PROGRESS REPORT
TECHNICAL SERVICES DEPT. - W.G. KRUMMRICH PLANT

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TITLE: AROCLOR: PROCESS IMPROVEMENT PLAN

PERSONNEL: D. R. Middleton (J. R. Savage)

PROBLEM: Report status of present work and present future plans.

SUMMARY: The status of the previous Process Improvement Plan published 7/29/64, is as follows:

	Long Range Target (1Q, 66)	Status
Rate	39.0M #/yr.	36.0M #/yr. only need 26.4 through 1969.
Yields (B1Ø)	98.0% Theory	98.5% of theory through June, 1965.
Manufacturing Cost	$5.983/cwt	$5.859/cwt through June, 1965.
Quality	0.40 ppm Thermal Chemical Chlorides (TCC)	Present average 0.50 ppm TCC. New target less than 0.15 ppm.

Presently targeted quality improvements are: Recommend facilities required to make Aroclor 1242 with a Thermal Chemical Chloride (TCC) of less than 0.15 ppm Cl by January 1966 and determine how to consistently ship Pyranols with a power factor of less than 5% at 100°C and 60 cycles by June 1966.

The capacity of Dept. 246 (Aroclor) is sufficient to meet forecasted sales plus 25% through 1969. The capacity of Dept. A-246 (Pyronols) will be increased to meet forecasted sales by up-grading the blending facilities (6/66) and providing storage for TCB, 1260 PPO, and 1254 PPO (1/67). To meet forecasted sales in Dept. B-246 (Pydraul), storage for one of the two product (Pydraul 200 and 280) will be provided by using the present TCB underground storage when it becomes available in 1/67.

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High speed drumming facilities will enable a reduction of 1 man, $10,000/yr. in 1/67. A work force evaluation will be made by 1/67 to determine feasibility of further reductions.

D. R. Middleton

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DETAILS

Synopsis of Process

The Aroclor Process consists of the following steps:

Chlorination

Batch chlorination of biphenyl (BiØ) with Snift Gas (contains approximately 86 mole % Cl_2) at 150°C produces crude Aroclor. The by-product is hydrogen chlorine (HCl) gas.

Blowing

Crude Aroclor, from 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 & Filtration

The distilled Aroclor is earth (Attapulgus) treated, filtered, and transferred to storage.

Blending & 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 which are produced at WGK are 1242, 1248, 1254, and 1260. The last two digits indicate the weight plus % chlorine contained in the chlorinated biphenyl mixture (Aroclor).

QUALITY

Aroclor

The two main quality measures of Electrical Grade Aroclor are resistivity and stability. Presently the major portion of quality work is aimed at improving Aroclor 1242 stability to less than 015 ppm 01 by the Thermal Chemical Chloride (TCC) method.

The questions to answer concerning Aroclor stability are:

1. What factors effect stability of Aroclor?

   a) Raw Material Impurities
   b) Chlorination Techniques
   c) Distillation Techniques
   d) Earth Treatment and Filtration

2. What combination of factors are necessary to produce desired quality at the least cost?

   a) Impurity free raw materials
   b) Chlorination Technique: temperature, feed rate, catalyst, geometry of chlorinator, etc.
   c) Distillation Techniques: stripping and/or rectifying
   d) Earth Treatment and Filtration
   e) Chemical Treatment

Chlorination:

Chlorination techniques (in present WGK Plant Equipment) affect the amount of over and under chlorinated BiØ, but not necessarily the final stability of the product. The variables which have been measured were: amount of catalyst, method of catalyst addition, chlorinator, chlorination rate, chlorination temperature. The first three were the most significant variables.

Distillation:

Laboratory distillations, in which low & high boiling fractions (chemical nature of these are not known) were removed from plant crude, produced Aroclor with less than 0.2 ppm TCC. Due to variability of plant crudes the size of the fractions varied from 1-3% for low boilers and 10-15% for high boilers. It may or may not be feasible to recycle these fractions to non-electrical Aroclor production.

Future Aroclor Quality Work

1) Organic Research is presently running continuous distillation tests to determine column design and operating conditions needed to refine present WGK and Anniston Plant crudes to less than 0.15 ppm TCC.

   Start: 6/65
   EDC: 9/30/65

2) Run plant test using revaporized Cl_2.

   Start: 8/65
   EDC: 10/65

Future Aroclor Quality Work (continued)

3) Investigate Earth Treatment. On two different tests, material earth treated in plant was 0.1 ppm Cl higher than laboratory treated material. Current work at Anniston will be followed.

Start: 9/65
EDC: 10/1/65
By: TSD , PR & D

4) Preliminary evaluation of Chemical Treatment of crude Aroclor to remove unstables.

Start: 7/26/65
EDC: 9/30/65
By: PR & D

5) Vapor Phase chlorination for 1242.

Start: 10/65
EDC: 12/65
By: TSD

6) By 12/1/66 recommend facilities needed to produce Aroclor 1242 at various TCC levels between 0.5 and 0.1 ppm.

