Process Area Or Step	Variable Or Parameter	Description Of Parameter As It Affects Safety, Quality, Yield, Rate or Other	Badge For Best Known Process Performance	Supervision Frequency of Monitoring	MEASUREMENT OF VARIANCE			INTERACTION WITH OTHER VARIABLES	HOW CORRECT VARIANCES	COMMENTS
					Frequency	Method	Accuracy			
A. Finished goods adjustments (when necessary)	The following analyses are the ones more likely to be out of specifications:									
	(a) Specific Gravity and refractive Index	Quality	Specification	Each Batch	Each Batch	10114 10125	± 0.001 ± 0.0002	Gravity and index increase or decrease together.	For low gravity and index, add Aroclor. For high gravity or index add TCB or TTCB. In most circumstances add more of a normal component only. If conditions are such that the addition of a different Aroclor or a different chlorobenzene would be beneficial, these may be added in small amounts with supervisory permission.	
	(b) Electrical properties (Power factor resistivity)	Quality	Specification	Each Batch	Each Batch	11608 11607	Unknown	Related to free chlorides	If in the mix tank a blend has a power factor higher than 3.0% (spec. is 5.0%, max.), the batch is earth treated. One or more buckets of attapulgus earth are added manually, the batch agitated for 2 hours and then circulated through a filter. After 1 hour the mix is analyzed and filtration continued. The procedure is repeated if necessary.	
	(c) % Chloride Scavenger (Glycidal phenyl ether or unox epoxide).	Quality	Specification	Each Batch	Each Batch	11,865 13,014	± 0.002%	There is some evidence that earth treatment may remove some chloride scavenger.	If not enough scavenger is present, add more. If too much is present, earth treatment may lower the percentage. A second alternative is to build a larger batch using less scavenger.	
	(d) H_2O	Quality	Specification	Each Batch	Each Batch	10,620	± 2.5 ppm	Too much water may lower electrical properties.	If water content is high, sparge with air or nitrogen.	

MONS 055616

DEPT. A-246 (Mix Tank)

Kind of Mix _____ Lot No. _____ Date _____

Material Added	Meas. BP	AP	Date	Time	AM	PM	Operator	

Sampled by _____ Date _____ Time _____ AM PM

Analysis received: Date _____ Time _____

Sp. Gr. _____ Reactive Index _____

Adjustments & Resamples

Material Added	DP	AP	Date	Time	Operator	Sampled Date	Sampled Time	Sampled Operator	Analysis Received Date	Analysis Received Time	Sp. Gr.	Ref.Ir

FINAL SAMPLE TAKEN BY _____ at _____ AM PM

Press Blowing at _____ AM PM Press Cleaned at _____ AM PM By _____

COMMENTS:

MONS 055617

Dept. 640 — Daily Transfer Sheet — Date

Product	Batch No.	From Tank	Meas. B.P.	Meas. A.P.	Time	Oper.	To Tank	Meas. B.P.	Meas. A.P.	Oper.	Time

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.

DEPT. 259 - STANDARD MANUFACTURING PROCESS

Pyranols, Inerteens, and FR-O

APPENDIX K

BACKGROUND INFORMATION

Monsanto began producing Aroclors in 1929 and has been using the same process in principle ever since. Specifications on Aroclor became more stringent with time. The General Electric Company mixed some of the different Aroclors to form products with intermediate physical properties and named the mixtures Pyranols. Later, Aroclor was mixed with Trichlorobenzene, tri-tetrachlorobenzene, toluene, butyl acetate and cresyl diphenyl to form pyranols with special properties. As products with lower allowable free organic chlorides were required, chloride scavengers such as tin tetraphenyl, glycidyl phenyl ether and Unox Epoxide were added to the mix.

Pyranols at the present time are formed by mixing Aroclor and Trichlorobenzene or Tri-tetrachlorobenzene. Glycidyl phenyl ether and unox epoxide are the best chloride scavengers now known and are the only chloride scavengers used.

Monsanto's Aroclors, especially the chlorinated biphenyls including types 1242, 1248, 1254 and 1260, used alone or in combination with chlorinated benzenes, are commonly used dielectric materials of the ASKAREL class.

Askarel is a generic name referring to liquid dielectrics derived from halogenated aromatic compounds possessing excellent chemical and dielectric stability and fire resistance over the temperature ranges and operating conditions of transformers and capacitors in the electrical industry. The electrical industry's use of these fluids have been in accordance with the General Electric Company's patents and developments.

Resulting from the wide use of these materials in the electrical industry trade names have been established to identify them by different manufacturers of electrical equipment. Listed alphabetically, the trade names include, "Chlorextol," Allis Chalmers; "Diaclor," Sangamo Electric; "Dykanol," Cornell Dubilier; "Elemex," Line Materials; "Hyvol," Aerovox; "Inerteen," Westinghouse Electric; "Noflamol," Wagner Electric; and"Pyranol," General Electric Company.

The electrical and fire-resistant properties of Askarel type fluids have enabled them to capture a share of the market from the lower-cost transformer oils.

DEPT. 259 - STANDARD MANUFACTURING PROCESS

Pyranols, Inerteens, and FR-O

APPENDIX L

TIME CYCLE

The cost standard capacity (1970 and 1971) of Dept. 259 for Pyranol production is 1.7 M lbs./mo., or approximately 20 M lbs./yr. The production for 1970 will be about 15.0 M lbs. Storage facilities are the limiting factor in Pyranol production. There are no finished goods storage tanks. Tank cars are loaded and drums filled directly from #2 or #3 Mix Tank. The fact that four electrical grade blends are made in two mix tanks means that at most, two of the four blends are available in bulk quantities. If both tanks were in the blending cycle, none of the blends would be immediately available in bulk.

These facts also affect batch size. Efficient use of equipment, manpower, and laboratory analysis would indicate that large batches should always be made. The pressure of time may dictate, however, that only a small batch be made, large enough for only one specific order. This would then make it possible to make a different blend immediately afterward.

The following table shows an approximate time cycle for a 12,000 gal. batch of Inerteen 70/30, Inerteen PPO, or Pyranol A13B3B. A batch of Inerteen 54201 CM would take less time because it does not contain a chlorobenzene.

TIME CYCLE

Step	70/30, PPO, or A13B3B	54201 CM
1. Charge Aroclor and chlorobenzene	4 hrs.	2 hrs.
2. Blend major components	4	-
3. Sample for control and analysis	2	-
4. Adjust and reanalyze (if necessary)	0-6	-
5. Charge chloride scavenger	1	1
6. Blend total batch	3	3
7. Sample and final analysis	10	10
8. Earth treat and reanalysis of electrical properties (if necessary)	0-6	0-6
Totals -	24-36 hrs.	16-22 hrs.

From this point on, the batch cycle is dependent upon how the product is packaged. Bulk shipments can be loaded at a rate of 35-50 GPM depending on filter condition. Drums (55 gallon) can be filled at a rate of 40-44 per man per shift.

If for any reason a tank car analysis is out of specification, the product may have to be unloaded to the mix tank, reworked, analyzed, and reloaded.

DEPT. 259 - STANDARD MANUFACTURING PROCESS

Pyranols, Inerteens, and FR-O

APPENDIX M

QUALITY CONSIDERATIONS

Pyranols and Inerteens are functional chemicals. Pyranols and Inerteens are used mainly as transformer fluids in the electrical industry. Qualities exhibited by Pyranols and Inerteens include excellent chemical and dielectric stability and fire resistance over the temperature ranges required of transformers and capacitors.

Pyranols and Inerteens are manufactured under very carefully controlled conditions in order to meet the strict and exacting electrical requirements and properties. Good quality Aroclor is essential for producing high grade Pyranols. Any contemplated process change must be carefully evaluated before the actual change is made. Changes in product properties or off-grade products can extensively damage electrical equipment.

Notes on quality not mentioned elsewhere:

1. On one occasion TCB became mixed with TTCB. No pure tetrachlorobenzene was available so that the mixture could be made to meet TTCB specifications. The mixture was blended with TCB and used as TCB. After blending, the mixture contained about 3-4% tetrachlorobenzene. The Inerteens 70/30 and PPO made utilizing this mixture were all in specification.

2. It is not always necessary to wash a tank car before loading it with a product different from its previous contents, assuming the heel is small (12" wide or less) and assuming that it is otherwise clean. Two such cases are shown below. In the third case the car must be washed because 5420ICM does not contain chlorobenzenes.

	PREVIOUS PRODUCT	CURRENT PRODUCT TO BE LOADED
(a)	Aroclor 1242 or 1254	Any Pyranol or Inerteen
(b)	Any Pyranol or Inerteen	Inerteen 70/30, PPO, or Pyranol A13B3B.
(c)	Inerteen 70/30, PPO, or Pyranol A13B3B must be washed.	Inerteen 5420I CM

3. A "quick and dirty" method for checking for organic contamination in Aroclor is to add sulfuric acid to the Aroclor and heat it. If contaminated, the Aroclor will turn dark. If not, it will retain its water white color. This test is not appropriate for the electrical grade blends because the chloride scavenger will always turn black.

Dept. 259 - STANDARD MANUFACTURING PROCESS

Pyranols, Inerteens, and FR-O

APPENDIX N

Miscellaneous

This section contains the following data:

1. Additional raw material information
2. References
3. 1971 Production Cost Standard
4. Operations Report (1970 YTD)
5. Status Report of Department 246 Safety Audit
6. Dept. 246 Safety Audit
7. 1970 Aroclor Group Objectives
8. Manufacturing Improvement Plan

Dept. 259 - STANDARD MANUFACTURING PROCESS

Pyranols, Inerteens, and FR-O

APPENDIX N

Miscellaneous

Raw Materials

1. TCB and TTCB

   TCB and TTCB are received in tank car quantities from Hooker Chemical Company. The tank cars are samples and analyzed for specific gravity and index. The other properties are determined from the suppliers Certificate of Analysis. Cars are unloaded into a storage tank. Tank trucks are used to supply TCB and TTCB during times of shortage of material.

2. Aroclor 1242, 1254, 1260

   Received by pipeline from Department 246.

3. Glycidyl Phenyl Ether

   Purchased from Shell Chemical Company in 55 gallon drums, 475 lbs. each.

4. Unox Epoxide (EP-221)

   Purchased from Union Carbide in 55 gallon drums.

5. Attapulgus Earth

   Purchased in 50 lb. bags.

Dept. 259 - STANDARD MANUFACTURING PROCESS

Pyranols, Inerteens and FR-0

APPENDIX N

Miscellaneous (continued)

REFERENCES

1. St. Louis Report No. 2072, Job No. 2-02-750.01 - 3428, May 4, 1956.

   Title: Final Report on Aroclor Process Studies

   Summary: Purity of raw materials, catalyst concentration, reaction temperature, and rate of chlorination were the variables studied with respect to their influences on the stability of the finished product.

2. St. Louis Report No. 2420, Job No. 2-02-750.01 - 2681, January 8, 1960.

   Title: Assistance to Sales and Development Departments on Aroclors, Biphenyl and related products.

   Summary: Studies were made to measure physical properties and other data on the Aroclor series of compounds.

3. St. Louis Report No. 2540, Job No. 171-616, December 28, 1958.

   Title: The Effect of Prolonged Heat on the Electrical Properties of Aroclors.

   Summary: Aroclors 1232, 1242, 1248 and 1254 were held at 130°C. The power factor was periodically measured.

4. E. E. Martin, Process Description for the Manufacture of Pyranols and Inerteens, W. G. Krummrich Plant, June, 1957.

5. P. G. Benignus, The Proper Handling of Aroclors and Their Mixtures in the Electrical Industry, St. Louis, May 1, 1957.

PRODUCTION COST STANDARD — PLANT W.B. KRUMMRICH — Page 1 of

PRODUCT: PVC 215 — PRODUCT CODE: 21090 — Effective

NO.	DAY	TR	DIV.	LOC.	DIV.	LOC.	C.CTR	PRODUCT	P-F
	4	3	6-7	8-11	12-13	14-17	18-20	21-25	1-3
	1		03	1100	02	0255	254	21090	

CAPACITY: 1,645,000 — BLK. INV. $1D. — COST UNIT: CWT

4-25 — TYP 26 — TYP 27 — NO. 38-40 — UNIT COST 41-48 — EQUIPMENT USED: Dept. No. 810 50 — Percent

DUPL. COLS. 4-25 INTO ALL CARDS — CRS — TYP 3 — NO. 030 — TYP 3 — NO. 034 — TYP 3 — NO. 045

DUPLICATE COLS. 4-25 INTO ALL CARDS

P-F	4-25	TYPE 27	UNIT 34
1-3			
CRS	PRODUCTION BKT. QTY.	4	1

BRACKET 1 — INV.STD. UNIT COST: DAYS 36-38 = 30 | 10; UNIT STD. 39-46

BRACKET 2: DAYS 47-49 = 210; QUANITY 50-57 = 1,533,600

BRACKET 3: DAYS 58-60 = 210; QUANITY 61-68 = 1,242,000

BRACKET 4: DAYS 69-71; QUANITY 72-79

	PRODUCT COST	LK CL	AM T	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
	Material Cost				V														
DO NOT	Steam	530			F	114													
KEY	Electricity	533				11													
PUNCH	Comb. Air	536																	
THIS	Water-Purch.	539																	
SECTION	Water-Pits	542																	
	Fuel-Gas	545																	
	Fuel-Oil	546																	
P-F	DUPL. COLS. 4-25	26-29	36	37	38	48-55	CR 55				56-63		CR 63		64-71		CR 71	72-79	CR 79
1-3																			
CRS	Labor-Mfg.	570	2	1	F	627													
CRS	Salaries	575	2	1	B	1,2													
CRS	Payroll OH	578	2	1	F	5													
CRS	Factory Supplies	590	2	1	F														
CRS	Packing Labor	601	2	1	F	5													
	Packing OH	603	2	1	F	8													
	Laboratory	610	2	1	V	50													
CRS	Cloth & Laundry	614	2	1	F	30													
CRS	Tech. Service	621	2	1															
CRS	Pln. Prod. Res. & Dev.	625	2	1	B	15													
CRS	Waste Disposal	651	2	1															
CRS	Tank Car Storage	687	2	1	F	220													
CRS	Mechanical Exp.	694	2	1	B	625													
CRS	[illegible]	60	2	1	B	5													
CRS	[illegible]	601	2	1	F	25													
CRS	[illegible]	615	2	1	F	25													
CRS	[illegible]	615	2	1	F	50					50				50				
CRS	[illegible]	655	2	1		600									600				
CRS	Total Direct Conv.					7									51				
CRS	Depreciation	698	2	1	B	1,5					1,5				1,5				
CRS	Factory Indir. Exp.	760	2	1	B	1													
CRS	Total Indir. Exp.					1					1				1				
CRS	Total Product Cost					6					7				6				
CRS	Total F. & G. Cost					1					1				1				
CRS	Total Variable Cost					5					6				5				

	LABOR/UTILITY SERVICE	UNIT	EXP CL	QTY	CRD	VFB	STANDARD UTL. PRICE	CR	BRACKET 1	CR	BRACKET 2	CR	BRACKET 3	CR	BRACKET 4	CR
CRS	DUPL. COLS. 4-25		26-28	36	37	38	39-47		48-55	55	56-63	63	64-71	71	72-79	79
CRS	Labor	Hrs.	570	1	2		5.22		11		11		9			
CRS	Laboratory	Hrs.	610	1	1	V	10.00		5		5		11.0			
CRS	Steam	MBTU	530	1	1	F	1.35		10				6.1			
	Electricity	CKWH	533	1	1	F	10.00				15					
	Compair	MCFT	538	1	1											
CRS	Water-Purch.	MGAL	539	1	1											
CRS	Water-Pits	MGAL	542	1	1											
CRS	Fuel-Gas	MBTU	545	1	1											
CRS	Fuel-Oil	MBTU	546	1	1											

G-9701 REV 4-70

MONS 055629

PRODUCTION COST STANDARD

PLANT W. 6, KAMMRICH

Page 2 of [illegible]

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	81090

PRODUCT PYRAMIDS
PRODUCTION CODE 81090
BULK INV. STD. COST

EFFECTIVE [illegible]
CAPACITY [illegible]
COST UNIT [illegible]

PF	MATERIALS: 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	ANAPHLUS CLAY	505	19400		999	0	0				015			[illegible]	[illegible]
CR7						0									
CR7						0									
CR7						0									
CR7	55 GAL DRUM	505	93320		030	0	[illegible]				150			[illegible]	[illegible]
CR7	5 GAL CAN	505	94135		030	0	[illegible]			1	[illegible]			[illegible]	[illegible]
CR7						0									
CR7						0									
CR7						0									
CR7						0									
CR7						0									
CR7						0									
CR7						0									
CR7						0									
CR7	Cont. Handling	527				0					—			—	
CR7	R/M Whsg. & Handling	526									014			01400	
CR7	Gross Total Mat'ls.														
CR7	By-Products	523					0								
CR7							0								
CR7							0								
CR							0								
CR7							0								
CR7							0								
CR7	Total By-Products														
CR7	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

BRACKETS	1	2	3	4	5	6	7	8	TYPE PKG.	NET LB./PKG.	Gross Lb./Pkg.	Net Lb./Pallet	Gross Lbs. P.
Operating Period: DAYS	30	30	22						[illegible]				
SHIFTS	3	3	3										

PRODUCTION CONTROL DATA: CLASSIFICATION	AMOUNT					
Cost/Shut Down		[illegible]				
Cost/Start-Up						
Cost/Changeover						
Pkg. Changeover Cost						
Pkg. Rate Lbs./Mo.						

