

PROGRESS REPORT

TECHNICAL SERVICES DEPT. - W. O. KRUMMRICH PLANT

JOB NO.

1716:246

REPORT NO.

DATE

11, 29, 67

W.O. KRUMMRICH PLANT

RESEARCH

GENERAL OFFICE

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TITLE: AROCLOR AND AROCLOR BLENDS: PROCESS IMPROVEMENT PLAN

PERSONNEL: R. M. McCutchan (J. W. Molloy)

PROBLEM: The objective of this report is to present the Dept. 246 (Aroclors, Pyranols, and Pydrauls) Process Improvement Plan.

SUMMARY The existing batch chlorination plant will meet 1968 sales needs of 32.75 M lbs Aroclors by operating at 95% maximum capacity. Ready for 1969 production will be a new continuous chlorination plant with accompanying stills, earth treatment columns, storage tanks, and increased blend capacity at a cost of \$1.5 M. The total WGC Aroclor capacity of 65.0 M lbs/yr will be sufficient to meet sales needs through 1972 with a 40% excess. *at WGC*

It is anticipated that corporate quality goals will be met with the completion of the continuous chlorination system and earth column treatment startup. The "in plant" goals are as follows:

	1242	1254
Resistivity, x 10 ⁹ ohm-cm	10,000	15,000
Power Factor, %	0.6%	0.3%
Thermal Chemical Chloride, ppm	< 0.1	< 0.1

Savings of ~~\$110,000~~ will be realized during 1968 as a result of increased capacity. *\$14,000 saving 50,000 new saving*

Acknowledgments

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Thanks goes to D. C. Armstrong, V. Brawley, D. Fitzgerald, J. A. Gloeckner, and H. F. Ray for their assistance and cooperation in the gathering of data and writing of this report.

RM M^c Cutchan

/gdp

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DETAILSI. Synopsis of Process

The Aroclor process consists of the following steps:

Chlorination Batch chlorination of biphenyl ($\text{Bi}\phi$) with snift gas (approximately 86 mole % Cl_2) at 150°C produces Aroclor. The byproduct is hydrogen chloride (HCl) gas.

Blowing Crude Aroclor from the chlorinators, is blown with air to remove excess HCl before distillation.

Distillation Crude Aroclor which has been air blown is continuously fed to the stills. These stills are straight-take-over type with no fractionation.

Earth Treatment and Filtration The distilled Aroclor is earth (attapulgis) treated, filtered, and transferred to storage.

Blending and Loading The finished product from the storage tanks is loaded into cans, drums, tank trailers, and tank cars, or used for making blends (electrical and non-electrical).

The principal Aroclors produced at W GK are 1242, 1248, 1254, and 1260. The last two digits indicate the % chlorine (weight) contained in the chlorinated biphenyl mixture (Aroclor).

II. Scope of Report

This report pertains to both the existing batch chlorination plant and the proposed continuous chlorination plant which is expected to be on-stream by January, 1969.

III. TSD Process Job List

Prio.	Job	Capital	Savings/Benefits	EDC
1	Install heat exchanger on Project 5334 (approved). Follow startup.	\$8,000	Meet 1968 sales needs, insure \$25,000 rate savings in 1968.	2/1/68
2	Coordinate quality tests in conjunction with PR&D effort.	- 0 -	Protect \$5 M market	3/1/68
3	Make nitrogen blanket system operable.	- 0 - \$15,000	Quality	4/1/68
4	Determine biphenyl losses under various chlorinator conditions. Recommend conditions for 1968.	- 0 -	Quality, minimize losses	3/1/68

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III. TSD Process Job List (Continued)

Prio.	Job	Capital	Savings/Benefits	EDC
5	Investigate possible blend specification changes	- 0 -	Increase blend capacity \$1,000/yr in lab costs	3/1/68
6	Check still operation at pressure lower than 40 ppm	- 0 -	Quality	3/1/68
7	Evaluate level recorder for still #2, install if justified	\$1,500	Process control	4/1/68
8	Evaluate liquid nitrogen supply system for Depts. 246, 254	TBD	Lower nitrogen costs	1/1/69
9	Evaluate automatic drum flushing and drumming installation with new building	\$200-300 M	\$20,000/yr labor savings and quality improvement	7/1/69
10	Evaluate equipping #1 still with horizontal pump and boildown facilities	\$15,000	Increase distillation capacity by 5 M lbs/yr	1/1/70

IV. CapacityA. Aroclor

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1. Current Capacity

Department 246 is rated at 2.4 M lbs Aroclors/mo, or 28.8 M lbs Aroclors/yr. The department is averaging 2.5 M lbs/mo through October 1967. Aroclor 1967 sales needs will be met. Presently the bottleneck is chlorine availability and distillation rate.

