ORIGINAL

MONSANTO COMPANY

ORGANIC CHEMICALS DIVISION

STANDARD MANUFACTURING PROCESS

FOR

PYDRAUL A-200

DEPT. 259

PYDRAUL 280

DEPT. 259

Supersedes: Standard Manufacturing Process for Pydraul A-200 in Department B-246, dated October, 1966.

Prepared by: R. M. McCutchan

R M McCutchan Approved by:

Bill Corlew 12/9/70
General Manufacturing Superintendent

L. P. Stark 12/28/70
Research

J R Savage 12/11/70
Manufacturing Manager

Issued: December, 1970

Copy _____ of _____

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AMENDING RECORD SHEET

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MAJOR CHANGES from process dated October, 1966, follow:

The only changes of consequence incorporated in this Standard Manufacturing Process from data in superseded SMP's are:

1. Santolube 70A is used instead of Santolube 70.

2. Tricresyl phosphate produced at the W. G. Krummrich Plant is used in Pydraul 280, rather than TCP produced at the J. F. Queeny Plant.

3. "Boildown" production is used in Pydraul production. This material may be less stable (from an electrical use standpoint) than normal finished goods and may be over 20 APHA in color. This may or may not have been normal practice at the time of the previous SMP.

4. Annual capacity is 7.0M lbs. instead of 5.0M lbs.

R. M. McCutchan

DEPARTMENT 259-Standard Manufacturing Process
Pydraul A-200 and Pydraul 280

SECTION I

Synopsis of Process

Pydraul is a trade name used to designate a series of hydraulic fluids. Pydraul A-200 was the first one produced at the W. G. Krummrich Plant. Later (April, 1964) Pydraul 280 was produced. Both are fire resistant, the 280 being used almost exclusively in mining applications. Pydraul A-200 has a slightly higher specific gravity, but the 280 is more viscous.

Both Pydrauls are blends of Aroclor, phosphates (280 only), small amounts of petroleum additives, dye, and a defoaming agent. The blend components are as follows:

	% (wt.) except as indicated	
Raw Material	A-200	280
Aroclor 1242	33(vol.)	--
Aroclor 1248	67(vol.)	61.9
Aroclor 1260	--	15.9
Tricresyl phosphate	-	21.8
Santolube 70A	0.5	0.4
Lubrizol 1360	0.5	--
DC Fluid 200, 350CS	0.005	0.002
DuPont Oil Blue A Dye	0.0005	0.0007
Azo Oil Black	0.0002	--

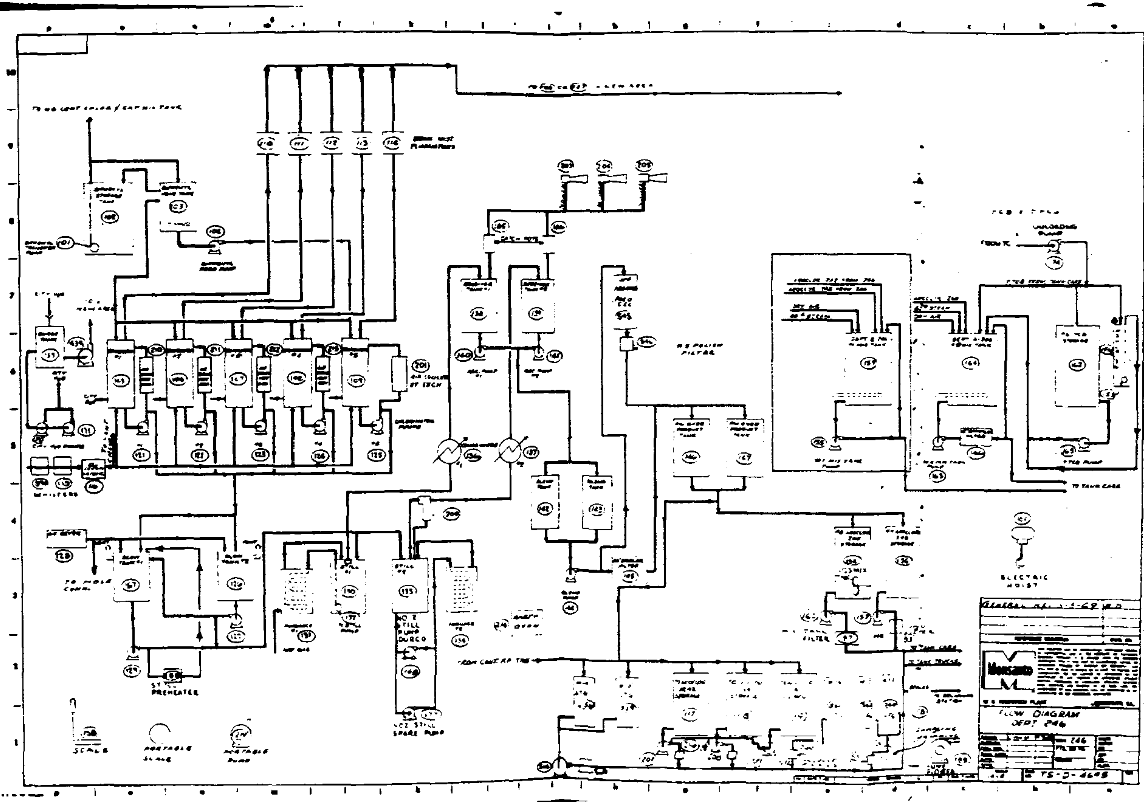
Pydraul A-200 and 280 are sold in 55 gal. drums and 5 gal. cans. Pydraul A-200 is also sold in bulk quantities.

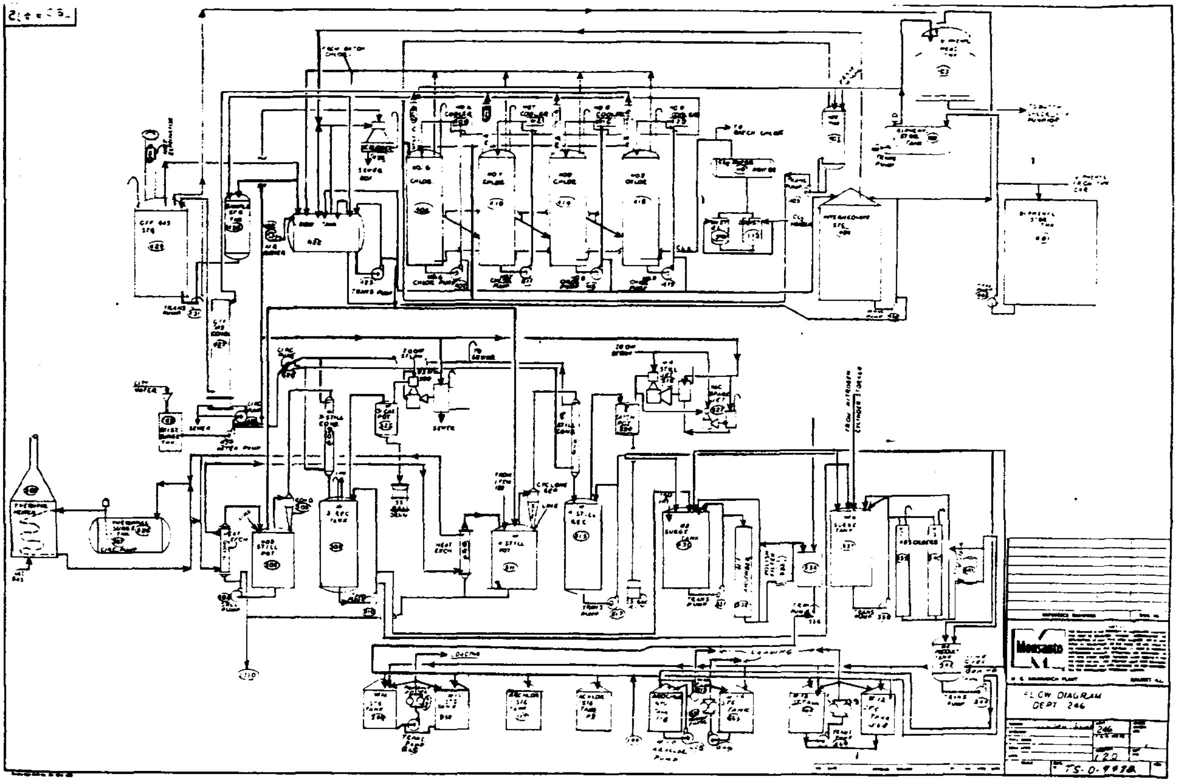
DEPARTMENT 259 - Standard Manufacturing Process
Pydraul A-200 and Pydraul 280

SECTION II

Flow Sheets

TS-D-4695 and TS-D-9472 are flow diagrams of Dept. 246 (Aroclor) and Dept. 259 (Pyranols and Pydrauls). The only equipment used in Pydraul production is #1 Mix Tank and pump, Items 159 and 155 on TS-D94695.


FLOW DIAGRAM
DEPT 246
Monsanto
ELECTRIC HOIST
STILL PREHEATER
SCALE
PORTABLE SCALE
PORTABLE PUMP
NO 2 STILL PUMP DURCO
TO TANK CARS



DEPARTMENT 259 - Standard Manufacturing Process
Pydraul A-200 and Pydraul 280

SECTION III

Process in Detail

A. Batch Data

The raw materials necessary to produce typical batch sizes are:

Raw Material	A-200 12,000 Gal.	A-200 8,000 Gal.	280 140,000 Lbs.
Aroclor 1242	4000 gal.	2670 gal.	--
Aroclor 1248	8000 gal.	5330 gal.	87,000 lbs.
Aroclor 1260	--	--	22,500 lbs.
Tricresyl phosphate	--	--	30,000 lbs.
Santolube 70A	700 lbs.	500 lbs.	560 lbs.
Lubrizol 1360	700 lbs.	500 lbs.	--
DC Fluids 200,350CS	7.5 lbs.	5.0 lbs.	3.0 lbs.
DuPont Oil Blue A Dye	326 gms.	264 gms.	1.0 lbs.
Azo Oil Black	120 gms.	80 gms.	--

B. Blending Of Major Components

Primary chemical reactions are absent in the production of the Pydrauls. The only process step is blending, which is done at 80-100°C.

A-200
Aroclor 1242 and 1248 are pumped from storage in Dept. 246 to #1 Mix Tank. The mixture is agitated for four hours, and a 16 oz. sample taken for analysis of specific gravity.

The desired specific gravity of the Aroclor mixture is 1.429-1.431 @ 25°C. Small additions of either Aroclor 1242 or Aroclor 1248 are added as necessary to achieve this gravity. When the small components are added later, the specific gravity usually decreases by 0.003-0.005.

280
Tricresyl phosphate (TCP) is received by trailer and pumped to #1 Mix Tank. The necessary weights of the Aroclor 1248 and Aroclor 1260 are calculated based on the trailer weight of TCP. The Aroclors are transferred to #1 Mix Tank, agitated for four hours, and a 16 oz. sample taken for analysis of specific gravity and viscosity.

DEPARTMENT 259 - Standard Manufacturing Process
Pydraul A-200 and Pydraul 280

SECTION III (cont'd.)

Process in Detail (cont'd.)

B. Blending of Major Components (cont'd.)

280
If the specific gravity or the viscosity of the batch is off specification, one or more the the following factors may have caused the deviation.

a. An error in charges made to the vessel.

b. Specific gravity and viscosity specifications for the raw materials, are broad and the properties of the batch will be affected accordingly.

c. Insufficient mixing.

The properties of the batch are brought into specification by following this guide:

d. If both viscosity and specific gravity are out of specification, adjust charges to correct viscosity first. In so doing, the specific gravity will be corrected normally at the same time. If only the specific gravity is off specification proceed to e. below.

1. If the 100°F viscosity is high - "out of specification" - add TCP. The addition of 1.0 lbs. TCP/100 lbs. batch will lower the 100°F viscosity of the batch about 1.5 centistokes.

2. If the 100°F viscosity is low, - "out of specification" - add Aroclor 1260. The addition of 1.0 lb. Aroclor 1260 per 100 lb. batch will increase the 100°F viscosity about 1.7 cs.

e. After making the necessary adjustment for viscosity, if the specific gravity is still out of specification, proceed as follows:

1. If the Sp. Gr. 25/25°C is high, add a mixture of 68 wt. % TCP and 32 wt. % Aroclor 1260. Add 1 lb. of this mixture/100 lbs. batch for each 0.0012 units high.

2. If the Sp. Gr. 25/25°C is low, Add a mixture of 91 wt. % Aroclor 1248 and 9% Aroclor 1260. Add 10.0 lbs. of mixture per each 100 lbs. batch per 0.0067 units low.

DEPARTMENT 259 - Standard Manufacturing Process
Pydraul A-200 and Pydraul 280

SECTION III (cont'd.)

Process in Detail (cont'd.)

C. Blending of Minor Components

Only after proper specific gravity and viscosity are obtained are the minor components added. This should be done when the batch temperature has fallen below 70°C. At higher temperatures Lubrizol 1360 begins to decompose.

Lubrizol 1360 imparts good anti-wear properties to Pydraul A-200. Since TCP provides ample anti-wear protection, Lubrizol 1360 is not a components in Pydraul 280.

Santolube 70A is a rust inhibitor.

Dow Corning Fluid inhibits foaming caused by Santolube 70A.

The dye does not change any property other than color.

D. Sampling and Packaging

After all components have been added the batch is agitated for six hours. Three 16 oz. samples are taken for final analysis.

If the batch meets all specifications (See Appendix B), the finished Pydraul is drummed or loaded in trailers (A-200 only).

Drum net weights are:	55 gal.	5 gal.
Pydraul A-200	645 lbs.	59 lbs.
Pydraul 280	625 lbs.	60 lbs.

The Pydraul must be allowed to cool to 40°C or less to fill drums to the proper weight.

When Pydraul A-200 is loaded in a tank trailer, two 16 oz. samples from each compartment are taken for analysis.

DEPARTMENT 259 - Standard Manufacturing Process
Pydraul A-200 and Pydraul 280

SECTION IV

Comments on Process

A. Blending

Any in-specification Aroclor can be used for Pydraul production. Experience indicates that good correlation of specific gravity and viscosity of the finished goods is more easily obtained when the specific gravity and viscosity of the Aroclors are near the middle of the specification ranges.

When producing Pydraul 280, the targeted specific gravity is toward the lower end of the specification range. It is much easier to add additional Aroclor than it is to add more TCP.

B. Yields

All Aroclor yields are assumed to be standard, 99% of theory. Exact proportions vary from batch to batch depending upon the exact specific gravity of the Aroclors involved. The only raw material on which an actual yield is calculated is TCP. Standard is 99% of theory, but this has seldom been achieved. In spite of close process control, YTD (1970) yield is 97.3%. The primary reason is that small Aroclor adjustments are not made after specification is obtained. This is because if too much Aroclor is added and more TCP is necessary, then drums of TCP must be ordered. The department has no TCP storage.

C. Quality

Care is taken to avoid a Pydraul 280 batch with specific gravity higher than specification for the reasons mentioned above. All other analyses for Pydraul A-200 and 280 are relatively easy to obtain.

Nearly all "boildown" production from the Aroclor operation is used to make Pydrauls. Aroclors with colors up to about 150APHA are suitable for Pydrauls. Pydrauls of the 312 series, produced at JFQ can tolerate Aroclor color up to about 300-350 APHA.

DEPARTMENT 259 - Standard Manufacturing Process
Pydraul A-200 and Pydraul 280

SECTION IV (cont'd.)

D. Capacity

The Pydraul capacity of Dept. 259 is about 7.0M lbs. per year. This is equivalent to one 12,000 gal. batch per week.

The only bottleneck is storage. The #1 Mix Tank has the dual purpose of a blending tank and a storage tank. Bulk orders often are placed with very little lead time. Therefore, bulk amounts are sometimes held in #1 Mix Tank in anticipation of an order. At other times drumming from #1 Mix Tank is delayed due to a greater need for other drummed products.

Pydraul A-200 and Pydraul 280 occupy the same equipment.

DEPARTMENT 259 - Standard Manufacturing Process
Pydraul A-200 and Pydraul 280

APPENDIX A

EQUIPMENT LIST

ITEM NO.	EQUIPMENT NAME	EQUIPMENT NO.	DESCRIPTION
159	#1 Mix Tank, Speed Reducer and Motor	21-0321 37-5176 66-2168	Tank (Nooter), Dwg. D-6455, 14' O.D. x 10' high, 3/8" shell, steel construction. Capacity is 15,000 gals. Agitator motor is 7.5 HP, 1750 RPM.
155	#1 Mix Tank Pump and Motor	19-3172 66-2651	Durco pump model WH2 alloy construction, 2" x 1 1/2" with 8" impeller. Capacity of 160 gpm at 55' head.

DEPARTMENT 259 - Standard Manufacturing Process
Pydraul A-200 and Pydraul 280

APPENDIX B

SPECIFICATIONS

The following is a list of the raw materials used in the manufacture of Pydrauls at the W. G. Krummrich Plant. Specification sheets that are available are included.

Material Code	Raw Material
81101	Aroclor 1242
81102	Aroclor 1248
81105	Aroclor 1260
80071	Tricresyl Phosphate
81797	Santolube 70A
39050	Lubrizol 1360
31100	DC Fluid 200,350CS
20640	duPont Oil Blue A Dye
20317	Azo Oil Black

The following is a list of the finished Pydrauls produced in Department 259. Specification sheets are included.

Product Code	Product
81096	Pydraul A-200
81119	Pydraul 280

Monsanto
ORGANIC CHEMICALS DIVISION
W. G. Krummrich & Anniston

FINISHED PRODUCT SPECIFICATION

PRODUCT		DEPT.
Aroclor 1242	Non-Electrical Grade	WGK 246 Ar 2

PLANT	PRODUCT CODE	USE
WGK & Ann.	81101-82612	Sales

DATE EFFECTIVE	SALES CODE
9/25/67	1040-240-04/11/16-03/09

APPROVALS

PRODUCTION	RESEARCH
P. E. Heisler	M. E. Gibbs
SALES	**QUALITY CONTROL (Chief Chemist)**
W. E. Ault	W. J. Gresham

GENERAL DESCRIPTION: Mixture

CHEMICAL FORMULA:

MOL WT.

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS	ISSUED BY
7/15/64	3 x 16 oz. W.M. Bottles	L. E. Hornback

UNRESTRICTED INFORMATION

	CHARACTERISTIC	LIMITS	METHOD WGK	METHOD Anniston
(R)	Condition	Clear	10084	G-1
(R)	Color, APHA	100 max.	10084	046
(R)	Sp. Gr. (25/15.5°C.)	1.381 - 1.392	10114	052
(R)	Acidity (mg. KOH/g.)	0.010, max.	10087	050
(R)	Moisture (H_2O) (ppm)	50, max.	10620	047
	Distillation Range (ASTM D-20 Corrected)		10117	14-31-54
	10% Distilled by wt.	325°C., min.		
	90% " " "	360°C., max.		
	Viscosity @100°F. (SUS)	82 - 92	10086	049
	Flash Point (°F)	338 - 392	10123	14-28-54
	Fire Point	None	10123	14-28-54

MONS 046587

(R) Routine Analysis, All others Analysed by request Only

Monsanto
ORGANIC CHEMICALS DIVISION

W. G. Krummrich & Anniston
FINISHED PRODUCT SPECIFICATION

PRODUCT		DEPT.
Aroclor 1248 Non-Electrical Grade		WFK 246 An 2
PLANT	PRODUCT CODE	USE
WGK & Ann.	81102 - 82641	Sales
DATE EFFECTIVE	SALES CODE	
9/25/67	1040-260-04/11/16-03/09	

APPROVALS

PRODUCTION	RESEARCH
P. E. Heisler	M E. Gibbs
SALES	QUALITY CONTROL (Chief Chemist)
W. E. Ault	W. J. Gresham

GENERAL DESCRIPTION: Mixture

CHEMICAL FORMULA:

MOL WT.:

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS	ISSUED BY
7/15/64	3 x 16 oz. W.M. Bottles	L. E. Hornback

UNRESTRICTED INFORMATION

	CHARACTERISTIC	LIMITS	WGK METHOD	Anniston METHOD
(R)	Appearance	Colorless to light yellow-green liquid	10084	G-1
(R)	Condition	Clear	10084	G-1
(R)	Color, APHA	100 max.	10084	046
(R)	Sp. Gr. @65/15.5°C.	1.405 - 1.415	10114	052
(R)	Acidity (mg. KOH/g.)	0.010, max.	10087	050
(R)	Moisture (H_2O) (ppm)	50, max.	10620	047
(R)	Viscosity @130°F. (SUS)	73 - 80	10086	049
	Flash Point (°F)	370, min.	10123	14-28-54

MONS 046588

(R) Routine Analysis, All others Analysed by request Only

Monsanto
ORGANIC CHEMICALS DIVISION
W. G. Krummrich & Anniston
FINISHED PRODUCT SPECIFICATION

PRODUCT			SPEC.
Aroclor 1260 Non-Electric Grade			A1 WGK 246 ?
PLANT	PRODUCT CODE	USE	
WGK & Ann.	81105 - 82614	Sales	
DATE EFFECTIVE	SALES CODE		
9/25/67	1040-290-04/11/16-03/09		

APPROVALS

PRODUCTION	RESEARCH
P. F. Heisler	M. E. Gibbs
SALES	QUALITY CONTROL (Chief Chemist)
W. E. Ault	W. J. Gresham

GENERAL DESCRIPTION: Mixture

CHEMICAL FORMULA:

MOL WT.

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS	ISSUED BY
7/15/64	3 x 16 oz. W.M. Bottles	L. E. Hornback

UNRESTRICTED INFORMATION

	CHARACTERISTIC	LIMITS	WGK METHOD	Anniston METHOD
(R)	Condition	Clear	10084	G-1
(R)	Color, APHA	150, max.	10084	046
(R)	Sp. Gr. @90/15.5°C.	1.555 - 1.566	10114	052
(R)	Acidity (mg. KOH/g.)	0.014, max.	10087	050
(R)	Moisture (H_2O) (ppm.)	50, max.	10620	047
(R)	Viscosity @210°F. (SUS)	72 - 78	10086	049
	Flash Point	None	10123	14-28-54
	Fire Point	None	10123	14-28-54

MONS 046589

(R) Routine Analysis - All others Analyzed by request Only

Monsanto
ORGANIC CHEMICALS DIVISION

RAW MATERIAL
SPECIFICATION

MATERIAL CODE	MATERIAL
80071	Tricresyl Phosphate A Grade
PLANT: WGK	USING DEPTS.: 259
DATE EFFECTIVE: 1/31/69	SUPPLIER: J F. Queeny

APPROVALS

PRODUCTION	RESEARCH
J. W. Molloy	J. W. Baker
PROCUREMENT	QUALITY CONTROL (Chief Chemist)
J. Leyerle	R. Blowers

GENERAL DESCRIPTION

CHEMICAL FORMULA

$(CH_3C_6H_4)_3\ PO_4$

mol. wt. 368.18

SUPERSEDES SPECS OF	SAMPLE FOR ANALYSIS	ISSUED BY
11/27/68	1 x 16 oz. NN Bottle	Higgerson/Stites

CHARACTERISTIC	LIMITS	METHOD	
TEST On Each Lot	Internal Use	JFQ Methods	WGK Methods
	Acidity	0.20 meq./100 grams max. (=0.01% as H_3PO_4)	4 - A	12,236
(R)	Appearance	Clear, practically colorless to light yellow liquid	16 - B	12,233
	Color	APHA 75 max.	38 - D	10,007
	Moisture (By KF in methanol)	0.15%, max.	78 - B	12,238
	Odor	No foreign odor	84 - A	10,060
(R)	Specific Gravity at 25/25°C.	1.157 to 1.173	116 - B	
	Stability to $KMnO_4$	65% transmission min.	118 - D	
(R)	Refractive Index * at 25°C.	1.5540 - 1.5560		11,784

*Identification only. Tentative limits based on very little data. Shipments are not to be rejected because of failure to comply with these limits.

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ORGANIC CHEMICALS DIVISION

RAW MATERIAL SPECIFICATION

MATERIAL CODE	MATERIAL
82138 5/1/9/	Santolube 70-A
PLANT	**USING DEPTS.**
WGK	259
DATE EFFECTIVE	**SUPPLIER**
1/23/70	Nitro

APPROVALS

PRODUCTION	RESEARCH
J. W. Molloy	J. F. Palmer, Jr.
PROCUREMENT	**QUALITY CONTROL (Chief Chemist)**
J. Leyerle	R. Blowers

GENERAL DESCRIPTION

CHEMICAL FORMULA

SUPERSEDES SPECS OF	SAMPLE FOR ANALYSIS	ISSUED BY
2/25/69	1 x 16 oz. W/M Bottle	Stites/Burgeson

CHARACTERISTIC	LIMITS		METHOD
TEST	UNRESTRICTED	RESTRICED	
On each lot			
Appearance and Condition	Clear, oily liquid		6-C-01
Color, ASTM D11.	5.5 max.		ASTM D-1500
Neutralization Number	56 ± 5		6-A-24
Solubility, 5% by Volume in B & A Petroleum Ether (30°-60°C).	Clear		6-V-22
Emulsion	40,40,0(30 min.)		6-S-28
Upon Request			
Santolene C Presence		Positive Phosphorus Test	6-S-59
Specific Gravity at 25°C	Typical 0.92 ± 0.5		6-D-07
Viscosity, SUS at 210°F.	Typical 180 ± 110		6-X-02

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ORGANIC CHEMICALS DIVISION

RAW MATERIAL
SPECIFICATION

MATERIAL CODE	MATERIAL
39050	Lubrizol 1360
PLANT	USING DEPTS.
WGK	259
DATE EFFECTIVE	SUPPLIER
12/6/67	Lubrizol

APPROVALS

PRODUCTION	RESEARCH
P. E. Heisler	L. R. Stark
PROCUREMENT	QUALITY CONTROL (Chief Chemist)
J. D. Leycrle	W. J. Gresham

GENERAL DESCRIPTION

CHEMICAL FORMULA

SUPERSEDES SPEC OF	SAMPLE FOR ANALYSIS	ISSUED BY
11/20/64	2 x 16 oz. W.M. Bottle	L. E. Hornback

CHARACTERISTIC	LIMITS	METHOD
UNRESTRICTED INFORMATION		
Specific Gravity @15.5/15.5°C	about 1.125	*
Phosphorus	7.8%, min.	
Sulfur	16.0%, min.	
Zinc	8.2%, min.	
Viscosity @210°F (98.9°C)	about 60 SSU	
Pounds/gallon @15.5°C	about 9.35	

*Analyses to be obtained from Supplier on request.

Shippers analysis covering the above requirements will be mailed to the W. G. Krummrich Plant Laboratory - Chief Chemist the same day shipment is made.

Monsanto
ORGANIC CHEMICALS DIVISION

RAW MATERIAL
SPECIFICATION

MATERIAL CODE	MATERIAL
31100	Dow Corning 200 Fluid - 350 cs.
PLANT: WGK	USING DEPTS.: 259
DATE EFFECTIVE: 4/17/68	SUPPLIER: Dow Corning Corp.

APPROVALS

PRODUCTION	RESEARCH
T. W. Dalton	J. W. Baker
PROCUREMENT: R. F. Neunuebel C. A. Pratte	QUALITY CONTROL (Chief Chemist): W. J. Gresham

GENERAL DESCRIPTION

CHEMICAL FORMULA

SUPERSEDES SPECS OF	SAMPLE FOR ANALYSIS	ISSUED BY
3/18/65	1 x 8 oz. W.M. Bottle	L. E. Hornback

CHARACTERISTIC	LIMITS	METHOD
UNRESTRICTED INFORMATION		
Appearance	Syrupy Liquid	T-2134
Viscosity @25°C.	330 - 370 cs.	T-2132
Color - Modified ASTM D-848-45T	1.5, max.	T-2142
Flash Point	600°F., min.	T-2138
Neutralization Number	0.05, max.	80-B (JFC
Stability (Viscosity Change after 16 hrs. @200°C.)	10, max.	118-31100 (JFQ)

This material is shipped upon invoice certification of compliance with specifications.

(R) Routine Analysis. All others Analyzed by request only

MONS 046593

Monsanto
ORGANIC CHEMICALS DIVISION

FINISHED PRODUCT SPECIFICATION

PRODUCT		DEPT.
PYDRAUL A-200		259
PLANT: WGK	PRODUCT CODE: 81096	USE: Sales
DATE EFFECTIVE: 7/29/69	SALES CODE: 4595-200-11-03	

APPROVALS

PRODUCTION: J. Molloy	RESEARCH: J. W. Baker
SALES: W. E. Ault	QUALITY CONTROL (Chief Chemist): R. Blowers

GENERAL DESCRIPTION — CHEMICAL FORMULA

MIXTURE

MOL WT:

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS	ISSUED BY
6/29/66	2 x 16 oz. W.M. Bottles	Higgerson/Stites

CHARACTERISTIC		LIMITS	METHOD
UNRESTRICTED INFORMATION			
(R)	Appearance	Cloudy, Blue Liquid	12,809
(R)	Flash Point	350°F., min.	12,803
(R)	Moisture, K.F.	0.05%, max.	12,810
(R)	Neutralization Number	0.80 - 1.10 mg. KOH/g.	12,794
(R)	Sp. Gr. @ 25/25°C.	1.415 - 1.430	12,804
(R)	Viscosity,		12,837
	@ 50°F.	900 cs., max.	
	@ 100°F.	30.0 - 33.0 cs.	
	@ 210°F.	2.80 - 3.00 cs.	
RESTRICTED INFORMATION			
(R)	Foam Test	150 ml., max.*	12,805

*Disposition of lots failing this limit will require approval of the Sales Department.

Monsanto
ORGANIC CHEMICALS DIVISION

FINISHED PRODUCT SPECIFICATION

PRODUCT		DEPT.
Pydraul 280		259
PLANT	PRODUCT CODE	USE
WGK	81119	Sales
DATE EFFECTIVE	SALES CODE	
10/15/67	4596-280-11-03	

APPROVALS

PRODUCTION	RESEARCH
P. E. Heisler	J. W. Baker
SALES	QUALITY CONTROL (Chief Chemist)
W. E. Ault	W. J. Gresham

GENERAL DESCRIPTION — CHEMICAL FORMULA

MOL WT.

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS	ISSUED BY
12/28/64	2 x 16 oz. W.M. Bottle	L. E. Hornback

CHARACTERISTIC	LIMITS	METHOD
UNRESTRICTED INFORMATION		
(R) Appearance	Cloudy Blue Liquid	12809
(R) Acidity (Neut. #)	0.2 - 0.5 mgKOH/g	12794
(R) Moisture	0.15%, max.	12810
(R) Pour Point	+20°F, max.	10115
(R) Flash Point	350°F, min.	12803
(R) Viscosity		12837
100°F	56 - 62cs	
210°F	3.90 - 4.10 cs	
(R) Sp. Gr. @25/25°C	1.385 - 1.405	12804

MONS 046595

(R) Routine Analysis - All others Analyzed by request Only

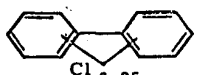
DEPARTMENT 259 - Standard Manufacturing Process
Pydraul A-200 and 280

APPENDIX C

PHYSICAL CONSTANTS

This section contains physical constants data and physical and functional properties of Pydraul A-200.