CONTAINERS:	USAGE/UNIT	PRICE PER CONT.	CONT. COST/UNIT	PKG. UNIT STD.
93320 55 GAL DRUM	150	8.[illegible]	1 313	
94135 5 GAL CAN	1 6[illegible]	1.85000	3 115	
93231 20 GAL DRUM	751	8.11000	2 279	

THER INFORMATION

DOWNTIME SUMMAR	[illegible]	RL	TOT
Repair	0 %	0 %	
Process	1.00	0	[illegible]
Other	1.00	0	
Inventory	0	0	
Total	2.00	0	
On-Stream	[illegible] %	[illegible] %	[illegible]
On Stream Rate	[illegible]		

MONS 055630

APPROVAL	SIGNATURE	DATE
	[illegible]	[illegible]
	[illegible]	[illegible]

PRODUCTION COST STANDARD — PLANT W.G. Krumrine — Page 3 of 5

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	207	81220

PRODUCT Flyash
PRODUCTION CODE 81220
BULK INV. STD. COST
EFFECTIVE 1-1-71
CAPACITY
COST UNIT CWT

PF	MATERIALS — DUPLICATE COLS. 4-25 INTO ALLCARDS	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	Transport Rec (Rail)		54xx	0		0						
CR7	Misc Handling Stor?			2220		0					3.25	
CR7	9220 Trucks Rec			46	220	0					11700	
CR7	Misc Disp Ash Pond			60	222	0					10.72	
CR7						0						
CR7	Transp Rec (Rail)					0						
CR7	Trans Trucks Rec			46	220	0					11700	
CR7	Misc Disp Ash			60	222	0					10.72	
CR7						0						
CR7	Transp Rec (Rail)					0						
CR7	Trans Trucks Rec			46	220	0					11700	
CR7	Misc Disp Ash			60	222	0					10.72	
CR7						0						
CR7						0						
CR7	R/M Wtsg. & 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						0					
CR7	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 ST

BRACKETS	1	2	3	4	5	6	7	8	TYPE PKG.	NET LB./PKG	Gross Lb./Pkg.	Net Lb. Pdlt.	Gross Lbs.
Operating Periods DAYS													
SHIFTS													

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	PROD. UNIT STD.

OTHER INFORMATION

DOWNTIME SUMMARY	OT	RT	TOTAL
Repair	%	%	
Process			
Other			
Inventory			
Total			
On Stream	%	%	
On Stream Rate		#/Hr.	

MONS 055631

APPROVAL	SIGNATURE	DATE

PRODUCTION COST STANDARD

PLANT Wm. Kenwick

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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	457	81090

PRODUCT [illegible]

PRODUCTION CODE 81090

BULK INV. STD. COST

EFFECTIVE 1-1-[illegible]

CAPACITY

COST UNIT C[illegible]

PF	DUPLICATE COLS. 4-25 INTO ALLCARDS	EXP CE	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	[illegible]		[illegible]			0									
CR7	[illegible]		[illegible]			0								11750	
CR7	[illegible]		[illegible]			0								[illegible]	
CR7	[illegible]		[illegible]			0								[illegible]	
CR7						0									
CR7	[illegible]					0									
CR7	[illegible]					0								[illegible]	
CR7	[illegible]					0								[illegible]	
CR7	[illegible]					0								[illegible]	
CR7						0									
CR7	[illegible]					0									
CR7	[illegible]					0								[illegible]	
CR7	[illegible]					0								[illegible]	
CR7						0									
CR7						0									
CR7	R/M Wkg. & Handling	526													
CR7	Gross Total Matls.														
CR7	By-Products	523					0								
CR7							0								
CR7							0								
C[illegible]							0								
C[illegible]							0								
CR7							0								
CR7	Total By-Products														
CR7	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

BRACKETS	1	2	3	4	5	6	7	8
Operating Periods DAYS								
SHIFTS								

PRODUCTION CONTROL DATA	CLASSIFICATION	AMOUNT
	Cost/Shut Down	
	Cost/Start-Up	
	Cost/Changeover	
	Pkg. Changeover Cost	
	Pkg. Rate Lbs./Hr.	

TYPE PKG.	NET LB/PKG.	Gross Lb./Pkg.	Net Lb./Pallet	Gross Lb./

CONTAINERS	USAGE/UNIT	PRICE PER CONT.	CONT. COST/UNIT	PKG. UNIT STD

THER INFORMATION

DOWNTIME SUMMARY	DT %	RL %	TOTAL %
Repair			
Process			
Other			
Inventory			
Total			
On-Stream			
On Stream Rate			

MONS 055632

APPROVAL	SIGNATURE	DATE
	[illegible]	4/16/70

PRODUCTION COST STANDARD

PLANT W. G. KRUMRICK — Page 5 of 5

MO	DAY	YR	DIV.	LOC	DIV.	LOC	CCTR	PRODUCT	PRODUCT	EFFECTIVE
	4*	$	6-7	8-11	12-13	14-17	18-20	21-25	PRODUCTION CODE 81090	CAPACITY
		1	02	0003	02	0003	259	81090	BULK INV. STD. COST	COST UNIT

PRODUCT: PUMPS

MATERIALS

PF	DUPLICATE COLS. 1-4-25 INTO ALL CARDS	EXP CL	PRODUCT	LOC	FORM. PKG.	$ & 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	PUMP SUBASSEMBLY					0									
CR7						0									
CR7	24"-64V MACHINING			X20		0							2.125		
CR7	8110-12"x6" REACTOR			1020		0							100.00		
CR7						0									
CR7	COST SUMMARY					0		ANY SIZE		STANDARD					
CR7	CAST NICKEL CASING					0									
CR7	81020 .07525	.02				0		.12657		.11502			.11875		
CR7	81211 .0065					0		.06579		.11033			.11959		
CR7	81215 .0065					0		.06585		.10370			.11959		
CR7	81217 .0065					0		.06587		.11033			.11959		
CR7	81218 .0065					0		.06587		.11033			.11959		
CR7	81219 .0065					0		.06587		.11033			.11959		
CR7	81110 .07525					0		.08592		.10705			.10741		
CR7						0									
CR7	R/M Whsg. & Handling	526													
CR7	Gross Total Mat'ls.														
CR7	By-Products	523					0								
CR7							0								
CR							0								
CR							0								
CR							0								
CR7							0								
CR7	Total By-Products														
CR7	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. ST

BRACKETS	1	2	3	4	5	6	7	8
Operating Periods: DAYS								
SHIFTS								

TYPE PKG.	NET LB./PKG.	Gross Lb./Pkg.	Net Lb./Pallet	Gross Lbs.

PRODUCTION CONTROL DATA

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

CONTAINERS:	USAGE/UNIT	PRICE PER CONT.	CONT. COST/UNIT	PKG. UNIT STD

OTHER INFORMATION

DOWNTIME SUMMARY	DT	RL	TOTAL
Repair	%	%	%
Process			
Other			
Inventory			
Total			
On-Stream	%	%	
On Stream Rate			

MONS 055633

APPROVAL	SIGNATURE	DATE
		7/10/72

DEPT. 246 1970 OPERATION REPORT
>clors 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	3073254	4054904	5055954	4267264	3793791	4084713	4633687	5928
SCHED.	3118613	2841584	3969985	3969407	3073254	4054904	4960000	4267264	3793791	4084713	4800000	4959
ACT.YTD	3118613	5960197	9930182	13899589	17672843	21927747	26983701	31250965	35044756	39129469	43763156	49692

PRODUCTION - AROCLORS BY KIND

1232	0	0	0	33500	-0-	-0-	0	-0-	-0-	-0-	-0-	423
1242	2133478	1659600	2720901	2463352	2540720	2293136	2360725	2227526	2431054	2658334	3659746	4692
1248	329056	548981	388068	742814	254785	587952	919216	569605	225583	325488	285346	228
1254	399369	573264	519416	510227	421136	825887	1432762	1163566	722600	883225	446041	521
1260	256710	59739	341600	229514	746600	347923	291051	306577	415814	217666	242554	446
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.
YTD	100.99	101.39	100.26	100.38	100.03	100.07	100.35	100.48	100.34	100.52	100.57	100.

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	0.2
RESISTIVITY	5900	12270	9760	18680	10970	14780	9480	14,660	7640	12,900	14,900	14,8
POWER FACTOR	1.65	1.61	0.98	0.57	0.74	0.97	1.36	0.91	1.37	1.12	1.10	0.9
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-	2	2	0	0	1	0
SERIOUS	0	0	0	0	0	-0-	0	0	0	0	0	0

COMPLAINTS(9 in 1969)

[illegible]	0	1	2	1	0	0	0	0				

MONS 055634

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

MONS 055635

DEPT. 259 197[illegible] 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	194516	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	773
DEPT.	316	212	288	392	300	253	241	152	336	493	389	299
TOTAL	783	440	473	750	643	615	737	515	659	1157	1173	1072

MONS 055636

DEPT. 259 197( )PERATION 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.
ACTUAL	92302	140200	270741	132000	134225	286485	240760	281270	408380	255500	416923	29414
SCHED.	92302	140200	270741	132000	134225	286485	240760	281270	408380	255500	416923	29414
ACT. YTD	92302	232502	503243	635243	1069468	1355953	1596713	1877983	2286363	2541863	2958785	325292

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

WHSE.	415	179	195	445	213	176	217	152	200	184	318	47
DEPT.	75	89	0	71	64	136	95	29	135	-0-	123	
TOTAL	490	268	195	516	270	312	312	181	335	184	441	48
												-

Pydraul 280(811.19)

PRODUCTION-280 (0.96M# in 1969)

ACTUAL	0	132500	0	0	96875	265000	131875	118750	0	113125	125000	0
SCHED.	0	132500	0	0	96875	265000	131875	118750	0	113125	125000	0
ACT.YTD	0	132500	132500	132500	229375	494375	626250	745000	745000	858125	983125	98312
PYDRAUL 625												12742

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

TCP Mo.	N/A	97.26	N/A	N/A	93.61	98.79	101.80	92.52	0	98.09	108.31	98.6
TCP YTD	N/A	97.26	97.26	97.26	95.68	97.32	98.23	97.27	97.27	97.38	98.65	98.6

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

WHSE.	85	90	46	46	1	22	72	58	58	173	35	46
DEPT.	0	0	0	0	0	22	0	1	1	-0-	-0-	30
TOTAL	85	90	46	46	1	44	72	59	59	173	35	76

MONS 055637

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 Biϕ, 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 Biϕ, 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 ∅ 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 Bi∅ if the Aroclors are consistently chlorinated to near their upper limits and there are no significant losses. Bi ∅ 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 2.08M lbs. Order level was high and inventories were increased by 0.5M 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 1.0M 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

November 2, 1970

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

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

REFERENCE

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.

RM McCutchan

R. M. McCutchan

/gjs

MONS 055647

MONSANTO COMPANY

ORGANIC DIVISION

W. G. KRUMMRICH PLANT

PROCESS SAFETY AUDIT

DEPARTMENT 246

AROCLORS, PYRANOLS, PYDRAULS

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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 should be properly equipped to handle a flammable liquid.	3

Depts. 246 and 259

	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

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	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

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 (TR48). 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 #31 of panel mounted 32 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 2 for [illegible] 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" line traced and insulated overflow/vent line back to Item 102 to maintain a constant charge size (500 gal.) to the batch chlorinator.

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 temperature 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 temperature 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 temperature 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 acid

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, 599) in parallel which remove any entrained liquids. From there it passes through a chlorine 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 incoming 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 installed 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 sign 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. 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 wat if any is spilled on the skin.

Glycidal Phenyl Ether is used as a chlorine scavenger in producing Pyrenols; 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, Rhomoric 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 irritation of the eyes and mucous membranes. It is a general nuisance 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 lime (dust). Adequate ventilation and dust removal equipment should be used in the handling area.

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Lime is added to the stills to neutralize any liberated HCl to 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 33050)

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. Direct 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 indicated 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 entering 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 (3") are tied into the drowning jet as well as to the atmosphere.

The crude Aroclor (1242) 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 #3 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 [illegible] 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 use 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 explosion 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 1). 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 Project 6939 - "Install Level Measurement on Product Tanks" provides continuous field indication of these tank levels. Due to the batch-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 (95%) 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 provide #1 & #2 blend and finished product tanks similar to the system 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 down, kept off until the batch is complete, any spills cleaned up, closed off and a gas test of the area made. These provisions 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 1955. 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 the temperature sufficient to cause the mixture to burst into flame.

D) References

1) Factory Insurance Association:
Safeguarding Flammable Liquids (1953).

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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.

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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.	"
1146-1248	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 CX (1242 PPO)	811.10	70% Aroclor 1242 and 0.20% Glycidyl phenyl ether.			

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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 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	628.66	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.

MONS 055627

Dept. 246 - Group Equipment (Batch Plant)

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

MONS 055678

Dept. 246

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			

MONS 055629

Dept. 246

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 (166)(185)	#2) Catch	4'6" x 5'5".	--	No	No	"	"	"
21-0756	#1) Pots	4'6" x 5'5"	--	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

MONS 059680

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 side
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

MONS 055681

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	Nc	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

MONS 055682

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	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

MONS 055683

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 055684

Dept. 285 (1802 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 cor Cl_2	20"x6'3"	--	No	No	No	No	No

MONS 055685

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$\emptyset$ 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.

MONS 055686

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, & high 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 on the low fire setting for 10 min. before the high fire setting can be activated. (auto valve 1/4 sec.) (5) A purge system is in this furnace. The pilot can not be ignited w/o 5 min. purge has been completed.
Therminol surge tank Item 586	

MONS 055687

/1/68

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

tem	Equipment Location	Description
	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 is 3" and discharges on 1st level, 14" abov floor.
	5 chlorinator jackets items 105 thru 109	80# steam, no regulator. Pressure relief valve set for 90#. Storeroom code 04-31632.
	#1 still item 130	Rupture disc with vacuum support 8 inch, monel, bursting pressure 3 PSIG @ 72°F. Storeroom code 51-13
		Rupture disc discharge is 6", and is directed West above roof of lean-to, 4th level.
	#2 still item 133	Rupture disc with vacuum support, 8", monel, bursting pressure 31 PS @ 72°F. Storeroom code 51-13465.
		Rupture disc discharge is 4" and is directed east above roof of control roo 3rd level.
	Chlorine Vaporizer Item 116	Consolidated bronze safety valve type 1471 (1" NPT scrwd.) East end top of vaporizer, pressure relief Cl_2 side set for 50 PSI.
	Chlorine Vaporizer Item 116	Rupture disc burst @ 50 PSI 100°F Model 1A. Storeroom Code 51-13416
	Chlorine Vaporizer Item 116	East end, bottom of vaporizer, mercoid pressure switch set at 40 PSI, (wi turn off steam is behind S.E. pane board in control room.
	Sparkler press 36" Item 145	Jacket tested for 100 PSI. 80# st regulated to 20#. Storeroom code pressure relief valve - 04-31632.

Item	Equipment Location	Description
9.	Biphenyl Head Tank Jacket Item 103	Jacket tested for 105# hydrostetic 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.

MONS 055690

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.

MONS 055691

Sauget, Illinois

January 28, 1970

CC: Manager
G. L. Bratsch
R. M. Blowers
T. W. Dalton
D. W. Jackson
W. A. Kuba - 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	T&D/Prod.
2. Supply department data to comply with MGK Procedure L-40.	4/1	Production
3. Use safety device and interlock system inspection frequency developed for department.	Continuing	Production
4. Install addition to fume removal system.	7/1	T&D
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. Maint.
9. Make safety evaluation of drum loanto.	1/1	Mech. Maint.
10. Review grounding of Equipment	4/2	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 CMA explosion damage.		Maint.
15. Install alarm in drumming station.	6/1	Maint.
16. [illegible]		

MONS 055692

II. QUALITY

A. Objectives

1. Maintain 1969 Aroclor Quality Level

		1969 1242	1969 1254
a. Resistivity(10^9 OHM-CM)	[illegible]	3021	19785
b. Power Factor(% at 60 CY)	1.9	2.09	0.61
c. TCC(PPM)	0.14	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.

MONS 055693

III. CAPACITY

A. Objectives

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

B. Actions

	EDC	Responsibility
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	Responsibility
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 miscbarges 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

MONS 055694

V. YIELDS

A. Objectives

	Goal	70 Std.	69 Act.	70 Act.
Biphenyl	99	93	99.24	
TCB	98	98	98.34	
TTCB	98	98	94.30	
TCP	98	99	91.66	

B. Actions

	EDC	Responsibility
1. Continue close surveillance of blending procedures and raw material shipments.	Continuing	Prod.