2. Sales Forecast - WGK (H. J. Day, 9/7/67)

Aroclor	1968	1969	M Lbs 1970	1971	1972
1242	16,107	19,037	21,484	23,772	25,572
1248	5,049	4,596	4,571	4,447	4,861
1254	4,831	5,039	5,462	5,957	6,257
1260	6,638	6,953	7,345	8,140	8,485
1262	125	135	145	155	165
TOTAL	32,750	35,760	39,007	42,471	45,340
Dept. Cap.	37,200*	New 40 M lbs/yr Plant			

*(Based on installation of still preheater and increased Cl₂ rate.)

IV. Capacity (Continued)3. Capacity to Meet 1968 Sales

Current department capacity is not sufficient to meet 1968 sales needs. Capacity increases are planned in both the chlorination and distillation steps to an overall capacity of 37.2 Mlbs Aroclors/yr, or 3.1 M lbs/month.

a. Chlorination

1. Project 3824 installs a 6" chlorine feed line to Dept. 246 (EDC 2/1/68).
2. Project 4864 increases chlorine revaporization capacity (EDC 1/15/68).
3. The capacity of the brink's mist eliminators is being checked. Work may be necessary to eliminate excessive yield losses at elevated rates and temperatures.
4. In-line specific gravity instruments are needed, and will be installed in the continuous chlorination plant.

b. Distillation

Project 5334 installs a spiral heat exchanger to preheat the still feed (EDC 1/1/68). This gives a 10% surge capability and insures needed production until the expansion is complete.

4. Storage Capacity, M Gal.

Product	Present Capacity, After Blending Project Complete	1968 Add 5 Tanks & Remove Un'gd.	1971 Add Three Tanks	Minimum 1971 Storage Recom. By H. J. Day, 6/67
1242	55	80	140	132.0
1248	20	40	40	25.2
1254	20	40	40	34.4
1260	30	20	20	20.2
TOTAL	125	180	240	211.8

All new tanks will be 20,000 gallon aluminum tanks with nitrogen blanket facilities.

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IV. Capacity (Continued)B. Aroclor Blends1. Current Capacity

Dept. A-246 is rated at 1.2 M lbs/mo Pyranols (14.4 M lbs/yr) and B-246 at 0.575 M lbs/mo Pydrauls (6.9 M lbs/yr). However, this capacity can not be achieved because of lack of mix tank capacity. During the first nine months of 1967 these blends were produced:

	<u>Nine Months, Lbs.</u>	<u>Extrapolated</u>
Pyranols: 1260 PPO	3,618,590	for year 1967
1254 PPO	2,339,788	
A13B3B	<u>1,040,080</u>	
	6,998,458	9.3 M lbs
Pydrauls: A-200	1,535,118	2.0 M lbs
TOTAL BLENDS	8,533,576	11.3 M lbs

2. Future Capacity and Sales Forecast

Project 2844 provides for changes and additions to loading and transfer lines, metering facilities, and the conversion of No. 8 storage tank to No. 3 mix tank. This will increase mix tank capacity from 27.5 M gal. to 47.5 M gallons, and should make possible the rated capacities of 14.4 M lbs/yr Pyranols and 6.9 M lbs/yr Pydrauls.

Aroclor Blend Sales Forecast, M Lbs.
(H. J. Day, 9/26/67)

	<u>Expanded Capacity</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>
<u>Pyranols:</u>						
Inerteen PPO (1260)		7,200	7,500	8,000	8,700	9,200
Inerteen 54201 KA		2,000	1,800	1,950	2,100	2,100
Pyranol A 13 B 3 B		<u>1,736</u>	<u>1,800</u>	<u>1,900</u>	<u>2,200</u>	<u>2,200</u>
TOTAL PYRANOLS	14,400	10,936	11,100	11,850	13,000	13,500
<u>Pydrauls:</u>						
					<u>0196079</u>	
Pydraul A-200		2,340	1,700	1,600	1,100	1,100
Pydraul 280		<u>197</u>	<u>240</u>	<u>280</u>	<u>320</u>	<u>320</u>
TOTAL PYDRAULS	6,900	2,537	1,940	1,880	1,420	1,420
<u>TOTAL BLENDS</u>	21,300	13,473	13,040	13,730	14,420	14,920

IV. Capacity (Continued)C. Drumming1. Current Capacity

Drumming is done on two shifts, one standard operator per shift, 5 days per week. The standard operator also helps load trailers and tank cars (25% of time). During the 12 month period, June 1, 1966 - May 31, 1967, the following drums and cans were filled: (see Appendix A for detailed drumming report)