PHYSICAL CONSTANTS DATA

SUBSTANCE	STRUCTURAL FORMULA
AROCLOR 1260	
COMPILED BY: A. M. Ellenburg	DATE: 4/25/57

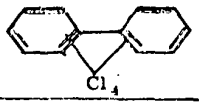
NAME		SOURCE & RATE
Formula	$C_{12}H_{3.75}Cl_{6.25}$	
Molecular Weight	361 (Avg.)	
Appearance	Lt. Yell. soft sticky resin	Monsanto Bull. OP-115(1)
Boiling Point at 760 mm Range	365-420°C.	"
Boiling Point at 5 mm "	195-245°C.	"
Boiling Point at mm		
Boiling Point at mm		
Crystallizing Point	Non-Crystallizing	"
Melting Point		
Solution Point		
Specific Gravity @ 25/25/°C.	1.620	"
Specific Gravity @ 90/15.5°C.	1.555-1.566	Specification 2/14/55
Pounds per Gal. @ 25°C	13.50	MB OP-115
Coefficient of Expansion 20-100°C.	0.00067 cc/cc/°C.	
Refractive Index @ 25°C n D	1.6455-1.6465	Specification 2/14/55
Infra Red Spectrum (References)		
Ultra Violet Spectrum (References)		
Viscosity @ 210°F.	72-78 SUS	MB OP-115
Viscosity @		
Surface Tension		
Solubility in Water	Insoluble	" "
Solubility in		
Solubility in		
Flash Point °F (Tag) C. O. C.	None	"
Fire Point °C C. O. C.	None	"
Heat of Combustion		
Heat of Formation		
Thermal Stability (cal./gm/min.)		
Latent Heat of Fusion		
Latent Heat of Vap. cal/gm	48	Calculated
Specific Heat @ 25°C.	0.228	MB OP-115
Critical Temperature		
Critical Pressure		
Dissociation Constant		
Specific Heat @ 300°C.	0.303	"
Other Constants: Pour Point	25-34°C.	"
Dielectric Constant 100°C. 60 cy.	3.6-3.8	"
Toxicity (Give Reference)	Contact Medical Dept.	MB OP-115

MONS 046597

NOTE

PHYSICAL CONSTANTS DATA

SUBSTANCE: AROCLOR 1248

STRUCTURAL FORMULA: 

COMPILED BY: A. M. Ellenburg

DATE: 4-25-57

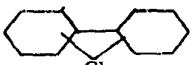
NAME		SOURCE & DATE
Formula	$C_{12}H_6Cl_4$	
Molecular Weight	292 (Avg.)	
Appearance	Yellow Tinted Mob. Oil	Monsanto Bull. OP-115(1)
Boiling Point at 760 mm Range	345-385°C.	"
Boiling Point at 3 mm "	165-210°C.	"
Boiling Point at mm		
Boiling Point at mm		
Crystallizing Point	Non-crystallizing	"
Melting Point		
Solution Point		
Specific Gravity @ 25/25 °C.	1.445	"
Specific Gravity @ 65/15.5°C.	1.405-1.415	Specifications 9/9/54
Pounds per Gal. @ 25 °C	12.04	M.B. OP-115
Coefficient of Expension 25-65°C.	0.00070 cc/cc/°C.	"
Refractive Index @ 25°C n D	1.6285-1.6305	Specification 9/9/54
Infra Red Spectrum (Reference)		
Ultra Violet Spectrum (Reference)		
Viscosity @ 130°F.	73-80 SUS	M.B. OP-115
Viscosity @		
Surface Tension Dynes/cm @20°C.	44.2	J. Coll. Sci. 7, 166, (195
Solubility in Water	Insoluble	M.B. OP-115
Solubility in 3A Alcohol @ 25°C.	15 g./100 cc	"
Solubility in Pyridine @ 29°C.	111.4g./100 cc	"
Flash Point °C (Method) C.O.C.	196°C.	"
Fire Point °C C.O.C.	None	"
Heat of Combustion		
Heat of Formation		
Thermal Stability (cal./kg/min.)		
Latent Heat of Fusion		
Latent Heat of Vap. cal/gm.	54	Calculated
Specific Heat @ 25°C.	0.277	M.B. OP-115
Critical Temperature		
Critical Pressure		
Dissociation Constant		
Specific Heat @ 300°C.	0.356	"
Other Constants: Pour Point	0°C. or lower	"
Other Constants: Thermal Conductivity, cal/cm/°C/sec.	23.6 @ 28°C.	To be published
Other Constants: Dielectric Constant, 100°C., 60 cy.	4.5-4.7	M.B. OP-115
Toxicity (Give Reference)	Contact Medical Dept.	M.B. OP-115

MONS 046598

NOTE: These data should not be released outside of Monsanto Chemical Company. Use additional sheets if necessary.

Form 610

PHYSICAL CONSTANTS DATA

SUBSTANCE	STRUCTURAL FORMULA
AROCLOR 1242	
COMPILED BY: A. M. Ellenburg	DATE: 4-25-57

NAME		SOURCE & DATE
Formula	$C_{12}H_7Cl_3$	
Molecular Weight	257 (avg.)	
Appearance	Colorless Mobile Oil	Monsanto Bull. OP-115 (1956
Boiling Point at 760 mm Range	325 - 360°C.	"
Boiling Point at 3 mm "	155-195°C.	"
Boiling Point at mm		
Boiling Point at mm		
Crystallizing Point	Non-crystallizing	"
Melting Point		
Solution Point		
Specific Gravity @ 25/25°C.	1.380	"
Specific Gravity @ 25/15.5°C.	1.381 - 1.392	Specification 2-14-55
Pounds per Gal. @ 25°C	11.50	M. B. OP-115
Coefficient of Expansion 25-65°C.	0.00068 cc/cc/°C.	"
Refractive Index @ 25°C. n_D	1.6245 - 1.6265	Specification 2-14-55
Infra Red Spectrum (Reference)		
Ultra Violet Spectrum (Reference)		
Viscosity @ 210°F.	34-35 SUS	M. B. OP-115
Viscosity @ 100°F.	82-92 SUS	"
Surface Tension Dynes/cm @ 20°C.	45.3	J. Coll. Sci. 7, 166, (1952
Solubility in Water	Insolable	M. B. OP-115
Solubility in 3A Alcohol @ 29°C.	23.3 g./100 cc	"
Solubility in Pyridine @ 30°C.	132.5 g./100 cc	"
Flash Point °C (Method) c.o.c.	180°C.	"
Fire Point °C c.o.c.	None	"
Heat of Combustion		
Heat of Formation		
Thermal Stability (cal./kg/min.)		
Latent Heat of Fusion		
Latent Heat of Vap. cal/gm.	61	Calculated
Specific Heat @ 25°C.	0.293	M. B. OP-115
Critical Temperature		
Critical Pressure		
Dissociation Constant		
Specific Heat @ 300°C.	0.380	"
Other Constants: Pour Point	-14°C. or lower	"
Other Constants: Thermal Conductivity, cal/cm/°C/sec.	24.0 @ 28°C.	To be published
Other Constants: Dielectric Constant, 100°C., 60 cy.	4.7 - 4.9	M. B. OP-115
	MONS 046599	
Toxicity (Give Reference)	Contact Medical Dept.	M. B. OP-115

NOTE: These data should not be released outside of Monsanto Chemical Company. Use additional sheets if necessary.

DEPARTMENT 259 - Standard Manufacturing Process

PYDRAUL A-200 and 280

APPENDIX C

PHYSICAL CONSTANTS - W. G. KRUMMRICH PLANT

*PYDRAUL A-200-PHYSICAL & FUNCTIONAL PROPERTI

Appearance: Slightly cloudy, light yellow, oily liquid.

Viscosity:	Centistokes	Saybolt Universal Seconds
at 210°F	2.86	35.8
at 100°F	30.14	142.
at 40°F	1920.	8500.

Density:

at 100°F	1.4161 gm./ml.
at 60°F.	1.4305 gm./ml.

Flash Point (COC): 380°F.

Fire Point (COC): 680°F.(1)

Hot Manifold (MIL-F-7100), 1300°F.- Does not flash or burn on tube or after leaving tube.

Low Pressure Spray Flammability (AMS 3150-B) - Flame brightened, but did not increase.

High Pressure Spray Flammability (AMS 3150-B)- Will not ignite.

Molten Metal Ignition (molten aluminum alloy at 1150 to 1250°F) - Does spontaneously ignite. Flashes by spark.

Pour Point: + 15 °F.

Neutralization No. mg KOH/gm. to pH 11: 0.83(2)

Steam Turbine Oil Rust (ASTM D-665) 10.0 at 48 hours(3) MONS 046600

Foam (ASTM D-892)

	Foam Vol. ml.	Collapse Time Seconds
at 75°F	30	60
at 200°F.	8	60
at 75°F	35	60

Shell Four-Ball Wear: Steel-on-steel 4 Kg. - 0.21 mm.

167°F, 630 RPM, 1 hr. 10 Kg. - 0.29
40 Kg. - 0.43

*Pydraul A-200 was formerly named OS 95

HYDRAUL A-200 and 280

APPENDIX C

PHYSICAL CONSTANTS (Cont'd.) - W. G. KRUMMRICH PLANT

Shell Four-Ball Wear: 167°F, 630 RPM, 1 Hr. — Steel-on bronze: 4 Kg. - 1.20; 10 Kg. - 1.40; 40 Kg. - 1.70

Almen E.P. — Passing load - 48 lb. 24,000 psi. Passing torque - 41 lb.

Almen Wear (wt. loss mg.): 1.3 mg.

Timken Load (passing): 50 lb., 16,340 psi film strength

Steam Turbine Oil Oxidation (ASTM D-943): (1008 hours exposure)

Viscosity	
100°F. Initial	30.12 cs.
Final	30.03 cs.
210°F. Initial	2.87 cs.
Final	2.86 cs.
Acidity Initial, TAN	0.82
Final, TAN	0.21
Fluid Appearance	Greenish brown with greenish white deposit in tube bottom.
Steel Appearance:	Soft black deposit on surface.
Copper App.	Black rough (etched) surface.
Four-Ball Wear:	Initial 10 Kg.-0.29 mm., Final 10 Kg.-0.41 mm.

Oxidation-Corrosion: (Fed. Sped. 791 Method 530.8, 168 hrs. at 250°F).

Metal Attach (wt. change mg/cm.^{2})

Copper	- 0.05 no etch, greenish to straw stain.
Aluminum	-+0.01 clear
Magnesium	- 0 very slight trace surface pitting
Steel	-+0.01 clear
Cadmium Plate	- 0.01 clear

Viscosity	
100°F. Initial	30.1 cs.
Final	31.8 cs.
210°F. Initial	2.86
Final	2.93
Acidity, TAN	
Initial	0.82
Final	0.68
Evaporation Loss, %:	0.6

MONS 046601

DEPARTMENT 259 - Standard Manufacturing Process

PYDRAUL A-200 and 280

APPENDIX C

PHYSICAL CONSTANTS (Cont'd.) - W. G. KRUMMRICH PLANT

Oxidation-Corrosion: (Fed. Spec. 791 Method 530.8, 168 hrs. at 250°F.) (Cont'd.)

Fluid Appearance: Clear, light amber, no deposits.

(1) fluid boiled over onto heater.
(2) apparent high acidity due to nature of additives present.
(3) rust rating: REL M-400, 10.0 - no rusting.

DEPARTMENT 259 - Standard Manufacturing Process
Pydraul A-200 and 280

APPENDIX D

UTILITIES

The utilities used in Pydraul production are electricity and 80 psi steam. Both are treated as variable costs on the cost report. The usage of each is shown below.

1. ELECTRICITY - 1970 YTD (9 mos.) average monthly usage is 2000 KWH.
   Items using electricity are:

Item No.	Equipment	Rating	Voltage
155	#1 Mix Tank Pump	__ HP	440
159	#1 Mix Tank Agitator	7.5 HP	440
--	Miscellaneous	__	110

2. 80 PSI STEAM - 1970 YTD (9 mos.) average monthly usage is 325M BTU's. Steam is used in the #1 Mix Tank heating coil, pipe tracing, and for miscellaneous cleaning.

DEPARTMENT 259 - Standard Manufacturing Process
Pydraul A-200 and 280

APPENDIX E

PERSONNEL

Departments 246 and 259 are operated with one work force. For this reason the description of operating classifications and assignments given below are for both Dept. 246 and 259.

OPERATING CLASSIFICATIONS

JOB	NUMBER OF MEN (21 shifts/week)
Premium Operator	4
Still Operator	4
Second Operator	4
Standard Operator	2
#1 Swingman	1
#2 Swingman	1
Repairman	1
Porter	1/2
TOTAL	17 1/2 men

There is one premium operator, one still operator, and one second operator every shift. The Standard Operators work the day and middle shifts 5 days/week. #1 Swingman works as the hourly foremen on Saturday and Sunday, as Premium Operator on Monday, and Repairman on Thursday and Friday. #2 Swingman works 3 shifts as a Standard Operator, one shift as a Still Operator, and one shift as a Second Operator. The repairman works Saturday-Wednesday on the day shift. The porter works 1/2 time in 246/259 and 1/2 time in 243/244/248. A typical work schedule is included in this Appendix.

OPERATING ASSIGNMENTS

Only the major equipment and operating responsibilities are indicated in this listing. All are responsible for safety and housekeeping.

PREMIUM OPERATOR: Operates 4 continuous chlorinators and 5 batch chlorinators. The premium operator has been required to run only 4 of the 5 batch chlorinators if the continuous chlorinators are running.

STILL OPERATOR: Is responsible for 4 take-over stills, runs only 3 or less at a time.

SECOND OPERATOR: Operates two blend tanks, two finished product tanks, 9 storage tanks, three mix tanks, makes all Pyranol and Pydraul mixes, loads trailers and tank cars, and belongs to the Fire Brigade.

DEPARTMENT 259 - Standard Manufacturing Process
Pydraul A-200 and 280

APPENDIX E (cont'd.)

STANDARD OPERATOR: Fills, stencils and labels 5-pint bottles, and 5, 30, and 55 gallon drums.

REPAIRMAN: Unloads cars and trailers of biphenyl, TCB, TTCB, and finished product. Does minor repair work in department.

HOURLY FOREMAN: Is department foreman on weekends, responsible for maintenance arrangements, night sheets, and line-up of work.

PORTER: Cleans offices, control room, repair room, rest room, and smoking shelter.

DEPT 246 SCHEDULES

SCR#	NAME	JOB
1		#1 SWINGMAN
2		REPAIRMAN
3		PREM. OPER
4		"
5		"
6		"
7		2ND OPER.
8		"
9		"
10		"
11	NUNS	STD OPER.
12		"
13	0469006	STILL OPER.
14		"
15		"
16		"
17		#2 SWINGMAN

		S M T W T F S	S M T W T F S	S M T W T F S	S M T W T F S	S M T W T F S
RELIEF FOREMAN	R	1 1	1 1	1 1	1 1	1 1
REPAIRMAN	S	2 2 2 2 1 1 2	2 2 2 2 1 1 2	2 2 2 2 1 1 2	2 2 2 2 1 1 2	2 2 2 2 1 1 2
PREMIUM OPERATOR	D	3 1 4 4 4 4 4	5 5 5 5 5 6 6	6 6 6 3 3 3 3	3 1 4 4 4 4 4	5 5 5 5 5 6 6
	M	5 5 5 5 5 6 6	6 6 3 3 3 3 3	1 4 4 4 4 4 4	5 5 5 5 5 6 6	6 6 6 3 3 3 3
	L	6 6 3 3 3 3 3	3 1 4 4 4 4 4	5 5 5 5 5 6 6	6 6 6 3 3 3 3	3 1 4 4 4 4 4
STILL OPERATOR	D	16 16 13 13 13 13 13	14 14 14 14 14 15 15	15 15 15 17 16 16 16	16 16 13 13 13 13 13	14 14 14 14 14 15 15
	M	14 14 14 14 14 15 15	16 16 16 16 16 17 16	16 16 13 13 13 13 13	14 14 14 14 14 15 15	15 15 15 17 16 16 16
	L	15 15 15 17 16 16 16	15 15 13 13 13 13 13	14 14 14 14 14 15 15	16 16 15 15 17 16 16	16 16 16 13 13 13 13
SECOND OPERATOR	D	7 8 8 8 8 8 9	9 9 9 9 10 10 10	10 10 17 7 7 7 7	7 8 8 8 8 8 9	9 9 9 9 10 10 10
	M	9 9 9 9 10 10 10	10 10 17 7 7 7 7	7 8 8 8 8 8 9	9 9 9 9 10 10 10	10 10 17 7 7 7 7
	L	10 10 17 7 7 7 7	7 9 8 8 8 8 9	9 9 9 9 10 10 10	10 10 17 7 7 7 7	7 8 8 8 8 8 9
STANDARD OPERATOR	D	17 11/5 11 11 11 11 11	17 11/5 12 12 12 12 12	17 11/5 11 11 11 11 11	17 11/5 12 12 12 12 12	17 11/5 11 11 11 11 11
	M	12 12 12 12 12 12	11 11 11 11 11	12 12 12 12 12 12	11 11 11 11 11	12 12 12 12 12 12
1970		S M T W T F S	S M T W T F S	S M T W T F S	S M T W T F S	S M T W T F S
APRIL		1 2 3 4 5 6 7	8 9 10 11 12 13 14	15 16 17 18 19 20 21	22 23 24 25 26 27 28	29 30
MAY		10 11 12 13 14 15 16	17 18 19 20 21 22 23	24 25 26 27 28 29 30	31	1 2 3 4 5 6 7 8 9
JUNE		21 22 23 24 25 26 27	28 29 30	1 2 3 4 5 6 7	8 9 10 11 12 13 14	15 16 17 18 19 20
JULY			1 2 3 4 5 6 7	8 9 10 11 12 13 14	15 16 17 18 19 20 21	22 23 24 25 26 27 28
AUGUST		2 3 4 5 6 7 8	9 10 11 12 13 14 15	16 17 18 19 20 21 22	23 24 25 26 27 28 29	30 31
SEPTEMBER		13 14 15 16 17 18 19	20 21 22 23 24 25 26	27 28 29 30	1 2 3 4 5 6 7	8 9 10 11 12
OCTOBER		25 26 27 28 29 30 31		1 2 3 4 5 6 7	8 9 10 11 12 13 14	15 16 17 18 19 20 21
NOVEMBER			1 2 3 4 5 6 7	8 9 10 11 12 13 14	15 16 17 18 19 20 21	22 23 24 25 26 27 28
DECEMBER		6 7 8 9 10 11 12	13 14 15 16 17 18 19	20 21 22 23 24 25 26	27 28 29 30 31	29 30 1 2 3 4 5
1971 JAN		17 18 19 20 21 22 23	24 25 26 27 28 29 30	31	1 2 3 4 5 6 7	8 9 10 11 12 13 14
FEBRUARY		27		1 2 3 4 5 6 7	8 9 10 11 12 13 14	15 16 17 18 19 20 21
MARCH		1 2 3 4 5 6 7	8 9 10 11 12 13 14	15 16 17 18 19 20 21	22 23 24 25 26 27 28	29 30 31
APRIL		11 12 13 14 15 16 17	18 19 20 21 22 23 24	25 26 27 28 29 30		1 2 3 4 5 6 7 8 9 10

DEPARTMENT 259 - Standard Manufacturing Process
Pydraul A-200 and 280

APPENDIX F

PACKAGING AND SHIPPING

About 50% of the Pydraul A-200 produced is sold in trailers and 50% in drums. All of the Pydraul 280 is sold in drums. The two Pydrauls account for about 1/3 of the total drumming done in the Aroclor department.

Finished lots of Pydraul are sampled in the mix tank and again in the trailer when sold bulk. Samples are normally not taken from drums.

Drumming is done at about 40°C into 5 and 55 gal. drums. The drums are steel, 18 gauge, no lining, and are painted white.

CONTAINERS AND WEIGHTS

Product	5 Gal.	30 Gal.	55 Gal.	Trailers	Cars
Pydraul A-200	59#	--	645#	Yes	No.
Pydraul 280	60#	--	625#	No	No

The drummed product is sold to the WGK warehouse and from there sold to customers. Minimums and maximums for number of drums in the warehouse is set by Production and Production Planning personnel. They are reviewed at least once a year. Warehouse stock reports are reviewed by production at least weekly to determine needs. On the following page is a listing of all Dept. 246/259 drummed products.

Aroclor

Dept. 246 - Drum Stocks

Date

Product	Grade	Minimum	Maximum	On Hand	Needed	Filled
1242 x 600 E	241					
1242 x 600 NE	240					
1242 x 55 E	241					
1242 x 55 NE	240					
1248 x 600 E	261					
1248 x 600 NE	260					
1248 x 55 E	261					
1248 x 55 NE	260					
1254 x 600 E	281					
1254 x 600 NE	280					
1254 x 60 E	281					
1254 x 60 NE	280					
1260 x 600 E	291					
1260 x 600 NE	290					
1260 x 60 E	291					
1260 x 60 NE	290					
1262 x 600 NE	300					
1262 x 60 NE	300					
1254 + 10% Xylene	286					
Therminol FR						
I x 600	245					
I x 55	245					
II x 600	265					
II x 55	265					
III x 600	285					
III x 60	285					

Pyranol & Pydraul

Date

1260 PPO x 674	200					
1260 PPO x 360	200					
1260 PPO x 65	200					
70-30 PPO x 674	210					
" PPO x 360	210					
" PPO x 60	210					
A13B3B x 675	300					
A13B3B x 360	300					
A13B3B x 65	300					
A13B3B x 60						
1242 PPO x 600	215					
1242 PPO x 320	215					
1242 PPO x 55	215					
Pydraul A200 x 645	200					
Pydraul A200 x 59	200					
Pydraul 280 x 625	280					
Pydraul 280 x 60	280					

MONS 046608

DEPARTMENT 259 - Standard Manufacturing Process
Pydraul A-200 and 280

APPENDIX G

MATERIAL BALANCE

A detailed material balance on Dept. 259 was not made because losses in the process are negligible in terms of yield. Minor losses are discussed in Appendix H.

Tricresyl phosphate yields are normally less than standard (99.0%). This is due to the fact that blends are made and adjusted to a specific gravity range rather than by percent composition.

DEPARTMENT 259 - Standard Manufacturing Process
Pydraul A-200 and 280

APPENDIX H

PRODUCT LOSSES

Very small losses occur at #1 Mix Tank pump as leakage. Drip pans are routinely checked and emptied into scrap Aroclor drums as needed.

Sample bottles are flushed with the Pydraul that is being sampled. The flush material is put into scrap Aroclor drums. Essentially no product goes to either a sewer or the atmosphere.

DEPARTMENT 259 - Standard Manufacturing Process
Pydraul A-200 and 280

APPENDIX I

PROCESS CONTROL

Three forms are included in this section:

1. A table of process control variables.
2. A Pydraul batch sheet.
3. A daily transfer sheet (for all transfers made by Second Operator).

KEY VARIABLES

The only process type key variable is the s.g. of the Aroclor blend when making a Pydraul A-200 mix. This should be adjusted to 1.429-1.431 @ 25°C before proceeding with the additives.

The finished goods must of course be in specification.

DEPT. 259 (#1 Mix Tank)

Kind of Mix _____ Lot No. _____ Date _____

Material Added	BP	AP	Date	Time	AM	PM	Operator	Comments

Sampled by _____ Date _____ Time _____ AM PM

Analysis Received: Date _____ Time _____

Sp. Gr. _____ Viscosity _____

Adjustments & Resamples

Material Added	BP	AP	Date	Time	Operator	Date	Time	Analysis Received Operator	Date	Time	Sp.Gr.	Viscosity

Material	Lbs.	Time	Operator
Lubrizol 1360			
Santolube 70			
D. C. 200 Fluid			
Blue A Dye			
Azo Oil Black Dye			

Final Sample Taken by _____ at _____ AM PM

Final Sample OK'd by Lab at _____ AM PM

MONS 049612

DEPT 246

SECOND OPERATOR DAILY TRANSFER SHEET

DATE _____

PRODUCT	LOT NUMBER	FROM TANK	MEASURE B.P.	MEASURE A.P.	OPERATOR	TO TANK	MEASURE B.P.	MEASURE A.P.	OPERATOR	COMMENTS

DEPARTMENT 259 - Standard Manufacturing Process
Pydraul A-200 and 280

APPENDIX J

SAFETY AND TOXICITY DATA

The following data is pertinent for Departments 246 and 259:

I. LOCATION OF SAFETY EQUIPMENT

A. Fire extinguishers

1. Carbon dioxide - 1st floor, NE of lean-to
2. Dry chemical - 1st floor, SE of lean-to
3. Dry chemical - 2nd floor, west wall
4. Dry chemical - 2nd floor, west wall

B. Gas masks

1. 1st floor, on sprinkler house
2. 1st floor, outside west wall of repair room
3. 2nd floor, on west wall
4. Control room, east wall
5. 4th floor, on handrail by #1 chlorinator

C. Scott air pak

1. Outside west wall of lean-to

D. Emergency clothing

1. Box on 2nd floor, west wall

E. Safety showers with eye wash

1. Batch department, 1st floor
2. " " 2nd floor
3. " " 3rd floor
4. Continuous department, 1st floor
5. " " 2nd floor
6. " " 3rd floor
7. West side of tank farm (alarm in control room)
8. Control room (eye batch only)

DEPARTMENT 259 - Standard Manufacturing Process
Pydraul A-200 and 280

APPENDIX J (cont'd.)

SAFETY AND TOXICITY DATA

II. SAFETY PRECAUTIONS AND DATA

A. Personal safety equipment

1. Hard hat
2. Safety glasses
3. Goggles
4. Rubber or canvas gloves
5. Rubber overshoes

B. Fire

Pydraul A-200, 280 and their components are not fire hazards. Automatic fire extinguishers and sprinklers have been installed in building CR to combat fires.

C. Toxicity (see next section)

D. Miscellaneous

There are many accidents that can occur which may be classified as health and safety hazards. These accidents can result from steam leaks, product leaks, and other minor hazards normally present to some degree in a chemical plant.

E. Safety Record (Depts. 246/259)

1. Lost time accidents - Last occurred on January 28, 1948.

2. Serious injuries - The last two serious injuries were:
   (a) 8/5/70 - See attached informal investigation report.
   (b) 12/2/68 - Refer to formal investigation report L-17-20-68.

3. Minor injuries - For the years 1969 and 1970, the frequency of minor injuries is about one per month, or about - 0.75 per man per year.

DEPARTMENT 259 - Standard Manufacturing Process
Pydraul A-200 and 280

APPENDIX J (cont'd.)

SAFETY AND TOXICITY DATA

III. TOXICITY

A. Lubrizol 1360

This additive should not be heated above 120°C as H_2S can be liberated. H_2S (hydrogen sulfide) is a poisonous gas.

B. Aroclors *

1. Recommended maximal atmospheric concentrations (MAC for 8 hrs.):

a) Aroclor 1242 - 1.0 mg per cubic meter of air
b) Aroclor 1254 - 0.5 mg " " " " "

2. Hazards and control

a) Inhalation: Absorption is chiefly by inhalation. Concentrations in the workroom atmosphere should be maintained below the recommended levels. Where the chlorinated diphenyls are used at room temperatures, the hazard of inhalation is considered slight or absent. When these materials are subjected to elevated temperatures, the process either should be completely enclosed or other adequate mechanical exhaust ventilation must be provided to reduce concentrations to safe levels.

b) Skin contact: Operations and handling procedures should be such as to avoid the possibility of prolonged or repeated skin contact. Contaminated clothing must be laundered before reuse.

c) Eye contact: Eye protection should be used where there is a possibility of liquid splashes.

3. Emergency Treatment: Skin surfaces exposed to chlorodiphenyls should be thoroughly washed with soap and water at once. If clothing has been contaminated it should be removed promptly.

If exposure to a high vapor concentration occurs, as in the case of spills at elevated temperatures, the patient should be moved from exposure and kept at rest until seen by a physician. Oxygen should be administered if breathing is difficult.

DEPARTMENT 259 - Standard Manufacturing Process
Pydraul A-200 and 280

APPENDIX J (cont'd.)

SAFETY AND TOXICITY DATA (cont'd.)

III. TOXICITY (cont'd.)

3. Eyes contaminated with chlorodiphenyl should be irrigated with water for at least 15 minutes and the patient should be seen by a physician.

4. Special procedures: Persons who are regularly or repeatedly exposed to chlorodiphenyls should be examined periodically to detect early evidence of skin irritation and/or liver damage. Persons with known liver disease should not be exposed to repeated contact with the chlorodiphenyls.

*The information in this section is from the Hygienic Guide Series published by the American Industrial Hygiene Association. The particular pamphlet is "Chlorodiphenyls", Jan.-Feb. 1965.

MONSANTO COMPANY

Sauget, Illinois

August 14, 1970

cc: G. L. Bratsch
D. J. O'Toole
R. M. McCutchan

TO: Mr. Bill Corlew

SERIOUS INJURY ACCIDENT

INFORMAL INVESTIGATION

DATE OF INCIDENT:	August 5, 1970
LOCATION:	Unloading Dock #5, Track 10A
TYPE OF ACCIDENT:	Struck by Thermocouple
CAUSE OF ACCIDENT:	Faulty Procedure
NATURE OF INJURY:	Laceration above left eyebrow
PERSON INVOLVED:	Carl McCoy, Repairman
INVESTIGATING COMMITTEE:	Walt Parker Roy Hall Woody Ban V. Brawley, Chairman

/gjs

DESCRIPTION

The repairman was heating a tank car (NATX 21258) of Biphenyl for unloading. The 2 inch standpipe was full of solid Biphenyl (x pt is 68.8°C). Normal practice is to lower a "hair-pin" steam pipe into the standpipe to melt the Biphenyl, this practice was followed. The hair-pin was then removed and an 8 foot s.s. thermocouple was inserted in the standpipe. The thermocouple senses the Biphenyl temperature and a TIC controls an automatic valve in the steam line to the heating coils on the car.

Two hours later the standpipe was still full of Biphenyl but it had solidified around the top of the thermocouple. An 18 inch hair-pin steam pipe was used to melt the frozen Biphenyl around the top of the thermocouple. When the hair-pin had melted 15 inches down, the thermocouple suddenly raised upward with great force striking the repairman above the left eyebrow.

The investigating committee concluded that both ends of the standpipe was plugged with solid Biphenyl and the Biphenyl between the plugs expanded from the heat applied to the car. The top plug raised upward when the pressure beneath it was great enough to break the bond that was holding it to the standpipe. At this time the plug was being melted by the 18 inch steam pipe.

The moisture content on this car was 510 p.p.m., normal is 50 p.p.m. This could have been a contributing factor in the incident by vaporizing in the standpipe and exerting additional force on the top plug.

SPECIFIC RECOMMENDATIONS

1. Use the air inlet line for the thermocouple.

2. If the air inlet line cannot be used for the thermocouple, the standpipe will be used but only after air is blown thru it to be certain it is open.

3. If neither of the above can be used, the large dome opening will be used.

GENERAL NOTES

Our Biphenyl dept. in Anniston, Ala., was called to discuss this incident. They never had an experience of this nature, but did comment that solid Biphenyl seems to expand as it is thawed.