VI. PROCESS CONTROL

A. Objectives

1. Improve operational control of the process.

B. Actions

	EDC	Responsibility
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.	1/1	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	Responsibility
1. Quantify process material going to toxic dump.	2/1	Production
2. Determine adequacy of dromming 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. Maint.
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. Engr. 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 Responsibilit
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. 3/18/70
Manufacturing

C. H. Deubner, Gen. Supt.,
Maintenance

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

W. R. Kuhn, TPM 3/19/70

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

Prepared by:

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MONS 055697

AROCLOR MANUFACTURING

IMPROVEMENT PLAN

DISTRIBUTION

W. G. Krummrich Plant

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T. W. Dalton
C. N. Deubner
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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.

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

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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	8.6
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)	Resistivity (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, Prodelec 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. Heggart, 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

MONS 055719

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.

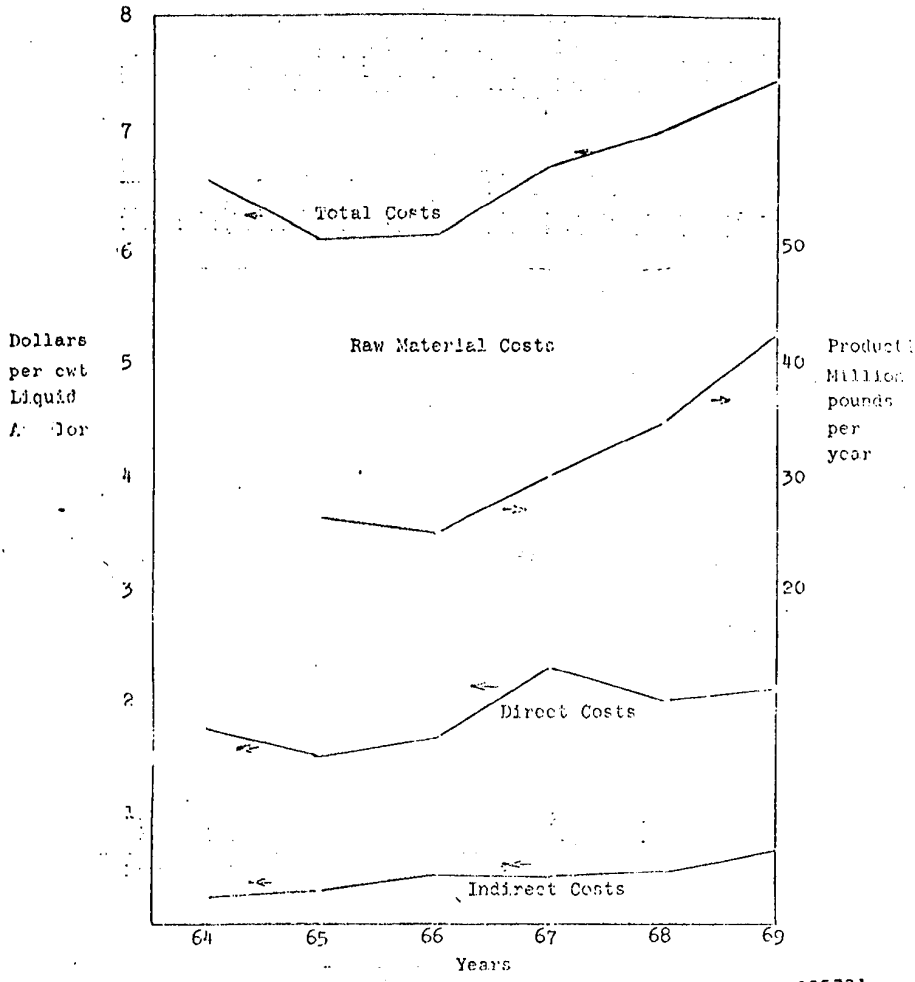
COSTS

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.

MONS 055720

AROCLOR COSTS AND PRODUCTION COMPARISON GRAPH

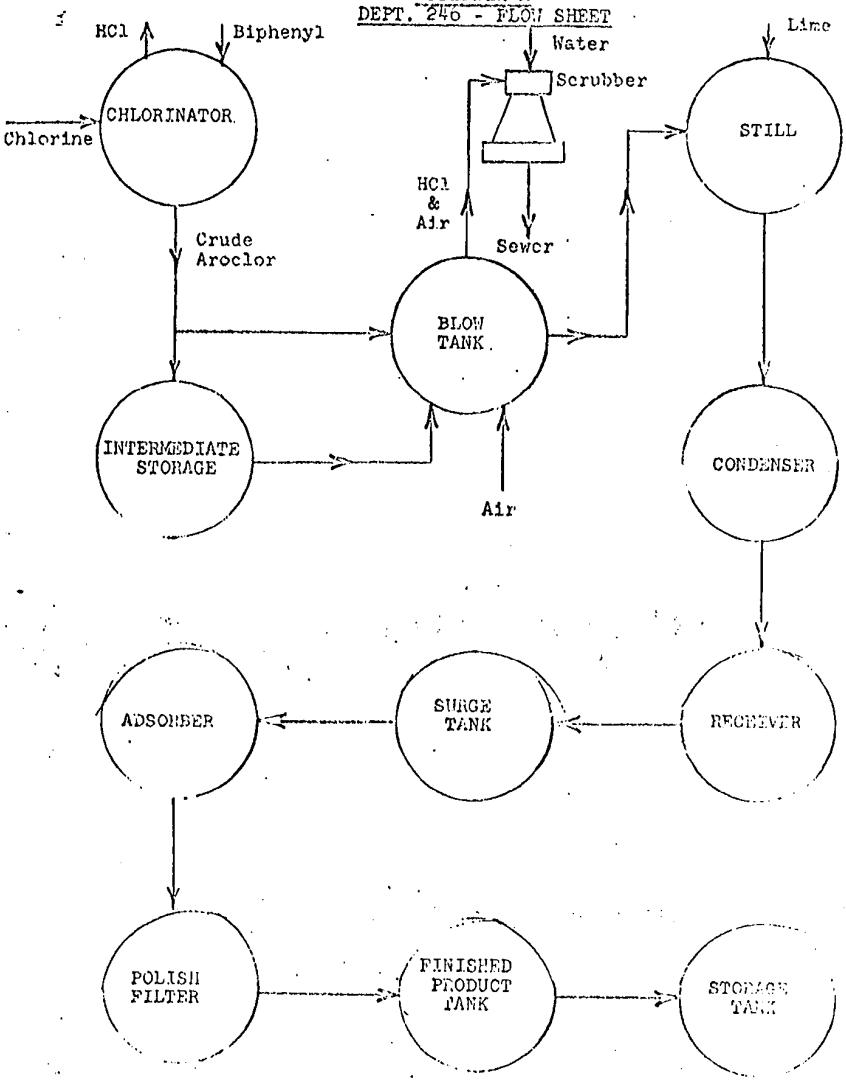


MONS 055721

V. APPENDIX

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

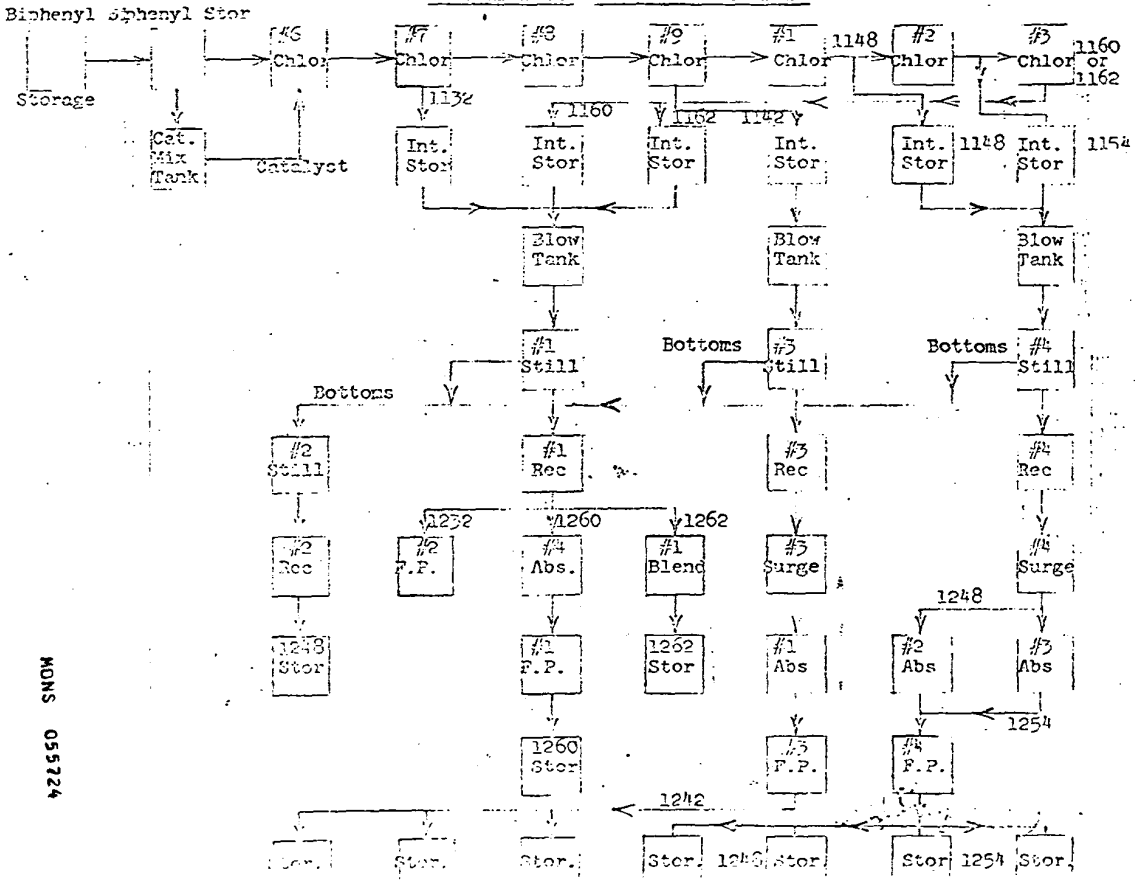
APPENDIX A
DEPT. 246 - FLOW SHEET



MONS 055723

APPENDIX B

POSSIBLE CONTINUOUS ARRANGEMENT



MONS 055724

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	4.89
- 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

MONS 055725

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	Not Analyzed	53,631	0.19
- 5		24,800	0.30
- 6		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

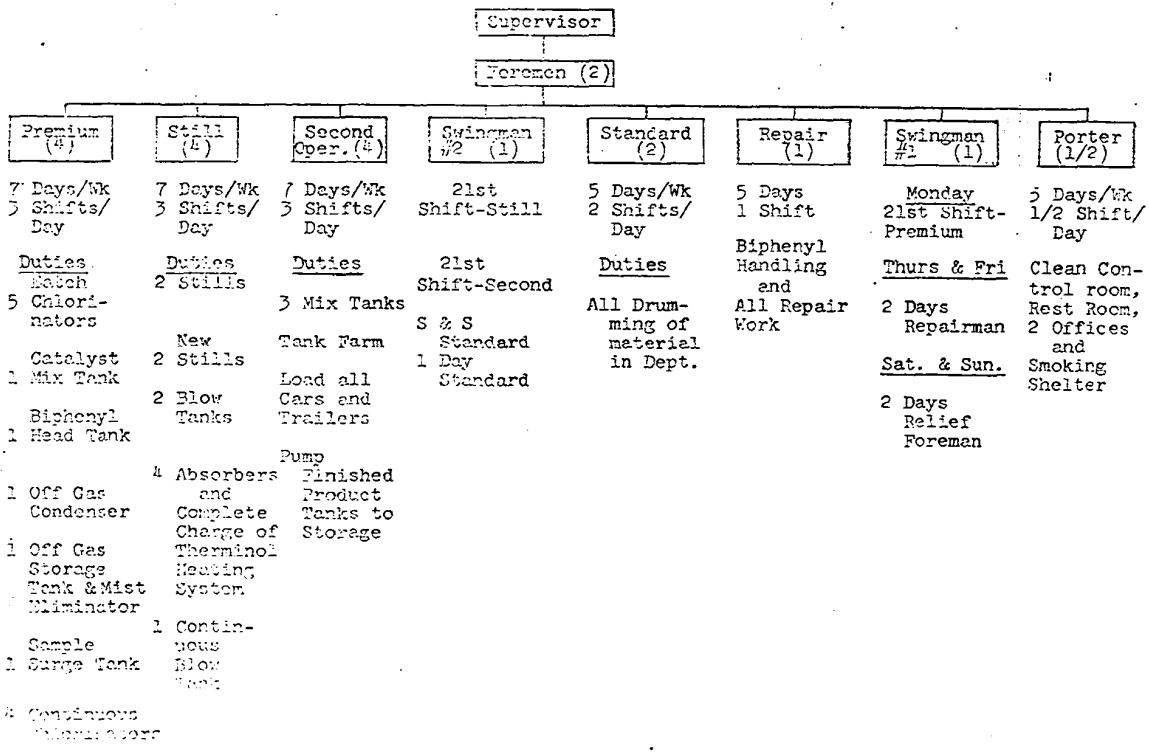
QUALITY COMPARISON FOR ELECTRICAL GRADE AROCLOR 1242

Property	Monsanto Specification	W.G.K.[1]	Anniston[1]	Askarel[2]	Dreyer[3]	Kanegafuchi[3]	Prodelec[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	0.25
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	4.89	4.83
1000 cycles		4.83	4.82				
60 cycles		4.86	4.83				
Resistivity at 100°C (OHM-CM)10^{-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



MONS 055728

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.

MONS 055729

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 & Couple Lines	0	0	Production	3/1/70	
	G. Piping Modifications on	5000	20	TSD (Mech. Design	5/1/70	

MONS 055730

APPENDIX F. WORK PLAN - (Continued)

NO.	ITEM	EST. COST	EST. MAN-DAYS	RESPONSIBILITY	EDC	COMMENTS
3	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

MONS 055731

APPENDIX G. PROCESS CONTROL STATUS REPORT AND OBJECTIVES

PROCESS	Aroclor	Pyranols	Pydraul	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

MONS 055732

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

MONS 055733

MONSANTO COMPANY

ORGANIC CHEMICAL DIVISION

STANDARD MANUFACTURING PROCESS

FOR

PYRANOLS

DEPT. 259

INERTEENS

DEPT. 259

FR-0

DEPT. 259

Supersedes: Standard Manufacturing Process for the of Pyranols and Inerteens in Department A-246, Dated October, 1966, and all amendments.

Prepared by: R. M. McCutchan

Approved by:

General Manufacturing Supt.

WR Richard
Research

Manufacturing Manager

Issued: December, 1970

Copy 9 of 15

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5. Manufacturing Superintendent - W.G.K.
6. W.G.K. Department Supervisor
7. W.G.K. Technical Service Department
8. W.G.K. Process Research
9. W.G.K. Library
10. D. Danna - G.O.
11. D. Danna - G.O.
12. D. Danna - G.O.
13. Extra
14. Extra
15. Extra

MONS 055560

AMENDING RECORD SHEET

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DEPT. 259 - STANDARD MANUFACTURING PROCESS
Pyranols, Inerteens, FR-O

SECTION I

SYNOPSIS OF PROCESS

Pyranol and Inerteen are tradenames used to designate mixtures of Aroclor and either trichlorobenzene (TCB) or tri-tetrachlorobenzene (TTCB). A chloride scavenger, glycidyl phenyl ether or unox epoxide 221 is also added.

Pyranols are used as a dielectric in electrical equipment (transformers), and particularly as a transformer cooling medium. The addition of TCB or TTCB to the Aroclor increases fludity of the blend at only a slight expense to its electrical properties. Extreme care is used in the production of pyranol blends because the customer specifications are very stringent.

At the present time four electrical grade blends are made. They are:

	Common Name	Other Names
1.	Inerteen 54201 CM	Inerteen 100-42, 1242 PPO
2.	Inerteen 70/30	Inerteen 54201 KA, 1254 PPO
3.	Inerteen PPO	1260 PPO
4.	Pyranol A13B3B	----

One other blend, Therminol FR-O, is included in this SMP because its components are similar to the electrical grade blends listed above. Therminol FR-O is a low temperature heat transfer fluid and is not considered an electrical grade product.

The proportion of components blended to manufacture the various blends are listed below:

Wt. % Product	Inerteen 54201 CM	Inerteen 70/30	Inerteen PPO	Pyranol A13B3B	Therminol FR-O
TCB	---	30	40	---	---
TTCB	---	---	---	55	20
Aroclor 1242	---	---	---	---	80
Aroclor 1254	---	70	---	---	---
Aroclor 1260	---	---	60	45	---
Unox Epoxide	---	---	---	0.125	---
Glycidyl Phenyl Ether	0.20	0.20	0.20	---	---

Primary chemical reactions are absent in the production of these blends. The manufacturing steps are blending, earth treatment and filtration, and packaging.

Blending is a simple mixing operation. Small adjustments are necessary until proper specific gravity and refractive index are obtained. To improve electrical properties, a small amount of attapulgus earth is added to the blend and subsequently filtered out. The electrical grade products are sold in tank cars or in drums of 55 gal, 30 ga., and 5 gal. Therminol FR-O is sold in trailers or 55 gallon drums.

