40 PM	12:40 AM	1154
676	3/11	#2	12:20 AM	1:20 AM	1154
677	3/11	#3	1:10 AM 2	2:40 AM	1154
678	3/11	#2	2:05 AM	3:30 AM	1154
679	3/11	#3	3:55 AM	5 35 AM	1154
680	3/11	#2	6 AM	7 30 AM	1154
681	3/12	#3	8:25 AM	1200 NOON	1154
682	3/12	#2	11:20 AM	3:05 PM	1154
683	3/12	#3	3 05 PM	4:35 PM	1154
684	3/12	#2	4:35 PM	6 PM	1154
685	3/12	#3	6 PM	7:30 PM	1154
686	3/12	#2	7 30 PM	9 00 PM	1154

Calculation of gas concentration for 3/12/79 run

$$Cl_2 = \#HCl\left(\frac{35.5 \times 2}{36.5}\right)$$

$$= 1135\left(\frac{35.5 \times 2}{36.5}\right)$$

$$= 1135\left(\frac{71}{36.5}\right) = 2208\ \#/HR$$

Assume 83% Cl_2 in gas

$\#$ AIR $= 0.20 \times 2208 = 442\ \#$

TOTAL GAS $= 442 + 7135 = 1577\ \#/HR$

$$PPM\ PCB's = \frac{0.714\ \#PCB/24}{1577}$$

$$= 189\ ppm$$

$$PPM\ 1109 = \frac{\text{[illegible]}/24}{1577}$$

$$= 2.56\ ppm$$

PCB-ARCH-EXT0375655

(2)

PCB's / DAY

Based on 3/20/74 run

#PCB's/DAY = (57534 # HCL/DAY)(45.5 X 10^{-6})

= 2.617 #/DAY

mono/DAY = (.345/3.25)( ) = 0.278 #/DAY

TOTAL/DAY = 2.895/DAY

Based on 3/13/74 run

PCB/DAY = (57534 # HCL/DAY)(26.2 X 10^{-6})

= 1.507 #/DAY

mono/DAY = (.097/.714)( ) = 0.205 #/DAY

TOTAL/DAY = 1.507 + .205 = 1.712 #/DAY

Average dose ~

2.895
1.712
4.607

2 | 4.607

2.303 ~ 2.3 #/DAY

at 100% OST

2.3 X .85 = 1.955 #/DAY

PCB-ARCH-EXT0375656

(1) Calculation of PCB losses from Aroclor scrubber

HCL from Aroclor 1016

$27.55\ \bar{m}\ \#/YR \times 42.47\ \frac{\#\ HCL}{CWT} = 11.70\ \bar{m}\ HCL$

HCL from Aroclor 1242 account 81100

$14.218\ \bar{m}\ \#/YR \times 65.316\ \frac{\#\ HCL}{CWT} = 9.29\ \bar{m}\ HCL$

$20.99\ \bar{m}\ HCL$

$\sim 21\ \bar{m}\ \#\ HCL/YR$

$\#/DAY = \frac{21\ \bar{m}\ \#\ HCL/YR}{365\ DAY/YR}$

$= 57534\ \#/DAY$

Assume 85% OST

$\#/DAY = 57534 / .85$

$= 67687\ \#/DAY$

PCB conc on 3/20/74 RUN

PCB's $\frac{3.25\ \#/DAY}{71350\ \#\ HCL} = 45.5 \times 10^{-6}$

conc in gas $\left(\frac{2970}{4130}\right) = 32.7\ PPM$

PCB conc on 3/13/74 RUN

PCB's $\frac{0.714\ \#/DAY}{27200\ \#\ HCL} = 26.2 \times 10^{-6}$

conc in gas $\left(\frac{2970}{4130}\right) = 18.84\ PPM$

FORM 7411-5 (WA) U.S.A.

Scrubber was charged at 2⁰⁰ PM 2/27/74

Analysis

Date	2/27/74	2/28/74	2/28/74	2/28/74
Time	4 00 PM	8 00 PM	6 00 PM	12 MN
$B_1\phi$	0.005%	0.028%	.010%	.005%
o CL $B_1\phi$	0.018%	0.131%	.169	.176
m CL $B_1\phi$	< .001%	< .001	< .001	< .001
p CL $B_1\phi$	.007%	.038	.051	.040
TOTAL MONO	.025%	.170	.221	.217%
DI's	—	—	.073	.081

	3/3/74 4PM	3/6/74 9 AM	3/8/74 10 3 AM	3/11/74 8 AM (?)	3/12/74 8 AM
$B_1\phi$	0.008%	.013%	.033%	.032%	0.015%
o	0.207	.238	.323	.281	.303%
m	.001	< .001	< .001	.004	.001%
p	.023	.022	.071	.060	.051%
MONO	.231%	0.260	0.307	.345	.360
DI's	.164	.170%	.394%	.395	0.458

	3/9/74 8AM	3/8/74	3/14/74	3/10	3/12	3/13
$B_1\phi$	0.026	0.033	0.016	0.021	.015	.018
o	0.367	0.323	0.214	0.308	.343	.315
m	0.003	< .001	0.003	.002	< .001	< .001
p	0.084	.071	0.047	.066	.057	.048
MONO	0.454	.394	0.264	.376	.360	.363
DI's	0.388		0.311	.442	.458	.543