Size	55 Gal.	30 Gal.	5 Gal.	Total
Aroclors	7221	- 0 -	569	7,790
Blends	<u>8249</u>	<u>540</u>	<u>2,148</u>	<u>10,937</u>
TOTALS	15,470	540	2,717	18,727

Grand Total: 18,727 drums and cans

Average Output: 36 drums and cans/man/shift

2. Future Drumming NeedsTotal Production, M Lbs

	1967 (Est.)	1972 (Sales Forecast)	5 Year % Increase
Aroclor	29.4	45.3	54.2%
Blends	11.3	14.9	31.9%

On the assumption that drumming requirements increase proportionally in 1972 with total production, 26,600 drums and cans will be needed. By adding one man on third shift drumming, these needs can be met with an average output of 34 drums and cans/man/shift. After 1972, a seven-day operation may be needed.

If drumming requirements increase sharply, a more automated drumming facility might be considered. (A rough estimate of such an installation including building is \$200-300 M.) Another source of justification for an automated system is the possible need of a drum flushing system for improved "as packaged" quality. Anniston TSD has the assignment of determining total company needs for Aroclor drum flushing. Results of their studies will dictate drumming needs for future quality requirements.

D. Tank Car and Trailer Loading

The following table shows the number of tank cars and trailers loaded during June 1, 1966 - May 31, 1967, and the projected loadings for 1972:

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	<u>6/66 - 5/67</u>	<u>1972</u>
Tank Cars:		
Aroclors	72	111
Pyranols	95	125
Total	167	236
Trailers -		
95% Aroclors	197	300
5% Pydrauls		

The existing loading facilities plus the two unloading docks included in the proposed plant expansion (CEA 1800) will be adequate through 1972.

E. Expansion - Continuous Chlorination (CEA - 1800)

1. Scope

- a. Five new 22,000 gallon aluminum storage tanks (EDC 7-1-68)
- b. Railroad spur and two unloading docks
- c. One 100,000 gallon biphenyl storage tank
- d. Three existing 15,000 gallon underground tanks will be dismantled.
- e. Separate transfer lines for each product from day tanks to tank farm, and from tank farm to loading or drumming areas.
- f. Chain of four chlorinators with external cooling and continuous feed tank (EDC 12-1-68)
- g. Continuous blow tank and intermediate storage tank
- h. Two semi-continuous distillation systems
- i. Four continuous porocel column treatment systems
- j. A complete therminol heating system
- k. Additions to the existing control room including instrumentation
 1. Electrical substation changes to supply power
- m. Motor control center
- n. Foreman's office

2. Capacity

After the continuous chlorination plant is on stream, all biphenyl will be chlorinated to the 1142 level in the new plant. It will then be chlorinated to the 1148, 1154, and 1160 levels in the batch plant. In 1972, based on H.J. Day's forecast of 9-7-67, the capacities and requirements of each plant will be:

- a. Chlorinator Capacity, M lbs./yr.

	1972 Sales Forecast	Maximum Capacity Based on 1972 Product Split
For Internal Use:		
Continuous System (1142)	15.9	6.5
For Sales:		
Continuous System (1142)	25.6	36.5
Batch System using 1142 as feed for 1148, 1154, and 1160	19.8	8.0
Batch System using biphenyl as feed for 1148, 1154, 1160	0.0	21.0
Total Aroclors For Sales	45.4	65.5

b. Still Capacity, M lbs./yr.

<u>Still No.</u>	<u>Product</u>	<u>1972 Sales Forecast</u>	<u>Maximum Capacity Based on 1972 Product Split</u>
1	1260-62	8.6	12.0
2	Boildown only, all aroclors		
3 (new)	1242	25.0	25.0
4 (new)	1242	0.6	10.0
	1248	4.9	6.5
	1254	6.3	8.5
Total Aroclors		45.4	62.0

Based on the current sales forecast and maintaining a 30% surge capacity at W.G.K., the expanded plant will be adequate through 1973.