Pyranols

The quality of WGK Pyranols (Transformer Blends) must be improved to meet the market's power factor requirements. The target is to consistently ship material with a power factor of less than 5% at 100°C and 60 cycles, and have little or no deteriation during transit. Future work in this area is as follows:

1) Initiate studies to define the power factor problem.

Start: 4th Q of 65
EDC: 6/66
By: TSD

2) From above information take appropriate action.

Start: 6/66
EDC: 6/67
By: TSD

3) Studies to determine effect of exposure to various metals is presently underway.

EDC: 10/65

CAPACITY

Dept. 246 - Aroclor

Capacity of Dept. 246 (92% On-Stream Time)

	1966 Forecast*	1969 Forecast*	Demonstrated 1965 Extrapolated	Potential
Yearly	27.4M#	31.6 M#	29.9M#	36.0M#
Monthly	2.3M#	2.64M#	2.6M#	3.0M#
Monthly plus 25% Surge Capacity	2.9M#	3.3 M#	-	-

*H.J. Day's forecast dated 5/12/65 multiplied by 1.2

The potential capacity of Dept. 246 is sufficient to meet the needs of future forecasted sales. The department bottlenecks are:

Product	Bottleneck
1242	Distillation
1248) 1254) 1260)	Chlorine Availability

The Cl_2 bottleneck can be relieved by cleaning or replacing the snift gas line from the Cl_2 Dept.

The distillation bottleneck can be relieved by furnace burner alterations and demonstration of high capacity still pump with 3" furnace coil.

The only active work in the capacity area is the above demonstration. EDC 11/65.

Dept. A-246 - Pyronals

Capacity of Dept. A-246

	Present Capacity 1965 Extrapolated	1966 Forecast	1969 Forecast	Debottlenecked Capacity
1260 PPO	6.32M#	6.1 M#	7.5 M#	
1254 PPO	4.61M#	4.3 M#	4.5 M#	
A_1B_2B	1.04M#	1.15M#	1.15M#	
Total for Year	11.97M#	11.55M#	13.15M#	25.0M#
Avg. Monthly	1.0 M#(Max.)	0.96M#	1.1 M#	2.0M#
Avg. Monthly + 25%	--	1.20M#	1.37M#	

For flexibility in Dept. A-246 it is desirable to have sufficient capacity to meet 25% surges and sufficient storage for 200,000# of each 1254 and 1260 PPO.

The present capacity of A-246 is 1.0M# (when making the 3 blends). No storage is available for these blends.

A design premise has been submitted for facilities to increase capacity to 2.0M#/month. ($25, - 30,000). This increase can't be realized until the following storage is available:

New 20,000 gallon tank for 1254 PPO
New 20,000 gallon tank for 1260 PPO
New 20,000 gallon tank for TCB (R/M)

Estimated cost of these storage facilities is $105,000. Design premise will be out 9/65. Installed January 1967.

Dept. B-246 - Pydrauls

	Capacity of B-246				
	1966 Forecast	1967 Forecast	1969 Forecast	Demonstrated Capacity	Future Capacity
A-200	4.7 M#	5.22M#	5.26 M#	6.0 M#	
A-280	0.7 M#	1.0 M#	1.5 M#		
Total Yearly	5.4 M#	6.22M#	6.75 M#	6.0M#	Meet Forecasted Sales
Total Monthly	0.45M#	0.52M#	0.56 M#	.50M#	
Monthly + 25%	0.56M#	0.65M#	0.705M#	-	

Presently A-200 is the principal blend which is made in the No. 1 Mix Tank. The capacity is limited by sales, because the product is stored in the Mix Tank. The blending capacity will be increased to at least 1.0M#/month (if sales are available) as part of the $25-30,000 up-grading job for A-246. As A-280 sales materialize storage for one of these blends will be needed to attain flexibility. For short range No. 6 underground storage (present TCB) can be used following installation in New TCB storage (January 67). Presently there are no long range (thru 1969) plans for Pydrauls storage.

YIELDS

The raw materials for manufacturing Aroclor are Chlorine Snift Gas and Biphenyl. The Snift Gas usage is not measured, it is calculated. The Biphenyl yields are as follows:

1964 BiØ Yield	96.57%
1965 BiØ Yield (through June)	98.5%
1965 Standard BiØ Yield	95.5%

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The BiØ yield losses are as follows:

Chlorinator Off-Gas (Collected in Brink and discarded)	0.4%
Still Bottoms	0.5%
Still Vacumm System	0.1%
Unknown	0.4%
TOTAL	1.4%

On the average, the Aroclor produced is about 50% Cl_2, therefore the Cl_2 loss is also approximately 1.4%. In a 29M# year the yield losses, based on raw material costs, amount to the following:

Cl_2	$4,300
BiØ	6,400
TOTAL	$10,700

The chlorinated BiØ and BiØ which is collected in the Brink ($3,200/yr.) are presently not recycled because its effect on stability is not known.