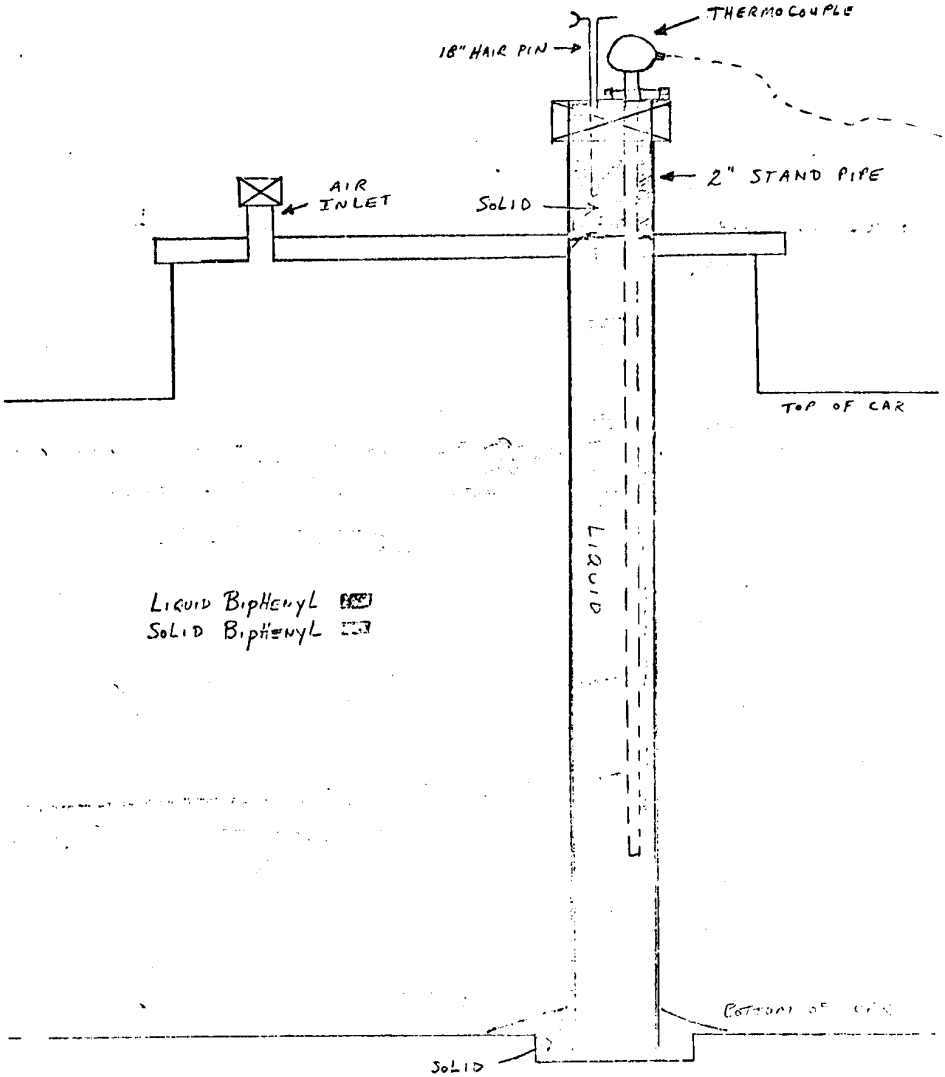
We wanted to discuss the unloading of Biphenyl cars by pump or air pressure but they do not unload cars.

Mr. Lamar Falkner, Dept. Supervisor, appreciated the fact that we called to advise them of the incident.

Investigating Committee

Walt Parker
Roy Hall
Woody Ban

/gjs


THERMOCOUPLE
18" HAIR PIN
AIR INLET
SOLID
2" STAND PIPE
TOP OF CAR
LIQUID
LIQUID BIPHENYL
SOLID BIPHENYL
SOLID

MONS 046621

DEPARTMENT 259 - Standard Manufacturing Process
Pydraul A-200 and 280

APPENDIX K

BACKGROUND INFORMATION

Monsanto has been actively interested in functional fluids since 1948. Two lines of products, Skydrol fire resistant aircraft hydraulic fluids and Pydraul fire resistant industrial hydraulic fluid, have been introduced and several individual fluids have reached commercial status.

Formulation work was done by Monsanto on an Aroclor base fluids in an effort to develop a satisfactory fluid of lower price than the Pydrauls available on the market. Viscosity index improved versions were abandoned due to unfavorable costs and performance characteristics. This project resulted in a non-viscosity index improved, fire resistant, Aroclor base industrial type hydraulic fluid designated OS-95.

In May 1958, six batches of OS-95 (later to be named Pydraul A-200) were prepared for the first time in the research pilot plant.

Pydraul 280 was first product in April, 1964. Its primary use is in mining applications in Europe.

DEPARTMENT 259 - Standard Manufacturing Process
Pydraul A-200 and 280

APPENDIX L

TIME CYCLE AND CAPACITY

The cost standard capacity (1970 and 1971) of Dept. 259 for Pydraul production is 585,000 lbs./mo. or approximately 7M lbs./year. The production for 1970 will be about 3.5M lbs. of Pydraul A-200 and 1.0M lbs. of Pydraul 280. Storage facilities are the limiting factor in Pydraul production. There is no finished goods storage tank. Trailers are loaded and drums filled directly from the #1 Mix Tank.

The following table shows an approximate time cycle for a 12,000 gallon batch of Pydraul A-200 or 280.

TIME CYCLE

Charge major components (Aroclors and TCP)	4 hours
Blend major components	3 hours
Sample for control and analysis	2 hours
Charge additives	1 hour
Blend total batch	3 hours
Sample and final analysis	3 hours
TOTAL	16 hours

(If one adjustment for specific gravity or viscosity is needed, add 6 hours)

From this point on, the batch cycle is dependent upon how the batch is packaged. If it is all bulk shipments, 3 or 4 trailers could be loaded in one shift if they were properly scheduled. Actual pumping time is about 1 hour for a 4000 gallon trailer.

Drums (55-gallon) can be filled at a rate of 40-44 per man per shift. This means that about - 5-6 man-shifts of drumming are needed if the entire tank is to be drummed. Usually two man-shifts of drumming per day are done. Drumming can be delayed even more if an urgent need arises for a different drummed product.

The production of another Pydraul batch must be delayed at times because there is no storage tank, only a mix tank. For instance:

> 4000 gallons of Pydraul A-200 are in the mix tank with plans for drumming it that day. An order is received for a trailer of A-200 for the next day. There is not enough time to drum the A-200 and make another batch, so the mix tank must sit idle for a day until the trailer is loaded.

Dept. 259 - Standard Manufacturing Process

PYDRAUL A-200 - 280

APPENDIX M

QUALITY CONSIDERATIONS

Pydraul A-200 is an Aroclor base, fire resistant, industrial type hydraulic fluid which was formulated to meet viscosity and lubricating requirements, and anti-rust characteristics specified by the sales department. The physical and functional properties of Pydraul A-200 are discussed in the following sections.

1. VISCOSITY

The required viscosity range of Pydraul A-200 is 200 to 300 absolute SUS. The results of formulation work as given in table 1 indicate that a mixture of one part Aroclor 1242 to two parts of Aroclor 1248 by weight exhibits the lower limit viscosity of 200 SUS absolute at 100°F.

2. LUBRICATING PROPERTIES

Results of four-ball wear tests on the Aroclor base stocks as given in table 2 indicates the necessity of an anti-wear additive. Lubrizol 1360 imparts good anti-wear properties to Aroclor based fluids.

3. RUST INHIBITION

Previous work with rust inhibitors for Pydrauls has indicated that Santolube 70 is relatively effective as an inhibitor as measured by the ASTM D-665 rust test.

4. MISCELLANEOUS

A. APPEARANCE

Pydraul A-200 is a blue liquid with a hazy appearance. The haze is due to very small quantities of antifoamant, DCF-200.

B. FOAM

The use of Santolube 70 in the Pydraul blend causes undesirable foaming. A concentration of 50 ppm Dow Corning Fluid 200 inhibits foaming.

C. NEUTRALIZATION NUMBER

Unused Pydraul A-200 has a total acid number of about 0.8. This apparent high acid number is due to the nature of the Lubrizol 1360 and Santolube 70 present.

DEPARTMENT 259 - Standard Manufacturing Process
Pydraul A-200 and 280

APPENDIX M

QUALITY CONSIDERATIONS

4. MISCELLANEOUS

D. Process Changes

It is important that any contemplated process changes be carefully evaluated before the actual change is made, since the quality of Pydraul A-200 can only be determined by full scale performance tests. Tests such as those given in table 3 are necessary to evaluate the product.

E. Boil Down Material

At the end of a distillation run, the still charge is partially boiled down and then transferred to #2 Still where it is further boiled down. The production from #2 Still (by current practice) is always used for Pydraul A-200 production.

TABLE 1

HIGH AROCLOR FLUID FORMULATION

Formulation Number	Formulation (% wt.)	Kinematic Viscosity Centistokes		Saybolt Seconds	
		100°F.	210°F.	Kin, 100°F.	Abs, 100°F.
1	55% Aroclor 1248, 45% Aroclor 1242	27.6	----	130	183
2	18% Aroclor 1254, 82% Aroclor 1242	24.7	----	117	166
3	78% Aroclor 1248, 22% Aroclor 1232	22.6	----	108	150
4	61% Aroclor 1248, 39% Aroclor 1242	29.0	----	---	193
5	20% Aroclor 1254, 80% Aroclor 1242	25.7	----	---	---
6	81% Aroclor 1248, 19% Aroclor 1232	24.30	----	---	---
7	65% Aroclor 1248, 35% Aroclor 1242	30.17	----	142	200
8	27% Aroclor 1254, 73% Aroclor 1242	29.6	----	---	---
9	88% Aroclor 1248, 12% Aroclor 1232	31.3	----	---	---
10	66% Aroclor 1248, 33% Aroclor 1242, 0.5% Santolube 393, 0.5% Santolube 70, 100 ppm. DCF-200	30.22	2.87	142	200

TABLE 2

PYDRAUL A-200 ADDITIVE STUDY

Aroclor 1242		Aroclor 1248		Sant. 393	Sant. 70	Other Additive	4-Ball Wear	Almen EP	
Lot	%	Lot	%	%	%	%	(1)	Load Pounds	Torque psi
Pydraul F-9							0.63	50	43
Cellulube 220							0.56	27	35
T-410	100	--	0	0	0	0	0.81	--	--
---	0	T-512	100	0	0	0	0.83	50	38
T-410	33	T-512	66	0.5	0	0	--	44(2)	39
T-410	33	T-512	65.95	1.0	0.05	0	--	40(2)	34
T-410	33⅓	T-512	66.3	0.5	0.05	0	0.55	38(2)	46
T-412	33⅓	T-523	66.3	0.5	0.05	0	0.53	34(2)	38
T-410	33	T-512	66	0.5	0.5	0	0.46	48	41
T-412	33	T-523	66	0.5	0.5	0	0.45	50	40
T-412	33.1	T-523	66.1	0.5	0.05	0.25(3)	--	38(2)	40
T-412	33.1	T-523	66.25	0.5	0.05	0.10(4)	--	--	--
T-412	33.0	T-523	66.15	0.5	0.05	0.20(4)	--	--	--
---	33.0	---	66	0.1	0	0	0.53	--	--

(1) 1 hr., 40 kg., 630 rpm, steel-on-steel.
(2) Squealing during most of run.
(3) No. 5 Process Oil (Santolube 70 inert).
(4) Dioctylmaleate.

MONS 04627

TABLE 3

EVALUATION OF USED PYDRAUL A-200

Chevrolet - Bay City Division - 260 Hrs. (14 hrs. at 190°F.)

	Pydraul A-200 New	Pyuraul A-200 Chev.-Bay City Div., 260 Hr.
Viscosity		
100°F., cs.	30.63	31.8
210°F., cs.	2.89	3.05
4-Ball Wear (630 RPM, 1 Hr., 167°F.)		
Steel-on-Steel		
4 kg.	.21	.20
10 kg.	.29	.26
40 kg.	.43	.59
Steel-on-Bronze		
4 kg.	1.20	.95
10 kg.	1.40	1.48
40 kg.	1.70	1.69
Neutralization Number	0.82 TAN	0.82 TAN
Rust Test (REL, F-101, 10.0-Perfect)	10.0	10.0
Appearance	Yellow, slight cloudy	Reddish-brown-nearly opaque

DEPARTMENT 259 - Standard Manufacturing Process
Pydraul A-200 and 280

APPENDIX N

MISCELLANEOUS

This section contains the following information:

1. Additional Raw Material Information
2. References
3. Production Cost Standard (1971)
4. Operation Report (1970 YTD)
5. Status Report on Safety Audit (11/2/70)
6. Department 246 Safety Audit (May, 1969)
7. 1970 W.G.K. Aroclor Group Objectives (1/28/70)
8. Manufacturing Improvement Plan for Aroclor (March, 1970)

Dept.. 259 - Standard Manufacturing Process

PYDRAUL A-200 & 280

APPENDIX N

RAW MATERIALS

1. AROCLOR 1242

Aroclor 1242 is received from Department 246 by pipeline. Aroclor 1242 batches are composited in a storage tank and a lot analysis is run on the composite sample. The Aroclor 1242 must pass all non-electrical specifications before it is transferred to Department 259 .

2. AROCLOR 1248

Aroclor 1248 is received from Department 246 by pipeline. Aroclor 1248 is composited and sampled in the same manner as Aroclor 1242.

3. LUBRIZOL 1360

Lubrizol 1360 is received in 55 gallon drums.

4. SANTOLUBE 70 A

Santolube 70Ais received from the Nitro plant in 55 gallon drums.

5. BLUE A DYE

Blue a dye is purchased from the DuPont Company. The material is received in 25 lb. boxes.

6. AZO BLACK DYE

Azo black dye is from the Allied Chemical Company. The material is received in 25 pound boxes.

7. DOW CORNING FLUID 200

Dow Corning Fluid 200 is purchased from the Dow Corning Corporation. The material is received in 5 gallon cans.

8. TRICRESYL PHOSPHATE

TCP is received by trailer from Dept. 243/244/248 at W.G.K. Until mid-1970, it was received from J.F.Q.

Dept. 259 - Standard Manufacturing Process

PYDRAUL A-200 and 280

APPENDIX N

REFERENCES

1. St. Louis Research Report No. 2472, Job No. 2-02-760.01-3505 (II), February 16, 1960.

   Title: Functional Fluids Application Research

   Summary: This Report includes application studies of Aroclor base fluids. Discussion includes formulation, physical and functional properties of Pydraul A-200.

2. St. Louis Research Report No. 2842, Job No. 2-02-750.01-3550, November 7, 1961.

   Title: Application Research - Fire Resistant Fluids

   Summary: Report includes investigation of problem areas arising in Pydraul fluids. Reference job numbers are 3505, 3766 and 4009.

3. St. Louis Research Report No. 1562, Job No. 2-02-750.01-2815, July 6, 1956.

   Title: Function Fluids - Application Research for 1954-55.

   Summary: Report includes formulation studies, property determinations, and sample preparations of Pydrauls.

PRODUCTION COST STANDARD

PLANT W. G. Krummrich

Page 1 of ✓

PRODUCT: PYROCAT A-200

PRODUCT CODE: 81096X

Effective 1-1-71

NO.	DAY	TR	DIV.	LOC.	DIV.	LOC.	C.CTR	PRODUCT	P-F
4*	5	6-7	8-11	12-13	14-17	18-20	21-25	1-3
1	1	02	0003	02	0003	259	81096	

CAPACITY: 585,000

COST UNIT: CWT.

4-25

DUPL. COLS. 4-25 INTO ALL CARDS

BLK. INV. STD. 8,326

CR5

TYP	TYP	NO.	UNIT COST
26	27	38-40	41-48
	3	030	9[illegible]
	3	034	11[illegible]
	3	045	

EQUIPMENT USED

Dept. No.	Percent
8109D	[illegible] %
	%
	%

DUPLICATE COLS. 4-25 INTO ALL CARDS

P-F		TYPE	UNIT	BRACKET 1 INV. STD. UNIT COST DAYS	BRACKET 1 UNIT STD	BRACKET 2 DAYS	BRACKET 2 QUANITY	BRACKET 3 DAYS	BRACKET 3 QUANITY	BRACKET 4 DAYS	BRACKET 4 QUANITY
1-3	4-25	27	34	36-38	39-46	47-49	50-57	58-60	61-68	69-71	72-79
CR6	PRODUCTION BKT. QTY.	4	1	30	8,326	30	585,000	210	427,500		

	PRODUCT COST	EX CL	AMT	CRD	VFB	AMOUNT	CR	BRACKET 1 UNIT COST	BRACKET 1 AMOUNT	CR	BRACKET 2 UNIT COST	BRACKET 2 AMOUNT	CR	BRACKET 3 UNIT COST	BRACKET 3 AMOUNT	CR	BRACKET 4 UNIT COST	BRACKET 4 AMOUNT	CR
DO NOT KEY PUNCH THIS SECTION	Material Cost				V	—		[illegible]	47[illegible]		[illegible]	24[illegible]							
	Steam	530			F	57		125	731		125	536							
	Electricity	533			F	7		[illegible]	25		[illegible]	19							
	Comp. Air	536				—		—	—		—	—							
	Water-Purch.	539				—		—	—		—	—							
	Water-Plt.	542				—		—	—		—	—							
	Fuel-Gas	545				—		—	—		—	—							
	Fuel-Oil	546				—		—	—		—	—							

P-F																			
1-3	DUPL. COLS. 4-25	26-28	36	37	38	39-47	CR 55	48-55		CR 63	56-63		CR 71	64-71		CR 79	72-79		CR
CR8	Labor-Mfg.	570	2	1	F	219		[illegible]	219		[illegible]	165							
CR8	Salaries	575	2	1	B	—		—	—		—	—							
CR8	Payroll OH	578	2	1	F	108		[illegible]	108		[illegible]	95							
CR8	Factory Supplies	590	2	1	F	10		[illegible]	50		[illegible]	37							
CR8	Packing Labor	601	2	1	F	243		[illegible]	243		[illegible]	243							
	Packing OH	603	2	1	F	35		[illegible]	35		[illegible]	18							
	Laboratory	610	2	1	V	50		[illegible]	200		[illegible]	147							
CR8	Cloth & Laundry	614	2	1	F	10		[illegible]	25		[illegible]	18							
CR8	Tech. Service	621	2	1	B	—		—	—		—	—							
CR8	Plt. Proc. Res. & Del.	687	2	1	B	—		—	—		—	—							
CR8	Waste Disposal	661	2	1	—	—		—	—		—	—							
CR8	Tank Car Storage	687	2	1	—	—		—	—		—	—							
CR8	Mechanical Exp.	694	2	1	B	—		—	—		—	—							
CR8	[illegible]	613	2	1	F	5		[illegible]	10		[illegible]	7							
CR8			2	1															
CR8			2	1															
CR8			2	1															
CR8			2	1															
CR8	Total Direct Conv.					734		[illegible]	1636		[illegible]	1285							
CR8	Depreciation	698	2	1	B	—		—	—		—	—							
CR8	Factory Indr. Exp.	760	2	1	B	—		—	—		—	—							
CR8	Total Indr. Exp.					—		—	—		—	—							
CR8	Total Product Cost					744		[illegible]	[illegible]		[illegible]	3[illegible]							
CR8	Total F & B Cost					6[illegible]		[illegible]	1435		[illegible]	11[illegible]							
CR8	Total Variable Cost					[illegible]		[illegible]	4736.7		[illegible]	[illegible]							

	LABOR/UTILITY SERVICE	UNIT	EXP CL	QTY	CRD	VFB	STANDARD UTL. PRICE	BRACKET 1	CR	BRACKET 2	CR	BRACKET 3	CR	BRACKET 4	CR
CR8	DUPL. COLS. 4-25		26-28	36	37	38	39-47	48-55	55	56-63	63	64-71	71	72-79	79
CR8	Labor	Hrs.	570	1	2	F	[illegible]	[illegible]		[illegible]		3[illegible]			
CR8	Laboratory	Hrs.	610	1	1	V	10000	50		200		147			
CR8	Steam	ABTU	530	1	1	F	11500	50		644		472			
CR8	Electricity	CKWH	533	1	1	F	1097.20	6		23		17			
	Compair	MCFT	536	1	1										
CR8	Water-Purch.	MGAL	539	1	1										
CR8	Water-Plt.	MGAL	542	1	1										
CR8	Fuel-Gas	ABTU	545	1	1										
CR8	Fuel-Oil	ABTU	546	1	1										

MONS 046632

PRODUCTION COST STANDARD

PLANT W. G. KRUMMRICH

Page 1 of 2

MO.	DAY	TR	DIV.	LOC	DIV.	LOC	CCTR	PRODUCT
	4*	5	6-7	8-11	12-13	14-17	18-20	21-25
		1	02	0003	02	0003	259	81096

PRODUCT AVGSW-A-200
PRODUCTION CODE 81096
BULK INV. STD. COST 8.3246

EFFECTIVE 1-
CAPACITY
COST UNIT

MATERIALS

PF	DUPLICATE COLS.-4-25 INTO ALL CARDS	EXP CL	PRODUCT	LOC	FORM. PKG.	S & U	CODE	SUBSTITUTABLE MAT'L. STD. YIELD %	STANDARD QTY. PER UNIT	CR	RAW MAT'L STD. UNIT PRICE HANDLING STD. UNIT PRICE	UNIT COST
1-3	4-25	26-28	29-33	34-37	38-40	44	45	46-51 52-53	54-57 58-60	60	61-64 65-69	
CR7	DCF 350 C.S.	505	81100		999	0	0					
CR7	LUBRIZOL 1360	505	39050		999	0	0					
CR7	AROCLOR 1242	520	81101	0003	999	0	0		33			
CR7	AROCLOR 1248	520	81102	0003	999	0	0		66			
CR7	STABILUBE 70-A	505	81351		999	0	0					
CR7						0						
CR7						0						
CR7	55 GAL DRUM	505	93130		030	0	0		157			
CR7						0						
CR7	5 GAL. CAN	505	94135		034	0	0		1			
CR7						0						
CR7						0						
CR7						0						
CR7						0						
CR7	-COMPUTER MATERIALS	527				0			550			
CR7	R/M Whsg. & Handling	526										
CR7	Gross Total Mat'ls.											
CR7	By-Products	523					0					
CR7							0					
CR7							0					
CR7							0					
CR7							0					
CR7							0					
CR7	Total By-Products											
CH7	Net Total Materials											

DO NOT KEY PUNCH DATA BELOW THIS LINE

MAT'L. USAGE DATA	CODE	MATERIAL	THEO. USAGE	THEO. TO STD. ON	STD LBS	THEO LBS	% THEO/STD
	81101	AROCLOR 1242	33.00		330.03	308.03	
	81102	AROCLOR 1248	66.00		165.01	154.51	

BRACKETS	1	2	3	4	5	6	7	8	TYPE PKG.	NET LB./PKG.	Gross Lb./Pkg.	Net Lb./Pallet	Gross Lbs./Pal
Operating Period: DAYS	30	30	22						93130	425	693	2550	
SHIFTS	3	3	2						94135	51	64	744	

PRODUCTION CONTROL DATA

CLASSIFICATION	AMOUNT
Cost/Shut Down	
Cost/Start-Up	
Cost/Changeover	
Pkg. Changeover Cost	
Pkg. Rate Lbs./Mo.	

CONTAINERS:	USAGE/UNIT	PRICE PER CONT.	CONT. COST/UNIT:	PKG UNIT STD.
93130 - 55 GAL DRUM	1			
94135 - 5 GAL CAN	1			

MONS 046633

OTHER INFORMATION	DOWNTIME SUMMARY	DT	RL	TOTAL
	Repair	— %	— %	
	Process	1.00	—	
	Other	1.00	—	
	Inventory	—		
	Total	2.00	—	
	On-Stream	73 %	100 %	%
	On Stream Rate	2.0 #/Hr.		

APPROVAL	SIGNATURE	DATE
	[signature]	7/10/70
	[signature]	7/15/70

PRODUCTION COST STANDARD — PLANT W.6, KRUMMRICH — Page 1 of 3 — Effective 1-1-71

PRODUCT: PYDRAUL 220 — PRODUCT CODE: 81119 X

NO.	DAV	TH	DIV.	LOC.	DIV.	LOC.	C CTR	PRODUCT	P-T
	4*	5	6-7	8-11	12-13	14-17	18-20	21-25	1-3
		1	02	0003	02	0003	259	81119	

CAPACITY: 585000 — BLK. INV. STD. — CR5

COST UNIT: CWT — 11.284

4-25	TYP	TYP	NO.	UNIT COST
	26	27	38-40	41-48
DUPL. COLS. 4-25		3	030	12.45700
INTO ALL CARDS		3	034	14.99760
		3	045	

EQUIPMENT USED — Dept. No. 81010 — Percent 32

DUPLICATE COLS. 4-25 INTO ALL CARDS

P-T				
1-3	4-25	27	34	
CR6	PRODUCTION BKT. QTY.	4	1	

	DAYS	UNIT STD.	DAYS	QUANITY	DAYS	QUANITY	DAYS	QUANITY
BRACKET	1 INV STD. UNIT COST		2		3		4	
	36-38	39-46	47-49	50-57	58-60	61-68	69-71	72-79
	30	11.28400	200	555 800	220	429 000		

PRODUCT COST	EX CL	AMT	CRD	V R	BRACKET 1 AMOUNT	CR	BRACKET 2 UNIT COST	BRACKET 2 AMOUNT	CR	BRACKET 3 UNIT COST	BRACKET 3 AMOUNT	CR	BRACKET 4 UNIT COST	BRACKET 4 AMOUNT	CR
Material Cost				V			11.177	6539		11.[illegible]	47154				
Steam	530			V	57		0665	375		[illegible]	875				
Electricity	533			V	7		0633	20		0633	14				
Comp. Air	536			V	—		—	—		—	—				
Water-Purch.	539			V	—		—	—		—	—				
Water-Plt.	542			V	—		—	—		—	—				
Fuel-Gas	545			V	—		—	—		—	—				
Fuel-Oil	546			V	—		—	—		—	—				

P-T							BRACKET 1	CR	BRACKET 2	CR	BRACKET 3	CR	BRACKET 4	CR
1-3	DUPL. COLS. 4-25	26-28	36	37	38	39-47	48-55	55	56-63	63	64-71	71	72-79	79
CR8	Labor-Mfg.	570	2	1	F	219	[illegible]		[illegible]		165			
CR8	Salaries	575	2	1	B	—	—		—		—			
CR8	Payroll OH	578	2	1	F	103	[illegible]		[illegible]		95			
CR8	Factory Supplies	590	2	1	F	10	[illegible]		25		19			
CR8	Packing Labor	601	2	1	F	242	[illegible]		[illegible]		243			
	Packing OH	603	2	1	F	25	[illegible]		25		19			
	Laboratory	610	2	1	V	50	[illegible]		165		120			
CR8	Cloth & Laundry	614	2	1	F	10	[illegible]		25		19			
CR8	Tech. Service	621	2	1	B	—	—		—		—			
CR8	Plt. Proc. Res. & Dev.	659	2	1	B	—	—		—		—			
CR8	Waste Disposal	661	2	1	—	—	—		—		—			
CR8	Tank Car Storage	687	2	1	—	—	—		—		—			
CR8	Mechanical Exp.	694	2	1	B	—	—		—		—			
CR8	Cloth LAUNDRY-SAFETY	612	2	1	F	—	—		—		—			
CR8			2	1										
CR8			2	1										
CR8			2	1										
CR8			2	1										
CR8	Total Direct Conv.					729	[illegible]		1208		925			
CR8	Depreciation	698	2	1	B	—	—		—		—			
CR8	Factory Indr. Exp.	760	2	1	B	—	—		—		—			
CR8	Total Indr. Exp.					—	—		—		—			
CR8	Total Product Cost					[illegible]	11.[illegible]		66510		11.[illegible]		47935	
CR8	Total F & B Cost					[illegible]	[illegible]		1015		847			
CR8	Total Variable Cost					50	11.[illegible]		65556		11.[illegible]		47074	

LABOR/UTILITY SERVICE	UNIT	EXP CL	QTY	CRD	VF B	STANDARD UTL. PRICE	BRACKET 1	CR	BRACKET 2	CR	BRACKET 3	CR	BRACKET 4	CR
DUPL. COLS. 4-25		26-28	36	37	38	39-47	48-55	55	56-63	63	64-71	71	72-79	79
Labor	Hrs.	570	1	2	F	5[illegible]	[illegible]		[illegible]		[illegible]			
Laboratory	Hrs.	610	1	1	V	1 100200	50		165		120			
Steam	MBTU	530	1	1	V	1 13200	50		333		243			
Electricity	CKWH	533	1	1	V	1 07003	6		18		13			
Compair	MCFT	536	1	1		—	—		—		—			
Water-Purch.	MGAL	539	1	1		—	—		—		—			
Water-Plt.	MGAL	542	1	1		—	—		—		—			
Fuel-Gas	MBTU	545	1	1		—	—		—		—			
Fuel-Oil	MBTU	546	1	1		—	—		—		—			

6-2761 REV 4-70

MONS 046634

PRODUCTION COST STANDARD

PLANT W.G. KRUMMRICH — Page 2 of 2

MO.	DAY	TR	DIV.	LOC	DIV	LOC	CCTR	PRODUCT
	4*	5	6-7	8-11	12-13	14-17	18-20	21-25
		1	02	0003	02	0003	257	81119

PRODUCT Pydraul 280

PRODUCTION CODE 81119

BULK INV. STD. COST 11.324

EFFECTIVE 1-1-7[illegible]

CAPACITY [illegible]

COST UNIT [illegible]

PF 1-3	MATERIALS: DUPLICATE COLS. 4-25 INTO ALLCARDS 4-25	EXP CL. 26-28	PRODUCT 29-33	LOC 34-37	FORM. PKG. 38-40	S & U 44	CODE 45	SUBSTITUTABLE MAT'L. STD. YIELD % 46-51	52-53	STANDARD QTY. PER UNIT 54-57	58-60	CR 60	RAW MAT'L. STD. UNIT PRICE / HANDLING STD UNIT PRICE 61-64	65-69	UNIT COST
CR7	TRICRESYL PHOS.	520	81112	0003	999	0	0			22.020				22.41	[illegible]
CR7	AROCLOR -1248	520	81102	0003	902	0	0			[illegible]				[illegible]	[illegible]
CR7	AROCLOR -1260	520	81105	0003	999	0	0			[illegible]				[illegible]	[illegible]
CR7	SANTOLUBE-70 A	505	51351		[illegible]	0	0			[illegible]				[illegible]	[illegible]
CR7						0									
CR7						0									
CR7	55GAL DRUM	505	93130		030	0	0			.161				7.[illegible]	[illegible]
CR7						0									
CR7	5GAL CAN	505	94135		034	0	0			1.650				1.85[illegible]	[illegible]
CR7						0									
CR7						0									
CR7						0									
CR7						0									
CR7						0									
CR7	Container Handling	527				0				—				—	[illegible]
CR7	R/M Whsg. & Handling	526								—				—	[illegible]
CR7	Gross Total Mat'ls.														11.1[illegible]
CR7	By-Products	523					0								
CR7							0								
CR7							0								
CR7							0								
CR7							0								
CR7							0								
CR7	Total By-Products														
CR7	Net Total Materials														11.[illegible]

DO NOT KEY PUNCH DATA BELOW THIS LINE

MAT'L. USAGE DATA	CODE	MATERIAL	THEO. USAGE	THEO. TO STD. ON	STD LBS	THEO LBS	% THEO STD
	80071	TCP	21.000	97.00	45.510	[illegible]	[illegible]
	81105	Aroclor 1260	61.900	97.00	[illegible]	[illegible]	[illegible]

BRACKETS	1	2	3	4	5	6	7	8
Operating Period: DAYS	30	30	22					
SHIFTS	3	3	3					

TYPE PKG.	NET LB./PKG.	Gross Lb./Pkg.	Net Lb./Pallet	Gross Lbs./Pa
93130	625	673	2500	[illegible]
94135	60	65	960	[illegible]

PRODUCTION CONTROL DATA

CLASSIFICATION	AMOUNT
Cost/Shut Down	
Cost/Start-Up	
Cost/Changeover	
Pkg. Changeover Cost	
Pkg. Rate Lbs./Mo.	

CONTAINERS	USAGE/UNIT	PRICE PER CONT.	CONT COST/UNIT	PKG UNIT STD
93130- 55 GAL DRUM	.161	7.[illegible]	1.273	
94135- 5 GAL CAN	1.[illegible]	1.8500	3.115	

MONS 046635

OTHER INFORMATION

DOWNTIME SUMMARY	DT	RL	TOTAL
Repair	— %	— %	—
Process	1.00	—	[illegible]
Other	1.0[illegible]	—	[illegible]
Inventory	—	—	—
Total	4.00	—	[illegible]
On-Stream	9[illegible] %	[illegible] %	%
On Stream Rate	8[illegible] #/Hr.		