DEPT. 259 - STANDARD MANUFACTURING PROCESS
Pyranols, Inerteens, FR-O

SECTION I (cont'd.)

SYNOPSIS OF PROCESS

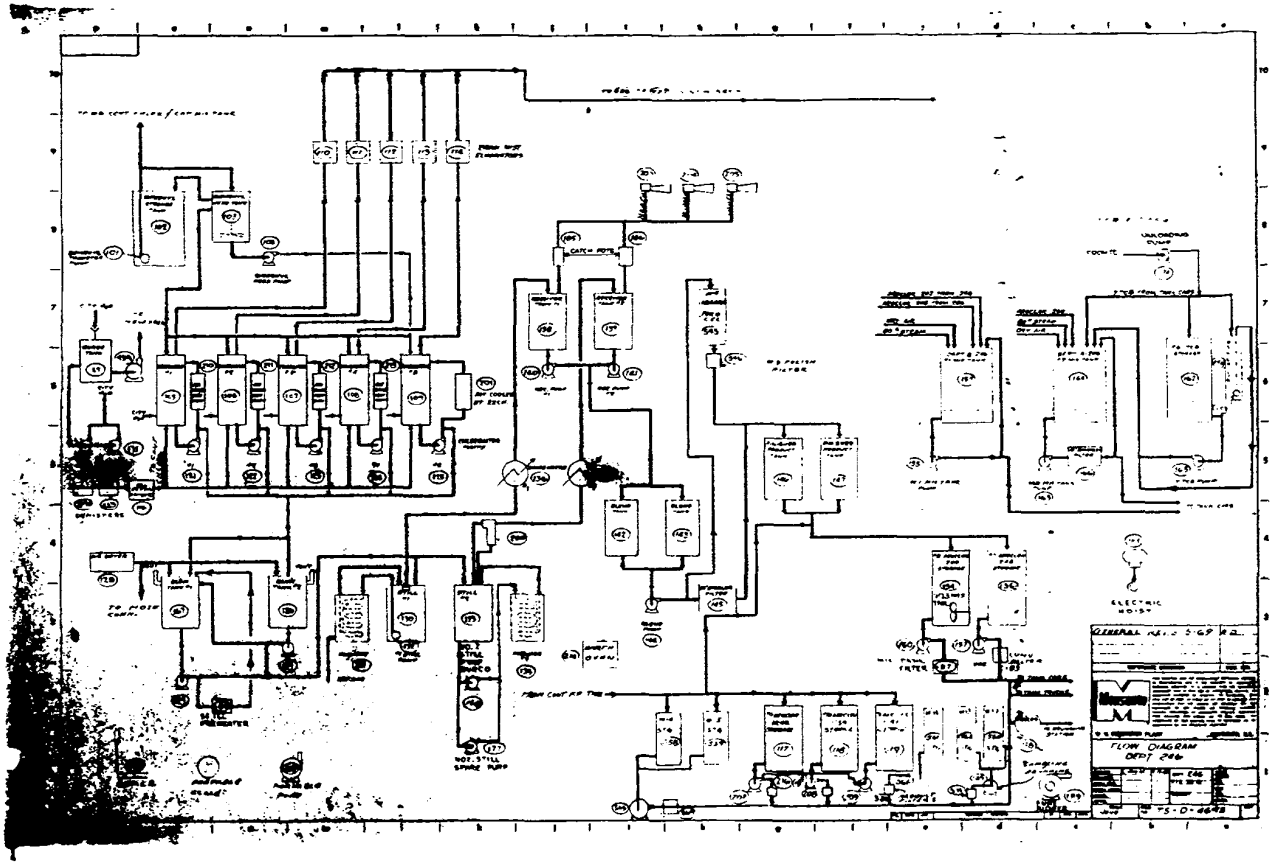
The Pyranol tradename is used by the General Electric Corporation and Inerteen by the Westinghouse Electric Corporation.

DEPT. 259 - STANDARD MANUFACTURING PROCESS
Pyranols, Inerteens, FR-O

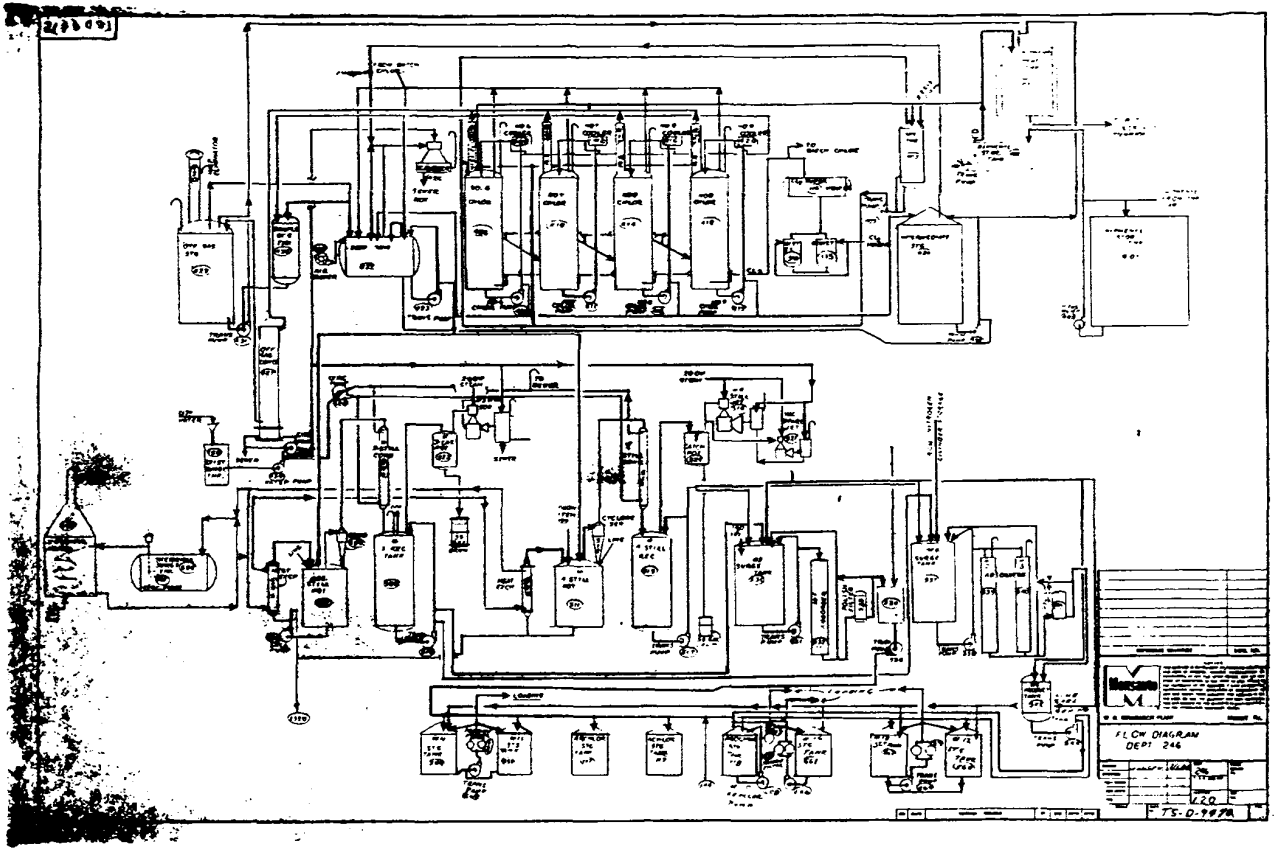
SECTION II

FLOW SHEETS

Flow sheets for the blending operations are hi-lighted on the following department drawings.



MONS 055566



MONS 055567

DEPT. 259 - STANDARD MANUFACTURING PROCESS
Pyranols, Inerteens, FR-0

SECTION III

PROCESS IN DETAIL

A. BLEND CALCULATION

The first step in making a blend is to determine the batch size desired, and the weight of each major component based on the percentages listed in Section I. Using these weights, and the known specific gravity and refractive index of both the Aroclor and chlorobenzene, the theoretical S. G. and index of the blend is calculated. This is done simply by weighted averages. By trial and error the ratio of the major components is shifted slightly, if necessary, so that both specific gravity and refractive index will be as near as possible to the middle of their respective specification ranges.

B. BLENDING

The major raw materials are pumped to the mix tank (#2 or #3), the chlorobenzene first. This is to avoid the more viscous Aroclor from clinging to the walls and bottom of the tank. The mix tank contents are agitated for at least four hours after the major components have been added. The blend is heated to 90-100°C during this time. A 16 oz. control sample is taken for S. G. and index. If adjustments are needed, they are calculated in the same way as the original batch. Once S. G. and index are in spec., the chloride scavenger (glycidyl phenyl ether or unox epoxide) is added based on the total batch weight.

C. EARTH TREATMENT AND FILTRATION

After agitating for another 4 hours a final sample of three 5-pint bottles is taken. If all analyses are in specification, and the power factor at 60 cycles is under 3.0% and the resistivity is at least 1500×10^9, then the product is ready for packaging. (These quality levels have been set within the department.) If this quality is not met, then 20-25 lbs. of attapulgus earth is added to the blend, agitated for 4 hours, and circulated through a filter for 1-2 hrs. Samples are taken and reanalyzed for electrical properties. This earth treatment step can be repeated as often as necessary. The 3.0% power factor and 1500×10^9 resistivity levels were set for efficiency of operation only (See CI in "Comments on Process" section. The critical analysis is the tank car analysis.

D. PACKAGING MONS 055568

See Appendix F for container sizes and product weights.

In the case of tank cars or trailers, product samples are taken from the car or trailer and an analysis run. If a certificate of analysis is requested, this is the one used. Drum samples are not taken, but merely identified by lot number which correlates to a mix tank analysis.

DEPT. 259 - STANDARD MANUFACTURING PROCESS
Pyranols, Inerteens, FR-O

SECTION IV

A. RAW MATERIAL YIELDS

In calculating yields, the Aroclor yield is assumed to be 100% and the chlorobenzene yield calculated on that basis. Therefore, minor losses will show up as chlorobenzene yields less than 100%. Actual material losses are very small, an estimated 0.2%. Very small losses occur at the mix tank vents, leaking pumps, and in discarded filter cartridges. The only significant loss occurs when a tank car is overfilled. A yield loss (but not a material loss) occurs when drums are filled to more than the indicated net weight.

Chlorobenzene yields do not necessarily reflect only the above mentioned losses. The yields also reflect the specific gravities and refractive indices of the chlorobenzenes and the Aroclors. This is because the finished product is made to meet certain specification ranges, not a certain weight ratio. Therefore, it is possible to have below 100%chlorobenzene yields even with no material losses. Likewise, yields over 100% can be legitimate and do occur.

B. CAPACITY

The rated monthly capacity of Dept. 259 for producing Pyranols is 1.68M lbs. The first time this level of production was demonstrated was in October, 1970, when 2.08M lbs. were produced. A more "normal" level is 1.0-1.3M lbs./mo. The primary bottleneck to higher production is the fact that the two mix tanks are also the only storage tanks. Loading or drumming is done directly from the mix tanks. Response to orders with little or no lead time is poor because four blends are made in only two mix tanks.

A few minor points:

1. The mix tanks should be agitated and circulated while charging as well as afterwards to reduce actual blending time. If this is done, it was decided after evaluation that in-line stationary mixer was not needed.

2. There are no problems in making a batch on top of a heel. At times this can be done advantageously in order to get to the next batch more quickly.

3. Brodie meters were installed to meter Aroclor and chlorobenzenes to the mix tanks. After much testing it was decided that the reliability of gauge board level indicators more than offset the time saving offered by the meters.

SECTION IV (cont'd.)

C. QUALITY

Quality is singularly the most important consideration in the production of electrical grade blends. The production of off-grade blends has resulted in much controversy, extended correspondence, and chemical research. No attempt will be made to cover the entire scope of the quality problem. Some of the factors related to quality are discussed briefly:

1. Electrical Properties - A rather arbitrary "mix tank specification" has been observed by the department for power factor @ 60 cycles and resistivity. This is a maximum of 3.0% power factor and a minimum of 1500×10^9 resistivity. This is more stringent than the formal plant specification because these two analyses must be in specification in the tank car. Normally these electrical properties drop when pumping from tank to tank, or tank to car. The reason for this is unknown, but the suspicion is always contamination. It is also recognized that proper sampling is extremely important.

2. Moisture - The moisture content of Pyranol and Inerteen batches can be reduced to 10-15 ppm by blowing the batches with N_2 supplied by Dept. 246. In the blowing operation, the batch should not be heated above 100°C for prolonged periods to prevent TCB or TTCB vaporization losses. The vaporization loss of sufficient TCB or TTCB may throw the blend out of specification on specific gravity and refractive index and require a TCB or TTCB adjustment.

   Pyranols and Inerteens have an affinity for moisture. Tanks and containers should be kept closed when possible.

   When a low moisture content has been achieved and the material is to be drummed, a high temperature (120°C-140°C) is better for maintaining the low H_2O level than is continued blowing with N_2. It should be noted, however, that if the drums or cans are quite full at normal temperatures, at the higher temperatures the required net weights cannot be met. This recently caused changing the 5 gallon A-13B3B and Inerteen PPO cans from 65 lbs. to 60 lbs.

3. Early in 1970 the refractive index specification for A13B3B and Inerteen PPO was widened. Prior to this the specific gravity usually had to be very near the low end of the range in order that the refractive index be in specification on the high side. In other words, the two ranges did not correlate well with each other.

SECTION IV (cont'd.)

C. QUALITY (cont'd.)

4. Attapulgus earth tends to remove a small amount of the glycidyl phenyl ether in a batch. If a batch is extensively earth treated after the scavenger has been added, there should be a final re-analysis for the glycidyl phenyl ether.The only known way of removing excess scavenger is by earth treatment or by lowering the percentage by compositing a larger batch.

5. Chloride Scavenger - Many of the inorganic chloride troubles of the past have been traced to the chloride scavenger. Tin tetraphenyl is no longer used as a chloride scavenger because the mixes would not pass the 0.1 ppm inorganic chloride specification in many instances. Unstable glycidyl phenyl ether has been responsible for off-grade Inerteen PPO in the past. Inerteen batches with chloride concentrations as high as 0.30 ppm have been successfully treated to reduce the chloride concentration to 0.1 ppm by the addition of 10-20 pounds of Attapulgus earth to the mix tank and circulating the batch through the filter.

6. Raw Material Stability - During 1947, considerable difficulty was encountered producing pyranosl that would pass the 0.1 ppm specification on inorganic chlorides. After extensive research work, the difficulty was traced to the instability of the raw material trichlorobzenene.

At the present time, so many variations in the final analysis are experienced that it is virtually impossible to track down where the electrical properties degrade. The variations are probably due to sampling variances, bottle contamination, atmospheric contamination in plant and laboratory, and personal analytical techniques. When these difficulties are closer to a solution, the following improvements should be evaluated:

(1) Earth treat or porocel treat TCB or TTCB before it is blended with the Aroclor.

(2) Flush car to be loaded with high quality 1242 rinse, and then upgrade rinse between uses, or, load car with product and then circulate car contents through an absorber before shipping.

Dept. 259 - Equipment List

Pyranols, Inerteens, FR-O

APPENDIX A

Item No.	Equipment Name	Equipment Number	Description
* 142	#1 Blend Tank	21-0779	Tank made by Graver. DWG. E-862. Welded steel tank, 7' dia. x 7' high, dished heads 1/2", shell 3/8". All surfaces sprayed with .005" zinc, then .003" tin. 2" xHy pipe coil. Cast bronze stirrer and bronze shaft. Test pressure of tank is 60# hydro., coil is 300# hydro. pressure. Capacity 2,000 gals.
* 143	#2 Blend Tank	21-1399	Same as Item No. 142.
* 144	Blend Pump	19-1757 66-3718	Taber Pump 304 s.s., 2 ' x 1 1/2 Capacity is 60 gpm, 100 head. Motor is 10 hp, 1800 rpm.
152	#5 TCB Storage Tk.	21-1310	Tank made by Leader Iron Works. C-609. 10' OD x 26' long on Str side, dished heads, shell 1/2" head 1/16". Test of tank is 60# and coil is 300# hydro pressure. All coils, supports, and inside surface sprayed with .005" zinc and .003 tin.
153	#5 TCB Storage Tank Pump	19-0929 66-0856	Taber Vert. sub. pump type L-2. 2 1/2" x 2" length 4'7" Cap. 50 gpm at 40' static head. Motor is 3 HP, 1800 RPM.
154	#3 Mix Tank	21-3526	Alpha Tank 12' x" dia. x 22' high. 20,000 gal. stg. capacity Aluminum constructed. Dwg. TS-D-3011.