V. Quality

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A. Goals

→ The following Aroclor quality goals were set at the corporate aroclor meeting held on May 9-10, 1967:

	<u>In - Plant</u>	<u>As Packaged</u>	<u>Delivered</u>
1242: Resistivity	10,000	5,000	3,000
Power Factor	0.6%	0.9%	1.0%
TCC	< 0.1ppm	-	0.1ppm
1254: Resistivity	15,000	10,000	5,000
Power Factor	0.3%	0.4%	0.5%
TCC	< 0.1ppm	-	0.1ppm

B. 1967 Aroclor Quality

In December 1966 the removal of the catalyst baskets from the chlorinators was completed at W.G.K. No other normal operating conditions have been changed. During 1967 the only quality shift has been an improvement in the electrical properties of both 1242 and 1254 during the third quarter. This is unexplained. Normal quality ranges have been as follows:

W.G.K. - 1967 - In Plant Analysis

	1967	8/67 - 11/67	
	<u>Normal Range</u>	<u>Average</u>	<u>Spec.</u>
1242: Resistivity	1,000-10,000	6,000	500
Power Factor	0.5-3.0	0.7	5.0
Tcc	0.45-0.6	0.49	0.65
1254: Resistivity	5,000-40,000	40,000	None
Power Factor	0.2-1.0	0.2	None
TCC	0.6-1.0	0.8	None

For a complete storage tank analysis record of Aroclor 1242 and 1254, see Appendix B.

C. Batch Quality Studies and Recommendations

Since early in 1967 there has been a concerted effort to improve Aroclor stability and electrical properties. This is a corporate effort headed by D.C. Armstrong of W.G.K. PR&D. It was initiated by the realization that Monsanto's Aroclor was surpassed in quality by foreign competitor's products.

The following quality factors have been considered and/or investigated: (For a complete report of IR&D batch work, see J.A. Gloeckner's progress report 91370: 3794-1.)

1. Chlorination

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*high HCl conc.
antichlor
best up before use.*

- a. Higher temperature chlorination will improve Aroclor quality. Four storage tanks of 1242 have been made at 195°C with an average 0.30 ppm TCC. The normal material made just prior to the tests averaged 0.45 ppm TCC. Optimum temperature has not been determined.
- b. Higher ferric chloride concentrations (0.2%) are beneficial at 150°C. At 200°C, the benefit is doubtful.
- c. Catalyst particle size was checked and found to vary considerably. (See Appendix C) Pennsalt is the only supplier of anhydrous ferric chloride and they do not attempt to control particle size.
- d. Biphenyl quality is an important variable under normal conditions. At higher temperature or catalyst level the effect of biphenyl quality is greatly reduced.
- e. Initial reaction temperature does not affect quality as long as it is at least 120°C.
- f. Bromine was added to the chlorine to a 700-800 ppm level and used to make a storage tank of 1242. At reaction conditions of 195°C and 8 lbs. FeCl₃/batch, a TCC of 0.47 was obtained. This material was life-tested by Electric Utilities and approved.
- g. Sparger design has been changed to give better chlorine distribution and to prevent catalyst settling. Resulting quality data has not been obtained.
- h. Off-gas condensate is not suitable as a raw material for electrical grade aroclor, but could be used for non-electrical grade. In an initial test, off-gas losses increased by five times when increasing the reaction temperature from 150°C to 195°C. Cost of yield loss would increase by \$40,000 for production of 30 M lbs.

Conclusion: Only one change can be recommended to improve Aroclor quality in the chlorination step. A temperature of 195°C should be used if off-gas losses can be minimized.

2. Filtration of Crude Aroclor

If catalyst concentrations higher than 0.05% are used, the undissolved ferric chloride should be removed before distillation. A centrifuge installation would cost \$25-40,000.

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*sublime
VP code
steam dist
check before off
for inner C.I.B.
impurity*

3. Distillation

- a. A lime charge equivalent to 0.8% of the chlorination mass should be used (present practice).
- b. For good process control, a level recorder is recommended for No. 2 Still. Especially during boil-downs, guess work risks line pluggage and considerable downtime.

4. Earth treatment vs. Porocel.

In the present plant, 20lbs. of attapulugus earth is mixed into a blend tank of distilled aroclor for 30 minutes and then filtered to a finished product tank. Varying amounts of earth and porocel were tried, but no significant quality difference was noted. Power factor was measured on a temporary in-line instrument.

5. Storage and Transfers

- a. All aroclor storage tanks should be 21-25,000 gallon aluminum tanks with a nitrogen blanket. The existing nitrogen system does not work and is being checked for modifications. It will be operable by 4-1-68.
- b. Separate aluminum transfer lines should be available for each aroclor product.

D. Continuous Chlorination Recommendations

WGC PR&D recommends the following process conditions be used in the continuous chlorination Aroclor plant expansion:

1. Chlorination

a. <u>Temperature</u>	<u>Min. Temp</u>	<u>Max. Temp.</u>
Biphenyl Feed Tank	100°C	120°C
Chlorinator 1	140	160
2	150	170
3	170	190
4	190	210

b. Catalyst

Use 0.1% FeCl₃ having a mesh size specification of 50% less than 15 microns and 100% less than 50 microns. Direct addition of the catalyst to the chlorinators is being explored. No baskets are to be used.

c. Yield Losses (cont'd following page)

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- c. Yield Losses(cont'd) Based on laboratory continuous chlorinations, vapor losses are expected to be 2-3 times that experienced at the Anniston plant. This material should be used for non-electrical grade Aroclor production.
- d. Circulation rate should be as high as possible compatible with good maintenance (narrows isomer distribution).