APPROVAL	SIGNATURE	DATE
	[illegible signature]	9/10/70
	[illegible signature]	9/15/70

DEPT. 246 19 OPERATION REPORT
Aroclors 811.00

PRODUCTION - TOTAL AROCLORS (42.7M# in 1969)

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
ACTUAL	3118613	2841584	3969985	3969407	3973254	4054904	5055954	4267264	3793791	4084713	4633687	5928859
SCHED.	3118613	2841584	3969985	3969407	3973254	4054904	4960000	4267264	3793791	4084713	4800000	4959846
ACT.YTD	3118613	5960197	9930182	13899589	17872843	21927747	26983701	31250965	35044756	39129469	43763156	49692015

PRODUCTION - AROCLORS BY KIND

1232	0	0	0	33500	-0-	-0-	0	-0-	-0-	-0-	-0-	42350
1242	2133478	1659600	2720901	2463352	2540720	2293136	2360725	2227526	2431054	2658334	3659746	4692201
1248	329056	548981	388068	742814	264783	587958	919216	569605	225583	325488	285346	228208
1254	399369	573264	519416	510227	421136	825887	1432762	1163566	722600	883225	446041	521978
1260	256710	59739	341600	219514	746609	347923	291051	306577	415814	217666	242554	444122
1262	0	0	0	0	-0-	-0-	52200	-0-	-0-	-0-	-0-	-0-

PER CENT YIELD ON BIPHENYL: Std: 98.0% 1969: 99.23%

MONTH	100.99	101.82	98.62	100.69	98.78	100.26	101.60	101.31	99.19	102.13	100.93	99.30
YTD	100.99	101.39	100.26	100.38	100.03	100.07	100.35	100.48	100.34	100.52	100.57	100.41

AVERAGE QUALITY OF 1242 EG LOTS: (1969 Avgs: 0.15 ppm; 3000 x 10^9 ohm-cm; 2.1%)

TCC	0.11	0.15	0.14	0.15	0.20	0.16	0.16	0.12	0.15	0.23	0.28	0.24
RESISTIVITY	5900	12270	9760	18680	10970	14780	9480	14,660	7640	12,900	14,900	14,400
POWER FACTOR	1.65	1.61	0.98	0.57	0.74	0.97	1.36	0.91	1.37	1.12	1.10	0.89
NO. OF LOTS	4	6	8	5	8	8	6	4	6	8	11	13

SAFETY (12 minor injuries in 1969)

MINOR	1	0	2	3	1	-0-	1	2	0	0	1	0
SERIOUS	0	0	0	0	0	-0-	0	1	0	0	0	0

COMPLAINTS (9 in 1969)

NUMBER	0	1	2	1	0	0	0	0	0	0	0	0

MONS 046636

PERSONNEL (1969: O.T. 10.8%, E.H. 5.6%, ABS.HRS. 3.4%)

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
OVERTIME	8.2	11.4	5.6	8.1	12.0	21.4	22.0	14.9	16.6	17.6	8.2	9.0
O.T.,YTD	8.2	9.7	8.3	8.2	9.0	10.9	12.7	13.0	13.4	14.0	13.6	12.1
EXTRA HRS.	9.7	6.9	11.5	5.4	7.7	7.1	9.2	3.4	6.5	12.4	7.6	0.5
E.H.,YTD	9.7	8.4	9.5	8.4	8.3	8.1	8.3	7.6	7.5	8.1	8.1	6.7
ABSENTEE HRS.	2.5	2.5	1.7	3.5	2.6	1.5	2.0	6.3	13.6	9.8	4.0	1.2
ABSENTEE HRS.YTD	2.5	2.5	2.2	2.6	2.6	2.4	2.3	2.9	4.0	4.7	4.6	4.3

INVENTORY (1969 Average: Whse. 1240M#, Dept. 1320M#)

WHSE.	1091	1162	1056	1017	592	459	463	280	493	454	645	955
DEPT.	1285	1098	926	1238	1105	789	1264	1238	1411	1071	1176	1360
TOTAL	2376	2260	1982	2255	1697	1248	1727	1518	1909	1525	1821	2315

DEPT. 259 1970 OPERATION REPORT
Pyranols 810.90

PRODUCTION - TOTAL PYRANOLS (13.0M# in 1969)

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
ACTUAL	975824	874607	902782	1549342	1125058	1332715	1174529	1162698	1015412	2086825	1165616	1813463
SCHED.	975824	874607	902782	1549342	1125058	1332715	1174529	1162698	1015412	2086825	1165616	1813463
ACT.YTD	975824	1850431	2753213	4302555	5427613	6760328	7934857	9097555	10112967	12199792	13365408	15178871

PRODUCTION - PYRANOLS BY KIND

1260 PPO	331250	116992	198100	331641	494516	184436	109076	253877	304015	340554	129408	-0-
70/30	170464	450520	457472	641781	168197	517414	617573	497351	488377	929867	562562	554486
1242 PPO	253365	201000	251000	448100	287715	148685	303125	244595	111000	420860	365600	947240
A13B3B	220745	106095	(3790)	127820	174630	482180	144755	166875	61510	371919	108046	311672
FR-0									50510	23625	-0-	-0-

YIELDS - (TCB 1969 Act. 98.3%, 1970 Std. 98.0%; TTCB 1969 Act. 94.3% 1970 Std. 98.0%)

TCB Mo.	96.48	100.62	99.03	100.74	101.01	99.71	99.79	99.59	97.47	99.44	98.51	100.88
TCB YTD	96.48	98.50	98.69	99.42	99.76	99.75	99.75	99.73	99.63	99.60	99.51	99.59
TTCB Mo.	99.41	96.38	-	105.67	98.93	103.34	98.26	102.34	94.18	103.99	95.78	103.09
TTCB YTD	99.41	99.18	99.16	100.16	99.81	101.31	100.95	101.11	100.72	101.36	101.04	101.32

INVENTORY (1969 Average: Whse. 540M#, Dept. 300M#)

WHSE.	467	228	185	358	348	362	496	363	323	664	784	778
DEPT.	316	212	288	392	300	253	241	152	336	493	389	294
TOTAL	783	440	473	750	643	615	737	515	659	1157	1173	1072

DEPT. 259 1970 O[illegible]RATION REPORT
Pydrauls A-200(810.96)

PRODUCTION - A-200(3.95M# in 1969)

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
TUAL	92302	140200	270741	432000	134225	286485	240760	281270	408380	255500	416923	294140
HED.	92302	140200	270741	432000	134225	286485	240760	281270	408380	255500	416923	294140
T. YTD	92302	232502	503243	935243	1069468	1355953	1596713	1877983	2286363	2541863	2958786	3252926

INVENTORY A-200(1969 Average: Whse. 270M#, Dept. 80M#)

SE.	415	179	195	445	212	176	217	152	200	184	318	479
PT.	75	89	0	71	64	136	95	29	135	-0-	123	4
TAL	490	268	195	516	276	312	312	181	335	184	441	483
												-

Pydraul 280(811.19)

PRODUCTION-280 (0.96M# in 1969)

TUAL	0	132500	0	0	96875	265000	131875	118750	0	113125	125000	0
HED.	0	132500	0	0	96875	265000	131875	118750	0	113125	125000	0
T.YTD	0	132500	132500	132500	229375	494375	626250	745000	745000	858125	983125	983125
DRAUL 625												127424

YIELD(TCP 1969 Act. 91.7%, 1970 Std. 99.0%)

P Mo.	N/A	97.26	N/A	N/A	93.61	98.79	101.80	92.52	0	98.09	108.31	98.62
P YTD	N/A	97.26	97.26	97.26	95.68	97.32	98.23	97.27	97.27	97.38	98.65	98.65

INVENTORY(1969 Average: Whse. 100M#, Dept. -0-)

HSE.	85	90	46	46	1	22	72	58	58	173	35	46
EPT.	0	0	0	0	0	22	0	1	1	-0-	-0-	30
OTAL	85	90	46	46	1	44	72	59	59	173	35	76

MONS 046639

COMMENTS

JANUARY Operations normal. "Extra hours" high due to training for vacation relief and replacement of man laid off.

FEBRUARY The resistivity of the 1242 EG lots would appear to be significantly higher, but this must be qualified. First, quality averages are meaningful only over periods longer than one month because the range is wide. Second, the laboratory air scrubber was installed and may(or may not) account for two unusually high resistivity analyses.

The TCB and TTCB yields are actual for 1970 and do not reflect credit received in 1970 for mischarges in 1968-69.

Pyranol stocks are low partly by decision,partly because of TCB shortage.

MARCH Operations normal. Volume increased.

APRIL Operations normal. Total group production was second highest on record. Total Pyranol production was at highest level in past six years, reflecting shift of Aroclor 1260 and 1260 blends from Anniston. Better Aroclor electrical properties reflect improved analytical techniques - no reason to believe the quality has shifted.

MAY The production rate continued at a high level. A bulk shipment of Aroclor 1254/10% Xylene was made in a trailer in Dept. 268. The demand for Aroclor 1260 was unusually high causing some late shipments of 1260 blends. Beginning on about 5/12 and lasting for approximately one week, sulfuric acid and carbon tetrachloride was entrained in the chlorine received. All Aroclor 1242 produced during this time was in specification (EG) but unstables were higher than normal. Aroclor 1254 made at this time was also high in unstables but in spec. The 1254 was used as non-electrical.

JUNE Sulfuric acid in chlorine continued to be a problem in the first half of June. High TCC's were noted in one lot of Aroclor 1242EG; lot KM-477 had 0.36 ppm vs. a "normal" of 0.1-0.2 ppm. Yields on Biø, TCB, and TTCB are all above standard for the month and YTD. TCP yield is below std., 97.32% actual vs. 99.0% standard, but is much improved over last year's actual of 91.7%. Total inventories, bulk and drummed, continue a downward trend. Overtime is high covering vacations and an open Still Operator's job.

JULY Total Aroclor production was highest ever, reflecting the sudden demand for plasticizers grades. Yields on Biø, TCB, TTCB and TCP were all above standard. Drained 33 1/2 gallons of sulfuric acid from the Cl_2 brink tanks during the month. Total inventories were raised considerably because of the increase in sales. Overtime was high due to vacations and training of operators and new employees to enable the dept. to increase production of heavy Aroclors.

AUGUST — The demand for plasticizer Aroclor faded by mid-month. The four shift helpers hired to meet the high demand during July/August were released on 8/24. The demand for drummed products was lower as inventories of NE Aroclors were allowed to drop to near zero. The necessity for overtime decreased but was still higher than normal. A serious injury (first for the year) was sustained by Carl McCoy.

SEPT. — Production level returned to "normal" after high surge demands in July and August. "Normal" level will be increasing as customers are transferred from Anniston to WGK. Shipped to Sprague Electric in September and will ship to Westinghouse, Bloomington, in October.

Since the Bi Ø yield YTD continues to be over 100%, a few comments are in order. Since Aroclor 1242 is a mixture of isomers of varying molecular weights, degree of chlorination is measured by sp. gr., 1.381-1.392 @ 25°C, which corresponds to 41.5-42.5% chlorine by weight. Theory chlorine is 42.0%. The percent difference in the amount of chlorine used between 42.0% and 42.5% by weight in the finished goods is about 1.2%. Therefore, it is theoretically possible to have over 100% yields on BiØ if the Aroclors are consistently chlorinated to near their upper limits and there are no significant losses. Bi Ø tank car weights are not checked and may also contribute to the high yields. The biphenyl yield shown in this report reflects actual operations. The cost report data will appear slightly different because some reworked Aroclor was transferred to 811.00.

Resistivity of Aroclor 1242 EG has been better than last year. This is probably more a factor of sampling and analysis than product quality.

The complaint procedure as practiced has changed. Last year complaints were formal. This year, complaints are relayed personally and acted upon quickly. Formal complaints are seldom written up.

Absenteeism is high because W. Walker and C. McCoy have been absent about the entire month. Extra hours are high to cover the absenteeism, vacations, and for training a man to replace R. Antoff who is being laid off - more in October. Overtime is high to cover absenteeism and for extra drumming.

TCB and TTCB yields are actual on this report. The cost report data will be different because it includes credit received from Hooker early in the year and because one lot of reworked Aroclor was transferred to Pyranols.

OCTOBER

Pyranol production set a record of 2.0$\bar{M}$ lbs. Order level was high and inventories were increased by 0.5$\bar{M}$ lbs. to a more "normal" level. Whse. stock had been quite low.

Aroclor 1242EG customers new to WGK serviced in October were Westinghouse (Bloomington), Cornell-Dubilier, and Electronic Components. The only former Anniston customer not yet served is Aerovax.

Aroclor 1260EG production is still out of specification on A.C. Cl^- and sometimes on Monsanto Stability. Details on this problem are reported in a separate report. One indication of poorer Aroclor 1242EG quality appeared in October. The TCC's have increased significantly, from an average of 0.15ppm to 0.23 ppm, with two lots being over 0.30 ppm. A relationship between these two problems has not been established.

The primary reason for high overtime hours has been the high demand for drummed products; also some vacation time was covered with overtime. November O.T. should be less than 10.0%. A utility shift helper has been obtained for drumming. A third standard operator job will be posted if drum demand continues. Extra hours were high because three men were laid off (D. Hindman, P. Lutman, and D. Athy) and their replacements trained. This will continue into November. Absentee hours decreased from September because W. Walker returned in mid-month, but C. McCoy was again absent for the entire month.

The third lot of Aroclor "scrap" was reworked. The material was Inerteen PPO.

NOVEMBER

Total Aroclor production in November was second only to July, 1970. Aroclor 1242 production was nearly 1.0$\bar{M}$ lbs. higher than the previous high made in March, 1970.

The thermal chemical chlorides analysis of Aroclor 1242 continued to climb, a two-month trend. The range on 11 electrical grade lots was 0.21-0.38 ppm; the average was 0.28 ppm. This trend is not reflected in any other analysis.

The Aroclor 1260 quality problem is still not resolved. There is some evidence that at least part of the problem is analytical. A sample of 1260 that was analyzed as out of specification by the WGK laboratory (Monsanto stability and after corrosion chlorides) was in specification on both properties as analyzed by the Anniston laboratory.

Labor figures of overtime, extra hours, and absenteeism returned to more normal levels after high levels for several months.

ANTICIPATED IN DECEMBER

1. Record production of Aroclor 1242 and total Aroclors.
2. Higher inventories due to loading extra tank cars before the receipt of orders.
3. High overtime, especially in still operator category.
4. First time production of Pydraul 625 and a short run of seldom made Aroclor1232.

DECEMBER

Aroclor production was at an all-time high breaking the previous record (July, 1970) by 17%. Aroclor 1242 production was 4.7M lbs. and downtime was only about 0.5%. Using the standard OST of 91% Aroclor 1242 capacity is about 52M lbs./year. This is approximately the same capacity demonstrated several months ago in a two-day run.

Aroclor 1242 thermal chemical chlorides improved over last month but they are still higher than the 1969/first half of 1970 "normal". Two lots of Aroclor 1260 were produced and both were in specification on all properties - first time in three months. Operating conditions were not changed for either the 1242 or 1260.

Minor injuries during 1970 were 12 in number - identical to 1969.

Drum stocks of the fastest moving products were increased to targeted levels - finally caught up from the surge demand experienced in July and August. The removal of slow-moving items is to be completed by 4/1/71.

Pyranol production was the second highest on record, including nearly 1.0M lbs. of Inerteen 54201 CM. No Inerteen PPO was produced and no more will be produced until open orders are in hand. About 10,000 gallons of Pydraul 625 were produced. This was the first time produced at W.G.K., and possibly only time. Pydraul 625 is an obsolete product.

Total Aroclor Group production broke the old record (July, 1970) by 23%.

Monsanto

FROM (NAME & LOCATION) R. M. McCutchan, W. G. Krummrich

DATE November 2, 1970

SUBJECT Status of Dept. 246/259 Safety Audit Recommendations of May, 1969

REFERENCE

cc V. Brawley
T. Carrico
D. O'Toole
D. Schillinger

TO : B. Corlew

This memo is a second status report on the 36 recommendations made in the Dept. 246/259 Safety Audit issued in May, 1969. The first status report of 3/5/70 is attached. The box score is:

Date	Recommendation Completed	No Work Justified	Job Open
May, 1969	-	-	36
3/5/70	9	3	24
11/1/70	19	11	6

Completions (or decisions to do no work) on the remaining six recommendations will be made by 4/1/71. Details on the current status follow. "Open" recommendations are marked with an asterisk.

Recommendations

1. (a) The west biphenyl storage tank (Item 102) should be controlled at 100°C or below, or (b) the tank equipped to handle a flammable liquid.

   Status - A Taylor Fulscope temperature controller controls at 95°C. Completed on 3/23/70.

2. (a) The batch biphenyl head tank (Item 103) should be kept at or below 100°C., or (b) the tank equipped to handle a flammable liquid.

   Status - Lowering the temperature of the biphenyl tank (#1, above) causes the normal temperature in the biphenyl head tank to be about 100°C. No further work will be done.

*3. A means should be found to control the temperature in the biphenyl/catalyst mix tank (Item 403) at 100°C or less.

   Status - Work done on #1 (above) did not help much in controlling the temperature in the biphenyl/catalyst mix tank. Further work yet to be done.

Recommendations (cont'd.)

4. A high pressure alarm set for 45 psi should be installed on the chlorine vaporizer (Item 116).

   Status - No work justified.

5. A high pressure alarm set for 50 psi should be installed on the nitrogen header.

   Status - No work justified.

6. The xylene storage area should be laid off and a sign "Xylene-Flammable" erected.

   Status - Completed.

7. A means should be found to insure that Lubrizol 1360 is not heated above 100°C.

   Status - A drum of Aroclor 1248 was put on the plate coil heater for 4 days. At the end of the time, the temperature was 65°C. No further work will be done.

*8. (a) Put flooring on the level of the discharge piping from the batch chlorinators, or (b) direct the discharge lines away from the working area and a blown seal warning device be installed.

   Status - The rupture disc lines will be extended down to floor level after #9 (below) is resolved.

*9. Investigate the adequacy of the size of the rupture discs (8") and discharge line (3") on the batch chlorinators.

   Status - TSD investigating what is considered safe practice.

10. All temperature alarm and automatic cut-offs on all chlorinators should be checked at 6 month intervals.

    Status - All safety devices have been put on a check-list and are tested routinely by department or by instrument shop.

Recommendations (cont'd.)

11. (a) A procedure should be adopted to prevent dropping the wrong chlorinator batch to #2 blow tank, or (b) #2 blow tank should be properly equipped to handle a flammable liquid.

    Status - #2 blow tank is now closed to the atmosphere as a result of the blow tank demister project. It is vented only to the drowning jet. No other work will be done.

12. A level recorder should be installed on #2 blow tank..

    Status - #2 blow tank now has a percentage gauge located in the control room and in the field.

13. (a) The gas fired still furnaces should be insulated and properly guarded, or (b) a warning sign be placed on the furnaces.

    Status - Since there is very little work activity near the furnaces, insulation or additional guarding is not necessary.

14. Expedite completion of TSD Project 6928 - "Install Level Recorder on #2 Still".

    Status - Completed.

15. Complete all actions recommended in formal investigation L-17-20-68.

    Status - Completed.

16. Expedite completion of TSD Project 6939 - "Install Level Measurement on Product Tanks".

    Status - Completed.

17. Develop project to nitrogen blanket #1 and #2 Blend and Finished Product Tanks.

    Status - These two tanks are not used often. Fumes are very minimal. No work is justified.

Recommendations (cont'd.)

18. Expedite completion of TSD Project 5377 - "Upgrade Lighting System in Dept. 246".

    Status - Completed.

*19. Determine flash point of Inerteen PPO, 54201 CM, and 54201 KA after the Glycidyl Phenyl Ether has been added. If the storage temperatures are within 15°C. of the flash point, either (a) Equip tank to handle flammable liquid, or (b) lower the storage temperature.

    Status - Work yet to be done.

20. Install relief system on 18" filter used when loading or drumming pyranols.

    Status - No work is justified.

21. Upgrade grounding system for Xylene drums.

    Status - Completed.

22. Concerning the Aroclor 1254 - 10% Xylene mix.
    (a) Determine flash point of mix.
    (b) Lower storage temperature as much as possible.
    (c) Evaluate need for vent and flame arrestor on #1 blend tank.
    (d) Ground in #1 blend tank.
    (e) Ground the Xylene mix drumming facilities and further alter to adhere to Monsanto safety specifications of handling flammable liquids.

    Status - All work was completed in anticipation of producing an Aroclor 1260/10% Toluene mix.

*23. Introduce a sufficient quantity of steam into the scrubber stack to snuff out any fire which could conceivably occur at the outlet.

    Status - Work yet to be done; evaluation.

24. Expedite completion of TSD Project 7004 - "Alter Truck Loading Dock".

    Status - Completed.

25. Write more specific procedures for shutdown during the preparation of a Xylene blend.

    Status - No work will be done because Xylene blends have been discontinued.

26. Evaluate need for an emergency exit on the north side of the department.

    Status - The possibility of a person being trapped on the north side of the second or third levels is extremely remote. No work is justified.

27. Provide for emergency lighting for Dept. 246.

    Status - Purchase of emergency lighting is not justified.

*28. Maintain a spare flame arrestor for Item 403 (catalyst mix tank).

    Status - Will resolve when recommendation #3 is completed.

29. Relocate chlorine discharge line from chlorine vaporizer rupture disc.

    Status - Completed.

30. Locate a 500# dry chemical fire extinguisher near Item 401 (100,000 gal. biphenyl storage tank).

    Status - No work justified.

31. Items 401 and 102 should be identified "BIPHENYL-FLAMMABLE).

    Status-Completed.

32. Extend fume removal system to continuous chlorinator area.

    Status - Completed.

33. Improve lime delivery method to #3 and #4 stills.

    Status - A ramp has been installed on second level so a dolly can be used for delivering lime. A forklift pad will be installed later (is a part of incineration project estimate).

34. Evaluate need for monitor nozzle near Item 401.

    Status - No work justified.

35. Evaluate need for controlled drainage from area around Item 401.

    Status - No work justified.

36. Install improved venting system on Item 102 (west Biphenyl tank).

    Status - Completed.

R. M. McCutchan

/gjs

, McCutchan

MONSANTO COMPANY

ORGANIC DIVISION

W. G. KRUMMRICH PLANT

PROCESS SAFETY AUDIT

DEPARTMENT 246

AROCLORS, PYRANOLS, PYDRAULS

Supervisor R. M. McCutchan

Supt. J. W. Molloy

Written by: H. F. Ray

R. M. McCutchan

May - 1969

Depts. 246 and 259

SAFETY AUDIT RECOMMENDATIONS

The following list of recommendations are included in the Safety Audit. An approximate priority has been set by department supervision for action on these recommendations. Targeted dates for completion of evaluation and/or action on the priorities are:

Priority	Date
1	8/1/69
2	2/1/70
3	11/1/70

	Recommendation	Priority
1.	(a) The west biphenyl storage tank (Item 102) should be controlled at 100°C. or below, or (b) the tank equipped to handle a flammable liquid.	2
2.	(a) The batch biphenyl head tank (Item 103) should be kept at or below 100°C., or (b) the tank equipped to handle a flammable liquid.	2
3.	A means should be found to control the temperature in the biphenyl/catalyst mix tank (Item 403) at 100°C. or less.	1
4.	A high pressure alarm set for 45 psi should be installed on the chlorine vaporizer (Item 116).	3
5.	A high pressure alarm set for 50 psi should be installed on the nitrogen header.	3
6.	The xylene storage area should be laid off and a sign "Xylene-Flammable" erected.	1
7.	A means should be found to insure that Lubrizol 1360 is not heated above 100°C.	2
8.	(a) Put flooring on the level of the discharge piping from the batch chlorinators, or (b) direct the discharge lines away from the working area and a blown seal warning device be installed.	3
9.	Investigate the adequacy of the size of the rupture discs (8") and discharge line (3") on the batch chlorinators.	3
10.	All temperature alarms and automatic cut-offs on all chlorinators should be checked at 6 month intervals.	1
11.	(a) A procedure should be adopted to prevent dropping the wrong chlorinator batch to #2 blow tank, ~~or (b) #2 blow tank~~, or (b) #2 blow tank should be properly equipped to handle a flammable liquid.	3

	Recommendation	Priority
12.	A level recorder should be installed on #2 blow tank.	3
13.	(a) The gas fired still furnaces should be insulated and properly guarded, or (b) a warning sign be placed on the furnaces.	3
14.	Expedite completion of TSD Project 6928 - "Install Level Recorder on #2 Still.	1
15.	Complete all actions recommended in formal investigation L-17-20-68.	1
16.	Expedite completion of TSD Project 6939 - "Install Level Measurement on Product Tanks".	1
17.	Develop project to nitrogen blanket #1 and #2 Blend and Finished Product Tanks.	2
18.	Expedite completion of TSD Project 5377 - "Upgrade Lighting System in Dept. 246".	1
19.	Determine flash point of Inerteen PPO, 54201 CM, and 54201 KA after the Glycidyl Phenyl Ether has been added. If the storage temperatures are within 15°C. of the flash point, either (a) Equip tank to handle flammable liquid, or (b) lower the storage temperature.	2
20.	Install relief system on 18" filter used when loading or drumming Pyranols.	3
21.	Upgrade grounding system for Xylene drums.	1
22.	Concerning the Aroclor 1254 - 10% Xylene mix: (a) Determine flash point of mix. 123°F. (50°C) (b) Lower storage temperature as much as possible. (c) Evaluate need for vent and flame arrestor on #1 Blend Tank. (d) Ground #1 Blend Tank. (e) Ground the Xylene mix drumming facilities and further alter to adhere to Monsanto safety specifications for handling flammable liquids.	1
23.	Introduce a sufficient quantity of steam into the scrubber stack to snuff out any fire which could conceivably occur at the outlet.	2
24.	Expedite completion of TSD Project 7004 - "Alter Truck Loading Dock".	1
25.	Write more specific procedures for shutdown during the preparation of a Xylene blend.	1
26.	Evaluate need for an emergency exit on the north side of the department.	3
27.	Provide for emergency lighting for Dept. 246.	3

	Recommendation	Priority
28.	Maintain a spare flame arrestor for Item 403 (catalyst mix tank).	2
29.	Relocate chlorine discharge line from chlorine vaporizer rupture disc.	1
30.	Locate a 500# dry chemical fire extinguisher near Item 401 (100,000 gal. biphenyl storage tank).	3
31.	Items 401 and 102 should be identified "BIPHENYL-FLAMMABLE).	1
32.	Extend fume removal system to continuous chlorinator area.	2
33.	Improve lime delivery method to #3 and #4 Stills.	1
34.	Evaluate need for monitor nozzle near Item 401.	2
35.	Evaluate need for controlled drainage from area around Item 401.	2
36.	Install improved venting system on Item 102 (west biphenyl tank).	2

PROCESS SAEETY AUDIT

Dept. 246

Aroclors, Pyranols, Pydrauls, Inerteens

I. Raw Materials

The following toxic rating code will be used in describing the toxicity of these materials:

0 - none
1 - slight
2 - moderate
3 - high
U - Unknown

A. Biphenyl (Code 82601)

1. Synonyms: Diphenyl
2. Description: White flakes or solid off white mass; somewhat pleasant odor.
3. Constants: Mol. Wt. 154.2; M.P. 69°C.; B.P. 255° C.; Density .9910 @ 75°/4°C.
4.* Flash Point: 235° F. (C.C.)
5.* Auto Ignition Temperature: 1004° F.
6. Toxic Hazard Rating:
   Acute Local: U
   Acute Systemic: Ingestion 3, Inhalation 3,
   Chronic Local: U

* See Appendix I for definition of these terms

7. Fire Hazard: Definitely when exposed to heat or flame; can react with oxidizing materials.
8. Fire fighting: CO_2 or dry chemical
9. Formula: $C_6H_5C_6H_5$
10. Biphenyl vapors are irritating to the upper respiratory tract. Workers should not be exposed to vapor levels throughout their shift in excess of the threshold limit value of 1 milligram per cubic meter of air (or about 0.2 ppm). The compound, or organic solutions of the compound can absorb through the intact skin; therefore, repeated skin contact should be avoided.

Biphenyl is received in 10,000 or 20,000 gallon tank cars on Track 10A from Anniston and in 4,000 gallon trailers from Associated Sales. The crystallized biphenyl is melted with 80 lb. steam using the coils in the cars and additional hairpin coils if necessary.

There are temperature indicating on-off controllers on tank car unloading spots 5 and 6 to keep the biphenyl from heating above the flash point. Temperature in the car is measured using a portable thermocouple and is controlled at 100°C. ± 2°.

A. Biphenyl (continued)

During the plant air (30 psig max.) unloading of the molten biphenyl there is no steam on the tank car coils so the material cannot be overheated. The transfer of the biphenyl to storage begins after the operator has visually inspected the car and has determined all the biphenyl has melted.

The tank trucks received from Associated Sales are unloaded at the Spot #4 tank car loading/unloading dock. The material in the tank truck is always in the liquid state and below the flash point so that no heating is applied in the department.

Tank car unloading spots 5 and 6 are equipped with self-supporting counterbalanced unloading arms and plant standard Hemco adjustable access ramps. Both docks are adequately grounded.

The molten biphenyl is then transferred to either the 100,000 gallon (Item 401) or 25,000 gallon (Item 102) storage tanks.

The biphenyl is stored in Item 401 at 100°C. The tank is equipped with a steam jacketed flame arrestor on the vent and a protecto-seal manway cover to protect the tank against overpressurization. The tank temperature is controlled by a field mounted temperature indicating controller (capillary system) which allows 80# steam to enter two fintube heaters inside the tank. The tank temperature is also recorded from a separate thermocouple on point #1 of the 24 point, panel mounted temperature recorder (TR18). A high temperature alarm sounds of point #1 reaches 113°C. Steam pressure on the manway, flame arrestor, and pipeline tracers is reduced to 18# to avoid heating the product above the flash point. The tank level is indicated both at the tank and on the panel board on a 0-100% dial gauge. This tank is grounded in three places.

The biphenyl is stored in Item 102 at 100 - 120°C. The tank temperature is recorded on point #11 of panel mounted 12 point recorder 29 - 6638. There is no temperature alarm system for this tank. The temperature controller is a self contained field mounted capillary system utilizing 80# steam. The tank is vented to the atmosphere and there is no dip-pipe in the charging line to the tank. It is recommended that either 1. The storage temperature be controlled at 100°C. or below or 2. The tank be equipped to handle a flammable liquid. (See Appendix I for proper flammable liquid handling conditions.) Items 401 and 102 should be identified "Biphenyl-Flammable". Fumes from the vent on Item 102 are significant during a transfer of biphenyl to the tank It is recommended that an improved venting method be installed on Item 102.

The biphenyl is transferred by a submerged pump from Item 102 to either the batch chlorinator head tank (Item 103), to the catalyst mix tank (Item 403), or to #6 chlorinator (Item 406).

Item 103 is a 700 gallon measuring tank located in the batch chlorinator area on the fifth level (top). There is a 1-1/2 inch traced and insulated overflow/vent line back to Item 102 to maintain a constant charge size (500 gal.) to the batch chlorinators.

A. Biphenyl (continued)

The biphenyl is kept molten with 80# steam reduced to 40#. A 60# relief valve protects the jacket. 40# steam (142°C.) keeps the head tank temperature above the flash point of biphenyl. There is no temperature recorder, controller or alarm on this system. This tank is considered a closed vessel.

It is recommended that either 1. The tank temperature be kept at or below 100°C. or 2. The biphenyl head tank be properly equipped to handle a flammable liquid.

Item 403 is a 1272 gallon feed tank located on the third level (top) in the continuous chlorinator area. There is a traced and insulated 3 inch overflow line which ties into the 1½ inch overflow line from the batch head tank on the second level of this batch chlorinator structure. The tank is vented to the atmosphere and is equipped with a steam jacketed flame arrestor. Steam pressure on the flame arrestor is controlled at 18#. The tank temperature is maintained by controlling the flow of 80# steam to an internal pipe coil utilizing a field mounted temperature indicating controller (capillary system). Although the tank temperatu is set for 100°C. the contents are normally in the range 120-130°C due to tracer heat-up in the circulating system. Level in the tank is indicated at the tank and recorded on the control panel. $FeCl_3$ catalyst is introduced into the tank manually on a once/day frequency. The tank is open to the atmosphere when charging catalyst.

It is recommended that means be found to allow the tank temperatur to be controlled at 100°C. or less. It is also recommended that a spare flame arrestor be maintained.