Dept. 259 - Equipment List

Pyranols, Inerteens, FR-O

Item No.	Equipment Name	Equipment Number	Description
**155	#1 Mix Tk. Pump	19-3172 66-2651	Durco pump model WH 2 alloy construction 2" x 1 1/2" 8" impeller. Cap. 160 gpm at 55' head.
**159	#1 Mix Tank	21-0321 66-2168	Tank (Nooter), Dwg. D-6455, 14' O.D. x 10' high. 3/8" shell, steel construction. Capacity is 15,000 gallons. Agitator motor is 7-1/2 H.P.,1750 R.P.M.
160	#3 Mix Tank Pump	19-1540 66-3133	Taber Horiz.,Cent. Pump 304 S.S. 2" suction, 1 1/2" discharge. Motor is 10 H.P.,1750 RPM.
162	#6 TTCB Storage	21-0848	Tank made by Graver. Dwg. E-4413. 8' ID x 25'6" long. Steam coil. Capacity 9,500 gals.
163	TTCB Pump	19-1111 66-0745	Blackmer pump #5-OL.All iron steam jacketed pump with CI base plate. Motor is 7 1/2 HP, 1750 RPM.
164	#2 Mix Tank	21-2621 23-4109 66-4592	Vertical cylindrical steel tank 10'6" ID x 23'0" high. Capacity 14,800 gal. Lightening mixer. Motor is 7 1/2 HP, 1800 RPM. Capacity 14,580 gals.
165	Pyranol Pump #2 Mix Tank Pump	19-2179 66-2971	Taber pump. 304 s.s. 2" suction 1 1/2" discharge. Motor is 10 HP, 1745 RPM.
166	18" Sparkler Filter for #2 Mix Tank	15-0172	Made by Sparkler Mfg. Co.,Model 18-D-12. Filter is all bronze construction.
174	TCB and TTCB Tank car unloading pump	19-1111	Blackmer Model 3202 Cast Iron. 2" x 2" suction and discharge.
187	18" sparkler filter for #3 mix tank	15-	Same as Item 166.

MONS 055573

DEPT. 259 - Equipment List

Pyranols, Inerteens, FR-0

ITEM NO.	EQUIPMENT NAME	EQUIPMENT NO.	DESCRIPTION
--	FILTER(at loading dock,Spot #3, Track 10A)	--	Alsop filter model no. PAK 125-4, 316s.s.,6000 in^2 filtration area, 840 in^3 volume.
***160	#2 mix tank pump	52-2875	Durco 2 x 1 1/2 x 9 1/2 (will take up to 11 1/2" impeller), Alloy 20. Motor is 7.5 HP, 1750 rpm
***165	#3 mix tank pump	52-2875	Same as Item No. 160.
145	36" Sparkler Filter (no longer used)	15-0238	33-D-12 horizontal plate filter, 30 4s.s., jacket tested for 30 psi.

* These are Dept. 246 items and are used for blends only when a small batch is needed (2000 gal. or less).

** Used for Pydraul blends.

*** New Item - 165 - placed old Item 160 in October, 1970.
New Item 160 replaced old Item 165 in December, 1970.

APPENDIX B

SPECIFICATIONS

The following is a list of the raw materials used for the manufacture of Pyranols and Inerteens. Specification sheets that are available are included for the materials.

MATERIAL CODE	RAW MATERIAL
58500	Tri-Tetrachlorobenzene
60200	Trichlorobenzene
81105	Aroclor 1260
81103	Aroclor 1254
61325	Unox Epoxide 221
81101	Aroclor 1242
36100	Glycidyl Phenyl Ether
19409	Attapulgus Earth
43101	Nitrogen

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

PRODUCT CODE	PRODUCT
81110	Inerteen 54201CM
81097	Pyranol A13B3B
81092	Inerteen PPO
81098	Inerteen 70/30
81109	Therminol, FR-0

Monsanto
ORGANIC CHEMICALS DIVISION

RAW MATERIAL SPECIFICATION

MATERIAL CODE	MATERIAL
58500	Tri-Tetrachlorocenzene Blend
PLANT: W.G.K.	USING DEPTS.: 259
DATE EFFECTIVE: 5/70	SUPPLIER: Hooker Electrochemical

APPROVALS

PRODUCTION	RESEARCH
A. F. Leisy	W. R. Richard
PROCUREMENT	QUALITY CONTROL (Chief Chemist)
J. Laverle	R. M. Blowers

GENERAL DESCRIPTION: Mixture

CHEMICAL FORMULA:

SUPERSEDES SPECS OF	SAMPLE FOR ANALYSIS	ISSUED BY
11/66	3 x 5 pt. Amber Bottles	

	CHARACTERISTIC	LIMITS	METHOD
	UNRESTRICTED INFORMATION		
	Color	APHA 15, max.	10,105
	Condition	Clear	10,105
(R)	Sp.Gr.@15.5/15.5°C	1.510-1.522	10,114
	Acidity(mg.KOH/g.)	0.014, max.	10,087
	Moisture (H_2O)	75 ppm, max.	10,620
(R)	Refractive Index @25°C	1.5775-1.5790	10,125
	Free Chlorides	0.10ppm, max.	10,116
	Crystallizing Point	-15°C or lower	12,035
	Last Crystal Point	0°C, max.	12,033
	Dielectric Strength@25°C	30KV, min.	11,605
	Distillation Range(ASTM D-850, Modified)		12,034
	First Drop	210°C, min.	
	5% by volume	215°C, min.	
	65% by volume	228°C, min.	
	90% by volume	255°C, max.	
	95% by volume	265°C, max.	
	Dry Point	278°C, max.	
	Corrosion Test 6 hrs. @210°C with bright aluminum foil		10,126
	Change in weight of Al	0.0%	
	Color	APHA 100, max.	10,1[illegible]
	Condition	Clear	10,1[illegible]
	Acidity(mg.KOH/g.)	0.014, max.	10,0[illegible]
	Free Chlorides	0.10ppm, max.	10,1[illegible]
	Chemical Composition		12,0[illegible]
	Trichlorobenzene	58.5%, min.	
	1,2,3,4Tetrachlorobenzene	26.0-29.0%	
	1,2,4,5Tetrachlorobenzene	3.0%, max.	
	Pentachlorobenzene	5.5%, max.	
	Fire Point	None to boiling point	10,123
	GENERAL INFORMATION		
	Dielectric Constant 1000 cycles, 100°C	4.8-5.1	
	Viscosity @100°F	28-32 SUS	

MONS 055576

Certificate of analysis required on the above properties - to be sent to the Chief Chemist, W. G. Krummrich Plant to arrive on or before [illegible] of shipment.

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

WGK-314

Monsanto
ORGANIC CHEMICALS DIVISION

RAW MATERIAL SPECIFICATION

MATERIAL CODE	MATERIAL
60200	Trichlorobenzene
PLANT	USING DEPTS.
WGK	259
DATE EFFECTIVE	SUPPLIER
11/13/70	Hooker

APPROVALS

PRODUCTION	RESEARCH
B. W. Corlew/R. McCutchan	W. R. Richard
PROCUREMENT	QUALITY CONTROL (Chief Chemist)
J. D. Leyerle	R. M. Blowers

GENERAL DESCRIPTION: TCB

CHEMICAL FORMULA: $C_6H_3Cl_3$

SUPERSEDES SPECS OF	SAMPLE FOR ANALYSIS	ISSUED BY
11/20/68	3 x 5 pt amber bottles	S. Shaulter/C. Stit

UNRESTRICTED INFORMATION

	CHARACTERISTIC	LIMITS	METHOD
	Color	APHA 15, max.	10105
(R)	Condition	Clear	10105
(R)	Sp. Gr. @15.5/15.5°C	1.460 - 1.477	10106
	Acidity (mg. KOH/g.)	0.014, max.	10109
	Moisture (H_2O)	75 ppm., max.	10620
(R)	Refractive Index @25°C	1.5680 - 1.5715	10125
	Free Chlorides	0.10 ppm., max.	10118
	Crystallizing Point	10°C, max.	10107
	Dielectric Strength @25°C	30 KV, min.	11605
	Distillation Range (ASTM D-850, Modified) (corrected for Stem and Barometric Pressure)		10103
	First Drop	205°C, min.	
	5% by volume	210°C, min.	
	50% by volume	213°C, min.	
	90% by volume	215°C, min.	
	Corrosion Test, 6 hrs at 210°C with bright aluminum foil		10126
	Change in weight of Al	0.0%	
	Color	APHA 200, max.	
	Condition	Clear	
	Acidity (mg. KOH/g.)	0.014, max.	
	Free Chlorides	0.10 ppm., max.	
	Monsanto Stability Test	0.5 ppm., max.*	11503
	Hydrolysis Stability Test	0.5 ppm., max.	12672
	Fire Point	None to boiling point	10123
	Fixed Chlorine	58.5%, min.	10023

*Every other car can be over 0.5 ppm but never over 1.0 ppm. Values ov 0.5 ppm to be cleared in advance.

Certificate of Analysis required on the above properties - To be sent to the Chief Chemist, W. G. Krummrich Plant to arrive on or before receipt of shipment.

MONS 055577

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

Monsanto ORGANIC CHEMICALS DIVISION Krummrich & Anniston RAW MATERIAL SPECIFICATION	MATERIAL CODE 61325	MATERIAL EP-221
	PLANT WGK & Ann.	USING DEPTS. 259 WGK 27 Ann.
	DATE EFFECTIVE 8/13/69	SUPPLIER Union Carbide

APPROVALS

PRODUCTION	RESEARCH
A. E. [illegible]	[illegible]
PROCUREMENT	QUALITY CONTROL (Chief Chemist)
J. Leverle	R. Blowers T. Bell

GENERAL DESCRIPTION

CHEMICAL FORMULA

SUPERSEDES SPECS OF	SAMPLE FOR ANALYSIS	ISSUED BY
7/21/66	1 - 16 oz. W M Bottle	Higgerson/Stitt's

CHARACTERISTIC		LIMITS	METHOD
UNRESTRICTED INFORMATION			
(R)	Appearance	Clear liq., free from dirt fibers, or other contamination	13019
(R)	Assay	88%, min.	13017
	Color	150 APHA, max.	10084
	Total Free Chlorides	10 ppm, max.	13021
	Refractive Index @25°C.	Report	13020
	Moisture	0.1%, max.	10[illegible]
	Acidity	0.2 mg KOH/gm, max.	10087
	Sp. Gr. @90/15.5°C.	Report	1301[illegible]

Supplier's certificate of analysis to be sent on day of shipment to:
Chief Chemist, Monsanto Co., Sauget, Ill.

OR Chief Chemist, Monsanto Co., Anniston, Ala.

MONS 055578

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

ORGANIC CHEMICALS DIVISION

RAW MATERIAL SPECIFICATION

	36100	MATERIAL: Glycidyl Phenyl Ether (Phenoxypropene Oxide)
	PLANT: WGK	USING DEPT.: 259
	DATE EFFECTIVE: 7/10/69	SUPPLIER: Shell Chemical Co.

APPROVALS

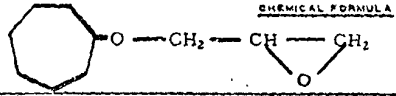
PRODUCTION: A. E. [illegible]	RESEARCH: W. S. Rapaport
PROCUREMENT: J. Leverle	QUALITY CONTROL (Chief Chemist): R. Blowers

GENERAL DESCRIPTION

$C_9H_{10}O_2$

mol wt. 150.17

CHEMICAL FORMULA



SUPERSEDES SPECS OF	SAMPLE FOR ANALYSIS	ISSUED BY
5/26/66	1 x 16 oz. W.M. Bottle	Higgerson/Stites

CHARACTERISTIC	LIMITS	METHOD
UNCLASSIFIED INFORMATION		
(R) Sp. Gr. @20/20°C.	1.105 - 1.115	11,864
(R) Total Chlorine (as Cl^-)	40 ppm, max.	12,510
GENERAL INFORMATION		
At the present time the material being supplied to WGK for use in the manufacturing of Westinghouse Inerteen PPO, is a commercial Grade of Glycidyl Phenyl Ether. In addition to the 2 tests shown above, the supplier's specification lists:		
Purity (Based on Epoxide Content, per cent by weight	98%, max.	---
Color	30 APHA, max.	---
The supplier's Technical Bulletin shows the following Physical Properties for the Refined Grade.		
Boiling Point @ 760 mm.	245°C.	11,862
Melting Point	3.5°C.	11,861
Flash Point	175°F.	-----
Refractive Index @20°C.	1.5314	11,863
Viscosity @20°C.	7.05 cs.	------
30°C.	4.88 cs.	------

Supplier's certificate of analysis to be sent on day of shipment to:

Chief Chemist, Monsanto Co., Sauget, Ill.

MONS 055579

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

WGK-816

Monsanto ORGANIC CHEMICALS DIVISION W. G. Krummrich Plant RAW MATERIAL SPECIFICATION	MATERIAL CODE 19409	MATERIAL Attapulgus Earth 200/UP
	PLANT WGK	USING DEPTS. 246 , 259
	DATE EFFECTIVE 2/3/69	SUPPLIER Mineral & Chemical Phillips Corp.

APPROVALS

PRODUCTION	RESEARCH
A. E. Leisy	W. B. Richard
PROCUREMENT	QUALITY CONTROL (Chief Chemist)
J. Leyerle	R. Blowers

GENERAL DESCRIPTION

Clay

CHEMICAL FORMULA

SUPERSEDES SPECS OF	SAMPLE FOR ANALYSIS	ISSUED BY
1/21/66	2 x 16 oz. W.M. Bottles	Higgerson/Stites

CHARACTERISTIC	LIMITS	METHOD
UNRESTRICTED INFORMATION		
(R) Volatile Matter (at 950°C.)	6 - 8%	
(R) Mesh Test:		
Through USS 325	90%, min.	

This material is not accepted without the supplier's analysis of the above properties.

MONS 055580

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

Monsanto
ORGANIC CHEMICALS DIVISION

RAW MATERIAL SPECIFICATION

MATERIAL CODE	MATERIAL
43099	Nitrogen Gas
PLANT	**USING DEPTS.**
WGK	See Below (3)
DATE EFFECTIVE	**SUPPLIER**
3/29/68	Air Reduction Sales Co.

APPROVALS

PRODUCTION	RESEARCH
J. W. M. T. W. D. O. D. D. E. D. M. J. M. C.	R. H. Mills ODeG. E. L. M. J. A. S.
PROCUREMENT	**QUALITY CONTROL** (Chief Chemist)
H. Lenser	W. J. Gresham

GENERAL DESCRIPTION **CHEMICAL FORMULA**

Grade - O. P. Special Nitrogen

SUPERSEDES SPECS OF	SAMPLE FOR ANALYSIS	ISSUED BY
2/18/65	----	L. E. Hornback

CHARACTERISTIC	LIMITS	METHOD
Assay (1)	99.9%, min.	(2)
Oxygen	0.1%, max.	
Hydrogen	0%	
Dew Point	-76°F.	

	Typical Analysis
Nitrogen	99.78%
Argon	0.12%
Oxygen	0.1%
Carbon Dioxide	.00005%
Acetylene	.00005%

(1) Nitrogen plus inert rare gases
(2) Any analyses to be obtained from supplier on request.
(3) 213, 244, 246, 247, A-255, A-256, 259, 267, 270, B-270 & 281.

MONS 055581

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

ROK-816

Monsanto
ORGANIC CHEMICALS DIVISION

KRUMMRICH AND ANNISTON

FINISHED PRODUCT SPECIFICATION

Aroclor 1242, Electrical Grade		WGK 246
WGK	81101 - 82612	SALES
10/22/69	1040-240-04/11/16-03/09	

PRODUCTION: A. E. Leisy

SALES: W. E. Ault

APPROVALS: R. M. Blowers; T. Bell

SUPERSEDES SPEC. DATED		
8/1/69	3 x 5 pt. Amber Bottles	Higgerson/Stites

CHARACTERISTIC	LIMITS	WGK	ANNISTON
UNRESTRICTED INFORMATION			
(R) Color (APHA)	40, max.	10084	14-44-54
(R) Condition	Clear	10084	G-1
(R) Sp.Gr. @ 25/15.5°C.	1.381 - 1.392	10114	14-49-54
(R) Acidity (mg. KOH/g.)	0.010, max.	10087	14-42-54
(R) Moisture (H_2O)	35 ppm., max.	10620	14-53-54
(R) Refractive Index @ 25°C.	1.6240 - 1.6260	10125	14-34-54
(R) Inorganic (Free) Chlorides	0.05 ppm., max.	12741	014
(R) Pour Point	-14°C. or Lower	10115	14-47-54
(R) Dielectric Constant (1000 cycles @ 100°C.)	4.70 - 4.90	11608	14-36-54
(R) Resistivity (500 VDC @ 100°C. 0.1" Gap) As OHM-CM x 10^9	500, min.	11607	14-35-57
(R) Hydrolysis Stability Test (As Chlorides)	0.5 ppm, max.	12672	010
(R) Monsanto Stability Test (As Chlorides)	0.4 ppm., max.	11503	14-61-57
(R) Distillation Range (ASTM D-20, Corrected)		10117	14-31-54
10% Distilled by wt.	325°C., min.		
90% Distilled by wt.	360°C., max.		
Sulfates	None	12169	-----
Dielectric Strength @ 25°C.	35 KV, min.	11605	043
Flash Point (°F)	338 - 392	10123	14-28-54
Fire Point	None	10123	14-28-54
Corrosion Test (6 hrs. @ 210°C. with bright aluminum foil)		10126	14-55-57
Change in wt. of AL %	0.0		
A.C. Color (APHA)	60, max.	10084	14-44-54
A.C. Condition	Clear	10084	G-1
A.C. Acidity (mg. KOH/g.)	0.010, max.	10087	14-42-54
A.C. Inorganic (Free) Chlorides	0.05 ppm., max.	12741	014
Visc. @ 100°F. (SUS)	82 - 92	10086	14- 4-53

OVER

MONS 055582

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

GENERAL INFORMATION

Specific Heat @ 25°C,	0.30
Coefficient of Expansion (25 - 65°C)	0.00068 cc/°C.
Fixed Chlorine	42.5 - 43.5%
Power Factor @ 100°C,	(Typical Values)
60 cycles	5
1000 cycles	0.30

SPECIAL CUSTOMER REQUIREMENTS

General Electric

Thermal Chemical Chlorides	0.65 ppm., max.	12722

Westinghouse

Hydrolizable Chlorine (Westinghouse Stability Test)	1.0 ppm., max.	T-2219

MONSANTO
ORGANIC CHEMICALS DIVISION

FINISHED PRODUCT SPECIFICATION

Aroclor 1254 Electrical Grad. | DEPT. 246 - 2

PLANT	PRODUCT CODE	USE
WGK and Ann.	81103 82613	Sales

DATE EFFECTIVE	SALES CODE
11/4/68	1040-280-04/11/16-03/09

APPROVALS

PRODUCTION	RESEARCH
A. E. Leisy	W. R. Richard
SALES	**QUALITY CONTROL (Chief Chemist)**
W. E. Ault	R. M. Blowers T. Bell

GENERAL DESCRIPTION

Also called Pyranol 1476

CHEMICAL FORMULA

MOL WT.