2. Crude Aroclor (1142) Storage

- a. Temperature should be as high as possible, 150-190°C minimum.
- b. Residence times should be as long as possible with a 12 hour minimum.
- c. The catalyst present in the storage tank forces polymerization of known types of unstable compounds.
- d. Agitation is recommended for optimum contact of catalyst and 1142. It will also minimize catalyst build-up in the tank.
- e. HCl removal will be accomplished by maintaining a mild vacuum (650 mm absolute) on the 1142 storage tank. Further work will determine if this is necessary. Air blowing is not recommended.

3. Distillation

- a. Lime charge of 0.8% adequately handles up to 0.2% catalyst concentration.
- b. Pressure is not very critical, but the lower the better. Starting with the same crude and distilling to the same yield, pressure and TCC are related as follows:

lot #

	<u>Pressure</u>	<u>Temperature</u>	<u>TCC</u>
	5 mm	190°C 178°?	0.27 ppm
	40 mm	240	0.23 - 0.27 ppm
	60 mm	280 260?	0.32 ppm

Plat compare →

yield
96.0
96.0

check

10.6-68
10-2
10-5

- c. A forecut of 1% will result in an improvement of 0.01-0.03 ppm TCC, independent of earth treatment method, chlorination conditions, or ageing. The forecut could be added to the condensate from the chlorinators and used for non-electrical aroclors. Present plant expansion does not anticipate making this forecut.

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4. Earth Treatment

Use porocel columns as demonstrated at Anniston.

5. Future Work

- a. Assist in plant demonstration at Anniston using chlorination conditions of 190-195°C in the third chlorinator and 0.04-0.06% FeCl₃ added directly to the first chlorinator.
- b. Define where catalyst should be added.
- c. Determine necessity of HCl removal from crude.
- d. Investigate effect of water and trace impurities in biphenyl on aroclor stability.

E. Aroclor Blends.

Specifications are normally met on all aroclor blends, but sometimes with great difficulty. The following conditions hinder the production of high quality blends:

1. General

- a. The blend tanks are inadequate in size and TTCB storage non-existent. Project 2884 will provide a third blend tank (20,000 gallons). It is recommended that one of the underground storage tanks (15,000 gallons) be retained for TTCB storage.
- b. There is only one supplier (Hooker) of TCB and TTCB. These raw materials have poor electrical qualities and are difficult to clean up.
- c. To aid in the mixing process, the blends are blown with plant air. The use of nitrogen would be a better practice.
- d. Earth treatment of the blends does little good, sometimes degrading the electrical properties. During 1967 earth treatment of 1260 PPO and 1254 PPO has been stopped. Less difficulty in meeting specifications has resulted.
- e. The chloride scavenger harms electrical properties.

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2. Specifications

- a. Pydrauls - No problems
- b. 1254 PPO - No problems
- c. 1260 PPO - Two causes make the specific gravity and refractive index specification difficult to meet:
 - (1) The specifications for the blend are narrower than for the components.
 - (2) The specific gravity and refractive index specifications do not correlate well with each other.

The per batch average is three blend adjustments and eight control sample analyses. This means increased lab costs, but more importantly, delay in shipments, below minimum drummed inventory, and poor TCB and TTCB yields.

A program to correct this problem was set up in 1966 by Don Harris and Bill Caraway, but was dropped after preliminary work because the dollar value was low (\$10-12M/yr.) Completion of this work is still needed as the time factor becomes more important and blend sales increase.

- d. A 13 B 3 B - This blend suffers from the same specific gravity and refractive index problems as does 1260 PPO. In addition, blends must be adjusted with 1260 since there is no TTCB storage. Finally, because of the poor quality TTCB, the electrical property specifications are difficult, and occasionally impossible to meet. Five electrical property checks and seven specific gravity and index analyses are made on an average batch.

VI. Yields

A. Biphenyl

<u>Year</u>	<u>Actual Yield</u>	<u>Standard</u>
1964	96.57%	
1965	98.39	
1966	98.66	
1967 (thru Sept.)	98.32	97.0%

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The yield loss is in the off-gas condensate and is worth \$12-15,000 in 1968. In the continuous chlorination plant this material will be used in the feed stream.