Item 406 is a 1729 gallon chlorinator located immediately east of Item 403. The biphenyl is fed continuously to this tank through a flow control system. The biphenyl is introduced into the chlorinated reaction mass via a dip pipe. Normal operating temperatures of this closed vessel is 150°C.

B. Chlorine (Code 81059)

1. Description: Greenish yellow gas
2. Formula: Cl_2
3. Constants: Mol. Wt. 70.914; M.P. = 101°C.; B.P. - 34.5°C.; Density 1.47 @ 0°C.
4. Toxic Hazard Rating:
   Acute local: Irritant 3; Inhalation 3
   Acute systemic: 0
   Chronic local: U
   Chronic systemic: U
   M.A.C. - 1 PPM in air per 8 hour day
5. Toxicology: Chlorine is extremely irritating to the mucous membranes of the eyes and respiratory tract. It combines with moisture to liberate nascent oxygen and from hydrochloric aci

B. Chlorine (continued)

5. Toxicology: (cont'd)
Both of these substances, if present in quantity, cause inflammation of the tissues with which they come in contact. If the lung tissues are attacked, Pulmonary edema may result. A concentration of 3.5 ppm produces a detectable odor; 15 PPM causes immediate irritation of the throat. Concentrations of 50 PPM are dangerous for even short exposures. 1000 PPM may be fatal even when the exposure is brief.

Because of its intensely irritating properties, severe industrial exposure seldom occurs, as the workman is forced to leave the area before he can be seriously affected. In cases where this is impossible, the initial irritation of the eyes and mucous membranes of the nose and throat is followed by cough; a feeling of suffocation and later pain and a feeling of constriction in the chest. If exposure has been severe, pulmonary edema may follow with râles being heard over the chest.

6. Fire Hazard: Moderate - can react to cause fire or explosion upon contact with turpentine, ether, ammonia gas, illuminating gas, hydrocarbons, hydrogen and powdered metals.

7. Explosion Hazard: Present by reaction with reducing agents.

8. Disaster Control: Dangerous; emits highly toxic fumes; will react with water to form toxic and corrosive fumes of HCl; Is heavier than air - gas will hug the ground. People without adequate protection should go across wind until out of the affected area.

Chlorine is transferred by a 6" pipe line from the Chlorine Department. As it enters the department it passes through two Brink Demisters (Items 115, 590) in parallel which remove any entrained liquids. From there it passes through a chlori vaporizer (Item 116) which adds enough heat to prevent any liquid chlorine from entering the system.

The vaporizer uses regulated 80# steam to heat up the incomin chlorine. If the Cl_2 pressure reaches 40 lbs., the steam is automatically shut off thus preventing further pressure buildup.

If due to a plug in the chlorine line past the vaporizer, the chlorine pressure builds up to 50# a relief valve and a rupture disc will relieve the pressure. This situation is highly unlikely as the chlorine supply pressure is controlled at 30 # in the chlorine department. However, since a failure in the steam controller or the chlorine department controls could cause a pressure of 50# to be exceeded and a subsequent discharge of chlorine gas to the atmosphere, it is recommended that a high pressure alarm for 45 psi be installe on the vaporizer. Also, the chlorine discharge line from the rupture disc should be relocated for improved operator safety

C. Nitrogen (Code 43099)

1. Description: Colorless gas
2. Formula: N_2
3. Constants: Mol. Wt. 28.02; M.P. - 210°C; B.P. - 195.8°C.; Density 1.2506 gr/liter at 0°C.
4. Toxicity: None. In high concentrations it is an asphyxiant.

Nitrogen is used for blanketing Aroclor in the blend tanks, surge tanks, finished product tanks, and storage tanks and on the #1 blend tank system before making a 125# and 10% Xylene mix. It is handled properly. Nitrogen lines are identified with orange signs with black letters. No Corby connections are present.

The nitrogen is stored in a liquid storage tank owned, operated, and maintained by Air Products. The tank is protected from over-pressurization by a relief valve set for 125# and a rupture disc set for 342#. Header pressure is controlled at 38#. There is an alarm for low supply pressure (10#) but none for high pressure. It is recommended that a high pressure alarm set for 50# be installed for the nitrogen header to avoid damaging the nitrogen pressure control valves.

D. Xylene (Code 64005)

20% Ortho
36% Meta
15% Para
28% Ethyl benzene
Purchased from Shell Petroleum Co.

1. Description: Colorless liquid.
2. Formula: $C_6H_4(CH_3)_2$
3. Flash Pt. 85° F. to 100° F. depending on composition of isomers.
4. Density: .864 @ 20°/4° C.
5. Explosive Range: 1.1 to 7.0% in air.
6. Toxic Hazard Rating:
   - Acute Local: Irritant 1
   - Acute Systemic: Inhalation 1
   - Chronic local: Irritant 1
   - Chronic Systemic: Inhalation 1
     Skin Absorption 1
7. M.A.C.: 200 PPM in air.
8. Fire Hazard: Dangerous when exposed to heat or flame; can react with oxidizing materials.
9. Fire fighting: Foam, CO_2, or dry chemical.
10. Explosion Hazard: Moderate in vapor form.

Xylene is used only to make an Aroclor 125# and 10% Xylene mi It is received in 50 gallon steel drums and stored on pallets on the east side of the department. Xylene is extremely flammable and should be handled and labeled as such. It is recommended that the Xylene storage area be laid off and a sign "Xylene - Flammable" erected.

E. Trichlorobenzene (Code 60200)

1. Description: Colorless liquid as received in Aroclor Department it is a mixture of 1,2,3 and 1,2,4 TCB and possibly other isomers.
2. Formula: $C_6H_3Cl_3$
3. Constants: Mol. Wt. 181.5; M.P. approx. 10°C., B.P. 213°C.
4. Flash Pt. about 230° F. (C.C.)
5. Toxic Hazard Rating:
   Acute local: U
   Acute Systemic: Ingestion 2; Inhalation 2
   Chronic local; causes loss of hair of experimental animals.
   Chronic Systemic: Ingestion 2; Inhalation 2
6. Fire Hazard: Moderate when exposed to heat or flame. When heated to decomposition (300°C.+) it emits highly toxic fumes of chlorides. Can react with oxidizing materials.
7. Fire fighting: Water, foam, CO_2 or dry chemical. TCB is used as a blending agent in the production of Pyranols. It is handled and stored safely in underground storage tanks #5 or #6.
8. Handling: TCB is normally received in either 8000 gallon tank cars or in 55 gallon drums. Unloading is handled by a positive displacement pump in either case. TCB may also be received by tank truck (4000 gal.). Unloading is then handled either by gravity or centrifugal pump.

F. Tri Cresyl Phosphate (Code 80180)

1. Synonyms: O-Tolyl phosphate
2. Description: Colorless liquid
3. Formula: $(CH_3C_6H_4)_3\ PO_4$
4. Constants: Mol. Wt. 368.36; M.P. -25 to -30°C. B.P. 410°C.
5. Flash Point: 460° F. (C.C.)
6. Toxic Hazard Rating:
   Acute Local: U
   Acute Systemic: Ingestion 3; Inhalation 2; Skin Absorption 2.
   Chronic Local: U
   Chronic Systemic: Ingestion 2, Inhalation 2; Skin Absorption 2.
7. Fire Hazard: Slight when exposed to heat or flame. When heated to decomposition it emits highly toxic fumes of oxides of phosphorus; can react with oxidizing agents.
8. Fire Fighting: Water, foam, CO_2 or dry chemical. It is used in the production of Pydraul 280.
9. Handling: TCP is received in either 4000 gallon tank trucks or in 55 gallon drums. Unloading is handled by a centrifugal pump for the trailers and a positive displacement pump for the drums. Trailers are unloaded directly into #1 mix tank.

G. Glycidyl Phenyl Ether (PPO) (Code 36100)

1. Description: Liquid
2. Formula: C_6H_4 CH_2 $CHOCH_2$
3. Constants: M.P. 3.5° C.; B.P. 245°C.
4. Flash Point: 175° F. (O.C.)
5. Toxic Hazard Rating:
   Acute local: U
   Acute Systemic: Ingestion 3; Inhalation 3.
   Chronic local: U
   Chronic Systemic: U
6. Fire Hazard: Moderate; when exposed to heat or flame. Can react with oxidizing materials; The vapors of glycidyl phenyl ether normally will not present a hazard at room temperature. Inhalation of vapors above 60°C. should be avoided. Material should be kept from eyes or skin.
7. Fire Fighting: Water, foam, CO_2 or dry chemical. When heated to decomposition it emits toxic fumes.
8. Handling: Avoid contact with eyes or skin. Wash off with water if any is spilled on the skin.

Glycidal Phenyl Ether is used as a chlorine scavenger in producing Pyranols; Inerteen PPO, 54201KA, and 54201 CM. It is stored safely in drums. The material is added to the blend through the suction pipeline of the #2 and #3 mix tank circulating pumps.

H. Lime (Code 38800) (Calcium Oxide)

1. Description: Fine white or slightly gray powder, Rhomeric Trigonal crystals.
2. Formula: CaO
3. Toxic Hazard Rating:
   Acute local: Irritant 3; Ingestion 1; Inhalation 3.
   Acute Systemic: Ingestion 2; Inhalation 3;
   Skin Absorption 0
   Chronic local: Irritant 3, Inhalation 2
   Chronic Systemic: Ingestion 2, Inhalation 3;
   Skin Absorption 0.
4. Toxicology:
   Has a caustic reaction and therefore is irritating to the skin. As a dust it can cause dermatitis and irritatio of the eyes and mucous membranes. It is a general nuisanc type of dust.
5. Fire Hazard: None
6. Explosion Hazard: Virtually none
7. Handling: Dust respirator, adequate protective clothing, including rubber coated gloves, optional rubber full cover apron, and full cover plastic goggles should be used when handling li (dust). Adequate ventilation and dust removal equipment should be used in the handling area.

MONS 046660

Lime is added to the stills to neutralize any liberated HCl an prevent sublimation of the $FeCl_3$ catalyst. It is handled in 50# bags.

I. Attapulgus Earth (Code 19400)

Attapulgus earth is an inert material and is handled in bags, drums or buckets. There should be no toxicity involved in handling this material, but as a matter of personal cleanliness, it should be washed from the skin or brushed from the clothing after handling it It should not be blown from the clothing or skin with an air hose as this is an unsafe practice.

J. Tri-Tetra Chlorobenzene Mix (Code 58500)

Received in tank cars, trailers or drums. This is a mixture of trichlorobenzene and tetra chlorobenzene. It is similar in properties to TCB and should be handled in the same way. It is stored in #5 or #6 underground storage tanks.

K. Unox Epoxide (Code 61320)

Handled in drums and used in production of Pyranol A13B3B. Purchased from Union Carbide; This material is dicyclo diepoxy carboxylate. Prolonged and repeated contact of liquid or breathing of vapors or mists may cause delayed and serious injury.

Operators should avoid contact of this material with skin or clothing and should avoid inhalation of vapors or mists. In case of contact the skin should be washed thoroughly with plenty of soap and water and contaminated clothing and shoes should be removed.

L. Dow Corning Fluid (Code 31100)

A defoamer used in Pydraul blends. It has a flash point in the order of 600° F. and should present no particular hazard in handling. In the interest of personal cleanliness it should be washed off if it comes in contact with the skin or clothing.

M. Santolube 70A (Code 82138)

Used in Pydraul A-200. Purchased from our Nitro Plant. This material chemically is the product of Oleic Acid and Triethylene tetramine reacted in Benzene with Tetra-prophenyl succinic anhydrid and #5 oil. Its exact structure is unknown. Handled in drums - should present no hazard as long as it is not over heated to decomposition. Should not breathe fumes. Should be washed off if it comes in contact with the skin.

N. Blue A Dye (Code 20640) and AZO Oil Black Dye (Code 20317)

Used only in small quantities in Pydraul A-200 and Pydraul 280. Should present no particular safety hazard. Should be washed off if in contact with the skin.

O. Porocel (Code 48289)

Porocel is an activated bauxite ore in 20/60 mesh form used for packing in the absorbers. It is received in 50# bags and manually dumped into the columns. Since it is aninert material there should be no toxicity involved in handling, but as a matter of personal cleanliness, it should be washed from the skin or brushed from the clothing after handling it.

P. Lubrizol 1360 (Code 39050)

1. Chemical Name: Zinc dialkyl dithiophosphates (an oil diluted blend).
2. Description: Amber oily liquid
3. Formula: $(RO)_2$ P-S-S $_2$ Zn

   "R" is a blend of 50% iso-butyl and 50% primary amyl.
4. Flash Point: 380°F. (C.O.C.)
5. Decomposition Temperature: 130°C. (trace amounts of H_2S)
   220°C. (rapid)
6. Toxicity: Moderately toxic and is an eye and skin irritant. Direc physical contact should be avoided. At high temperatures (see above) decomposition releases hydrogen sulfide (H_2S) a very poisonous gas. In the presence of water hydrolyzation occurs, again generating H_2S.
7. Handling: From a safety standpoint Lubrizol 1360 should not be heated above 120°C. to avoid generation of H_2S. To maintain maximum quality, a temperature of 54°C. should not be exceeded.

   A drum warmer is used to heat the 1360 prior to pumping into a blend. The warmer uses 80# steam (162°C.). It is recommended that a means be found to insure that the 1360 is not heated above 100°C.

Q. Ferric Chloride (Code 33500)

1. Description: Granular solid
2. Formula: $FeCl_3$ (Anhydrous)
3. Constants: Mol. Wgt. = 166.22, Melting Pt.= sublimes, solubility in H_2O = very soluble with heat rise.
4. Toxic Hazard Rating:
   Acute Local: Irritant 1; Ingestion 1
   Acute Systemic: U
   Chronic Local: Irritant 1
   Chronic Systemic: U
5. Fire Hazard: There is no fire hazard under normal conditions, but it will emit toxic fumes at high temperatures.
6. Handling: Protect the skin with approved protective clothing, avoid the breathing of $FeCl_3$ dust, wear approved respirator with adequate cartridge, and protect the eyes with approved goggles. There are no storage regulations; however, it should be stored in a dry place as heat is released upon solution in water and wet ferric chloride will not catalyze the chlorination reaction.

R. General Comments

1. All raw materials used are stable under the present operating conditions and would remain stable under conditions caused by imaginable equipment failure.

2. Biphenyl, Xylene and glycidal phenyl ether must be handled as flammable liquids under present operating conditions.

3. None of the operating areas is enclosed in such a way as to permit exposure to toxic materials.

4. The operators are knowledgeable and trained to carry out the available emergency procedure in the event of a spill.

R. General Comments (continued)

5. Adequate fire control is available in storage areas with the exception of biphenyl. It is recommended that:

   a. A 500# dry chemical fire extinguisher be located near Item 401.

   b. Evaluate the need for a monitor nozzle near Item 401.

   c. Evaluate the need for controlled drainage from area around Item 401.

II. PROCESS

A. Chlorination

Aroclor is produced by the batchwise and continuous chlorination of biphenyl or other Aroclors with snift gas chlorine (delivery pressure 25 to 30 psig) at a pressure of 2 - 4 psig. Normal operating temperatures are between 120 and 195°C. Hydrogen chloride gas is liberated during the reaction and is piped to the muriatic acid and chlorosulfonic acid departments. Ferric chloride is a catalyst for the reaction.

The chlorination reaction is exothermic (510 BTU/Lb. of chlorine) and is stable. Biphenyl can be chlorinated as fast as the exothermic heat can be removed from the batch and still maintain a batch temperature of 150°C. Continuous chlorinator temperatures vary from 150°C. in #6, 165°C. in #7, 180°C. in #8 to 195°C. in #9. In order to remove this heat, the reaction mass is continuously circulated at an average flow rate of 200 - 250 gpm from the bottom of the chlorinator up through an air-cooled heat exchanger (capacity 1,200,000 BTU/hr.) and back into the top of the chlorinator. Maximum batch chlorinator chlorine flow rate is 1500 lbs./hr. (pipe size and supply pressure limiting). At 510 BTU/lb. this rate of chlorine flow produces 765,000 BTU/hr. which can be safely removed by the heat exchanger. The maximum for the continuous chlorinators is 1700#/hr. which is equivalent to 865,000 BTU/hr.

Chlorination temperatures are measured at the following points:

1. In the center of the batch chlorinators.
2. At the overflow of the continuous chlorinators.
3. Just below the chlorine sparger in all chlorinators.
4. At the discharge of the batch chlorinator circulating pumps.
5. At the discharge of all of the air-cooled heat exchangers.

Point 1 is recorded on the 12-point recorder (6638). Point 2 is alarmed at 200°C. Point 3 alarms and shuts off the chlorine flow at 225°C. in the batch chlorinators, and alarms at 200°C. and shuts off chlorine flow at 205°C. in the continuous chlorinators. Point 4 is recorded on the 12-point recorder (6638). Point 5 is alarmed for low temperature (120°C.).

Each batch chlorinator is protected by a 8" - 20 lb. carbon rupture disc with a 3" discharge above the top operating level. Should a chlorinator rupture disc break any discharged liquids would be blown down through the grating onto anyone below. It is recommended that either:

1. Flooring be put on the level of the discharge piping from the chlorinators or
2. The discharge lines be directed away from the working area and a blown seal warning device (pressure) be installed.
3. The sizing of the rupture disc and discharge line be investigated. Unless the 8" disc broke up into small pieces it might be possible to clog the 3" discharge line with large pieces of carbon.

A. Chlorination (continued)

In addition to the rupture system, the batch chlorinators can be manually vented. All of the manual vents are tied into a central header system which is vented to #1 blow tank. This vent system is adequate.

Since several Sp. Gr. samples are required for control of the batch chlorination a fume collection system has been installed for all five sampling points as well as for the finished product drumming station. It is recommended that the fume removal system be extended to the continuous chlorinator area.

Each continuous chlorinator is protected by a 3" - 47 psig carbon rupture disc with a 3" discharge to the ground level. This system is adequate.

In addition to the rupture system, the continuous chlorinators can be manually vented. All of the manual vents (3") are tied into a central header system which is vented to the continuous blow tank. This system is adequate.

The chlorination system is well controlled. However, it is recommended that all temperature alarms and automatic cut-offs be checked at 6 month intervals.

Contamination of reactants with water and sulfuric acid will slow down if not completely stop the reaction. The same hazard exists here as it does when the chlorinators are short charged or not charged at all and chlorine flow continues. Because there is no means to detect chlorine in the off-gas (HCl), it is possible to chlorinate in the Brink demister or HCl transfer piping. When the heat from this exothermic reaction raises the temperature to 250°C., the chlorine will ignite the iron pipe. To detect the presence of chlorine in the off-gas header high temperature alarms (175°C. set pt.) are provided for each batch chlorinator & high temperature shut-downs set for 175°C. are also provided. A high temperature alarm set for 200°C. is installed in the continuous chlorinator off-gas header.

After use, samples from the continuous chlorinator system are fed by gravity into a sample surge which is continuously vented to the blow tank. This tank is also protected by a combination pressure/vacuum relief device (See App. IV). The tank is manually heated with 80# steam applied to an internal coil. Temperature and level are indicat in the field.

The HCl gas generated in the chlorinators passes through a shell and tube, water cooled heat exchanger and a brink demister for removal of entrained Aroclor prior to transfer to Dept. 218 and 217. The entrained material is collected in the off-gas storage tank. This tank is heated automatically by addition of 80# steam to external panel coils. Tank level, pressure, and temperature are indicated in the field. The tank is protected with a 3" - 27# carbon rupture disc The relief line discharges to the ground level. The tank may also be manually vented to the blow tank through a 3" line.

General Comments on Chlorination

1. Safe handling limits have been established and are observed.

2. There is no provision for disposing of reactants in an emergency.

3. All instruments fail safe.

B. Aeration

The Crude Aroclor is transferred from the batch chlorinators to #2 blow tank. This is a 2000 gal. steel tank with coils, an air sparger, and an 18" vent line. Here the Aroclor is air blown for 2 hours to remove any HCl remaining in the crude.

There are no controls on this tank. 200 lb. steam is used on the coils for the batch-made Aroclors 1248, 1254 and 1260. There is no danger of operating within the Aroclor flash points as long as this procedure is followed. It is possible, however, that the operator could drop the wrong batch from the chlorinator (i.e. one just charged). This would mean that essentially biphenyl was being heated with 200# steam (388° F = 200°C.). Since biphenyl flash point is 235°F., it is recommended that either:

1. A procedure be adopted to prevent dropping the wrong chlorinator.

2. #2 Blow tank be properly equipped to handle a flammable liquid.

Since there is no level recorder or controller on the tank, it is possible to overflow the tank and its hot contents on those below. It is recommended that:

1. A level recorder be put on #2 blow tank.

After air blowing, the contents of #2 blow tank are transferred to #1 blow tank where it is continuously fed to the distillation system. There is a level indicator but no steam pressure regulator on #1 blow tank. The contents of #1 blow tank can be fed through a spiral heat exchanger for heating prior to transfer to the stills. 200# is the heating medium. The preheater is protected on the product side by a 100# rupture disc which discharges into #1 blow tank. See App. IV.

Both the #1 and #2 blow tank vents (18") are tied into the drowning jet as well as to the atmosphere.

The crude Aroclor (1142) is transferred from the continuous chlorinators to the intermediate storage tank. This is a 15,000 gallon steel tank with external plate coils. Here the Aroclor is stored at 190°C. prior to being further processed. This tank is continuously vented (3") to the HCl drowning jet. There is also a 3" combination pressure/vacuum relief valve to protect the tank should the vent plug. Tank level is indicated both at the tank and on the control panel. A high level alarm sounds at 90% tank level. This system is adequate.

The crude Aroclor is aerated continuously as it is being fed to #3 still. The continuous blow tank is 1000 gallon steel vessel which is vented to the drowning jet. 5# air is provided by a positive displacement air blower through five 2" dip pipes. The venting system for the tank consists of two 4" lines tied into a 12" line to the drowning jet. Tank level is indicated and controlled in the field; however, high (90%) and low (10%) level alarms sound at the panel in the control room.

The city water booster pump which supplies water for the HCl drowning jet is alarmed at the control panel on shutdown to avoid HCl fume emissions.

C. Distillation

The straight take-over vacuum distillation is carried out in four still systems: #1 still (1100 gal. steel), #2 still (2200 gal. steel), #3 & #4 stills (2046 gal. steel). Normally #1, #2 and #4 stills are fed continuously from #1 blow tank and #3 still fed continuously from the continuous blow tank. However, due to piping flexibility any still can be fed from any desired blow tank. In any event the feed rate is controlled automatically to maintain a set level in the still pots. The contents of #1 & #2 still are circulated continuously through gas fired furnaces (one for each still). These furnaces are uninsulated and are in a position where personnel contact is possible. It is recommended that either 1. The still furnaces be insulated and properly guarded or 2. A warning sign be placed on the furnaces. Periodically the stills are charged with lime to neutralize residual HCl. Currently the lime is manually carried to #3 and #4 Stills on the second level (14'). It is recommended that an improved lime delivery method be used.

The contents of #3 and #4 stills are circulated continuously through therminol fired shell and tube heat exchangers (one for each still). The entire heating system is adequately insulated for personnel protection.

The therminol is heated in a gas fired furnace which is equipped with controls and interlocks specified by the CED Safety and Property Protection Section (See App IV).

Vacuum (30 - 50 mm Hg absolute) is mounted by six - 2 stage non-condensing steel Worthington ejectors. One jet is required for each still that is operating so there are two installed spares. Steam pressure is reduced to 160#, but the jets will take in excess of the maximum 200# available.

Each still pot & still receiver is equipped with a rupture disc and discharge line (See Appendix IV). In each case both the rupture disc and discharge line is properly sized and located. Each still is equipped with sufficient temperature measurement to insure safe operation. Overheating of the still contents causes formation of a tar-like substance, but presents no safety hazard.

The level in the #3 & #4 still pots is indicated both in the field and on the control panel. Normal control point is 50% full. One alarm sounds on low (10% and high (90%) level conditions.

C. Distillation (continued)

The level in #1 still is recorded on the control panel. At present there is no level indication, other than feed valve position, for #2 still. However, TSD Project 6928 - "Install level recorder on #2 Still" is scheduled for completion in early 1969. It is recommended that completion of this project be expedited.

The levels in #1 & #2 (1000 gal. each, monel) receivers are recorded on the control panel. These tanks are emptied batch-wise using a positive displacement pump.

The levels in #3 & #4 receivers (829 gal. each) are indicated in the field. An alarm sounds on high (90%) and low (10%) level conditions. Normal set point of 50% is controlled by continuous pump-out using a centrifugal pump & level control system.

Temperature in all four receivers is controlled by manual addition of 80# steam to internal coils. Steam heating is rarely needed except for Aroclor 1260 production.

A serious injury was incurred by a pipefitter in December, 1968 when removing the cap from the lime addition nozzle on #4 still pot. The accident resulted from pressure build-up on the still due to inadequate venting. It is recommended that all the actions resulting from the formal investigation (L-17-20-68) of this incident be completed as soon as possible on all four still systems.

The specific recommendations made in L-17-20-68 are:

1) Forward flow valves from the stills to the receivers should remain open at all times except when taking a still sample. A sign should be placed at the valve stating this.

2) The jets should be on while charging crude Aroclor and lime.

3) Change the one inch vent line on the still to a two inch line. Replace the vacuum indicator with a pressure/vacuum indicator. Keep vent valve open while removing the still cap.

4) Operating Instructions for the still charging procedure should be revised to specifically include the above recommendations. Operators should be retrained according to the revised instructions.

5) The design of the lime charging port should be evaluated for safe and easy operation.

6) Evaluate the adequacy of the grounding of the still.

D. Porocel Treating

The distilled Aroclor is transferred from the four still receivers to the absorption system. The major items of equipment in the four treating system include the following: #1 & #2 blend tanks (2000 gal. each, zinc & tin lined); #3 & #4 surge tanks (1045 gal. each, aluminum); #1, #2, #3 & #4 absorbers (3' diam. x 15' high, 316 SS) #1 & #2 finished product tanks (2000 gal. each, zinc & tin lined); #3 & #4 finished product tanks (1045 gal. each, aluminum); #1, #2 & #3 polishing filters (316 SS).

Levels in #1 & #2 blend tanks are indicated in the field. Since transfers are made into these vessels on a batch basis, this presents no problem. Temperature is controlled by addition of city water (manual) or 80# steam (automatic) to internal coils. The tank temperature is indicated in the field and recorded on the control panel. This system presents no hazard. Both these tanks are presently vented to the atmosphere.

Levels in #3 & #4 surge tanks are indicated in the field and on the control panel. Hi (90%) and Low (10%) level conditions are alarmed at the control panel. A level of 50% is normally maintained by balancing the absorber feed rate out of the surge tank against the still receiver input to the tank. Temperature is automatically controlled by addition of city water or 80# steam to internal coils. The tank temperature is indicated in the field and the temperature of absorber feed stream out of the tank is recorded on the control panel.

D. Porocel Treating (continued)

Both surge tanks are normally closed and nitrogen blanketed. Tank pressure is controlled between +4" W.C. and +7" W.C. by self contained pressure control valves. In the event the pressure control system fails, the tank is protected by a 2" combination varec pressure/vacuum relief device set for 6 oz. pressure and 1/2 oz. vacuum (See App. IV). Both these pressure control systems are adequately sized.

The four absorbers are packed with 5400# of Porocel (See Section I) The distilled Aroclor is fed by a centrifugal pump through a flow controller down through the porocel bed. The absorber is protected from overpressurization by a 2" - 10#/ rupture disc. The relief line discharges at ground level. Temperature in the absorber is automatically controlled by addition of 80# steam to tracers on the outer wall of the vessel. Absorber temperature is indicated in the field.

Aroclor leaving the absorbers passes through the polishing filters for removal of any porocel particles going forward from the absorber. Pressure on these filters is indicated in the field, however, there is no pressure relief system. Since (1) the filters are designed to hold 100#, (2) the filters are only sparingly traced with 80# steam, and (3) maximum pump pressure on the filters is 80# (normal 15#), it is felt that no pressure relief system is required.

After passing through the polishing filters the finished Aroclor enters the finished product tanks. Material is normally stored in these tanks at 100°C. by manual addition of 80# steam to internal coils. Temperature of #1 & #2 finished product tanks is recorded on the control panel; that of #3 & #4 finished product tanks is indicated in the field.

Level in #1 & #2 finished product tanks is measured by sticking the tank as these tanks are vented to the atmosphere. Approved TS Project 6939 - "Install Level Measurement on Product Tanks" propos continuous field indication of these tank levels. Due to the batc wise operation of these tanks, field indication is sufficient. In the interest of improved operations, potential product quality improvement, and reduced operator contact with Aroclor fumes, it is recommended that completion of this project be expedited.

Level in #3 & #4 finished product tanks is indicated in the field and on the control panel. An alarm will sound when a high (90%) level occurs. Normally, these two tanks are closed and Nitrogen blanketed. The pressure control and relief systems for these tanks is identical to those explained previously for #3 & #4 surge tanks.

In the interest of improved operations, potential product quality improvement, and reduced operator contact with Aroclor fumes, it is recommended that a project be developed to nitrogen blanket #1 & #2 blend and finished product tanks similar to the systems now in effect on #3 & #4 surge and finished product tanks.

General Comments on the Process

1. Accidental contamination of reactants will not form undesirable side products.

2. Process piping and controls are installed so as to prevent improper mixing of chemicals.

3. Sewering of materials would result in no hazards. If biphenyl, xylene, or glycidyl phenyl ether is sewered precautions must be taken to prevent ignition of the flammable liquids.

4. Department guarding conforms to the Illinois Health and Safety Code.

5. Ventilation is adequate to avoid exposure to toxic materials during all routine operations.

6. Lighting in the batch chlorinator area is below standard. It is recommended that completion of approved TSD Project 5377 - "Upgrade Lighting System in Dept. 246" be expedited.

III. Finished Goods

A. Blending and Finished Product Handling

Aroclors are produced in a variety of grades and blends for use in capacitors, transformers, heat transfer fluids and plasticizers. See Appendix II for a complete list of the Aroclors produced and their blends.

After the Aroclor has been porocel treated in the absorbers and transferred to the finished product tanks, it is transferred to an appropriate storage tank.

Aroclor vapors are toxic in high concentrations as well as irritating to the upper respiratory tract. Workers should not be exposed to vapor levels throughout their work shift in excess of the threshold limit value (TLV) of 1 mg/M^3 of air (or about 0.1 ppm). The material can absorb through the intact skin and on repeated contact can remove the natural oils from the skin and cause irritation and/or dermatitis. Skin or eye contact should be avoided.

1. Aroclor for Sales

Aroclor that is to be sold without an additive is normally stored as follows:

a. Aroclor 1242 - tanks #9 and 11 (20,000 gal. each), #14 and #15 (22,000 gal. each).

b. Aroclor 1248 - Storage tanks #7 & #10 (20,000 gal. each).

c. Aroclor 1254 - Storage tanks #12 & #13 (22,000 gal. each).

d. Aroclor 1260 - Storage tank #16 (22,000 gal.).

A. Blending and Finished Product Handling (continued)

All storage tanks are equipped with the proper breather or conservation vents. Storage temperatures (100°C.) are not such that grounding or flame arrestors be required.

2. Pyranols

Pyranols are used mostly in transformer applications and are made by blending Aroclors with chlorinated benzenes and other additives. These materials are mixed in #2 mix tank (14,500 gal.) and #3 mix tank (17,000 gal.) and then transferred to finished product containers. This system is adequately protected.

Three Pyranols - Inerteen PPO, 54201 CM, and 54201 KA - use 0.20% Glycidyl Phenyl Ether as an additive. This material has a flash point of 175° F. (80°C.). It is added to the Aroclor - Trichlorobenzene mix through the suction side of the circulating pump after laboratory analysis is completed. Storage temperature of the contents in #2 mix tank is between 90 and 100°C. This is above the flash point of the Glycidyl Phenyl Ether but may not be above flash point of the mix. It is recommended that a sample of Inerteen PPO, 54201 CM and 54201 KA be taken after the Ether has been added and a flash point determined. If storage temperatures are within 15C° of the flash point either:

1. The tank must be properly equipped to handle a flammable liquid or
2. The storage temperature must be lowered.

These materials are circulated through an 18" filter before transferring to the finished product containers. This filter is not protected with a rupture disc or relief system. It is recommended that an appropriate relief system be installed on the filter.