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS	ISSUED BY
6/28/65	3 x 5 pt. Amber Bottles	E. McEntire/S. Stites

UNRESTRICTED INFORMATION

	CHARACTERISTIC	LIMITS	WGK METHOD	Ann. METHOD
(R)	Color, APHA	50, max.	10084	14-44-57
(R)	Condition	Clear	10084	G-1
(R)	Sp. Gr. @65/15.5°C	1.495 - 1.505	10114	14-49-57
(R)	Acidity (mg. KOH/gm.)	0.010, max.	10087	14-42-57
(R)	Moisture (H_2O)	35 ppm, max.	10620	14-53-57
(R)	Refractive Index @25°C	1.6370 - 1.6390	10125	14-34-57
(R)	Inorganic (Free) Chlorides	0.05 ppm., max.	12741	014
(R)	Pour Point	7 - 12°C	10115	14-27-57
(R)	Dielectric Constant (1000 cycles @100°C)	4.15 - 4.35	11608	14-36-57
(R)	Resistivity (500 VDC @100°C 0.1" GAP) as OHM-CM x 10⁹	500, min.	11607	14-35-57
(R)	Hydrolysis Stability Test (as Chlorides)	1.0 ppm., max.	12672	010
(R)	Monsanto Stability Test (as Chlorides)	0.5 ppm., max.	11503	14-61-57
(R)	Distillation Range (ASTM D-20, Corrected)		10117	14-31-57
	10% Distilled by Wt.	366 - 378°C		
	50% Distilled by Wt.	371 - 383°C		
	90% Distilled by Wt.	379 - 394°C		
	Sulfates	None	12169	
	Dielectric Strength @25°C	35KV, min.	11605	043
	Flash Point	None	10123	14-28-57
	Fire Point	None	10123	14-28-57
	Visc. @210°F (SUS)	44-48	10086	14-4-57
	Corrosion Test (6 hrs @210°C with bright aluminum foil)		10126	14-55-57
	Change in wt. of Al (%)	0.0		
	A. C. Color, APHA	60, max.	10084	14-44-57
	A. C. Condition	Clear	10084	G-1
	A. C. Acidity (mg.KOH/g.)	0.010, max.	10087	14-42-57
	A. C. Inorganic (Free) Chlorides	0.05 ppm., max.	10118	010

MONS 055584

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

SPECIAL CUSTOMER REQUIREMENT

Cornell - Dubilier

Resistivity (500 VDC @100°C 0.1" GAP as OHM-CM x 10^9)	1500, min.	11607	14-35-54

GENERAL INFORMATION

Specific Heat @25°C	0.27
Coefficient of Expansion (25-65°C)	0.00066 cc/°C
Fixed Chlorine	54.5 - 55.5%

Arochlor 1260 Electrical Grade — Ann.27

Anniston And Krummrich

FINISHED PRODUCT SPECIFICATION

PLANT		
Ann.	82614-Ann.	Sales
DATE EFFECTIVE	SUPERSEDES	
10/22/69	1040-290-04/11/16-03-09	

APPROVALS

PRODUCTION	RESEARCH
A. E. Leisy	W. R. Richard
SALES	QUALITY CONTROL (& Env Control)
W. E. Ault	R. M. Blowers T. Bell
GENERAL DESCRIPTION	CHEMICAL FORMULA

MOL WT.

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS	ISSUED BY
5/25/66	3 x 5 pt. Amber Bottles	Niggerson/Stites

UNRESTRICTED INFORMATION

	CHARACTERISTIC	LIMITS	METHOD
(R)	Color (APHA)	150, max.	10084
(R)	Condition	Clear	10084
(R)	Sp. Gr. @ 90.15.5°C	1.555 - 1.566	10114
(R)	Acidity (mg KOH/g.)	0.014, max.	10087
(R)	Moisture (H_2O) (ppm)	35, max.	10620
(R)	Viscosity @ 210°F. (SUS)	72 - 78	10086
(R)	Refractive Index @ 25°C.	1.6455 - 1.6470	10125
(R)	Inorganic (Free) Chlorides	0.05 ppm, max.	10118
(R)	Pour Point (°C)	25 - 34	10115
(R)	Distillation Range (ASTM D-20, Corrected)		10117
	10% Distilled by wt.	385 - 398°C.	
	50% Distilled by wt.	390 - 404°C.	
	90% Distilled by wt.	400 - 420°C.	
(R)	Corrosion Test (6 hrs. @ 210°C. with bright aluminum foil)		10126
(R)	Change in weight of Al (%)	0.0	
(R)	A.C. Color (APHA)	150, max.	10084
(R)	A.C. Condition	Clear	10084
(R)	A.C. Acidity (mg. KOH/g.)	0.014, max.	10087
(R)	A.C. Inorganic (Free) Chlorides	0.05 ppm, max.	10118
	Flash Point	None	10123
	Fire Point	None	10123
	Fixed Chlorine (%)	59.5 - 60.5	10088
(R)	Dielectric Strength @ 50°C.	30 K.V., min.	11605
(R)	Resistivity (500 VDC @ 100°C. 0.1" gas as ohm-cm x 10^9)	500, min.	11607
(R)	Dielectric Constant 1000 cycles, 100°C.	3.6 - 3.8	11607

OVER

MONS 055586

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

		Limits	Method
RESTRICTED INFORMATION			
(R)	Monsanto Stability Test (As Chlorides in ppm.)	0.7, max.	11503
GENERAL INFORMATION			
(R)	Evaporation Loss after 6 hrs. @ 100°C. (%)	0.2, max.	10116
(R)	Stability test - after 30 days @ 100°C. in glass sealed in air.	No liberation of chlorine or chlorides	

MONSANTO
ORGANIC CHEMICALS DIVISION

FINISHED PRODUCT SPECIFICATION

PRODUCT: INERTEN 54201-C1		DEPT.: 626.47
PLANT: Anniston	PRODUCT CODE: 626.90	USE: Sales
DATE EFFECTIVE: 2-22-68	SALES CODE: 1050-215-16-09	

APPROVALS

PRODUCTION: H. L. Williams /s/ H. L. Williams 10/23/68	RESEARCH: U. R. Richard /s/ U. R. Richard 11/14/68
SALES: W. E. Ault /s/ W. E. Ault 11/19/68	QUALITY CONTROL (Chief Chemist): G. W. Miller /s/ G. W. Miller 10/22/68

GENERAL DESCRIPTION

99.8% Aroclor 1242
0.2% Phenoxypropene Oxide

CHEMICAL FORMULA

MOL WT.

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS: 3 x 5 pt. Amber bottles	ISSUED BY: G. W. Miller

CHARACTERISTIC	LIMITS	METHOD
(R) Color, APHA	60 Max.	046
(R) Condition	Clear	G-1
(R) Specific Gravity @ 25°/15.5°C	1.381-1.392	052
(R) Acidity (Mg KOH/g)	0.010 Max.	050
(R) Moisture, ppm	35 Max.	047
(R) Refractive Index @ 25°C	1.6240-1.6260	048
(R) Inorganic (Free) Chlorides, ppm	0.05 Max.	045
(R) Pour Point, °C	-17 or lower	053
(R) Resistivity, ohm-cm 500 VDC @ 100°C 0.1" Gap	100 x 10^9 Min.	121
(R) Distillation Range (ASTM D-20, corrected)		054
10% Distilled by wt.	325°C Min.	
90% Distilled by wt.	360°C Max.	
(R) Dielectric Strength @ 25°C	35 KV Min.	043
(R) Fire Point	None to Boiling	114
(R) Viscosity @ 100°F, SUS	82-92	049
(R) Phenoxypropene Oxide, %	0.18-0.22	071
(R) Corrosion Test - 6 hrs. @ 210°C with bright Al foil		136
Change in wt. of Al foil, %	0.0	
Color, APHA	100 Max.	046
Condition	Clear	G-1
Acidity (Mg KOH/g)	0.010 Max.	050
Inorganic (Free) Chlorides, ppm	0.05 Max.	014

MONS 055588

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

Monsanto
ORGANIC CHEMICALS DIVISION
Anniston & W.G.Krummrich

FINISHED PRODUCT SPECIFICATION

Transformer Pyranol A13D3B

259 27

PLANT	PRODUCT CODE	USE
Anniston WGK	81097 -Ann, -WGK	SALES
DATE EFFECTIVE	SALES CODE	
3/23/70	1050-300-16-03/09	

APPROVALS

PRODUCTION	RESEARCH
A. E. Leisy	W. R. Richard
SALES	QUALITY CONTROL (Chief Chemist)
W. E. Ault	R. Blowers T. Bell

GENERAL DESCRIPTION

Mixture of: 45% Aroclor 1260
55% Tri-Tetrachlorobenzene
EP-221

CHEMICAL FORMULA

MOL WT:

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS	ISSUED BY
9/69	3 x 5 pt. Amber bottles	Higgerson/Stites

	CHARACTERISTIC	LIMITS	METHOD
	UNRESTRICTED INFORMATION		
(R)	Color, APHA	150, max.	10,084
(R)	Condition	Clear	10,084
(R)	Sp.Gr. @ 15.5/15.5°C.	1.563 - 1.571	10,114
(R)	Acidity (mg. KOH/g.)	0.014, max.	10,087
(R)	Moisture (H_2O)	30 ppm., max.	10,620
(R)	Refractive Index @ 25°C.	1.6068-1.6088	10,125
(R)	Inorg. (Free) Chlorides	0.10 ppm., max.	12,741
(R)	Dielectric Strength @ 25°C.	35 K.V., min.	11,605
(R)	Resistivity (500 VDC @ 100°C; 0.1" gap as ohms/cm. x 10^9)	100, min.	11,607
(R)	Viscosity @ 100°F.	41 - 45 SUS	10,086
(R)	Pour Point	-44°C., max.	10,115
(R)	Active EP-221 (%)	0.115 - 0.135	13,014
(R)	Distillation Range (ASTM D-20, Corrected)		
	First Drop	210°C., min.	
	35% by vol.	240 - 256°C.	
	55% by vol.	290 - 330°C.	
	65% by vol.	385 - 400°C.	
	90% by vol.	395 - 415°C.	
(R)	Corrosion Test (6 hrs. @ 210°C. with bright aluminum foil)		10,126
	Change in weight of Al%	0.0	
	AC Color	APHA 200, max.	10,084
	AC Condition	Clear	10,084
	AC Acidity (mg. KOH/g.)	0.014, max.	10,087
	AC Inorg. (Free) Chlorides	2.0 ppm., max.	12,741
	Dielectric Constant 1000 cycles, 100°C.	3.8 - 4.2	11,608
	Fixed Chlorine	60.0 - 61.0	10,088
	Fire Point	None to boiling pt.	10,123
	Arc-Formed Combustible gases	1.0%, max.	10,711
	Electrical Stability (Aged 96 hours @ 100°C. covered jar, 15% air)		10,121
	Decrease in Resistivity	10%, max.	
	RESTRICTED INFORMATION		
(R)	Power Factor @ 60 cycles and 100°C	5.0%, max.	11,608

(over)

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

GENERAL INFORMATION

Dielectric Constant (1000 cycles @ 25°C.)	4.5 - 4.9	11,608

Monsanto
ORGANIC CHEMICALS DIVISION
Anniston & Krummrich

FINISHED PRODUCT SPECIFICATION

PRODUCT: Transformer Inerteen PPO			DEPT: WGK 252
PLANT: WGK DNN	PRODUCT CODE: 81092 82649		USE: SALES
DATE EFFECTIVE: 3/30/70	SALES CODE: 1050-200-16-03/09		

APPROVALS

PRODUCTION: A. E. Leisy	RESEARCH: W. R. Richard
SALES: W. E. Ault	QUALITY CONTROL (Chief Chemist): R. M. Blowers T. Bell

GENERAL DESCRIPTION

Mixture - 60% Aroclor 1260: 40% Trichlorobenzene
Plus 0.20% Phenoxypropene Oxide
(Westinghouse Inerteen 7336-9)

CHEMICAL FORMULA

MOL WT.

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS	ISSUED BY
5/29/69	3 x 5 pt. Amber Bottles	Higgerson/Stites .

	CHARACTERISTIC	LIMITS	METHOD
	UNRESTRICTED INFORMATION		
(R)	Color	APHA 150, Max.	10,084
(R)	Condition	Clear	10,084
(R)	Sp.Gr. @ 15.5/15.5°C	1.560 - 1.568	10,114
(R)	Acidity (mg. KOH/g.)	0.014, Max.	10,087
(R)	Moisture (H_2O)	30 ppm, Max.	10,620
(R)	Refractive Index @ 25°C.	1.6130-1.6154	10,125
(R)	Inorganic (Free) Chlorides	0.10 ppm., Max.	12,741
(R)	Dielectric Strength @ 25°C.	35 KV, Min.	11,605
(R)	Resistivity @ 100°C 500 VDC and 0.1" gap	100 x 10^9 ohm/cm, Min.	11,607
(R)	Viscosity @ 100°F.	52 - 56 SUS	10,086
(R)	Pour Point	-32°C., Max.	10,115
(R)	Distillation Range: (ASTM D-20, Corrected)		10,117
	First Drop	200°C., Min.	
	Below 270°C., by wt.	40%, Max.	
	90% by wt.	395 - 415°C.	
(R)	Corrosion Test, 6 hrs. @ 210°C. with bright Aluminum Foil		10,126
(R)	Change in wt. of Al.	0.0%	
	AC Color	APHA 200, Max.	10,084
	AC Condition	Clear	10,084
	AC Acidity (mg. KOH/g.)	0.014, Max.	10,087
	AC Inorganic (Free) Chlorides	2.0 ppm, Max.	12,741
(R)	Phenoxypropene Oxide	0.18 - 0.22%	11,865
(R)	Fire Point	None to Boiling Point	10,123
(R)	Dielectric Constant 1000 cycles, 100°C.	3.7 - 4.0	10,608
	Fixed Chlorine	59.1%, Min.	10,088
	Arc Formed Combustible Gases	1.0%, Max.	10,711
	Electrical Stability (ages 96 hrs. @ 100°C, covered jar, 15% air)		10,121
	Decrease in Resistivity	10%, Max.	
	RESTRICTED INFORMATION		
(R)	Power Factor @ 60 cycles and 100°C.	5.0%, Max.	11,608

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

(OVER)

GENERAL INFORMATION

Dielectric Constant 1000 cycles, 25°C,	4.0 - 4.3
Analysis of each 10 ml. fraction of a fractional distillation Chlorine/Hydrogen Ratio	1, min.
Arc Formed Combustible Gases	1.5%, max.

MONS 055592

Monsanto
ORGANIC CHEMICALS DIVISION

Anniston and Krummrich
FINISHED PRODUCT
SPECIFICATION

PRODUCT		DEPT.
INERTEEN 7 [illegible]6 TRANSFORMER FLUID		A [illegible] WGK
PLANT: Anniston WGK	PRODUCT CODE: Ann. 81098 - WGK	USE: SALES
DATE EFFECTIVE: 7/10/69	SALES CODE: 1050-210-16-03/09	

APPROVALS

PRODUCTION	RESEARCH
A. [illegible]	W. [illegible] Richard
SALES: W. E. Ault	QUALITY CONTROL (Chief Chemist): R. Blowers T. Bell

GENERAL DESCRIPTION

CHEMICAL FORMULA

Mixture 70% Aroclor 1254
30% Trichlorobenzene
Plus 0.20% Phenoxypropene Oxide

MOL WT.