B. Chlorine

Chlorine usages are calculated by the chlorine department and therefore are not a meaningful gauge to the aroclor department operations.

C. TCB and TTCB

	Actual Yield 1967 (thru Sept.)	Standard
TCB	98.22	99.0%
TTCB	93.92	99.0

The yield losses are worth \$10-12 M in 1968 and are due to lack of TTCB storage and mix tank capacity.

VII. Manufacturing Costs (First 3 quarters 1967)

Total cost variance on the Aroclor production and blending operation is (-) \$25,000 for the first three quarters of 1967. This is primarily due to unscheduled capacity in the blending operation. The blending facility is actually operating at its capacity, however.

The following items represent the larger cost variances for aroclor and blend production:

A. Compressed Air Act \$8,584 Sch \$4,425 Var (-) \$4,159

Aroclor blends are agitated with air during the time an in-specification analysis is being achieved. As specifications are difficult to meet, more than a normal amount of air is being used.

B. Supplies Act \$13,080 Sch \$16,974 Var \$3,894

Supply costs appear normal and are itemized in Appendix D.

C. Packing Containers Act \$92,638 Sch \$81,274 Var (-) \$11,364

A larger than expected percentage of aroclor and aroclor blends are being sold in drums.

D. Laboratory Act \$27,601 Sch \$23,376 Var (-) \$4,225

As noted previously, many control samples are analyzed in achieving blend specifications.

E. TSD, Experimental, and PR&D

Act \$83,409 Sch \$23,062 Var (-) \$60,347

Since early in 1967, an intensive program has been planned and pursued in an effort to improve Aroclor quality.

F. Mechanical Expense

Act \$94,045 Sch \$144,585 Var \$50,540

A plant expansion expected in 1967 which did not materialize causes the large positive variance.

Mechanical expenses and downtime during 1967 YTD are above 1966, but in line with 1964-65. Process downtime results primarily from low chlorine pressure. This should be corrected with the completion of projects 3824 and 4864. For a summary of 1964-1967 YTD mechanical expense and downtime, see Appendix E.

Appendix F. itemizes the mechanical expenses for 1966-1967 YTD. Pumps continue to be a source of high maintenance costs. It is recommended that all new pumps installed be equipped with mechanical seals. Replacement or modification of existing pumps to pumps with mechanical seals will be evaluated.

Appendix G. lists all projects currently pending, or completed during 1967.

VIII. Stream and Air Pollution

The principal stream pollutants from Dept. 246 are biphenyl and chlorinated biphenyl. These are sewered at a rate of 700-800 lbs./day and are not considered a pollution problem. The sewerage of this material will be eliminated with the aroclor plant expansion by January, 1969.

The principal air pollutant is HCl gas. This is minimized by drowning the blow tank vapors.

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APPENDIX "A"

DRUMMING OF AROCLOR & BLENDS, 6/66 - 5/67

Prod.	Type Container,			Gallons								
	55	30	5	55	30	5	55	5	55	30	5	
		June 1966			July			Aug.		Sept.		
1232							22					
1242				302			40		195		61	
1248	88		39	158			192		20			
1254	985		36	510		66	402	30	183			
1260												
1262							19					
A 13 B 3 B	138	64		251	7		352	132	297	148	255	
1254 PPO				95	22							
1620 PPO	249		16	91			96		153			
PYD												
A-200	196			203			438		377			
PYD												
A-280									60			
1254 + 10% XYL							76					
THERM 1	40			42					190		4	
THERM 2				104			4					
THERM 3												
TOTALS	1696	64	91	1656	29	66	1641	162	1475	148	320	

1609610

APPENDIX "A" (CONTINUED)

DRUMMING OF AROCLOR & BLENDS, 6/66 - 5/67

Prod.	Type Container, Gallons														
	55	30	5	55	30	5	55	5	55	30	5				
	Oct. 1966			Nov.			Dec.		Jan.						
1232															
1242	150			231			138		120						
1248				12			84								
1254	345		142	178		35	354		221						
1260									24						
1262	23														
A 13 B 3 B				91		1034	170	200	58	100					
1254 PPO							64		70		10				
1260 PPO	216						161	52	134	50	61				
PYD															
A-200	366			231			174		116						
PYD															
A-280									152						
1254 + 10% XYL				39					39						
THERM 1									28		32				
THERM 2	59			52			174		75						
THERM 3	70														
TOTALS	1229		142	834		1069	1319	252	1037	150	103				

2609610

TOWOLDMON0045412

APPENDIX "A" (CONTINUED)