3. Pydrauls

Pydrauls are used mostly as heat transfer mediums. They are made by blending various Aroclor grades with additives. They are mixed in #1 blend tank and stored under proper conditions.

4. Aroclor 1254 and 10% Xylene Mix

Xylene has a flash point of 85 - 100°F. which classified it very definitely as a flammable liquid. This mix is made in #1 blend tank. The xylene is stored in drums and unloaded by use of a dip pipe put into the drums. The drums are grounded but not adequately. It is recommended that this grounding system be checked and a proper one installed.

During preparation of a xylene mix smoking is permitted only in the control room and Foreman's office and signs are put up in the department to that effect. Electrical cigarette lighters are removed from their receptacles. #1 still is allowed to run as usual by permission of the fire insurance inspector but #2 still furnace is shut off and kept off until the batch is complete, any spills cleaned up, the tank closed off and a gas test of the area made. These provisions are a must.

III. Finished Goods (continued)

It is recommended that:

1. The flash point of the Aroclor 1254 and Xylene mix be determined.
2. Storage temperature be kept as low as possible.
3. Evaluate need for vent and flame arrestor on #1 Blend Tank.
4. The tank be grounded.
5. Ground the Xylene drumming facilities and further alter to adhere to Monsanto safety specifications for handling flammable liquids.

5. By-product HCl

a. Synonyms: Muriatic acid, Chlorohydric Acid, Hydrogen Chloride.
b. Description: Colorless gas
c. Formula: HCl
d. Toxic Hazard Rating:
   Acute local: Irritant 3; Ingestion 3, Inhalation 3
   Acute Systemic: U
   Chronic local: Irritant 2
   Chronic Systemic: U
e. M.A.C.: 5 ppm in air for 8 hr. day
f. Toxicology: Hydrogen chloride is an irritant to the mucous membranes of the eyes and respiratory tract. Concentration of 35 ppm causes irritation of the throat after short exposure. Concentrations of 50 to 100 ppm are tolerable for 1 hour. More serious exposures result in pulmonary edema and often laryngeal spasm. Concentrations of 1000 to 2000 ppm are dangerous even for brief exposures. Mists of HCl are considered less harmful than the anhydrous form since the droplets have no dehydrating effect.

This by-product containing a small amount of hydrogen is collected in a common header and flows to the central HCl absorption unit for the production of Muriatic Acid in Dept. 218 of Chlorosulfonic Acid in Dept. 217. If Dept. 218 or 217 is unable to use all the off-gas, it may be sewered in the Aroclor department after drowning it with water in a drowning jet. The removal of HCl from the off-gas concentrates the original quantity of hydrogen and air to a point within the explosive limits. Therefore, it is recommended that a sufficient quantity of steam be introduced into the scrubber stock to snuff out any fire which could conceivably occur at the outlet.

B. Loading Facilities

All loading facilities are adequate with the exception of the tank truck loading dock. It is recommended that an adjustable loading ramp be installed to compensate for varying trailer sizes. Approved TSD Project 7004 "Alter Truck Loading Dock" encompasses this recommendation.

IV. Safety Equipment

Stretcher Case on Pole 50 Ft. S.E. of Dept. 254.

A. 1st Floor

Fire Extinguishers
1. Dry Chemical - North of Sprinkler House
2. Carbon Dioxide snow - West wall at lean-to door.

Shower Location
1. Southeast Corner by Water Tank
2. New Area
3. Tank Farm (Alarm on Control Panel)

1. Eye Bath SE corner by water tank
2. Eye Bath New Area
3. Eye Bath Tank Farm

Gas Mask
1. North wall of sprinkler house
2. Outside on west side of repair room.

Scott Air Pak - Outside on west wall of lean-to.

B. 2nd Floor

Fire Extinguishers
1. Dry Chemical - West wall at head of stairs.
2. Dry Chemical - West wall at head of stairs.

Shower Location
1. Southeast Corner in old area.
2. New Area

1. Eye Bath
2. Eye Bath New Area

Eye Bath - Control Room

Gas Masks
1. Control Room
2. S.W. Corner Head of Stairs

Emergency Clothing - West Wall

C. Mezzanine Floor at #1 & #2 Still Furnaces

Safety Shower
Eye Bath

D. 3rd Floor
1. Safety Shower Old Area
2. Safety Shower New Area

1. Eye Bath Old Area
2. Eye Bath New Area

E. General Comments on Safety Equipment and Operations.

1. Sufficient instructions are available to cover shutdown during an emergency situation (steam failure, power failure, water failure, plant disaster). Date of last review - April 1956. It is recommended that more specific procedures be written to cover shutdown during the preparation of a xylene blend.

2. It is possible to trap personnel on the north side if the south and middle part of the department is contaminated. It is recommended that the installation of an emergency exit on the north side of the department be considered.

3. There are no emergency lighting facilities. It is recommended that equipment for emergency lighting be provided.

APPENDIX I

Definitions

A) Flash Point

The lowest temperature at which a flammable liquid will give off a flammable vapor which will burn momentarily. Fire protection standards recognize the "closed up (c.c.)" flash point. This is determined by testing the material in a closed cup. This test reveals the lowest temperature at which sufficient vapors escape at the surface of the material to flash when an ignition source is applied. This flash point temperature is the lowest temperature at which a stable explosive mixture of the material vapor and air can exist, and is the lower explosive limit expressed as temperature.

Many manufacturers, trade publications and the Interstate Commerce Commission recognize the "open cup (o.c.)" flash point. This is determined by testing the material in an open cup. Because some vapor escapes during the test and because the vapor above the liquid is usually cooler than when the closed cup test is made, the "open cup" test is as much as fifty or more degrees higher than the closed cup figure.

For this reason most of the flash points listed in this audit are by the "closed cup" method. We consider a liquid as flammable when the flash point is 140°F. or lower by the tag closed cup method (American Standards for testing materials or A.S.T.M. D56-56). Materials having flash points above 140° F. should be treated as flammable liquids if they are stored, handled or processed within a temperature range starting at 15°F. below their flash point and extending to above the auto ignition temperature.

B) Ignition Temperature (Fire Point)

The minimum temperature at which ignition will occur by application of flame or spark and burning will continue without further heating or application of flame.

C) Auto Ignition Temperature

The minimum temperature at which the substance will ignite spontaneously upon heating. The degree of danger is determined largely by the flash point of the liquid, the concentration of vapors in the air (whether the vapor-air mixture is in the explosive range or not) and the possibility of a source of ignition at or above a temperature sufficient to cause the mixture to burst into flame.

D) References

1) Factory Insurance Association:
Safeguarding flammable liquids (1953).

D) References (continued)

2) National Safety Council: Accident Prevention Manual for Industrial operations. (1955).

3) National Fire Protection Association: Standards of the National Board of Fire Underwriters for Storage, Handling and use of Flammable liquids. (Bulletin #30, 1958).

4) Commission of Illinois Publication: Rules and Regulations relating to labeling in the use, Handling and Storage of Substances Harmful to the Health and Safety of Employees. (June 1951).

5) Section VIII of the W.G.K. Design and Construction Manual - Safety Guidelines by T. H. Becker, 1958 and 1959.

E) Flammable Liquid Handling Precautions

1) Flame arrestor on tank vents.

2) Proper tank grounding per Std. E.2.

3) Dip pipe in loading line per D.3.2 Std. 31.

4) Flammable tanks indicated by signs "Flammable".

5) Inerting of the Tank.

Finished Products

Product	Code	Composition	Flash Point	Boiling Point (760 mm)	1. N.I.Sax - Dangerous Properties of Industrial Products. 2. T.H.Becker - W.G.K. Plant Flammable Hazardous Materials.
Aroclors					
1132-1232	811.15	Chlorinated Biphenyl 32% Chlorine			Slight fire hazard when exposed to heat or flame. Can become dangerous when heated to decomposition. Aroclors can emit highly toxic fumes. No problem operating temperatures.
1142-1242	811.01	Chlorinated Biphenyl 42% chlorine	350°F. c.c.	325°C.	"
1148-1248	811.02	Chlorinated Biphenyl - 48% Chlorine	382°F. c.c.	345	"
1154-1254	811.03	Chlorinated Biphenyl - 54% Chlorine	None	365°C.	"
1160-1260	811.05	Chlorinated Biphenyl - 60% Chlorine	None	385°C.	"
1162-1262	811.07	Chlorinated Biphenyl - 62% Chlorine	None	390°C.	
Inerteen PPO (1260 PPO)	810.92	60% Aroclor 1260 plus 40% Trichlorobenzene plus 0.20% Glycidyl phenyl Ether (PPO)	Flash Pt. of TCB is	--	Slight fire hazard when exposed to heat or flame. Vapors of Glydicdyl phenyl ether should not be inhaled above 60°C. No problem at operating temperatures.
54201 KA (1254 PPO)	810.98	70% Aroclor 1254, 30% Trichloro-benzene and .20% Glycidyl phenyl ether.	"	--	Same as above
54201 CM (1242 PPO)	811.10	100% Aroclor 1242 and 0.20% Glycidyl phenyl ether.			

Finished Products

Product	Code	Composition	Flash Point	Boiling Point (760 mm)	REMARKS
1254 + 10% Xylene	811.12	90% Aroclor 1254 and 10% Xylene	Flash Pt of Mix 123°F of Xylene is 85 to 100° F.	--	Fire and Explosion Hazard when exposed to heat or flame due to presence of Xylene.
Pyranol A1383B	810.97	45% Aroclor 1260 plus 55% tri-tetra chlorobenzene and 0.125% Unox Epoxide.	--	--	Fire and explosion hazard when exposed to heat or flame. Should avoid prolonged breathing of fumes. No problem at operating temperatures.
Pydraul A-200	810.96	33-1/3% Aroclor 1242, 66-2/3% Aroclor 1248 plus minor amounts of Santolube 70. Lubrizol 1360, DCF, A20-Oil Black dye and blue A dye.	Flash	--	Slight fire hazard when exposed to heat or flame. Can become dangerous when heated to decomposition as it will then emit highly toxic fumes. No problems at temperature handled in the dept.
Pydraul 280	811.19	Aroclor 1260, Aroclor 1248 plus 21.8% Tricresyl phosphate and minor amounts of Santolube 70 (.40%) DCF and Blue A dye.	Flash Pt. of Aroclor 1248 is 382°F.	--	Same as above.
Santicizer 794	811.04	50% Aroclor 1248 and 50% Aroclor 1260.	Flash Pt. of Aroclor 1248 is 382°F.	--	Same as above. No problem at operating temperatures.
Montars	828.68	Still bottoms from Aroclor Process.	--	--	These materials are extremely hot and must be handled carefully. Fumes must not be inhaled. Present drum area is enclosed and should be adequate. Fume respirator should be worn.

Equip. Number (Item Number)	Service	Size	Capacity Gallons	Jacket Relief	Breather Vent	Flame Arrestor	Relief or Rupture Disc	Grounded
21-2210 (102)	Biphenyl Feed Tank	10'6" x 40'6"	25,000	Coils No jacket	2"	No	None	No
21-0767 (103)	Biphenyl	4'6" x	700	Yes	1½" Vented to Biphenyl Stg. Tk.			
21-3261 (105)	Chlorinator #1	3' x 16'	850	Jacket over lower half of tank. 90# set on relief valve	2" Valved line headed with the chlor. to #1 blow tank.	No	Rupture Disc @ 20# - 3" line OK	No
21-3245 (106)	Chlorinator #2	3' x 16'	850	"	"	No	"	No
21-3251 (107)	Chlorinator #3	3' x 16'	850	"	"	No	"	No
21-1283 (108)	Chlorinator #4	3' x 16'	850	"	"	No	"	No
21-1432 (109)	Chlorinator #5	3' x 16'	850	"	"	No	"	No
38-5487 (116) (In parallel with new Vapor. Item #590).	Chlorine Vaporizer	8'-5/8" x 11'		When internal pressure = 50# steam auto. shut off.	No	No	No	No
21-2086 (126)	Blow Tank #2	7' x 7'	2,000	Coils - no Jacket	18" vent line to handle air blowing.	No	No	No

Equip. Number (Item Number)	Service	Size	Capacity Gal.	Jacket Relief	Breather Vent	Flame Arrestor	Relief or Rupture Disc	Grounded
20-0043 (130)	Still #1	6' x 5'6"	1100	No Jacket	No - Vacuum	No	30# Rupture Disc & 4" Line	No
27-0045 (131)	Furnace #1	3/16" x 3'9" x 4'10½"	600,000 BTU	"	6" Vent Stack to roof	No	No	No
20-0062 (133)	Still #2	6' x 11'10"	2200 Gal.	"	No	No	30# Rupture Disc & 4" Line	No
38-0770 (136)	Condenser #1	12" D x 5'		No	No	No	No	No
38-1378 (137)	Condenser #2	12" D x 5'		No	No	No	No	No
21-0771 (138)	Receiver #1	5'6" x 5'6"	1000	No Jacket	No	No	No	No
21-1377 (139)	Receiver #2	5'6" x 5'6"	1000	"	"	"	"	"
21-0779 (142)	Blend Tnk. #1	7' x 7'	2000	No Jacket	2" line around Bldg. dischg. 2 ft. from ground.	No	No	No
21-1399 (143)	Blend Tnk. #2	7' x 7'	2000	"	2" thru lean-to tees into #1 vent.	No	No	No
15-0238 (145)	Sparkler Filter	38"	--	Yes	No	No	No	No
21-0780 (146)	Fin. Prod. Tank #1	7' x 7'	2000		2" (manifold dischg. above control room)			
21-1400 (147)	Fin. Prod. Tank #2	7' x 7'	2000		2" conservation vent			

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Equip. Number (Item Number)	Service	Size	Capacity Gallons	Jacket Relief	Breather Vent	Flame Arrestor	Relief or Rupture Disc	Grounded
21-1310 (152)	Stg. Tank #5 TCB	10' x 26'	15,000	No	2 oz.	No	No	No
21-3526 (154)	#3 Mix Tk. Pyranol	12'6" x 22'	20,000	No	3" Traced & Insulated	"	"	"
21-2404 (156)	Stg. Tank #7 1248	13' x 20'	20,000	No	2" Vent	"	"	"
21-0750 (167)	Blow Tank #1	7' x 7'	2000	No	18" Vent	"	"	"
21-0321 (159)	#1 Mix Pydraul	14' x 10'	12500	No	2" Vent	No	"	"
21-2621 (164)	#2 Mix	10'6" x 23'	14580	No	3" traced	"	"	"
21-1396 (186)(185)	#2) Catch	4'6" x 5'6"	--	No	No	"	"	"
21-0756	#1) Pots	4'6" x 5'6"	--	No	"	"	"	"
38-5328 & 38-5564 - 67	Air Cooled Heat Exchanger	1.2 M BTU						
21-0848 (162)	Stg.Tank #6 TCB/TTCB	8'x25'6"	9,500	No	1½" - 3 ft. From Ground Level	No	No	No
21-4084 (117)	Stg.Tank #9 1242	12'6"x 22'	20,000	No	3" Conserv. Vent ± ½ oz.	No	No	No
21-4085 (118)	#10 1248	"	20,000	No	"	No	No	No
21-4086 (119)	#11 1242	"	20,000	No	3" Conserv. Vent ± ½ oz.	No	No	No

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Equip. Number (Item Number)	Service	Size	Capacity Gallons	Jacket Relief	Breather Vent	Flame Arrestor	Relief or Rupture Disc	Grounded
21-5229 (401)	Biphenyl Stg.Tank	25' x 30'	110,000	Coil 40# Set	Yes. 6" Steam Jacketed.	6" Steam Jacketed Vent with flame arrestors.	"Protectoseal Relief Cover on manway.	2 Grounds - north & south sides.
21-5230 (403)	Biphenyl Mix Tank	5'6" x 6'9"	1,272	Coil	Yes. 4" Steam Jacketed	Yes. Jacketed 50# set on F.A.Jacket.	No	No
21-5232 (406)	#6 Chlor-inator	4' x 20'	1,750	Shell Traced No Jacket	No. (Vented to off gas system)	No	3" Rupture Disc - 47 lbs	No
38-5888 (408)	#6 Chlor. Cooler	--	--	No	No	No	No	No
21-5233 (410)	#7 Chlor. Cooler	4' x 20'	1,750	Shell Traced No Jacket	No (Vented to off gas system)	No	3" Rupture Disc - 47 lbs	No
38-5889 (412)	#7 Chlor. Cooler	--	--	No	No	No	No	No
21-5234 (414)	#8 Chlor.	4' x 20'	1,750	Shell Traced No Jacket	No (Vented to off gas system)	No	3" Rupture Disc - 47 lbs	No
38-5890 (416)	#8 Chlor. Cooler	--	--	No	No	No	No	No
21-5235 (418)	#9 Chlor.	4' x 20'	1,750	Shell Traced No Jacket	No (Vented To off gas system)	No	3" Rupture Disc - 47 Lbs	No
38-5891 (420)	#9 Chlor. Cooler	--	--	No	No	No	No	No

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Equip. Number (Item Number)	Service	Size	Capacity Gallons	Jacket Relief	Breather Vent	Flame Arrestor	Relief or Rupture Disc	Grounded
21-5236 (422)	Blow Tank	4' x 10'	1,000	No	Vented to Drowning Jet	No	No	No
21-5237 (424)	Intermed. Stg.Tk.	11' x 22'	15,000	Coils	3" Vac-Press 6 oz. closes 4 oz. opens	No	No (Vented to Blow Tk.)	One - on East Side.
38-5892 (427)	Off Gas Condenser	20" x	--	No	No	No	No	No
21-5238 (429)	Off Gas Stg.Tank	7'6" x 8'9"	3,080	No	No	No	3" Rupture Disc 34# Burst.	No
21-5269 (435)	Sample Surge Tank	3'6" x 4'3"	325	No	2" Vac-Press 6 oz. press 4 oz. Vac.	No	No	No
21-5239 (502)	#3 Still Pot	78" x 93"	2,046	No	No	No	3" Rupture Disc - 20# Burst.	No
38-5893 (504)	#3 Still Heat Exch.	--	--	No	--	--	--	No
38-5895 (506)	#3 Still Vapor Cond.	--	--	No	No	No	Relief Valve 125# Press.	No
21-5241 (508)	#3 Receiver Tank	5'x5'3"	829	Coil	No	No	3" Rupture Disc. 104# Burst.	No
21-5240 (511)	#4 Still Pot	78" x 93"	2,046	No	No	No	3" Rupture Disc 20# Burst.	No
38-5896 (513)	#4 Still Condenser	--	--	No	No	No	Relief Valve 125# Press.	No

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Equip. Number (Item Number)	Service	Size	Capacity Gallons	Jacket Relief	Breather Vent	Flame Arrestor	Relief or Rupture Disc	Grounded
21-5242 (515)	#4 Still Rec. Tank	5' x 5'3"	829	Coil	No	No	3" Rupture Disc. 104# Burst.	No
21-5257 (523)	#3 Catch Pot	3'6"x4'3"	325	No	No	No	No	No
21-5258 (524)	#4 Catch Pot	3'6"x4'3"	325	No	No	No	No	No
38-5894 (526)	#4 Still Heat Exch.	--	--	No	No	No	No	No
21-5259 (530)	#3 Surge Tank	5'x6'9"	1,045	Coil	2" press-Vac relief 6 oz. - 1/2 oz. N_2 Blanket.	No	No	No
21-5243 (532)	#1 Absorber	36"x15'	(Packed 5900 lbs. of Porocel)	Shell Packed	No	No	2" Rupture disc, 140 lbs. burst.	No
21-5261 (534)	#3 Finished Product Tk.	5'x6'9"	1,045	Coil	2" press-vac. relief 6 oz. - 1/2 oz. N_2 Blanket	No - oz.	No	No
21-5260 (537)	#4 Surge Tk.	5'x6'9"	1,045	Coil	2" Press-Vac. Relief 6 oz. 1/2 oz. N_2 Blanket.	No	No	No
21-5244 (539)	#2 Absorber	36"x15'	(Packed with 5900 lbs. of Porocel)	Shell Traced	No	No	2" Rupture disc. 140# burst.	No

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Dept. 246 (1800 Expansion)

Equip. Number (Item Number)	Service	Size	Capacity Gallons	Jacket Relief	Breather Vent	Flame Arrestor	Relief or Rupture Disc	Grounded
21-5245 (540)	#3 Absorber	36" x 15'	(Packed with 5900 lbs. of Porocel)	Shell Traced	No	No	2" Rupture disc. 140# burst.	No
21-5247 (542)	#4 Finished Product Tk.	5'x6'9"	1,045	Coil	2" Press-Vac. Relief. 6 oz. - 1/2 oz. N_2 Blanket	No	No	No
21-5246 (545)	#4 Absorber	36"x15'	(Packed with 5900# of Porocel)	Shell Traced	No	No	2" Rupture disc - 140# burst.	No
21-5248 (558)	#14 Finished Product Stg. Tank	12'6"x24'	22,000	Coil	3" Press-Vac. 6 oz. 1/2 oz. N_2 Blanket.	No	No	2 - North & South Side.
21-5249 (559)	#15 Finished Product Stg. Tank.	12'6"x24'	22,000	"	"	"	"	"
21-5250 (560)	#12 Finished Product Stg. Tank	12'6"x24'	22,000	"	"	"	"	"
21-5251 (561)	#16 Finished Product Stg. Tank	12'6"x24'	22,000	"	"	"	"	"
21-5252 (562)	#13 Finished Product Stg. Tank	12'6"x24'	22,000	"	"	"	"	"
38-5897 (585)	Therminol Heater	6'4"x36'6"	--	No	No	No	No	No

MONS 046686

Dept. 246 (1800 Expansion)

Equip. Number (Item Number)	Service	Size	Capacity Gallons	Jacket Relief	Breather Vent	Flame Arrestor	Relief or Rupture Disc	Grounded
21-5253 (586)	Therminol Surge Tank	60"x72"	950	Coil	Yes	No	No	No
15-0733 (590) (Installed in parallel with existing unit Item #115)	Mist Eliminator for Cl_2	20"x6'3"	--	No	No	No	No	No

MONS 046687

APPENDIX IV

Dept. 246 - Safety Devices

Relief Valve, Rupture Disc. and Interlocks

4 Continuous Chlorinators	3" Rupture Disc. 47 lbs. Bursting Pressure. 51-13594
	Chlorinators 6-9 Rupture Disc discharge at ground level directly south of Blow Tank.
	Chlorinators 6-9 has a chlorine valve interlocked to both pump and high temperature at Sparger (205°C.)
$FeCl_3$ Mix Tank Item 403	Jacketed Flame Arrestor. This contains a Relief 1/2" valve to (Steam) Jacket. Discharges at 50 psig. 7-83332
Intermediate Storage (Item 424)	3" Combination vacuum-pressure vent pressure of 60% closes. Vacuum of 40% open. 5-16922
4-Continuous Chlorinator Fans Items 408, 412, 416, 420	These are interlocked to temperature. Will not start unless 120°C. in chlorinator.
Off Gas Stg. Tk. (Item 429)	3" Rupture disc 27# bursting pressure 51-13595.
Sample Surge Tk. (Item 435)	2" Combination pressure vacuum relief valve 6 oz. pressure, 4 oz. vacuum 5-16841.
Bi∅ Stg. Tk. (Item 401)	1" pressure relief valve. Set at 40# located in 80# steam line to tracers.
	24" "Protectoseal" relief cover on manway.
	6" Jacketed flame arrestor. Steam to jacket reduced to 18 PSIG.

Dept. 246 - Safety Devices

Relief valve, Rupture Disc and Interlocks

#3 & #4 Still Pots Items 502 & 511	3" Rupture Disc. 20 lbs. Bursting Pressure 51-13593 Still #3 discharges So. of Still Ground Level. Still #4 discharges No. of Still Ground Level.
#3 & 4 Condensers Items 506 & 513	1/2" Relief Valve 125# Relief Pressure 7-83333
#3 & 4 Receivers Items 508 & 515	(1) 3" Rupture Disc 104# Bursting Pressure 51-13591 (2) An electrically operated Solenoid valve is interlocked in this system. Pump failure will activate the solenoid to close the auto. valve in the forward flow line. The solenoid is also activated when the receiver reaches a low level. Low level is 20%. Both receivers discharge at the same respective locations as #3 & #4 Stills.
#3 & 4 Surge Tanks Items 530 & 537	2" Combination Relief Device 6 oz. pressure - 1/2 oz. vacuum
#3 & 4 Finished Product Tanks Items 534 & 542	2" Combination Relief device. 6 oz. pressure - 1/2 oz. vacuum
#12, 13, 14, 15 & 16 Finished Product Storage Tanks Items 560, 562, 558, 558 & 561	3" Combination Relief Device 6 oz. pressure - 1/2 oz. vacuum
#1, 2, 3 & 4 Absorbers Items 532, 539, 540 & 545	2" Rupture Disc 104# Bursting Pressure 51-13592 All absorbers discharge at ground level directly below absorbers.
Therminol Furnace Heater Item 585	(1) Pump failure, low therminol flow, (200 GPM). (2) Less than 10# gas pressure, & more than 30# gas pressure. Both shut down the system. (3) The furnace has a purple peeper to watch the pilot flame. (4) A timer is used to keep furnace at the low fire setting for 10 minute before the high fire setting can b activated. (auto valve 1/3 open). (5) A purge system is in this furnace. The pilot can not be ignited until 5 min. purge has been completed.
Therminol surge tank Item 586	

7/1/68

DEPT. 246 - SAFETY DEVICES
RELIEF VALVES, RUPTURE DISCS, AND INTERLOCKS

Item	Equipment Location	Description
1.	5 chlorinators items 105 thru 109	Rupture disc, carbon, 8 inch, 20 PSIG bursting pressure @ 70°F. Storeroom code 51-13466.
		#1, 2, 3 and 4 chlorinator rupture disc discharges are 3" and discharge on top level.
		#5 chlorinator rupture disc discharge in 3" and discharges on 1st level, 14" above floor.
2.	5 chlorinator jackets items 105 thru 109	80# steam, no regulator. Pressure relief valve set for 90#. Storeroom code 04-31632.
3.	#1 still item 130	Rupture disc with vacuum support 8 inch, monel, bursting pressure 31 PSIG @ 72°F. Storeroom code 51-1346
		Rupture disc discharge is 6", and is directed West above roof of lean-to, 4th level.
4.	#2 still item 133	Rupture disc with vacuum support, 8", monel, bursting pressure 31 PSIG @ 72°F. Storeroom code 51-13465.
		Rupture disc discharge is 4" and is directed east above roof of control room, 3rd level.
5.	Chlorine Vaporizer Item 116	Consolidated bronze safety valve type 1471 (1" NPT scrwd.) East end, top of vaporizer, pressure relief on Cl_2 side set for 50 PSI.
6.	Chlorine Vaporizer Item 116	Rupture disc burst @ 50 PSI 100°F Model 1A. Storeroom Code 51-13416.
7.	Chlorine Vaporizer Item 116	East end, bottom of vaporizer, mercoid pressure switch set at 40 PSI, (shut turn off steam is behind S.E. panel board in control room.
8.	Sparkler press 36" Item 145	Jacket tested for 100 PSI. 80# steam regulated to 20#. Storeroom code for pressure relief valve - 04-31632.

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Item	Equipment Location	Description
9.	Biphenyl Head Tank Jacket Item 103	Jacket tested for 105# hydrostatic pressure. Using 80# steam regulated to 40#. Storeroom code for pressure relief valve 04-31632.
10.	Biphenyl storage Item 102	High temperature alarm read from 12 point recorder 29-6638.
11.	Preheater for stills	Designed for 220 PSI, tested for 330 PSI. 2" carbon rupture disc, set for 100 PSI @ 350°F. (Not a Special Order.) Spared in Dept. Stocked locally.
12.	5 Chlorinators Item 105 thru 109	There are 2 alarms and 2 interlocks on each chlorinator: (1) A high temperature thermocouple is in the HCl line on top of each chlorinator. Alarm is set at 160°C.
13.	5 Chlorinators Item 105 thru 109.	Chlorine cut-off point is 175°C. (2) A high temperature interlock (chlorine shutdown) and alarm are activated at 225°C. The temperature is sensed at the bottom of the chlorinator near the chlorine sparger, and is indicated on individual panel board indicators.

DEPT. 246 SAFETY DEVICE INSPECTION METHOD & FREQUENCY

RELIEF VALVES, RUPTURE DISCS, AND INTERLOCKS

Item	Description	Frequency*	Method
1.	#1 thru #5 Chlorinator rupture discs	12 months	Inspect discharge line thru cross
2.	#1 thru #5 chlorinator jacket relief valves	12 months	Replace
3.	#1 still rupture disc	12 months	Replace
4.	#2 still rupture disc	12 months	Replace
5.	Chlorine vaporizer rupture disc	12 months	Replace if necessary
6.	Chlorine vaporizer relief valve	12 months	Replace
7.	Chlorine vaporizer Mercoid pressure switch	12 months	Manual check
8.	36" press jacket relief valve	12 months	Replace
9.	Biphenyl head tank jacket relief valve	12 months	Manual check
10.	Biphenyl storage tank high temperature alarm	6 months	manual check
11.	Preheater rupture disc	12 months	Replace if necessary
12.	#1 thru #5 chlorinator high temperature off gas alarm	6 months	Manual check
13.	#1 thru #5 chlorinator high temperature off gas shutdown	6 months	Manual check

*In addition to visual inspection during monthly hazard inspection.

APPENDIX V

Dept. 246 - Grounding List

Location of Grounds on New Expansion.

On Steel Structure: (All on ground level)	Located at South Side @ 1st, 3rd, 5th Vertical Support. North Side @ 2nd, 4th, 6th Vertical Support.
Nitrogen Storage:	One ground located East side on the North Support.
Biphenyl Storage (Vertical):	Two grounds one on North side - Other on South side.
Tank Farm:	
#9 Tank:	None (Grounded thru Bolts in Concrete)
#10 Tank:	None (")
#11 Tank:	None (")
#12 Tank:	Two Grounds Located at North Side & South Side
#13 Tank:	Two Grounds Located at North Side & South Side
#14 Tank:	Two Grounds Located at North Side & South Side
#15 Tank:	Two Grounds Located at North Side & South Side
#16 Tank:	Two Grounds Located at North Side & South Side
Intermediate Storage:	One Ground Located at West Side
New Office & MCC:	Two Grounds, Located 1 Foot Under Ground Level, at Foundation.
Loading Dock #5:	One Ground Located Northwest Support.
Loading Dock #6:	One Ground Located Northeast Support.

Sauget, Illinois

January 28, 1970

CC: Messrs.
G. L. Bratsch
R. M. Blowers
T. W. Dalton
D. W. Jackson
W. A. Kuhn - G.O.
J. J. Luecken
C. B. Williams

1970 AROCLOR GROUP OBJECTIVES

I. SAFETY

A. Objectives

1. No serious injuries for Dept. 246 and maintenance personnel in 246 area.
2. No disabling injuries for Dept. 246 and maintenance personnel in 246 area.
3. 0.75 minor injuries per man per year for Dept. 246 personnel.
4. Three minor injuries per year for all maintenance personnel while in Dept. 246.