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS	ISSUED BY
4/18/66	3 x 5 pt. Amber Bottles	Higgerson/Stites

CHARACTERISTIC		LIMITS	METHOD
UNRESTRICTED INFORMATION			
(R)	Color	50 APHA, max.	10,084
(R)	Condition	Clear	10,084
(R)	Sp. Gr. @ 15.5/15.5°C.	1.518 - 1.528	10,114
(R)	Acidity (mg. KOH/g.)	0.014 max.	10,087
(R)	Inorganic Chloride	0.05 ppm., max.	12,741
(R)	Viscosity @ 100°F.	58 - 62 SUS	10,086
(R)	Resistivity @ 100°C. ohm/cm	500×10^9 min.	11,607
(R)	Dielectric Strength @ 25°C.	35 KV, min.	11,605
(R)	Refractive Index @ 25°C.	1.6153 - 1.6173	10,125
(R)	Distillation		10,117
	1st Drop	200°C., min.	
	Below 270°C.	35%, max.	
	90% by wt.	379 - 394°C.	
(R)	Pour Point	-30°C., max.	10,115
(R)	Moisture (H_2O)	30 ppm., max.	10,620
(R)	Fire Point	None to boiling pt.	10,123
(R)	Phenoxypropene Oxide	0.18 - 0.22%	11,865
(R)	Corrosion Test 6 hrs. @ 210°C. with bright Al foil Change in wt. of Al	0.0%	10,126
	AC Color	200 APHA, max.	10,084
	AC Condition	Clear	10,084
	AC Acidity (mg KOH/g.)	0.014 max.	10,087
	AC Inorganic Chloride	2.0 ppm., max.	12,741
RESTRICTED INFORMATION			
(R)	Power Factor @ 60 cycles and 100°C.	5.0% max.	11,608

MONS 055593

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

Monsanto
ORGANIC CHEMICALS DIVISION

FINISHED PRODUCT SPECIFICATION

PRODUCT		DEPT.
THERMINOL FR-0		25[illegible]
PLANT	PRODUCT CODE	USE
WOK	81091	Sales
DATE EFFECTIVE	SALES CODE	
11/13/70	6145-000-11-003	

APPROVALS

PRODUCTION	RESEARCH
A. E. Leisy	W. R. Richard
SALES	QUALITY CONTROL (Chief Chemist)
W. E. Ault	R. M. Blowers

GENERAL DESCRIPTION

Formerly called MCS-295

CHEMICAL FORMULA

80% Aroclor 1242
20% Tri-tetra Chlorobenzene

MOL WT.

SUPERSEDES SPECS. OF	SAMPLE FOR ANALYSIS	ISSUED BY
11/4/68	3 x 16 oz. W.M.Bottle	

CHARACTERISTIC	LIMITS	METHOD
UNRESTRICTED INFORMATION		
(R) Appearance	Water white to pale yellow oily liquid	10038
(R) Visc. @ 100°F	7.6-8.4 cs	10086
(R) Fire Point	None to boiling pt.	10123
(R) Sp. Gr. @ 25/15.5°C	1.400-1.420	10114
(R) Pour Point	-15°F, max.	10115
(R) Acidity, mg KOH/g	0.05, max.	10087
(R) Water	75 ppm, max.	10620
(R) Distillation Range:		10147
1st drop	Report	
30% over	Report	

MONS 055594

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

WOK-339

APPENDIX C

PHYSICAL CONSTANTS DATA SHEETS

This section contains physical and chemical data of the raw materials and finished products.

DEGRADATION OF TCB

INORGANIC CHLORIDES

Time	Dark	Sunlight
0	.000004%	.000004%
3 days	.000004%	.0005%
7 days	.000004%	.001%

VAPOR PRESSURE OF PYRANOL 1481 (obsolete)

Temperature	Partial Pressure TCB	Partial Pressure Aroclor 1254	Total Pressure Pyranol 1481
112°C	13.12 mm	0.039 mm	13.16 mm
50	0.76	0.00051	0.76
40	0.34	0.00022	0.34
30	0.23	0.000086	0.23
20	0.111	0.000032	0.114
10	0.057	0.000011	0.057
0	0.027	0.0000036	0.027

MONS 055595

IN 610 60200

PHYSICAL CONSTANTS DATA

SUBSTANCE: TRICHLOROBENZENE

(Mixture of 1, 2, 3 & 1, 2, 4 T.C.B.)

STRUCTURAL FORMULA

COMPILED BY: Hooker Electrochemical Company

DATE: 7-25-57

NAME		SOURCE & DATE
Formula	$C_6H_3Cl_3$	Ref. 1
Molecular Weight	181.5	Ref. 1
Appearance	Clear colorless	Ref. 1
Boiling Point at 760 mm		
Boiling Point at mm		
Boiling Point at mm 50 psig	280°C	Ref. 2
Boiling Point at mm		
Crystallizing Point		
Melting Point	10°C, Max.	Ref. 3
Solution Point		
Specific Gravity @ 15.5°C/15.5°C	1.460-1.475	Ref. 3
Specific Gravity @		
Pounds per Gal. @ 15.5 °C	12.2	Ref. 2
Coefficient of Expansion Cubical	.00086	Ref. 2
Refractive Index @ 20 n_D	1.570	
Infra Red Spectrum *(Reference)*		
Ultra Violet Spectrum *(Reference)*		
Viscosity @ 100°F	1.100 Centistokes	Ref. 2
Viscosity @ 210°F	0.549 Centistokes	Ref. 2
Surface Tension @25°C	38.9 dynes/cm	Ref. 2
Solubility in Water		
Solubility in water @ 25°C	.0025 grams/100 grams	Ref. 2
Solubility in		
Flash Point °F *(Method)* Cleveland open cup	None	Ref. 2
Fire Point °C " " "	None up to boiling pt.	Ref. 2
Heat of Combustion		
Heat of Formation		
Thermal Stability (cal./gr/min.)		
Latent Heat of Fusion		
Latent Heat of Vap.	54 cal/gram	
Specific Heat @ 25°C	0.20	Ref. 2
Critical Temperature		
Critical Pressure		
Dissociation Constant		
Other Constants: Moisture content	.05%, Max.	Ref. 3
Other Constants: Distillation range	5°C, Max. incl 216°C	Ref. 3
Other Constants: Decomposition temperature	300 + °C	Ref. 2
Other Constants: Density correction factor	.00124 per 1°C	Ref. 2
Other Constants: Isomer distribution	Mixture 1, 2, 3&1, 2, 4	Ref. 2
References (1) Langes Handbook		
References (2) Hooker Data Sheet		
References (3) Hooker Specification		
Toxicity *(Give Reference)*		

MONS 055596

PHYSICAL CONSTANTS DATA

SUBSTANCE	STRUCTURAL FORMULA	Composition
TRI-TETRA BLEND	1, 2, 3, 4-Tetra	26-29%
	1, 2, 4, 5-Tetra	0- 3%
	Penta	0- 5.5%
	Trichlorbenzene	Remainder
COMPILED BY: D. K. Lynch	DATE: 12/13/54	Syst. No. 464 f V 204

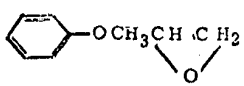
NAME		SOURCE & DATE
Formula	Mixture	Specification
Molecular Weight	---	
Appearance	W. W. Liquid	(GE material D5 B 69)
Boiling Point at 760 mm	210-278°C.	
Boiling Point at mm		
Boiling Point at mm		
Boiling Point at mm		
Crystallizing Point	-15°C. (Max.)	
Melting Point		
Solution Point	0°C.	
Specific Gravity at 15.5/15.5°C.	1.510-1.520	
Specific Gravity at		
Pounds per Gal. at 15.5°C	12.6	
Coefficient of Expansion		
Refractive Index at 25°C. n_D	1.5775-1.5790	
Infra Red Spectrum (Reference)		
Ultra Violet Spectrum (Reference)		
Viscosity at		
Viscosity at		
Surface Tension		
Solubility in Water		
Solubility in		
Solubility in		
Flash Point °F (Method)		
Fire Point °C	None to B.P.	
Heat of Combustion		
Heat of Formation		
Thermal Stability (cal./kg/min.)		0
Latent Heat of Fusion		
Latent Heat of Vap.		
Specific Heat		
Critical Temperature		
Critical Pressure		
Dissociation Constant		
Other Constants		MONS 055597

Toxicity (Give Reference) Sax, Handbook of Dangerous Materials Reinhold, N.Y. 1951 pp. 32 & 366. M.C.A.S.D. Sheet 94, 1954

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

DN 610 36100 PHYSICAL CONSTANTS DATA

SUBSTANCE: GLYCIDYL PHENYL ETHER (Phenoxypropeneoxide)

STRUCTURAL FORMULA: 

COMPILED BY: A. M. Ellenburg

DATE: 7/1.57

NAME		SOURCE & DATE
Formula	$C_6H_5OCH_2CHCCH_2$	
Molecular Weight	157.10	Ref. 1
Appearance		
Boiling Point at 760 mm	245°C	Ref. 1
Boiling Point at mm		
Boiling Point at mm		
Boiling Point at mm		
Crystallizing Point		
Melting Point	3.5°C	Ref. 1
Solidus Point		
Specific Gravity @ 20/4°C	1.1092	Ref. 1
Specific Gravity @		
Pounds per Gal. @ 20 °C	9.25	Ref. 1
Coefficient of Expansion	0.00081 cc/cc/°C	Ref. 1
Refractive Index @ 20°C n_D	1.5314	Ref. 1
Infra Red Spectrum (Reference)		
Ultra Violet Spectrum (Reference)		
Viscosity @ 20°C	7.05 cs	Ref. 1
Viscosity @ 30°C	4.88 cs	Ref. 1
Surface Tension 20°C	41.7 dynes/cm	Ref. 1
Solubility in Water @ 20°C	0.24% by wt	Ref. 1
Solubility in Octane @ 20°C	12.9%	Ref. 1
Solubility in Acetone	∞	Ref. 1
Flash Point °F (Closed) Tag Open Cup	175°F	Ref. 1
Fire Point °C		
Explosive Limits		
Point of Ignition		
Thermal Stability (cal./gr./min.)		
Upper Limit of Explosion		
Lower Limit of Explosion		
Solubility		
Critical Temperature		
Critical Pressure		
Critical Specific Volume		

Other Constants

Ref. (1) Shell Technical Bulletin: Sc:54-5

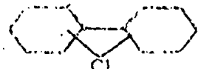
MONS 055598

Toxicity (Give References) LD 50 (Mice)	1.2 ml per kg.	Ref. 1
	Mainly skin irritant	Ref. 1

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

PHYSICAL CONSTANTS DATA

SUBSTANCE: AROCLOR 1242

STRUCTURAL FORMULA: 

COMPILED BY: A. M. Elsberg

DATE: 4-25-57

NAME		SOURCE & DATE
Formula	$C_{12}H_7Cl_3$	
Molecular Weight	257 avg.	
Appearance	Colorless Mobile O.	M-esanto Bull. OP-1.5, 1955
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 - 1.393	Specification 2-14-55
Pounds per Gal. @ 25 °C	11.50	M. B. OP-1.5
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-1.5
Viscosity @ 100 F.	82-92 SUS	"
Surface Tension Dynes/cm @ 20 °C.	45.3	J. Coll. Sci. 7, 164, 1952
Solubility in Water	Insoluble	M. B. OP-1.5
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-1.5
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.		
Other Constants: 60 cy.	4.7 - 4.9	M. B. OP-1.5
Other Constants: Solution Conductance (cond.	f.it²/ing/15	50°F 150°F
Other Constants: Viscosity, cp		0.0477 0.0327
Other Constants: Viscosity, cp		1530 93
		432 7
Toxicity (Give Reference)	Contact Medical Dept.	M. B. OP-1.5

MGNS 055599

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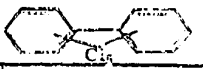
IN 619

PHYSICAL CONSTANTS DATA

SUBSTANCE: AROCLOR 1254

STRUCTURAL FORMULA: 

COMPILED BY: A. M. Ellerbarg

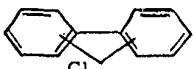
DATE: 4-25-47

NAME		SOURCE & DATE
Formula	$C_{12}H_6Cl_4$	
Molecular Weight	326 (Avg.)	
Appearance	Pale Yellow Isoparaffin oil	Monsanto Bul. OP 115/105
Boiling Point at 760 mm Range	365-401°C	"
Boiling Point at 3 mm "	180-220°C	"
Boiling Point at mm		
Boiling Point at mm		
Crystallizing Point	Non-crystallizing	"
Melting Point		
Solution Point		"
Specific Gravity @ 25/25°C.	1.538	
Specific Gravity @ 65/15.5°C.	1.495-1.505	Specifications 2/14/55
Pounds per Gal. @ 25°C	12.82	MB OP-115
Coefficient of Expension 25-65°C.	0.00066 cc/cc/°C.	"
Refractive Index @ 25°C n D	1.6370-1.6390	Specification 2/14/55
Infra Red Spectrum *(Reference)*		
Ultra Violet Spectrum *(Reference)*		
Viscosity @ 210°F	44-48 SUS	MB OP-115
Viscosity @		
Surface Tension Dynes/cm	50.3 @ 25°C. 42.0 @ 100°C	"
Solubility in Water	Insoluble	"
Solubility in 3A Alcohol @ 25°C	10 g./100 cc	"
Solubility in Pyridine @ 31°C.	114 g./100 cc	"
Flash Point °C. *(Method)* C.O.C.	None	"
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.	50	Calculated
Specific Heat @ 25°C.	0.261	MB OP-115
Critical Temperature		
Critical Pressure		
Dissociation Constant		
Specific Heat @ 300°C.	0.336	"
Other Constants: Pour Point	5-12°C.	"
Other Constants: Thermal Conductivity, Cal/cm/°C/Sec.	22.9 @ 28°C	To be published
Other Constants: Dielectric Constant, 100°C. 60 cy.	4.15-4.35	MB-OP-115
		MONS 055600
Toxicity *(Give Reference)*	Corp. Medical Dept.	M B OP-115

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

PHYSICAL CONSTANTS DATA

SUBSTANCE: AROCLOR 1260

STRUCTURAL FORMULA: 

COMPILED BY: A. M. Ellenburg

DATE: 4/25/57

NAME			SOURCE & DATE
Formula		$C_{12}H_{3.75}C_{16.25}$	
Molecular Weight		361 (Avg.)	
Appearance		Lt. Yell. soft sticky resin	Monsanto Bul. OP-115/19
Boiling Point at 760 mm	Range	385-420°C.	"
Boiling Point at 3 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 *(Reference)*			
Ultra Violet Spectrum *(Reference)*			
Viscosity @	210°F.	72-78 SUS	MB OP-115
Viscosity @			
Surface Tension			
Solubility in Water		Insoluble	" "
Solubility in			
Solubility in			
Flash Point °F *(Method)*	c.o.c.	None	"
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	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.	"
Other Constants: Dielectric Constant, 100°C. 60 cy.		3.6-3.8	"
			MONS 055601
Toxicity *(Give Reference)*		Contact Medical Dept.	MB OP-115

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

IN 819

PHYSICAL CONSTANTS DATA

SUBSTANCE: INERTEEN P.P.O.

STRUCTURAL FORMULA: Mixture
60% Aroclor 1260
40% Trichlorobenzene
0.2% Phenoxypropene Oxide

COMPILED BY: A. M. Ellenburg

DATE: 7-9-57

NAME		SOURCE & DATE
Formula		
Molecular Weight		
Appearance	Yellow tinted mobile oil	Ref. 1
Boiling Point at 760 mm Range	200 - 415 °C.	Ref. 1
Boiling Point at mm		
Boiling Point at mm		
Boiling Point at mm		
Crystallizing Point		
Melting Point		
Solution Point		
Specific Gravity @ 15.5/15.5 °C.	1.560 - 1.568	Ref. 1
Specific Gravity @		
Pounds per Gal. @ 15.5 °C	13.05	Ref. 1
Coefficient of Expansion (20 - 100 °C.)	0.0007 cc/cc/°C.	Ref. 1
Refractive Index @ 25 °C. n_D	1.6137 - 1.6157	Ref. 1
Infra Red Spectrum (Reference)		
Ultra Violet Spectrum (Reference)		
Viscosity @ 100 °F.	52 - 56 SUS	Ref. 1
Viscosity @ 20 °C.	15 cs.	Ref. 2
Surface Tension		
Solubility in Water		
Solubility in		
Solubility in		
Flash Point °F (Method) COC	None to boiling	Ref. 1
Fire Point °C		
Heat of Combustion		
Heat of Formation		
Thermal Stability (cal./gm/min.)		
Latent Heat of Fusion		
Latent Heat of Vap.		
Specific Heat (25 °C. - 80 °C.)	0.76	Ref. 2
Critic[illegible] Temperature		
Critical Pressure		
Chemical Stability		
Pour Point	-32 °C. or lower	Ref. 1
Other Constants: Dielectric Constant, 100 °C. 60 cy.	3.7 - 4.0	Ref. 1
Other Constants: Thermal Conductivity, cal/cm/sec/°C.	70 x 10^{-5} at 50 °C.	Ref. 2
Reference (1) Specifications 6-6-55		
Reference (2) Monsanto Chemical Ltd.		MONS 055602
Toxicity (Give Reference)	Contact Medical Dept.	