DRUMMING OF AROCLOR & BLENDS, 6/66 - 5/67

Prod.	Type Container		Gallons														
	55	5	55	30	5	55	30	5	55	30	5	55	30	5	55	30	5
	FEB.		MAR.			APRIL			MAY			TOTAL					
1232	41											63					
1242	176	53	92			18			98			1560					
1248	108		72			104			201			1039					
1254	134		250			448		36	456		71	4456			416		
1260												24					
1262	37											79					
A 13 B 3 B	2		30			52	35	53	130	99	175	1571	453		1849		
1254 PPO			14	15		1						244	37		10		
1260 PPO	143	74	255			141			151			1790	50		203		
PYD																	
A-200	223		60			224			158			2766					
PYD																	
A-280												212					
1254 + 10% XYL	39		38									231					
THERM 1	16		52			112						480			36		
THERM 2	110		90			143		34	14			825			34		
THERM 3			16		16	44						130			16		
TOTALS	1029	127	969	15	16	1287	35	123	1208	99	246	55 Gal.	15,470				
												30 Gal.	540				
												5 Gal.	2,717				

019693

TOWOLDMON0045413

APPENDIX B

ANALYSIS ELECTRICAL GRADE 1242

	Spec.	0.65 max.	500 min.	5.0 max.	
<u>Mo., 1967</u>	<u>Lot No.</u>	<u>TCC</u>	<u>Resistivity x 10⁹</u>	<u>P.F.</u>	<u>Comments</u>
January	KI-				
	401	0.25	1850	0.66	Normal operating condition unless otherwise noted. (150°C, 2 lbs FeCl ₃)
	402	0.29	3950	0.82	
	403	0.30	2000	1.83	
	404	0.37	600	2.20	
	406	0.41	800	1.29	
	407	0.49	600	2.64	
February	408	0.51	1030	4.44	
	411	0.45	3200	0.90	All other material sold as non-electrical
	412	0.33	2040	0.76	
March	415	0.59	1600	1.80	
	417	0.40	960	3.00	
	421	0.28	700	3.03	
	422	0.34	680	2.37	
April	423	0.45	900	3.38	
	427	0.47	1600	1.62	
	428	0.52	880	3.06	
	431	0.48	750	1.86	
May	436	0.32	2150	0.26	
	437	0.36	1300	3.24	
June	440	0.62	4240	0.66	
	444	0.61	2500	0.84	
	447	0.53	3250	0.85	
	448	0.28	2880	0.81	— (195°C, 8 lbs FeCl ₃)
July	451	0.59	2620	0.89	
August	455	0.55	2040	1.39	
	456	0.49	7489	0.31	
	457	0.47	5000	1.56	— (195°C, 8 lbs FeCl ₃ , 700-800 ppm Br ₂)
September	459	0.55	2560	0.99	
	462	0.63	2610	0.94	
	465	0.46	10400	0.52	
	469	0.47	6900	0.78	
October	471	0.38	22400	0.40	
	472	0.30	13600	0.36	— (195°C, 2 lbs FeCl ₃)
	475	0.44	13690	0.23	
	476	0.41	7350	0.40	
	477	0.26	13750	0.24	— (195°C, 2 lbs FeCl ₃)
November	480	0.50	4000	1.26	
	482	0.37	8000	0.19	— (195°C, 2 lbs FeCl ₃)

0196094

TOWOLDMON0045414

ANALYSIS ELECTRICAL GRADE 1254

Spec. - No plant specifications.

<u>Mo., 1967</u>	<u>Lot No.</u>	<u>TCC</u>	<u>Resistivity x 10⁹</u>	<u>P.F.</u>	<u>Comments</u>
	KI-				
January	601	0.69	8800	0.63	Operating conditions were 150°C, 2 lbs FeCl ₃ .
February	604	0.65	510	4.12	
March	605	0.68	5450	1.06	
	606	0.69	4080	0.90	
	607	1.00	22000	0.24	
	609	1.07	1200	2.53	
April	613	1.00	10400	0.49	
	616	0.99	22400	0.29	
May	618	1.19	6650	0.31	
	619	0.89	5900	0.63	
June	621	0.96	6400	0.78	
	623	0.79	36020	0.14	
August	625	1.06	24015	0.15	
September	628	1.05	43250	0.23	
October	631	0.50	800460	0.11	
	632	0.67	160000	0.20	

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TOWOLDMON0045415

APPENDIX C

FERRIC CHLORIDE PARTICLE SIZE

Particle size was determined by St. Louis Testing Laboratories, Inc.