B. Actions

	EDC	Responsibility
1. Evaluate need for sight glasses where they exist in preparation for plant wide change to Pres-Sure glasses.	4/1	TSD/Prod.
2. Supply department data to comply with WGK Procedure L-40.	4/1	Production
3. Use safety device and interlock system inspection frequency developed for department.	Con-tin uing	Production
4. Install addition to fume removal system.	7/1	TSD
5. Issue quarterly status for Safety Audit.	4/15	Production
6. Evaluate gas mask location/ relocation to control room.	4/1	Safety/ Production
7. Install ramp for lime delivery to 2nd level.	2/1	Maintenance
8. Install concrete pad for fork lift lime delivery.	7/1	Mech.Design
9. Make safety evaluation of drum leanto.	1/1	Mech.Design
10. Review grounding of Equipment	4/1	Maint./Prod.
a. List equipment to be grounded	2/1	Maint./Prod.
b. Implement grounding	4/1	Maint.
11. Establish equipment preventive maintenance procedure(SIAM).	1/1	Maint.
12. Extend elevator to 29 foot level.	5/1	Maint.
13. Widen walkway around fume scrubber.	5/1	Maint.
14. Complete repairs on ONA explosion damage.		Maint.
15. Install alarm in drumming station.	6/5	F&T

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II. QUALITY

A. Objectives

1. Maintain 1969 Aroclor Quality Level

	1969 1242	1254
a. Resistivity(10^9 OHM-CM)	3021	19785
b. Power Factor(% at 60 CY)	2.09	0.61
c. TCC(PPM)	0.15	0.52

2. Customer Complaints: <0.3/100 shipments
(1969 Actual: 0.51/100 shipments)
3. Improve reproduceability of electrical analysis.

B. Actions

	EDC	Responsibility
1. Resolve status of new electrical analysis(dependent on lab air scrubber).	1/1	Laboratory
2. Determine reasons for and correct discrepancies between lab analysis and in-line instrument indications of electrical properties.	*	TSD
3. Define effects of storage retention.	*	TSD
4. Define quality degradation during loading; need for loading through Porocel.	*	TSD
5. Evaluate need for isolated area for Aroclor analytical work.	*	Laboratory
6. Improve maintenance of Aroclor quality in sampling bottles. (Dependent on Action No.1 also). a. Sulfur treated bottles b. Bottles at constant temperature	*	Production
7. Install facilities to blow the mix tanks with nitrogen.	5/1	Production
8. Operating procedures changed to unload Pyranol cars with nitrogen.	Continuing	Production
9. Install weather protection at loading docks.	1/1	Mech. Design
10. Alter piping to locate polishing filters ahead of absorbers in #3 and #4 still systems.	6/1	Production
11. Relocate gear meters to point in process where maintenance costs will be decreased.	6/1	Production
12. Complete tank car inspection procedure.	Continuing	Prod.
13. Monitor quality of product and chlorine during change to Ag Grade KCl.	3/1	TSD/Prod.
14. Provide sales sample with necessary information for proper handling of Aroclor products.	4/1	Prod.

*Dependent on accomplishment of Objective 3.

15. Analyze competitive samples

III. CAPACITY

A. Objectives

1. Meet 1970 sales forecast of 42M pounds Aroclors and 12M pounds Aroclor blends.

B. Actions

	EDC	Responsibilit
1. Make Brodimatic meters operable.	7/1	Prod.
2. Publish MIP and issue status periodically.	2/1	TSD
3. Demonstrate maximum capacity.	Qrt.	Prod.
4. Insulate #7 storage tank.	5/1	TSD
5. Evaluate need for improved mixing facilities.	8/1	Prod./TSD
6. Evaluate need for increased loading rate of Pyranols.	4/1	Production
7. Demonstrate use of filter in xylene mix drumming line.	2/1	Production

IV. COST

A. Objectives

1. No negative variance from 1970 cost standard.
2. Mechanical expense not to exceed 1970 budget.
3. Overtime for Dept. 246 personnel - 8%.
4. Absenteeism for Dept. 246 - 3 %
5. Mechanical overtime 4%

B. Actions

	EDC	Responsibilit
1. Complete and implement preventive maintenance list.	3/1	Maint./Prod.
2. Install new pumps on #2 and #3 mix tanks.	6/1	Maint.
3. Annual physical inspection of warehouse stock to reduce repackaging costs.	6/1	Production
4. Set drum inventory levels agreed on by Production, Marketing and Production Planning.	3/1	Production
5. Eliminate overtime on porter job.	9/1	Production
6. Complete upgrading of control room.	4/1	Maintenance
7. Evaluate dismantling air dryers.	9/1	Production
8. Dismantle spiral heat exchanger.	4/1	Production
9. Check asset run versus physical check of department.	4/1	Production
10. Obtain credit for TCB and TTCB raw material mischarges in 1969.	3/1	Purchasing
11. Determine maximum water content in steel-HCl systems to avoid corrosion in off-gas system.	9/1	TSD
12. List and evaluate needs on high repair cost items.	2/1	Maintenance

V. YIELDS

A. Objectives

	Goal	70 Std.	69 Act.	70 Act.
Biphenyl	99	98	99.24	
TCB	98	98	98.34	
TTCB	98	98	94.30	
TCP	98	99	91.66	

B. Actions

	EDC	Responsibilit
1. Continue close surveillance of blending procedures and raw material shipments.	Con- tin uing	Prod.

VI. PROCESS CONTROL

A. Objectives

1. Improve operational control of the process.

B. Actions

	EDC	Responsibilit
1. Identify key process variables and initiate control charts.	4/1	Production
2. Prepare new operating instructions.	7/1	Production
3. Prepare Standard Manufacturing Process.	12/1	Production
4. Complete Data Bank.	11/1	Prod./TSD
5. Establish and implement key variable audit.	6/1	Prod./TSD
6. Make pertinent process control data available to operators.	3/1	Production

VII. POLLUTION

A. Objectives

1. Reduce Aroclor losses to sewer from 130 pounds per day to 10 pounds per day from department.
2. Evaluate need to reduce HCl air pollution.

B. Actions

	EDC	Responsibilit
1. Quantify process material going to toxic dump.	1/1	Production
2. Determine adequacy of drowning jet.	6/1	TSD
3. Catch all wastes from drip pans and sample lines.	3/1	Production
4. Modify piping on continuous blow tank to prevent accidental Aroclor losses to sewer.	5/1	Mech. Design
5. Modify absorber relief lines to prevent Aroclor from reaching the sewer.	6/1	TSD
6. Design and install a sewer basin to trap accidental Aroclor losses.	7/1	Mech.Design/ TSD
7. Establish two week PM on blow tank level control(discontinue with Item 4 completion).	1/15	Maintenance

VII. POLLUTION(Cont'd.)

B. Actions

	EDC Responsibility
8. Design and install a system to remove Aroclor entrained in HCl routinely sewered through drowning jet.	1/1/71 TSD
9. Continue to monitor sewers to find sizes and locations of Aroclor losses in plant.	Con- tin uing Production Control

Group Members:
V. F. Brawley
T. N. Carrico
Bob Eden
R. M. Humphries
W. A. Krull
J. R. Kuster
R. M. McCutchan

COMPANY CONFIDENTIAL

MANUFACTURING IMPROVEMENT PLAN

for

AROCLOR

DEPT. 246

Approved:

T. W. Dalton, Gen. Supt. Manufacturing — 3/18/70

C. N. Deubner, Gen. Supt., Maintenance

D. W. Jackson, Gen. Supt., Technical Services — 3/17/70

W. A. Kuhn, TPM — 3/19/70

Date Approved: Jan. 29, 1970
Date Issued : March, 1970

Prepared by:

W. A. Krull
R. M. McCutchan
R. M. Humphries
R. M. Fabian
T. E. Greenman

MONS 046699

AROCLOR MANUFACTURING

IMPROVEMENT PLAN

DISTRIBUTION

W. G. Krummrich Plant

G. L. Bratsch
T. W. Dalton
C. N. Deubner
D. W. Jackson
W. L. Watson/D. T. Mayer
T. E. Greenman
M. J. Beaudine
L. W. Sprandel
R. M. Humphries
R. M. McCutchan/W. Brawley/
T. Carrico
R. M. Blowers
B. R. Williams/C. F. Buckley

Anniston

J. C. Landwehr

General Offices

*H. S. Bergen
W. A. Kuhn
D. Danna (4)
R. E. Howard/J. O. Bright/
R. M. Kountz
D. B. Hosmer/F. J. Holzapfel
W. E. Chandler
W. R. Richard
D. A. Olson
P. G. Benignus

South Second Street

T. M. Patrick
R. H. Munch

* Summary Only

TABLE OF CONTENTS

TABLES

APPENDICES

SUMMARY:

A. Objectives

W. G. Krummrich Plant will help maintain the Aroclor franchise position by making Aroclor of a quality to match any in the world at or lower than the current cost. The Aroclor department also has the necessary capacity to meet the market demand as forecasted. The present position and needed modifications are outlined below.

B. Capacity

Sales for WGK Aroclors are forecasted to increase from 42.9M pounds in 1970 to 59.2M pounds in 1974. The Aroclor expansion was designed for 70.0M pounds/year capacity. However, a decision was made not to install all of the storage tanks since they are not required at present rates. Storage capacity and operator work loads restrict present capacity to an estimated 55.0M pounds/year. Present capacity is adequate until 1973. Drumming, blending, storage, and off-gas drowning jet capacities will be investigated to insure adequate surge capacity to meet forecasted sales.

C. Quality

During 1969 Manufacturing at WGK demonstrated the capability of producing electrical grade Aroclors which are equivalent to Anniston's from a customers point of view. The present quality is stated to be more than adequate by the Business Group and no effort will be made to improve it at this time. Efforts will be directed at maintaining this position. The following table shows the present quality situation for Aroclor 1242.

	TCC (ppm)	Resistivity (10^9 ohm-cm)	Power Factor (% at 60 cy.)
Present Aroclor 1242	0.15	3000	2.1
Specification	0.65 max.	500 min.	None

D. Yields

The present biphenyl yield in Aroclor production is 99+%, total potential compared to theory is only $10,000. No TSD effort is planned in this area.

In 1970 Manufacturing's goal is to improve raw material yields on Pydraul and Pyranol blends from 94% to 98%. Estimated savings are $5,000.

MONS 046702

SUMMARY:

E. Pollution Control

Water pollution control is the major problem area for this product group and correspondingly the bulk of the TSD effort for 1970 will be in this area. Losses are presently being investigated by the Pollution Control Section. The total effort and costs are presently in the process of being defined with a plant goal of 10 pounds per day set by 1/1/71.

F. Process Control

Effort is underway to develop the Aroclor data bank. The Operating Instructions and Standard Manufacturing Process documents will be revised by Production. The Department Safety Audit is current. Control charts have been developed and are being maintained by Production.

G. Conversion Costs

The manufacturing costs in 1969 for producing Aroclors at WGK and Anniston were essentially the same ($7.421/cwt @ WGK vs. $7.435/cwt @ Anniston). Increasing costs due to wages, salaries and materials at WGK are expected to be offset by increased production volume this year and in 1971. Following is a manufacturing cost projection:

	1968	1969	1970	1971
Total Bulk Aroclor Manufacturing Costs $/cwt	6.785	7.421	7.236	7.280

Present TSD effort in the chlorine department is projected to reduce chlorine costs from $53.34/ton to $41/ton by mid-1971. When this occurs, it will reduce Aroclor costs by an additional $0.65/cwt to $6.63/cwt. This is equivalent to $300,000/year savings at a 46.0M lbs/yr rate.

H. Mechanical Expense

The true repair portion of the mechanical expense is expected to increase in 1970 as the result of the expansion capital installed in late 1968 and due to increased labor and materials costs. High repair cost items will be reviewed to determine possible cost reductions.

SUMMARY:

I. Manpower

The projected manpower expenditure for TSD process engineering is 150 mandays for 1970. If TSD becomes involved with reclaiming Aroclors this estimate would increase substantially.

P.I.P. STATUS

The following items were part of the PIP dated 2/21/68 or the P.I.P. - six month status dated 11/22/68. This table gives the present status of these items as of January 1, 1970. Any items that were complete at the time of writing the six month status are not included in this list.

	JOB	STATUS
1.	Coordinate Quality Tests	Quality adequate as stated by W. A. Kuhn in memo dated 8/25/69. Some items noted in M.I.P.
2.	Fume Removal System	Installation complete. Extension of system in M.I.P. Action Plan
3.	Improve Blend Operation	Project complete
4.	Instrumentation Changes	Complete
5.	New Drumming Facility	Carried over to MIP
6.	Horizontal pump and boil-down facility #1 still	Project dropped.
7.	Investigate Possible Blend Specification Changes	In progress by Production supervision.

Other items mentioned in the PIP which may require work are biphenyl drying, bromine in chlorine, additional blend storage, and blend specifications. The blend items have been carried over to the M.I.P. The raw material items were not carried over since quality is adequate and Anniston is trying to eliminate the water contamination of biphenyl. However, the raw material quality will be monitored.

ACTION PLAN

On the following pages is the plan for completing projects to improve the manufacture of Aroclors at WGK. The need for the projects is described in the Details Section of this document.

GOALS AND WORK PLAN

ITEM		RESPONSIBILITY	EDC
I.	COST: MEET THE 1970 COST STANDARDS FOR ALL PRODUCTS		
	A. Reduce Drumming Costs		
	1. Evaluate Improved Drumming Facility	TSD (Process)	6/1/70
	B. Increase Yields		
	1. Improve blend raw material yields	Production	1/1/70
	2. Chlorine Usage Study	TSD (Process)	1/1/71
	C. Reduce Maintenance Costs		
	1. Determine Off-Gas Corrosion Level	TSD (Process)	9/1/70
	2. Preventive Maintenance List	Production/ Maintenance	3/1/70
II.	QUALITY: ALL SHIPMENTS RECEIVED BY CUSTOMERS IN SPECIFICATIONS		
	A. Roofs on Loading Docks	TSD (Mech. Design)	6/1/70
	B. Resolve Electrical Property Measurement	TSD/Prod./Maint. (Contingent on Lab Air Scrubber)	1/1/71
	C. Pre-Loading Quality Treatment	TSD (Process)	*
	D. Ag Grade KCl Test (Bromine)	TSD (Process)	3/1/70
III.	CAPACITY: HAVE PRODUCTION CAPABILITY TO MEET SALES NEEDS		
	A. Replace Mix Tank Pumps	Maintenance	6/1/70
	B. Drowning Jet Evaluation	TSD (Process)	6/1/70
	C. Improve Mix Tank Mixing	Production/TSD	8/1/70
	D. Establish Minimum Drum Inventory Level Approved by Prod., Production Planning & Marketing	Production	3/1/70

* Dependent on ability to reproduce electrical property measurements or II B.

GOALS AND WORK PLAN - (Continued)

ITEM		RESPONSIBILITY	EDC
IV.	SAFETY: NO DISABLING OR SERIOUS INJURIES TO PERSONNEL IN THE DEPARTMENT		
A.	Fume Removal System Extension	TSD (Process)	7/1/70
B.	Lime Delivery Facility	TSD (Mech. Design)	Hold
C.	Safety Audit Items	Production	11/1/70
V.	POLLUTION: PREVENT AROCLOR FROM LEAVING THE DEPARTMENT IN THE SEWERS		
A.	Control Rupture Disc Discharge	TSD (Process)	6/1/70
B.	Install Sewer Basins	TSD (Mech. Design)	7/1/70
C.	Sewer Pollution Check	TSD (Pollution Control)	Continuing
D.	Reduce Blow Tank Aroclor Losses	TSD(Process)	10/1/70
E.	Check Aroclor in Off-Gas	TSD (Process)	4/1/70
F.	Catch Wastes from Drip Pans and Sample Lines	Production	3/1/70
G.	Piping Modifications on Blow Tank	TSD (Mech. Design)	5/1/70
VI.	PROCESS CONTROL: MAINTAIN CONTROL OF PROCESS & PREVENT UPSETS		
A.	Complete Process Variable Chart and Key Variable List	Production	4/1/70
B.	Revise Operating Instructions	Production	7/1/70
C.	Revise Standard Manufacturing Process	Production	12/1/70
VII.	PLANT IMPROVEMENT: MAINTAIN HIGH LEVEL OF HOUSEKEEPING AND IMPROVE OPERATIONS		
A.	Upgrade Control Room	TSD (Mech. Design)	4/1/70
B.	Dismantle Obsolete Equipment	Maintenance	3/1/70
C.	Road & Sewer Improvements	TSD (Mech. Design)	Hold
D.	Pave Tank Farm	TSD (Mech. Design)	Hold
E.	Replace Lean-To	TSD (Mech. Design	Hold

DETAILS:

A. Process Synopsis

1. Present Situation

Department 246 produces Aroclors with 32, 42, 48, 54, 60 and 62 percent chlorine. The name for each Aroclor utilizes a four digit suffix number in which the last two digits indicate the approximate weight percent chlorine. For example, Aroclor 1242 contains approximately 42% chlorine.

Aroclor 1242 is produced continuously and the others batchwise, but the main process steps are the same. A flow sheet depicting the process is attached as Appendix A.

The chlorination is done by contacting biphenyl with chlorine gas to cause a substitution of chlorine atoms for hydrogen on the biphenyl molecule. The reaction is catalyzed with ferric chloride. Aroclor and hydrogen chloride are produced. The hydrogen chloride is piped to the chlorosulfonic and/or muriatic acid departments. The Aroclor produced is sent to an intermediate storage tank.

From the storage tank the crude Aroclor is blown with compressed air to remove any remaining HCl and then straight take over distilled with lime. The distilled Aroclor is put through a porocel packed absorber and held in nitrogen blanketed storage.

The Aroclor is either shipped as is or blended with other Aroclors, trichlorobenzene (TCB) or tri-tetrachlorobenzene (TTCB). The blends are made by pumping the materials to a tank where they are mixed to produce the correct properties. Products are shipped in tank cars, tank trailers and drums.

2. Optimum Process

The optimum process for Aroclor production should be the continuous production of all the Aroclors. This could be done by using seven chlorinators in series as shown on the flow sheet attached as Appendix B.

The number of stills needed would depend on how many products it was necessary to produce at any one time. Appendix B shows the proposed optimum process with three still lines. This system utilizes existing equipment primarily, with some additions necessary.

The optimum process will actually depend on the amount of production as well as the relative amounts of each. The forecasted rate does not warrant continuous chlorination to higher levels.

DETAILS:

B. Products - By-Products

1. Capacity

The following table shows the February 15, 1970 sales forecast for Monsanto U. S. Liquid Aroclors.

TABLE I

SALES FORECAST (M POUNDS)

Product	1970	1971	1972	1973
1221	0.5	0.2	0.2	0.2
1232	1.3	0.8	0.9	1.1
1242	54.4	59.7	64.7	69.8
1248	7.1	8.8	9.6	10.2
1254	13.7	14.5	15.2	16.2
1260	4.3	4.6	5.0	5.4
1262	1.1	1.2	1.2	1.3
TOTAL	82.4	89.8	96.8	104.2

Table II uses the February 15, 1970 sales forecast to show the part of the total U.S. Liquid Aroclor forecasted for production at W.G.K. The table also shows the 1969 production. Table III (on the following page) shows the forecasted blend production at W.G.K.

TABLE II

W.G.K. PRODUCTION (M POUNDS)

Product	1969	1970	1971	1972	1973
1221	0	0	0	0	0
1232	0.1	0.3	0.4	0.5	0.7
1242	22.7	24.2	27.0	29.8	32.7
1248	7.0	6.7	7.5	8.3	8.8
1254	8.6	7.7	8.4	8.9	9.6
1260	4.2	2.9	3.0	3.3	3.5
1262	0.1	0.1	0.1	0.1	0.1
TOTAL	42.7	41.9	46.4	50.9	55.4

TABLE III

*BLEND PRODUCTION (M POUNDS)

Product	1969	1970	1971	1972	1973
1260 PPO	2.8	0.7	0.7	0.7	0.8
1254 PPO	4.9	4.2	4.7	5.0	5.5
1242 PPO	3.5	0.7	0.8	0.9	1.0
A13B3B	1.7	1.2	1.2	1.3	1.4
TOTAL PYRANOL	12.9	6.8	7.4	7.9	8.7
Pydraul A-200	4.0	4.2	4.8	5.0	5.2
Pydraul 280	1.0	0.8	0.9	1.0	1.1
1254-10% Xylene	0.2	0.15	0.15	0.15	0.15

* The Aroclor in these blends is already included in Table II.

Table IV shows the known capacity of each step of the process in relation to the required capacity. The required capacity is taken from the 1973 forecast in Table II. The demonstrated capacity figures came from production records and capacity checks.

TABLE IV

CAPACITY COMPARISON (M #/YEAR)

Process Step	Demonstrated	1969 Production	1970 Forecast	1973 Forecast
Chlorination (1142)	37.5*	22.7	24.2	32.7
Chlorination (other Aroclors)	25.9**	20.0	17.7	22.7
Distillation (1242)	31.9*	22.7	24.2	32.7
Distillation (1248 & 1254)	21.9**	15.6	14.4	18.4
Distillation (1260, 1262, 1232)	8.5**	4.4	3.3	4.3
Absorption (1242)	51.7*	22.7	24.2	32.7
Absorption (1248)	35.9*	7.0	6.7	8.8
Absorption (1254)	34.4*	8.6	7.7	9.6
Absorption (1260)	60.7*	4.2	2.9	3.5
Blending (Pydrauls)	6.3**	5.0	5.0	6.3
Blending (Pyranols)	14.5**	12.9	6.8	8.7
Drumming (All)	17.2***	13.3	12.0	15.4

* Capacity Check
** Extrapolated Monthly Production Record
*** Extrapolated Monthly Production Record with 13 shifts/week plus overtime.

DETAILS

B. Products - By-Products

1. Capacity (Continued)

In every case in Table IV, the demonstrated capacity exceeds the forecasted 1973 production requirements. The chlorination and distillation figures represent something less than maximum capacity, so these operations appear adequate through 1973. The absorbers and blending also appear adequate.

The drumming and blend storage capacities were marginal in 1969. However, with the significant decrease forecasted for Pyranol blends (12.9 M pounds in 1969 vs. 6.8 M pounds in 1970) capacity in this area is adequate. The Pydraul and Pyranol blends will be watched for sales forecast changes and actions planned accordingly.

It is anticipated that Aroclor storage would restrict capacity to about 55 M pounds per year. This is above the 1973 forecast but the restriction may require investigation. When the recent expansion was installed, CED forecasted a need for three more 22,000 gallon storage tanks in 1970, but due to the reduced forecast, the additions can probably be postponed.

To operate the department at full rate, personnel additions may be necessary. It is anticipated by Production that the chlorinators and stills would need additional operators. Production will attempt operation at high rates at 6 month intervals to insure system capability.

The off-gas drowning jet in the department could restrict capacity due to jet size if it becomes necessary to operate when muriatic acid and chlorosulfonic acid are shut down. An evaluation of the scrubber will be made to determine the operating limit of the present system and the cost to add capacity.

2. Quality

As specified by W. A. Kuhn in a memo dated August 25, 1969 the finished goods quality of the Aroclor presently produced is satisfactory. Only minor projects to maintain the quality will be done. A project to put roofs on the tank car loading docks will be done which will insure against contamination while loading.

DETAILS:

2. Quality (Continued)

The following table relates the present storage tank quality of Aroclor 1242 to the present specifications. It also shows the present control levels at which production becomes concerned that the quality level is deteriorating and corrective action is taken.

AROCLOR 1242 QUALITY

	TCC (ppm)	Registivity (10^9 OHM-CM)	Power Factor (% at 60 cy.)
Specification	0.65 max.	500 min.	None
Storage Tank Quality	0.15	3,000	2.1
Control Level	0.20	1,500	3.5

The major quality concern at the plant is the analytical method used for electrical properties. The problem exists in the reproduceability of results with both the present method and the new tentative method. The tentative method tends to show better properties but is inconsistent. The present method requires meticulous lab procedures or shows poor results. To compound the problem, the manner of taking and handling the sample can ruin the results. This whole problem needs to be resolved.

The lab is installing a new air scrubbing system which may help the new tentative method. The short term procedure is to have Organic Research run samples periodically to check the plant lab results. Longer term, the new system will be checked when the air scrubber is installed. If it looks like the problem is solved, we will use this procedure. If not, an evaluation of an isolated Aroclor analytical facility will be made. Improved sampling procedures will also be tried.

Other measures that may improve the quality of Aroclor will be held in reserve until a better quality is needed to meet market demands. A list of these follows:

Measure	Effect
1. Separate chlorine revaporization	Better quality raw material
2. High temperature aging	May have slight stability benefit
3. Alternate absorber packings	Better electrical or stability qualities

DETAILS:

2. Quality (Continued)

Aroclor quality is generally consistent, but one upset has occurred. Colored product suddenly appeared in early June, 1969 and stayed until July. Procedures used to eliminate the problem included: Cleaning the intermediate storage tank, still, receiver and the line between the still and receiver; changing the porocel absorber; and making sure the still vacuum is vented at the receiver and not at the still. Since July 20, 1969 there has not been a color higher than 15 APHA. Of the items attempted to remove the color, it seems the venting of the still is the most likely suspect. Venting at the still could cause off color material to be drawn forward from the still bottoms.

For a few consecutive lots in September, 1969 Monsanto stability was high. After many attempts and failures at both Anniston and W.G.K., the lab re-runs came out within specifications. Part of the lab equipment evidently became contaminated. The quality of the Aroclor had not changed.

The quality of raw materials will be monitored with control charts. In May, 1969 the water content in biphenyl increased to 100 ppm. This could cause excessive corrosion in the off-gas system. Since October, 1969 the water content has returned to a normal level of about 50 ppm.

An evaluation will be made of a filtering and absorbing step just prior to loading tank cars and tank trailers. It is occasionally necessary to resample and sometimes unload a car or trailer because the electrical properties have deteriorated.

Nine complaints were received from customers in 1969 of which seven pertained to shipping container complaints and only two on material quality.

Appendix C contains a table showing some of the properties of W.G.K. Aroclor. The figures represent August, 1969 YTD production. The other table in Appendix D shows a comparison between Monsanto, Bayer, Soviet Askarel, Prodelac and Kanegafuchi products of similar chemical makeup. From the table, it can be seen that the products have similar quality except for the generally inferior quality of the Soviet Askarel. This table was made using WGK, PR & D Report No. 2, Job No. 4023, dated 4/28/69; Anniston Research and Development Report No. 3, Job No. 370-502, dated 7/19/68; and a memo from C. R. Coleman, Ruabon to J. N. Haggart, Brussels, dated 5/28/69.

DETAILS:

B. Products - By-Products (Continued)

3. Yields

The cost sheets and operations reports for 1969 for Dept. 246 were used to derive this table.

TABLE V

RAW MATERIAL USAGE

Raw Material	(Total Pounds) Theory	Actual	Difference	(Actual-Theory) $/yr Potential
Biphenyl	23,159,050	23,338,758	179,708	10,000
Chlorine	39,998,413	42,668,421	2,670,008	73,000
TCB	2,603,092	2,647,033	43,941	5,000
TTCB	991,327	1,051,778	59,951	7,000

The yield on Biphenyl is 99.3% and would be difficult to improve. The chlorine yield is not an accurate figure since a pro-rating procedure is used to determine usage. An attempt will be made to determine actual chlorine losses.

The low TCP, TCB and TTCB yields will be investigated by Production. The amount of these materials actually received may not be the same as the amount Purchasing specifies. If this is not the problem further investigation may be necessary.

4. Pollution Control

The escape of Aroclors to the environment poses a serious business threat to this product group. There is concern not only in the production of these products, but also customer handling of these products and the disposal of spent material. To cope with this problem we must reduce plant losses, educate users and resolve customer spent material disposal.

The WGK plant objectives for 1970 are to reduce Aroclor losses to the sewer to 30 pounds/day by 10/1/70 and to 10 pounds/day by 1/1/71.

DETAILS:

4. Pollution Control (Continued)

Present losses are estimated to be 230 pounds/day by the TSD Pollution Control Group. Of this total 130 pounds/day are estimated lost by Department 246 and the remainder from other departments in the plant.

These goals require the following actions:

a. Production housekeeping to reduce leaks and spills reaching the sewer. Actions have been taken to do this and more will be added as data shows the need.

b. A project to prevent the blow tank from overflowing due to instrument failure as it has in the past. Piping the blow line through the intermediate storage tank will prevent this loss. Mechanical Design has the project package out with completion expected in March, 1970. This is Estimate Number 1493 for $5,400 expense.

c. A project to prevent the losses from the relief lines of the absorbers from reaching the sewer. This is necessary because the rupture discs have allowed material to reach the sewer in the past and although production has made operation changes, we cannot be sure losses will not occur again. This project has Estimate No. 1512 for $6,000, of which $1,500 is expense and $4,500 capital. Installation is expected by 7/1/70.

d. A system to remove Aroclor carryover in the blow tank line is necessary since we know at least 25 pounds per day is lost here. This goes to the sewer through the drowning jet. Controls will be installed to reduce the air flow and an estimate will be made of costs to reduce the amount carried over in the remaining air.

e. A basin intercepting the sewer to collect the non-routine losses is being considered. This would allow the Aroclor to settle out of the sewer water leaving the department.

The total estimated expenditures for all these projects is about $50,000, half expense and half capital.

DETAILS:

4. Pollution Control (Continued)

Other pollutants are not thought to be of a serious nature. Atmospheric pollution is held down using a scrubber which will be evaluated for capacity. Some HCl loss is evident when a large amount of off-gas is sewered in the department.

Using yield data, the amount of waste materials was estimated by R. McCutchan based on 40 M pounds per year production. These figures account for all yield losses and are maximum amounts. This estimation is shown in Table VI.

TABLE VI

WASTE MATERIALS

Atmospheric Pollutants

Material	#/Year
HCl	8,000
Chlorine	Not Measurable
Aroclor + Biphenyl	Very Small
Pydraul	Slight
TCB & TTCB	1,800
Pyranol	3,600

Sewer Pollutants (Potential)

HCl	200,000
Aroclor	50,000
TCB & TTCB	10,000
Chlorine	0
Pydraul & Pyranol	10,000

Toxic Dump

Montar	160,000
Aroclor	40,000
Pyranol	0
Pydraul	0

DETAILS:

5. Process Control

The present level of operator training is adequate and the present training policy for new operators will be continued. The length of operator training varies from 3 to 6 weeks depending on the job.

The May, 1969 safety audit contains a number of control items which will be completed according to the priority set in the audit. A quarterly review and report on these items will be made.

In addition to these items the blending procedure may need modification depending on the outcome of the blend specification study.

Control charts are being initiated for the finished product and raw material analysis variables. These charts should give an indication as to the level of control existing in the department and the areas in need of improvement.

The Standard Manufacturing Process documents are being revised by Production. The documents will be completed for all products and processes. Attached as Appendix F is a list of process control measures to be taken along with expected dates of completion.

C. Assets

Since the facility is presently adequate to meet the forecasted manufacturing requirements, no major additions or changes are anticipated. The project to replace the lean-to used for drumming is presently on hold with no date of completion forecasted.

Minor changes in the assets of the department are outlined in the Action Plan and explained in various parts of the Details Section of this document.

The capitalization of the facility as of January 31, 1970 was:

Asset Value	-	$2,037,107
Accrued Depreciation	-	769,495
Book Value	-	1,267,612

DETAILS:

D. Personnel

No change in the present number of personnel is anticipated. The present number of operators is sufficient to handle the forecasted manufacturing requirements up to 55 M pounds/year.

If the rate is increased to a level near 100%, additional operators may be needed. A study of the needs of the department will be made when it appears the need is arising.

A listing of operators and their duties is attached as Appendix "D". The total number of operators in the department is 17-1/2.

E. Mechanical Expense

The 1968 and 1969 mechanical expense and the 1970 budget for Dept. 246 is tabulated below:

TABLE VII

	1968	1969	1970 (Budget)
Areas and Shops	$32,808	$54,600	$ 49,700
Plant-wide	37,367	39,700	50,500
91, 92 & 93 expense	86,156	41,200	66,900
% Absorbed O.H.	1,768	- 4,600	---
	$158,099	$131,000	$167,100

The primary repair cost occurred in the following categories:

TABLE VIII

	1968	1969	Change 1969-1968	1970 (Budget)
19 pumps	$15,153	$25,400	$10,247	$19,700
21 Tanks	3,689	5,013	1,324	3,400
87 Dept. Repairmen	4,018	11,600	7,582	9,800
97 Piping	5,339	5,300	39(-)	6,900
29 Instrument	7,820	16,300	8,480	12,800
35 Ejector	2,345	700	1,645(-)	2,500
80 Painting	2,769	200	2,569(-)	5,900
82 Insulation	6,158	12,190	6,032	15,200
96 Electrical	5,537	2,800	2,737(-)	9,300
98 Structural Steel	10,189	500	9,689(-)	500

DETAILS:

E. Mechanical Expense (Continued)

Of particular interest are:

Pumps: Pumps accounted for 26.9% of the total true repair expense. A Maint. Engineering assignment has been initiated to solve the therminol pump cost problem. This pump and other pump seal problems have been identified as the major problems.