The still bottoms are profitably sold as Montar. Presently no extensive future work is planned in this area.

HCl off-gas recovered by Dept. 217 and F-218 is 83.4% of theory, through June 1965. The loss amounts to about $45,000/year of Muriatic Acid credit.

COSTS

Dept. 246 - Aroclor - Basis Jan-July 1965

	Cost/100# Aroclor	Cost for 29M#/year
Material Costs		
Cl_2	2.090	606,000
BiØ	3.088	896,000
Misc.	0.015	4,350
HCl (Credit)	0.730 (-)	(-)211,000
Handling	0.033	9,560
Sub-Total	4.496	$1,300,000

COSTS (Cont'd)	Cost/100# Aroclor	Cost for 29MM#/yr
Direct Conversion		
Steam	0.098	28,700
Labor	0.223	64,600
Salaries	0.042	12,200
Supplies	0.080	23,200
Laboratory	0.082	23,800
TSD	0.069	20,000
Prod. Process Res.	0.081	23,500
Mech. Expense	0.337	92,800
Others	.097	28,200
Sub-Total	1.109	$321,000
Indirect		
Dep..	0.122	35,400
FIE	0.152	44,100
Sub-Total	0.274	$79,500
TOTAL PRODUCT COST	5.879	$1,700,000

In 1966 TSD and Prod. Process Res. costs should decrease after answers to quality (stability) problems are found.

In the first quarter of 1967 when blending facilities (Dept. A & B-246) are installed there will be a work force evaluation and possibly a reduction. Extrapoleted labor costs for Dept. A & B-246 in 1965 are:

Dept. A-246 (Pyranol) $14,850/12,000,000#

Dept. B-246 (Pydraul) $14,900/4,370,000#

In the first quarter of 1967 high speed durmming facilities should also be installed (TSD Job No. M5007) which will enable work force reduction of one man ($10,000/year savings).

STREAM AND AIR POLLUTION

The principal stream pollutants from Dept. 246 are BiØ, chlorinated BiØ, and HCl. None of these are presently considered a problem. In the future approximately 150#/day of BiØ chlorinated BiØ can be removed from the sewers by sending all off-gas brink collections to the toxic dump.

The principal air pollutant is HCl gas. This can be minimized by drowning the blow tank vapors and gases with the existing water jet.

ACKNOWLEDGEMENTS

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D. R. Middleton

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LIST OF CURRENT AND PROPOSED JOBS

TSD NO.	TITLE, OBJECTIVE	SAVINGS BENEFITS	CAPITAL	TSD TIME TO COMPLETION MAN-MONTHS	EDC	TECHNICAL SUCCESS FACTOR	STATUS, COMMENTS
3198	Aroclor: Improve Electrical Grade Quality	Protect Market Position	?	6	1/66 (Eval.)	100%	
3229	Aroclor: Install 3" coil in [illegible] 2 still furnace	Increase still capacity coil to be compatable with new low maintenance still pump	None	1/4	10/65	50%	Precedent having maintenance problem with new external still pump
3287	Aroclor: Improve loading and blending facilities	Capacity increase needed to meet sales, Possible work force reduction	$25 - $30,000	2	6/66	90%	Storage for Pyranols needed to realize full capacity increase
3362	Aroclor: Increase Capacity (to minimum of 2.[illegible]/month)	Meet sales in first half of 1965	None	1/2	10/65	100%	Capacity of Dept. 2[illegible]6 is 3.0[illegible]/mo. if sales are available.
M5007	Aroclor: Provide high speed drumming facilities	$10,000 savings from labor reduction	?		3/67	80%	Work is being done by TSD Mechanical Group
	Aroclor: Provide storage for 125[illegible] [illegible], 126[illegible] [illegible] and TCB	Increase capacity to meet sales, flexibility	$105,000	4	1/67	90%	Capacity increase from 3[illegible] cannot be realized without this job.
M5034	Aroclor: Provide roof above truck loading dock	Prevent shipment delays; save $1,200/yr demurrage	?	1/4		50%	
3441	Aroclor: Provide [illegible] measurement for [illegible] and #2 still [illegible]	Improve operations- No definite savings	$3,[illegible]	1/[illegible]	1/66	50%	
	Aroclor: Provide exhaust fan for Drumming Area	Safety - Fume inhalation					

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LIST OF CURRENT AND PROPOSED JOBS (Cont'd)

TITLE, OBJECTIVE	SAVINGS BENEFITS	CAPITAL	TSD TIME TO COMPLETION MAN-MONTHS	EDC	TECHNICAL SUCCESS FACTOR	STATUS, COMMENTS
Pyranols: Investigate high power factor problems	Needed to meet the industries future requirement					
Aroclor: Increase safety of still bottoms dropping operation	Safety		1/2	1/66	90%	
Pyranol's: Determine suitable material for shipment of Transformer Blends	$10-$20,000/year customer reimbursement		1/3	10/66	90%	TSD Materials Section presently working on.