Plant	WGK	Anniston	WGK	Anniston
Date Sample Tested	5/8/67	5/25/67	7/6/67	7/6/67
Per Cent less than 1 micron	---	6.6	5.4	---
Per Cent less than 5 micron	---	24.5	69.9	---
Per Cent less than 10 micron	17.4	42.5	91.4	8.5
Per Cent less than 20 micron	40.6	93.4	---	21.8
Per Cent less than 50 micron	85.5	---	---	69.7
Per Cent less than 100 micron	96.1	---	---	89.7

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TOWOLDMON0045416

APPENDIX D

SUPPLIES

Items over \$200 bought from the storeroom during 9 months of 1967:

Filter paper, Sparkler	\$662.50
Glass bottles, 5 pt.	607.52
Oakite cleaner	502.26
Seals (labels)	475.00
Filter cartridges	462.00
Soaps and detergents	351.88
16 oz. bottles and caps	335.93
Kerosene	277.20
Filter cartridges, Alsop	272.00
Pressure gauges	245.46
Rags	244.86
Steam hose	221.61
3-2" flanged tees, 4 gate valves	240.00

The above items account for about 50% of the total supply cost. The balance is made up of non-repeating items bought through the storeroom and through purchase orders.

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TOWOLDMON0045417

APPENDIX E

SUMMARY OF TRUE REPAIR, MECHANICAL
EXPENSE, AND DOWNTIME FOR 1964 - 1967 YTD (JULY)

<u>Category</u>	<u>1964</u>	<u>1965</u>	<u>1966</u>	<u>1967 YTD</u>
True Repair	\$ 80,404	\$ 82,302	\$70,450	\$47,397
Mechanical Expense	116,834	100,379	88,592	65,998
Repair D.T.	1.92%	2.93%	0%	1.60%
Process D.T.	3.29	2.00	0.46	3.44
Total D.T.	9.03	9.20	2.76	8.03

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TOWOLDMON0045418

APPENDIX F

MECHANICAL EXPENSES,

1966-1967 YTD (JULY)

<u>Category</u>	<u>1967</u> <u>Thru July</u>	<u>% of</u> <u>Total M.E.</u>	<u>1966</u>	<u>% of</u> <u>Total M.E.</u>
Pump	\$10,571	17.0%	\$10,048	11.3%
Furnace	1,384	2.2	1,844	2.1
Dept. repairmen	4,799	7.7	8,560	9.7
Instrument	3,539	5.7	7,340	8.3
Ejector	2,030	3.3	2,554	2.9
Platform	15,338	24.7	13,208	14.9
Plant Improvement	8,684	14.0	9,132	10.3
Work to Assist	5,702	9.2	9,124	10.3
Tank, Closed	575	0.9	2,647	3.0
Piping	2,844	4.6	8,722	9.8
Electrical	686	1.1	4,351	4.9
Miscellaneous	1,820	2.9	3,439	3.9
All Others	4,236	6.8	7,623	8.6
Total M.E.	\$62,208		\$88,592	

0196099

TOWOLDMON0045419

APPENDIX G

PROJECTS CURRENTLY PENDING

OR-COMPLETED DURING 1967

Engr. Auth. No.	Est. No.	Date App.	Description	Cost	Status
	5334	8/67	Install heat exchanger	\$ 8,000	EDC 1/1/68
	2844	4/66	Blending & Loading Facilities	60,000	Given to CED for construction; mat- erials being ordere
	5639	10/67	Relocate TCB Dock	2,100	
	1138	12/66	Install alarms on chlor.	3,450	Comp. 8/67
	4263	1/67	Dism. gravity instrument	500	Complete
	4467	3/67	Replace steel & hand- rails	18,810	Complete
	4448	4/67	Replace vacuum jet	4,620	80% complete
	4871	4/67	Install Exp. Filter	2,600	Comp. 6/67
	5018	5/67	P.M. painting steel	23,380	EDC 12/1/67
	5411	8/67	P.M. insulation repairs	5,375	Complete
S-842	3446	7/66	Install safety showers	2,700	Comp. 5/67
S-892	3528	7/66	Alter shower tracing	1,000	Comp. 5/67
S-893	2698	12/65	Alter 3 loading docks	5,700	Complete
S-670			Dismantle & replace lean-to	30,500	Held up pending study of drumming required.
S-650			Upgrade control room	4,000	Held up pending dept. expansion by CED.
S-647			Upgrade office	6,000	Est. sub. 8/67
S-7060			Upgrade lighting		
M-6049	R3771	8/66	Relocate 6" fire pro- tection line		Comp. 5/67
M-5034	3491	8/66	Roof over loading dock		Comp. 2/67
Minor			Install mech. remote room valve		Sch. for Dec. turn-around.
			Install spare #2 still pump	8,000	Estimate submitted

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TOWOLDMON0045420