PCB-ARCH-EXT0375658

OPERATION AT 90 C 3/13/79 TEST

CONCENTRATION

TIME	ORGANICS	PCB'S (1221 1242)	MONO 1109	# TOTAL
60 MIN	694 PPB	687 PPB	69 PPB	756 PPB
90 MIN	606 PPB	601 PPB	99 PPB	700 PPB
120 MIN	546 PPB	694 PPB	102 PPB	796 PPB
		3 | 1982 661	3 | 270 90	3 | 2252 751

/ DAY

60 MIN	0.750	0.742	0.075	0.817
90 MIN	0.655	0.650	0.107	0.757
120 MIN	0.590	0.750	0.110	0.860
AVER.	0.665	0.714	0.097	0.811

PCB-ARCH-EXT0375659

MONSANTO COMPANY

ORGANIC CHEMICALS DIVISION – W.G. KRUMMRICH PLANT
PROCESS RESEARCH AND DEVELOPMENT DEPARTMENT

18221

SUBJECT: Continued from J 18217

DEPT. NO.	PRODUCT	PREPARED BY (SIGNATURE)	DATE
214	Scrubber PCB	L. [illegible]	

Scrubber was changed at 2:00 PM 2/27/74

Analyses

Sample						
Date	2/27/74	2/28/74	2/28/74	2/28/74	3/3/74	3/4/74
Time	4:00 PM	8:00 AM	6:00 AM	12:00 MID	4:00 PM	Dry Down
Bi ϕ	0.005%	0.028%	0.010%	0.005%	0.008%	
Cl Bi ϕ	0.018%	0.131%	0.169%	0.176%	0.207%	
Cl Bi ϕ	<0.001%	<0.001%	0.001%	<0.001%	0.001%	
Cl Bi ϕ	0.007%	0.038%	0.051%	0.048%	0.023%	
Cl Mono Cl ϕ	0.025%	0.170%	0.221%	0.217%	0.231%	
Chlor Di's	—	—	0.073%	0.081%	0.164%	
Sfl wt	2.5134 gm	2.5375	2.5402	2.5249	2.5340	
Dwt	0.02014 gm	0.02014	0.02014	0.02014	0.02014 gm	

WITNESSED BY

DATE

Hi lights

The 15 tray Aroclor scrubber was started-up on 2/27/74. The scrubber is to remove PCB's from the chlorinator off-gas HCL. The scrubber has operated as designed. PCB's are effectively being removed. The 1216 distilled bottoms used to scrub the off-gas does last over a one week, so we will not have much of an increased work load. Pressure drop across the column is about 2 psi as planned. Pump start-up problems have been resolved: (1) the column circulating pump did leak badly - installation of a seal solved this, and (2) the scrubber liquor flow-indicator stuck - the instrument was replaced repaired. Remaining project work consists of completing the insulating of the HCL pipe lines and replacing the level indicator purge with nitrogen.

PCB-ARCH-EXT0375661

FORM 7411-5 U.S.A.

START 12:15 PM

DATE - 3/20/74

TEMPERATURE - °C

TIME		COL.	CIRIK	IN	OUT	GPM	LEVEL	SAMPLE
ACTUAL (12:2)	0	34	37	65	40	80	54	1, 2
12:45	20	30	37	61	36	✓	✓	3, 4
1:05	40							5, 6
1:25	60							7, 8
1:45	80	30	37	57	35	✓	✓	9, 10
			ΔP = 36"		HCL TK 4 3/4 #		DSM 0" (35)	
2:05	100		37	57	35	✓	✓	11, 12, 25
			ΔP = 19"					
2:25	120							13, 14
2:45	140	30	37	57	35	80		15, 16
			ΔP = 19"	HCL TK 4 3/4 #			54	
3:05	160							17, 18
3:25	180							19, 20

COMMENTS:

RUNNING TEST WITH C/S DOWN

12:25 PM [illegible] ϕ^2 [illegible] 100? 100? 85, 80?
147 157 187 112

5# on HCL TK

12:45 ϕ^2 [illegible] 100% 148, 158 190 198
130 100 83 79

1:45 70% ϕ

[illegible] 7 → 100#

PRES DROP

.1067
19
9603
1067
20273

Monsanto

FROM (NAME & LOCATION) D. K. Lynch - WGK

DATE March 26, 1974

CC W. C. Engman
G. Johnson
A. E. Leisy

SUBJECT Aroclor Scrubber

REFERENCE

TO : Ken Boucher

The recommendation for use of 1016 bottoms for the aroclor scrubber was based on 40°C. operation, cost of fluid and internal disposal capability. There is no known technical reason that other chlorinated biphenyl streams such as 1142, 1242, 1154, 1254, or mixtures could not be used as substitute fluids taking into consideration their physical properties.

Temperature of operation could be at any practical level within the limitations of the equipment and the properties of the fluid chosen.

The laboratory work done by Neil Thompson did not reveal the benefit of the low level chlorination that is apparently taking place in the scrubber, since he was working with simulated streams. Certainly advantage should be taken of this unexpected benefit.

Dan

D. K. Lynch

emc

Ref: Final Report No. 3844
Job No. 7309003

PCB-ARCH-EXT0375663