Dept. Repairman: This item accounted for 12.3% of the true repair costs. These costs will be reduced in 1970. High costs are attributed to leaks from new piping installed by outside contractors. Material costs will be investigated to improve any repetitious repairs being made by the repairman.

Instruments & Ejectors: These items accounted for 18% of the true repair expense. Costs will be approximately the same in 1970. Inflationary increases will be compensated for by improved P.M. of equipment.

Insulation: Insulation costs accounted for 12.9% of the true repair costs. Normal repairs and programmed upgrading planned for 1970 indicate an expenditure of approximately the same magnitude.

Maintenance Engineering:

1) Replacement of the obsolete Taber pumps on the #2 and #3 mix tanks is planned for 1970.

2) Alarm system tie-in for the spare #2 still pump will be completed in 1970.

3) Implement Safety and Inspection Procedure for unfired pressure vessels in 1970.

Programmed Plant Improvements:

1) Provide drainage North of department along tracks $ 30,000 Cap.

2) Replace lean-to to Building CR $100,000

These projects are on hold status at the present time.

DETAILS:

E. Mechanical Expense (Continued)

Corrosion in the off-gas system has occurred in the past in the header and the condensate tank vapor space. It would be useful to determine what moisture level can be tolerated, but it is not known if this level can be determined. If there is a good probability of success, the determination will be attempted on a low priority basis.

Estimated damages of $25,000 resulted from the explosion in Department 222. The repairs are presently in progress.

F. Conversion Costs

Table IX below shows a comparison between Krummrich and Anniston Liquid Aroclor raw material costs. The figures were obtained from the cost reports for the year 1969. Following is the comparison:

TABLE IX

RAW MATERIAL COMPARISON (¢/POUND)

Item	W.G.K.	Anniston	Difference W.G.K. - Anniston
Chlorine	2.674	2.433	0.241
Biphenyl	2.952	2.824	0.128
Drums	0.199	0.306	0.107-
HCl	0.575-	0.198-	0.377-
Nitrogen	0.013	0.023	0.010-
Lime	0.001	0.007	0.006-
5 Gal. Cans	0.004	0.004	----
Clay and Porocel	0.005	0.003	0.002
Ferric Chloride	0.006	0.002	0.004
Net Material Cost	5.279	5.404	0.125-
Material Handling	0.021	0.013	0.008
TOTAL RAW MATERIAL COST	5.300	5.417	0.117-

DETAILS:

F. Conversion Costs (Continued)

Although the total raw material costs are almost the same, there are some outstanding differences between the two plants. The muriatic acid credit at Krummrich is much higher and offsets the higher cost of chlorine and biphenyl. This comparison does not mean a great deal since the usage of raw material would depend on the type of Aroclor being produced. Chlorine and biphenyl are more costly at Krummrich.

Table X shows the direct conversion costs.

TABLE X

DIRECT COST COMPARISON (¢/POUND)

Item	W.G.K.	Anniston	Difference W.G.K. - Anniston
Steam	0.216	0.137	0.079
Electricity	0.029	0.023	0.006
Comp. Air	0.030	--	0.030
Water	0.024	0.020	0.004
Gas	0.004	0.021	0.017-
Wages	0.372	0.261	0.111
Salaries	0.070	0.041	0.029
Payroll Overhead	0.074	0.056	0.018
Supplies	0.050	0.058	0.008-
Packing Labor	0.044	0.050	0.006-
Packing Overhead	0.023	0.018	0.005
Laboratory	0.074	0.051	0.023
Clothing & Laundry	0.011	0.005	0.006
Technical Services	0.037	0.070	0.033-
Experimental	--	0.116-	0.116
Rental Equipment	0.002	--	0.002
Prod. Process Res.	0.047	0.008	0.039
Prod. Dept. Contr.	--	0.026	0.026-
Tank Car Storage	0.005	0.015	0.010-
Mech. Expense	0.305	0.561	0.256-
Start-up Expense	--	0.018	0.018-
Waste Disposal	--	0.074	0.074-
Research	--	0.001	0.001-
TOTAL DIRECT CONVERSION	1.417	1.398	0.019

DETAILS:

F. Conversion Costs (Continued)

Although the preceding table shows the total direct conversion costs about the same, four differences are evident. W.G.K. steam costs more per M BTU than Anniston, explaining the steam difference. Steam usage is about the same. Anniston has a credit listed under experimental amounting to about 12¢/cwt. Mechanical Expense and waste disposal are items where Anniston is significantly higher than W.G.K.

Table XI shows the indrect costs and a total.

TABLE XI

1969 INDIRECT & TOTAL COMPARISON (¢/POUND)

Item	W.G.K.	Anniston	Difference
Total Raw Material	5.300	5.417	0.117-
Total Directs	1.417	1.398	0.019
Depreciation	0.403	0.297	0.106
F.I.E.	0.301	0.323	0.022-
TOTAL PRODUCT COST	7.421	7.435	0.014-

The total product cost was roughly the same for the two plants. Anniston's higher raw material costs, due primarily to a smaller HCl credit, are offset by the WGK depreciation being higher than Anniston.

Table XII breaks down the Krummrich costs for 1968 and 1969; 1970 cost standards for a rate of 3,520,000 pounds per month (3,347,000 forecasted); and a rough prediction of 1971 costs. The 1968 and 1969 figures are corrected to reflect an approximate bulk cost which would correspond to the cost standard figure. The 1970 and 1971 figures represent a bulk cost taking into account the forecasted amount of each Aroclor.

TABLE XII

AROCLOR COSTS (¢/POUND)

Item	1968	1969	1970 Std.	1971
Total Raw Material	4.770	5.300	5.169	5.200
Total Directs	1.545	1.417	1.386	1.430
Total Indirects	0.470	0.704	0.681	0.650
Total Aroclor	6.785	7.421	7.236	7.280

DETAILS:

F. Conversion Costs (Continued)

The costs forecasted for 1971 assume that the raw material price will not change significantly. Items showing an anticipated increase are labor, salaries, payroll overhead, and mechanical expense. These items were increased by about 10%. The increases were offset by an anticipated increase in production causing the total costs to hold roughly the same.

Present WGK plant chlorine costs are $53.34/ton ($.02667/lb). This cost is targeted to be reduced to $41.00/ton ($.020/lb) by 7/1/71. This would decrease liquid Aroclor manufacturing costs by approximately $0.65/cwt to $6.63/cwt in mid 1971. This is equivalent to $300,000/yr at a 46.0M lb/year rate.

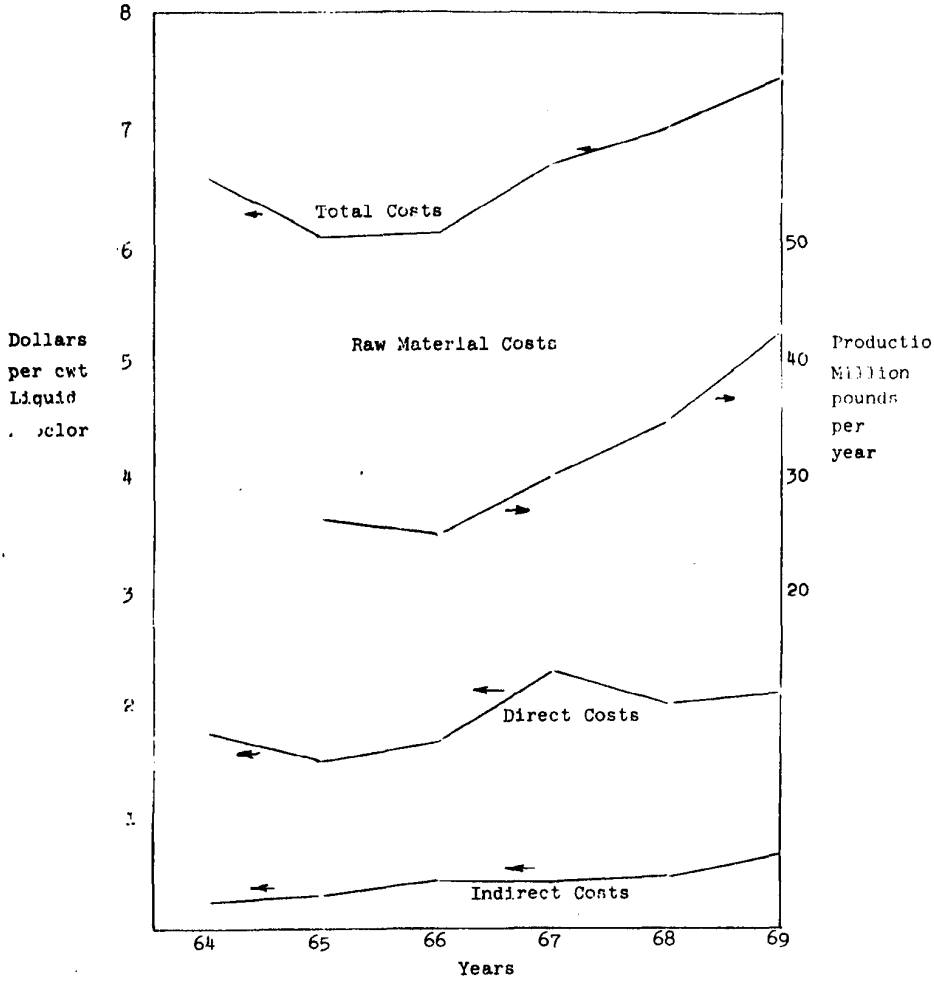
The following lists show the relative dollar amounts of each category and are taken from the December, 1969 YTD cost sheet.

COSTS

Items	Amount	%	%*
Raw Materials	$2,266,443	71.4	100.0
Direct Costs	606,474	19.1	100.0
Wages	159,072	5.0	26.3
Mechanical Expense	130,441	4.1	21.5
Steam	92,552	2.9	15.3
Laboratory	31,734	1.0	5.2
Payroll Overhead	31,802	1.0	5.2
Salaries	29,857	0.9	4.9
Prod. Process Res.	20,017	0.6	3.3
Supplies	21,213	0.7	3.5
Packing Labor	18,807	0.6	3.1
Technical Services	15,675	0.5	2.6
Compressed Air	12,877	0.4	2.1
Electricity	12,222	0.4	2.0
Packing Overhead	10,022	0.3	1.7
Water Purchased	10,218	0.3	1.7
Cl & Laundry Safety	3,082	0.1	0.5
Tank Car Storage	2,245	0.1	0.4
Gas	1,877	0.1	0.3
Clothing Laundry	1,615	0.1	0.3
Rentals Equipment	906	---	0.1
Experimental	200	---	0.0
Plant Trucks	40	---	0.0
Indirect Costs	301,089	9.5	100.0
Depreciation	172,113	5.4	57.2
FIE	128,976	4.1	42.8
TOTAL	$3,174,006	100.0	

* This shows the breakdown of each major division.

AROCLOR COSTS AND PRODUCTION COMPARISON GRAPH



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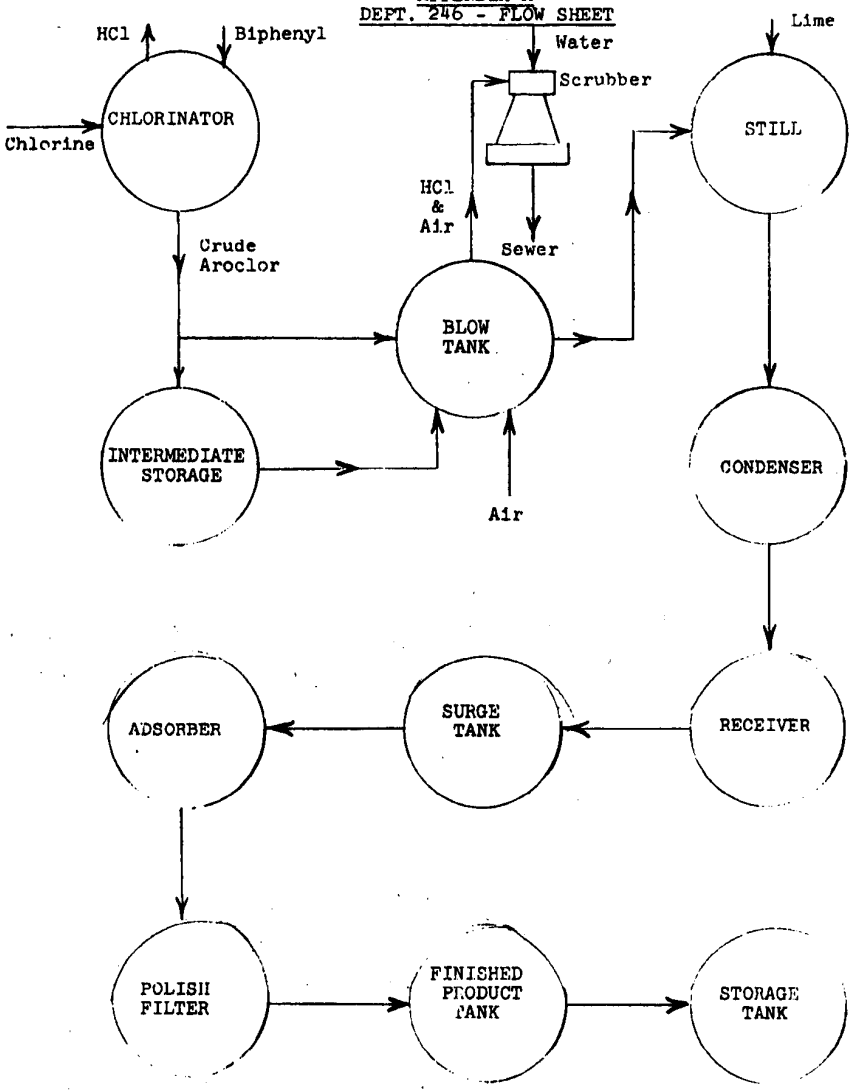
V. APPENDIX

The following pages are the items mentioned in the report as additional information relating to the process, quality and personnel.

APPENDIX A
DEPT. 246 - FLOW SHEET



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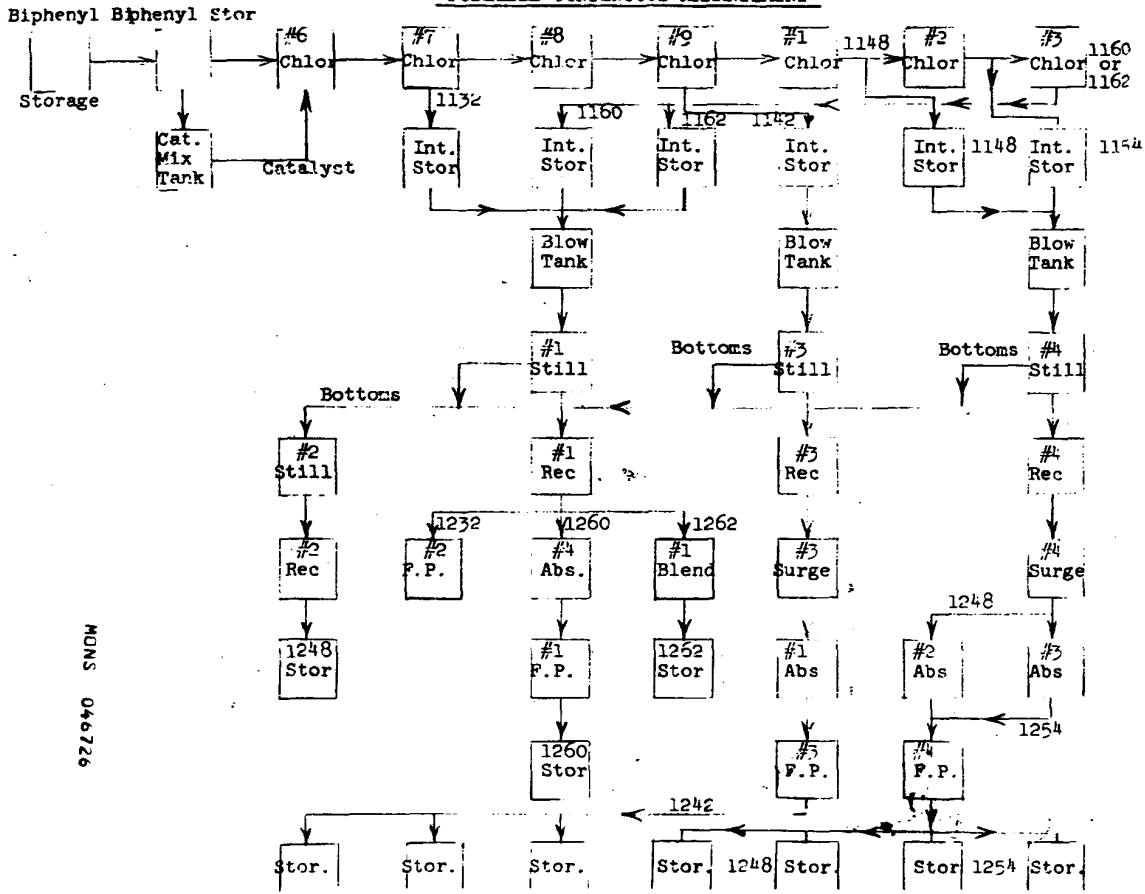
APPENDIX B

POSSIBLE CONTINUOUS ARRANGEMENT



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APPENDIX C

1969 ELECTRICAL GRADE AROCLOR ANALYSIS

1242 Lots	TCC (ppm)	Resistivity X10^{-9}	% Power Factor
KL-403	0.13	2600	1.26
- 4	0.16	1850	2.16
- 9	0.11	8900	0.77
- 12	0.12	2680	1.62
- 15	0.12	2400	1.66
- 22	0.15	1475	3.83
- 25	0.12	10400	0.60
- 27	0.13	2640	1.98
- 29	0.11	6404	0.99
- 31	0.16	1675	2.31
- 34	0.18	1065	3.16
- 37	0.18	3250	1.31
- 39	0.19	2150	1.27
- 43	0.11	1360	2.94
- 44	0.12	1300	1.40
- 46	0.14	2650	1.99
- 47	0.16	1750	2.83
- 49	0.14	4000	1.19
- 51	0.11	2000	1.77
- 52	0.18	1000	2.94
- 54	0.14	945	2.29
- 55	0.12	1020	2.50
- 57	0.18	2400	2.01
- 63	0.08	2640	1.80
- 65	0.10	1850	1.80
- 68	0.17	7450	0.81
- 71	0.07	2800	1.34
- 76	0.16	8160	0.99
- 78	0.15	1760	2.82
- 80	0.12	2480	1.86
- 81	0.13	2400	1.74
- 84	0.25	5925	1.17
- 86	0.09	2320	2.58
- 88	0.14	1480	2.58
- 89	0.15	3840	1.98
- 91	0.10	3650	1.39
- 93	0.17	1040	3.42
- 96	0.17	5443	4.80
- 98	0.23	2240	2.76
- 99	0.13	632	4.17
4003	0.13	2000	1.68
4006	0.17	1105	2.65
4007	0.24	1841	1.89
4016	0.10	1200	1.51
4018	0.14	8000	1.48
4019	0.19	6300	1.17
Specification	0.65 Max.	500 Min.	None

APPENDIX C

1969 ELECTRICAL GRADE AROCLOR ANALYSIS
(Continued)

1242 Lots	TCC (ppm)	Resistivity X10^{-9}	% Power Factor
4021	0.15	2960	1.49
4025	0.16	1200	4.62
4030	0.14	3760	1.29
4038	0.14	3520	2.28
4041	0.25	1680	3.00
4048	0.11	1520	2.70
1242 Average	0.15	3021	2.09
Specification	0.65 Max.	500 Min.	None
1254 Lots			
KL-603	0.57	8000	0.43
- 4	0.77	9445	0.44
- 7	0.80	16,250	0.36
- 9	0.49	17,600	0.35
- 13	0.57	30,400	2.40
- 15	0.46	7200	0.46
- 17	0.41	10,900	0.76
- 24	0.55	30,400	0.29
- 26	0.36	20,800	0.32
- 30	0.44	40,000	0.56
- 33	0.30	32,018	0.36
- 43	0.55	14,408	0.69
- 45	0.55	16,810	0.47
1254 Average	0.52	19,556	0.60
Specifications	None Set	500 Min.	None Set
1260 Lots			
KL-1003	|	53,631	0.19
- 5	Not	24,800	0.30
- 6	Analyzed	64,037	0.27
- 11		160,000	0.45
- 12	|	9,846	0.60
- 17	|	26,415	0.32
- 18		60,038	0.20
1260 Average		56,966	0.33
Specification		500 Min.	None Set

APPENDIX D

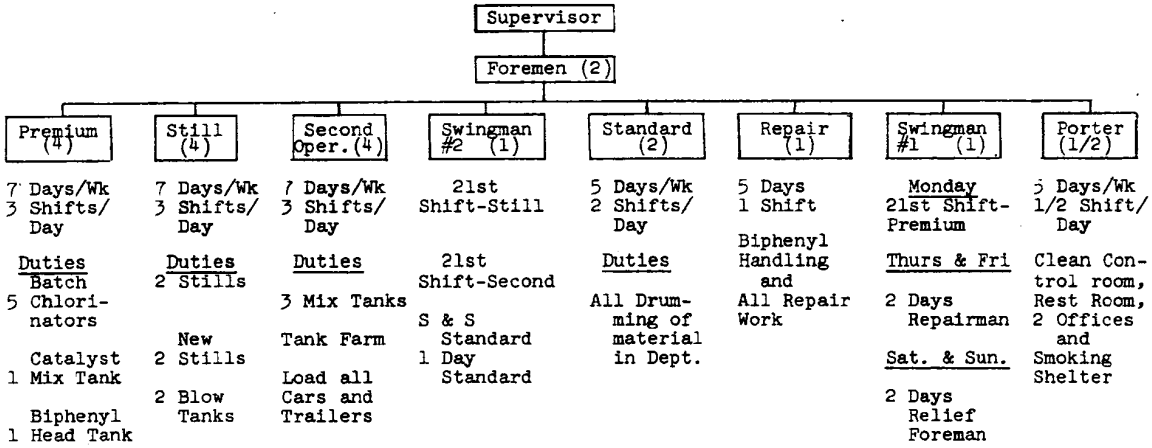
QUALITY COMPARISON FOR ELECTRICAL GRADE AROCLOR 1242

Property	Monsanto Specification	W.G.K.[1]	Anniston[2]	Askarel[3]	Bayer[3]	Kanegafuchi[3]	Prodelac[3]
Color (APHA)	40 Max.	10	15	40	10	10	10
Free Chloride (ppm)	0.05 Max	0.02	0.01	0.009	0.009	0.018	0.018
Acid No. (Mg KOH/g)	0.010"	0.001	0.001	0.002	0.001	0.001	0.001
Monsanto Stability (ppm)	0.4 Max	0.12	0.10	0.37	0.03	0.03	0.06
Hydrolysis Chlorides (ppm)	0.5 Max	0.06	0.12	0.67	0.07	0.11	0.11
Thermal Chemical Chlorides (ppm)	0.65 Max	0.14	0.18	1.95	0.14	0.16	0.16
Westinghouse Stability (ppm)		0.30	0.32				
ND at 25°C	1.6240-1.6260	1.6251	1.6247	1.6228	1.6240	1.6251	1.6246
Sp. Gr. at 25°C.	1.381 - 1.392	1.384	1.386	1.380	1.381	1.391	1.387
Viscosity at 100°C (SOS)	82 - 92	85.6	87.2	79.0			
Pour Plant (°C)	-14 Min.	-17	-18	-15			
Power Factor (100°C)							
1000 cycles		0.15	0.12	0.50	0.25	0.36	0.26
60 cycles		1.95	1.00	4.50	2.01	3.81	2.40
Dielectric Constant (100°C)	4.70 - 4.90			4.72	4.81	4.88	4.89
1000 cycles		4.83	4.82				
60 cycles		4.86	4.83				
Resistivity at 100°C (OHM-CMX10^{-9})	500	3500	3600	1200	800	500	700
Distillation Range (°C)							
10%	325 Min	331	327	323	327	328	329
90%	360 Max	353	352	351	349	350	346
Water (ppm)	35 Max	18	27	28	62	94	51

1) From WGK, PR&D Report No. 2, Job No. 91370:4023, dated 4/28/69.
2) From Anniston Report No. 2, Job No. 370-503 dated 7/3/68.
3) From samples received at Anniston in 1968 and reported in Research & Development Report No. 3, Job No. 370-502, dated 7/19/68.

APPENDIX E

DEPARTMENT 246 PERSONNEL



APPENDIX F. WORK PLAN

NO.	ITEM	EST. COST	EST. MAN-DAYS	RESPONSIBILITY	EDC	COMMENTS
1	Reduce Drumming Costs					
	A. Insulate #7 Storage Tank	$2500	0	TSD (Process)	1/1/70	CANCELLED
	B. Evaluate Improved Drumming	0	5	TSD (Process)	6/1/70	Report Drafted
2.	Increase Yields					
	A. Improve Blend Raw Material Yields	0	0	Production	1/1/70	Action Taken
	B. Chlorine Usage Study	0	10	TSD (Process)	1/1/71	In Progress
3.	Reduce Maintenance Costs					
	A. Determine Off-Gas Corrosion	0	10	TSD (Process)	9/1/70	MM&T Advice Needed
	B. Preventive Maintenance Lists	0	10	Prod/Maint.	3/1/70	In Progress
4.	Maintain Quality					
	A. Roofs on Loading Docks	8000	15	TSD (Mech. Design)	6/1/70	
	B. Resolve Electrical Property Measurement	0	0	TSD/Maint	1/1/71	Waiting for Lab Scrubber
	C. Preloading Quality Treatment	T.B.D.	20	TSD (Process)	*	Waiting for 4B
	D. Ag Grade KCl Test	0	10	TSD (Process)	3/1/70	Check effect on Aroclor
5.	Maintain Adequate Capacity					
	A. Replace Mix Tank Pumps	$5000	5	Maint.	6/1/70	Obsolete.
	B. Drowning Jet Evaluation	0	5	TSD (Process)	6/1/70	Check Capacity
	C. Improve Mix Tank Mixing	0	5	Production/ TSD (Process)	8/1/70	Minor Modification

* Dependent on ability to reproduce electrical property measurements - 4B.

APPENDIX F.

NO.	ITEM	EST. COST	EST. MAN-DAYS	RESPONSIBILITY	EDC	COMMENTS
5.	Maintain Adequate Capacity (Cont'd)					
	D. Establish Minimum Drum Inventory	0	5	Production	3/1/70	
6.	Provide Safe Working Atmosphere					
	A. Fume Removal System Addition	$8000	10	TSD (Process)	7/1/70	Extension of System
	B. Lime Delivery Facility	1000	5	TSD (Mech. Design)	Hold	waiting for fork lift app.
	C. Safety Audit Items	T.B.D.	15	Production	11/1/70	Ref. Safety Audit
7.	Keep Aroclor from Sewers					
	A. Control Rupture Disc Discharge	5000	15	(TSD-Process)	6/1/70	Recycle to Surge Tank
	B. Install Sewer Basins	$11,000	15	TSD (Mech. Design)	7/1/70	Trap Aroclor
	C. Sewer Pollution Check	0		TSD (Pollution Control)	Cont.	Sampling to continue
	D. Reduce Blow Tank Losses	0	10	TSD (Process)	10/1/70	Aroclor to sewer
	E. Determine Amount of Aroclor in Off-Gas	0	5	TSD (Process)	4/1/70	At Depts. 217 & 218
	F. Catch Wastes from Drip Pans & Sample Lines	0	0	Production	3/1/70	
	G. Piping Modifications on Blow Tank	5400	20	TSD (Mech. Design	5/1/70	

APPENDIX F. WORK PLAN - (Continued)

NO.	ITEM	EST. COST	EST. MAN-DAYS	RESPONSIBILITY	EDC	COMMENTS
8	Maintain Control of Process					
	A. Complete Process Variables Chart & Key Variable List	0	10	Production	4/1/70	In progress
	B. Revise Operating Instructions	0	10	Production	7/1/70	In progress
	C. Revise Std. Mfg. Process	0	10	Production	12/1/70	In progress
9	Maintain High Level of House-keeping and Improve Operations					
	A. Upgrade Control Room	$14,000	0	TSD(Mech.Design)	4/1/70	In progress
	B. Dismantle Obsolete Equipment	2,700	0	Maintenance	3/1/70	In progress
	C. Road & Sewer Improvements	30,000	20	TSD(Mech.Design)	On Hold	No work being done
	D. Pave Tank Farm	T.B.D.	10	" " "	On Hold	No work being done
	E. Replace Lean-to	$200,000	30	" " "	On Hold	No work being done

APPENDIX G. PROCESS CONTROL STATUS REPORT AND OBJECTIVES

PROCESS	Aroclor	Pyranols	Pydrauls	1254/10% Xylene Mix
I. Data Bank				
a. Standard Manufacturing Process	3/1/70	3/1/70	3/1/70	12/1/70
b. Safety Audit	3/1/70	3/1/70	3/1/70	3/1/70
c. Tentative Process	3/1/70	3/1/70	3/1/70	3/1/70
d. Chemical/Physical Properties	3/1/70	3/1/70	3/1/70	3/1/70
e. Monthly Operation Reports	3/1/70	3/1/70	3/1/70	3/1/70
f. Monthly Key Variable Reports	5/1/70	5/1/70	5/1/70	5/1/70
g. Process Control Audits	8/1/70	8/1/70	8/1/70	8/1/70
h. Complaint File	3/1/70	3/1/70	3/1/70	3/1/70
i. Customer Service File	3/1/70	3/1/70	3/1/70	3/1/70
j. Log Sheets	3/1/70	3/1/70	3/1/70	3/1/70
k. Operating Instructions	3/1/70	3/1/70	3/1/70	3/1/70
l. Data Bank Index	3/1/70	3/1/70	3/1/70	3/1/70
m. IFO's	3/1/70	3/1/70	3/1/70	3/1/70
II. Variables Analysis				
a. Variable Analysis	2/20/70	3/1/70	3/15/70	3/15/70
b. Key Variables	4/1/70	4/1/70	4/1/70	4/1/70
c. Key Variable Report	5/1/70	5/1/70	5/1/70	5/1/70

APPENDIX G (Continued) PROCESS CONTROL STATUS REPORT AND OBJECTIVES (Continued)

		Aroclor	Pyranols	Pydrauls	1254/10% Xylene Mix
III.	Standard Manufacturing Process Revision				
	a. Variable Analysis	Current-Batch 10/66 Cont. 9/68 Rev. 9/1/70	Current-10/66 Rev. 11/1/70	Current-10/66 Rev.-12/1/70	Current-None Rev.-12/1/70
	b. Key Variables	"	"	"	"
	c. Documentation and Reporting	"	"	"	"
IV.	Key Variable Control Instrumentation				
	a. IFO	Complete	Complete	Complete	Complete
	b. IPMO	Complete	Complete	Complete	Complete
	c. PM Program	6/1/70	6/1/70	6/1/70	6/1/70
	d. Control Setting Documentation	6/1/70	6/1/70	6/1/70	6/1/70
V.	Operating Instructions				
	a. Revision	Current-10/66 Rev. 6/1/70	Current 10/66 Rev. 7/1/70	Current-10/66 Rev. 7/1/70	Current-10/66 Rev. 7/1/70
	b. Operator Training	9/1/70	9/1/70	9/1/70	9/1/70
VI.	Management System				
	a. Reporting System	Same as II c. 5/1/70	5/1/70	5/1/70	5/1/70
	b. Process Control Committee	7/1/70	7/1/70	7/1/70	7/1/70
	c. Process Audit	8/1/70	8/1/70	8/1/70	8/1/70