PHYSICAL CONSTANTS DATA

SUBSTANCE: PYRANOL 1481 (Askarel)

STRUCTURAL FORMULA: Mixture
75% Aroclor 1254
25% Trichlorobenzene

COMPILED BY: A. M. Ellenburg

DATE: 7/9/57

NAME		SOURCE & DATE
Formula		
Molecular Weight		
Appearance	yellow tinted mobile oil	Specs. Jan 28, 1955
Boiling Point at 760 mm		
Boiling Point at mm		
Boiling Point at mm		
Boiling Point at mm		
Crystallizing Point		
Melting Point		
Solution Point		
Specific Gravity @ 15.5/15.5°C	1.525-1.535	"
Specific Gravity @		
Pounds per Gal. @ 15.5°C	12.75	"
Coefficient of Expansion (20 - 100°C)	0.0007 cc/cc/°C	Monsanto Chemical Ltd.
Refractive Index @ 25°C n_D	1.6205-1.6215	Specs. Jan 28, 1955
Infra Red Spectrum (Reference)		
Ultra Violet Spectrum (Reference)		
Viscosity @ 100°F	70-82 SUS	"
Viscosity @		
Surface Tension		
Solubility in Water		
Solubility in		
Solubility in		
Flash Point °F (Method)		
Fire Point °C C. O. C.	None to boiling	"
Heat of Combustion		
Heat of Formation		
Thermal Stability (cal./gr./min.)		
Latent Heat of Fusion		
Latent Heat of Vap.		
Specific Heat		
Critical Temperature		
Critical Pressure		
Dissociation Constant		
Pour Point	-15°C or lower	"
Other Constants: Dielectric Constant, 100°C.	60 cy. 4.1 - 4.6	"
Toxicity (Give Reference)	Contact Medical Dept.	MONS 055603

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

PHYSICAL CONSTANTS DATA

SUBSTANCE	STRUCTURAL FORMULA
PYRANOL 1488	Mixture 60% Aroclor 1260 40% Trichlorobenzene

COMPILED BY	DATE
A. M. Ellenburg	7-9-57

NAME		SOURCE & DATE
Formula		
Molecular Weight		
Appearance	Yellow tinted mobile oil	Ref. 1
Boiling Point at 760 mm Range	200 - 415°C.	Ref. 1
Boiling Point at mm		
Boiling Point at mm		
Boiling Point at mm		
Crystallizing Point		
Melting Point		
Solution Point		
Specific Gravity @ 15.5/15.5°C.	1.560 - 1.568	Ref. 1
Specific Gravity @		
Pounds per Gal. @ 15.5 °C	13.05	Ref. 1
Coefficient of Expansion (20 - 100°C.)	0.0007 cc/cc/°C.	Ref. 1
Refractive Index @ 25°C. n δ	1.6137 - 1.6147	Ref. 1
Infra Red Spectrum (Reference)		
Ultra Violet Spectrum (Reference)		
Viscosity @ 100°F.	52-56 SUS	Ref. 1
Viscosity @ 20°C.	15 cs.	Ref. 2
Surface Tension		
Solubility in Water		
Solubility in		
Solubility in		
Flash Point °F (Method) COC	None to boiling	Ref. 1
Fire Point °C		
Heat of Formation		
Heat of Formation		
Thermal Stability (cal./hr/min.)		
Latent Heat of Fusion		
Latent Heat of Vap.		
Specific Heat (25°C. - 80°C.)	0.26	Ref. 2
Critical Temperature		
Critical Pressure		
Dissociation Constant		
Pour Point	-32°C. or lower	Ref. 1
Other Constants: Dielectric Constant, 100°C. 60 cy.	3.7 - 4.0	Ref. 1
Other Constants: Thermal Conductivity, cal/cm/sec/°C.	20 x 10^{-4} at 50°C.	Ref. 2
Reference (1) Specifications 6-6-55		
Reference (2) Monsanto Chemical Ltd.		
Toxicity (Give Reference)	Contact Medical Dept.	

MONS 055604

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

DEPT. 259 - STANDARD MANUFACTURING PROCESS
Pyranols, Inerteens, and FR-O

APPENDIX D

UTILITIES

The utility calculations are based on 1970 YTD usages. Monthly YTD production averages 1.2M lbs.

The breakdown of utility usage by individual equipment is only an estimate. The estimates are based on the total monthly usage of each utility as taken from the cost report, and the relative period of time that each is operated.

1. ELECTRICITY - 440v, 3 phase, 60 cycle

ITEM NO.	EQUIPMENT MOTOR	MOTOR HP	PEAK LOAD KW	MONTHLY USAGE, KWH
153	TCB Pump	3.0	2.6	250
154	#3 Mix Tank	7.5	6.6	4000
160	#3 Mix Tank Pump	10.0	8.8	3000
163	TTCB Pump	7.5	6.6	250
164	#2 Mix Tank	7.5	6.6	4000
165	#2 Mix Tank Pump	10.0	8.8	3000
174	TCB/TTCB Tank Car Pump	5.0	4.4	500
	TOTALS	50.5	44.4	15000

In addition, 110V power is used for lighting and small miscellaneous equipment.

2. NITROGEN (bulk) - Because this cost is negligible, all N_2 costs are charged to Aroclors.

ITEM NO.	USING EQUIPMENT	NORMAL USE SCFH	PEAK USE SCFH	MONTHLY USAGE, SCF
154	#3 Mix Tank	4	5	2000
164	#2 Mix Tank	4	5	2000
	TOTALS	8	10	4000

3. STEAM (80 psig @325°F)

ITEM NO.	USING EQUIPMENT	NORMAL USE M BTU's/HR.	PEAK USE M BTU's/HR.	MONTHLY USAGE, M BTU's
154	#3 Mix Tk	500	750	300
164	#2 Mix Tk	500	750	300
---	Drum Heater and Misc.	50	100	40
	TOTALS	1050	1600	640

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.

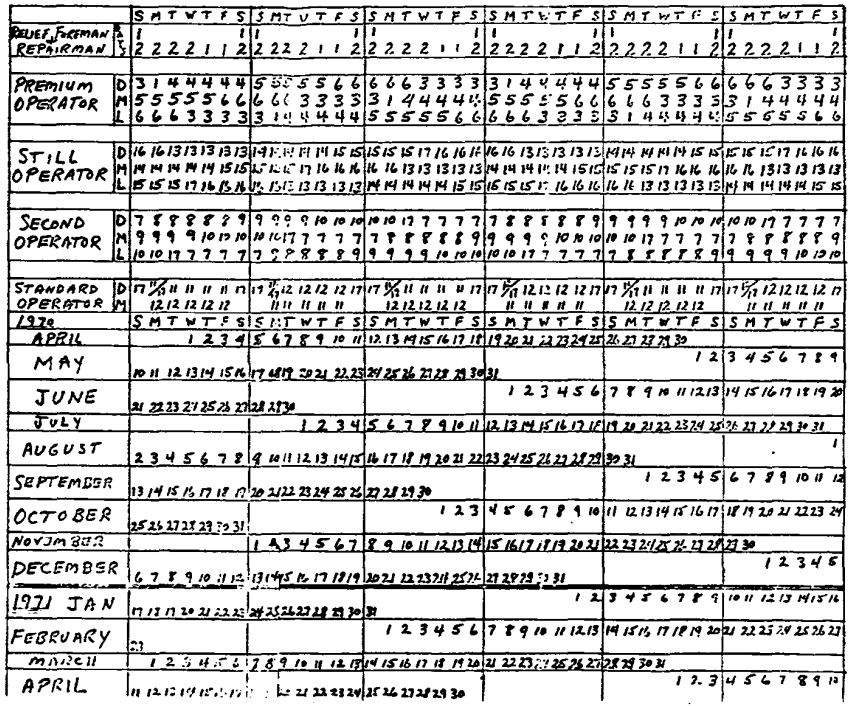
REPAIRMAN: Unloads cars and trailers of biphenyl, TCB, TTCB, and finished product. Does minor repair work in department.

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

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



MONS 055608

DEPT. 259 - STANDARD MANUFACTURING PROCESS
Pyranols, Inerteens, and FR-0

APPENDIX F

PACKAGING AND SHIPPING

Aroclors, and Pyranols are filled about 30% in drums and 70% in tank cars or tank trucks. About 2/3 of the Pydrauls are drummed and 1/3 sold as bulk.

A substantial amount (about 30%) of the Aroclor produced is used to make Pyranols and Pydrauls. This % will drop to 20-25% as the Aroclor-containing Pydraul formulations are replaced.

Sales are largely directly to the customer. The remainder is in bulk shipments to the J. F. Queeny Plant or to Therminol users within W.G.K.

All electrical grade tank truck shipments are made in the customers' trucks which are stainless steel. Non-electrical Aroclors are shipped in leased trucks and may be iron although other materials of construction are suitable. Pydraul is shipped in steel tank trucks. At present no Pyranols or Inerteens are shipped by truck.

Electrical grade Aroclor and Pyranols are shipped in solid aluminum tank cars or in lined tank cars either 4,000 or 8,000 gallons in capacity. The lining is either tin, zinc or aluminum spray because iron contamination is detrimental to the electrical properties. Electrical grade cars are either owned by Monsanto or on a long term lease. Non-Electrical grade Aroclor is shipped in steel cars.

All bulk shipments of material are sampled from the final container. That is all tank cars and tank trucks are sampled and analyzed after loading. Drums are not analyzed; the storage tank analysis is used unless a drum sample analysis is requested.

Tank cars and tank trucks are inspected by supervision to be sure they are free of dirt and water or other foreign material before loading. Heels are drained before loading when their quality is questionable or when it is incompatible with the material to be loaded. Car washing when necessary is done by the repair track. Tank cars are sealed with a numbered aluminum seal by repair track personnel.

Epoxy phenolic double lined drums are used for Aroclors, Therminols, and Pyranols and plain steel drums are used for Pydrauls.

The drummed product is sold to the W.G.K. 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
42 x 600 E	241					
42 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					
erminol 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					
A1B3B3B x 675	300					
A1B3B3B x 360	300					
A1B3B3B x 65	300					
A1B3B3B x 60						
1242 PPO x 600	215					
1242 PPO x 320	215					
1242 PPO x 55	215					
Pydraul A200 x 675	200					
Pydraul A200 x 55	200					
Pydraul 280 x 675	280					
Pydraul 280 x 60	280					

MONS 055610

DEPARTMENT 259 - STANDARD MANUFACTURING PROCESS
Pyranols, Inerteens, and FR-O

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.

TCB and TTCB yields on individual batches can be less than standard or over theory. This is due to the fact that blends are made and adjusted to a specific gravity range rather than by percent composition. (See "Yield" section of Comments on Process).

The attapulgus earth and nitrogen is used to upgrade the electrical properties. They do not become a part of the finished goods.

DEPT. 259 - STANDARD MANUFACTURING PROCESS
Pyranols, Inerteens, and FR-O
APPENDIX H
PRODUCT LOSSES

Estimated product losses in terms of source are shown below:

Source	Typical 12,000 Gal. Batch (gals.)	Loss (Est.) % of Total Produced	Loss (Est.) #/Yr. Based on 15M Pyranols
1.Spills	10 gal.	0.082%	12,500 lb.
2.Samples and rinses	6	0.050	7,500
3.Retained in empty drums	2	0.017	2,500
4.Pump leakage	2	0.017	2,500
5.Filter waste	2	0.017	2,500
6.Fumes	2	0.017	2,500
TOTALS	24 gallons	0.200%	30,000 lbs.

DISCHARGE TO ATMOSPHERE

Based on the above estimate, Pyranol production losses to the atmosphere amount to about 2500 lbs. of material per year (source #6). This is TCB, TTCB, and Aroclors. This estimate is based on a minimal amount of mix tank vent sampling data.

DISCHARGE TO SEWERS

Materials from sources #2 and #4 are currently being held in drums for incineration. Product from sources #3 and #5 go to the landfill. Spills (source #1) soak into the soil and chat in the department area. It is unknown whether or not any of the material gets to the sewer via rainwater run-off. Within six months a project will be completed which will collect any spills in a settling basin.

DEPT. 259 - STANDARD MANUFACTURING PROCESS
Pyranols, Inerteens, and FR-O

APPENDIX I

PROCESS CONTROL

Three forms are included in this section:

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

KEY VARIABLES

1. TCB and TTCB Quality - The certificate of analysis should be noted before the material is used. If poor quality chlorobenzenes are used, poor blends result. In some cases the low quality blend can be upgraded, but in others it cannot.

2. Mix Tank Temperature - In most cases the temperature should be 90-100°C. At lower temperatures high moisture content is possible. At high temperatures (130°C. and above) loss of the chlorobenzene may be great enough to throw the specific gravity or refractive index out of specification.

3. Use of Batch Sheets - In a batch blending operation the only operating data available is that which the operator records. Therefore these records must be maintained properly. If the batch is in specification on the first analysis, the transfer data will be little used. When problems occur the raw data is indispensible.

MONS 055613

Pyranols 1260 PPO, 70/30, A13B3B, and 54201 CM

Process Area or Item	Variable or Parameter	Description of Parameter As It Affects Safety, Quality, Yield, Rate or Other	Range For Best Known Process Performance	Supervision Frequency of Monitoring	Measurement of Variance: Frequency	Method	Accuracy	Interaction With Other Variables	Out of Control Variables	Comments
1. Raw Material Analysis (a)	Aroclor 1242, 1254 and 1260 analysis.	Quality	In specification	At least gravity is checked before each use.	Each finished lot of Aroclor	(See finished goods specifications sheets).		Directly affects all finished goods analyses.	Make adjustments when necessary.	The reliability of Aroclor quality is very high. Therefore a specific gravity and refractive index check is the only required analysis prior to its use in a Pyranol (Inerteen) blend.
(b)	TCB and TTCB	Quality	In specification	S.G. and Index are checked on each shipment	Each shipment	10118 10125	± 0.001 ± 0.0002	Directly affects all finished goods analyses.	Accept or reject shipment.	TCB and TTCB are supplied by Hooker. A Certificate of Analysis is received with each shipment.
2. Raw Material Addition (a)	Contents of tank before charging raw materials.	Quality	For different products, the mix tank should be empty before charging; identical products can be built on a heel.	Each batch	Each batch	Level Indicator	± 1"	Each Pyranol has different chemical and physical properties.	Drum out mix tank before making new batch.	Normally a new mix is not made on an existing heel. This is done only when drumming a tank empty would unduly delay the production of another identical mix (or other similar circumstance).
(b)	Proportions of major components	Quality	The ratios should be near those specified in the Standard Manufacturing Process - but not necessarily exactly.	Each batch	Each batch	Level gauges, or meter.	± 50 gal.	The most critical analyses are specific gravity and refractive index. When these are correct usually all other physical analyses are correct.	Manual valves or automatic cutoff meters are used in charging a mix tank. Specific gravities can be averaged. Refractive indices can be averaged, but with less accuracy and reliability.	In relationship to the old specifications (prior to 9/1/70) for Inerteen PPO and A13B3B, the specific gravity had to be near the lower limit for these two products, and the refractive index near the upper limit. This meant specs. were difficult to achieve and TCB and TTCB standard yields were often not met.

MONS 055614

Process Area Or Step	Variable Or Parameter	Description Of Parameter As It Affects Safety, Quality, Yield, Rein or Other	Range For Best Known Process Performance	Supervision Frequency of Monitoring	MEASUREMENT OF VARIANCE			INTERACTION WITH OTHER VARIABLES	NEW CONTROL VARIANCES	COMMENTS
					Parameter	Method	Accuracy			
2. Raw Material Addition (c) (continued)	Order of addition	Rate	Add TCB, or TCB first, then Aroclor.	Each batch	Each batch	By instruction	--	A constant gravity blend analysis will be achieved more quickly if the lighter, less viscous is added first.	By instruction	After gravity and index has been achieved, the small percentage additives are added.
(d)	Temperature of raw materials	Rate	100°C. in raw material storage tanks.	Once/month	Continuous	TI	± 2°C.	Affects pumping time and initial temperature of mix.	Steam pressure reducer	
(e)	Agitation and circulation during PM addition	Rate	There should be agitation and circulation during raw material addition.	Spot check only	Each batch	By physical check.	--	Will affect the total batch cycle time.	By operator training	
3. Mixing (a) (#2 and #3 Mix) Tanks	Temperature	Rate	90-100°C.	Once/week	Continuous	TIC	± 2°C.	At lower temperatures, the mix time will be longer.	TIC set point at 95°C.	
(b)	Agitation	Rate Quality	Agitator on, as well as circulating pump.	Daily	Each batch	Visual check	--	Without agitation thorough mixing is not accomplished.	By instruction	
(c	Mixing Time	Rate Quality	4 hrs. after components are added.	Spot check	Time of RM charging and time of sample taking is noted on log sheet.	--	--	Large batches may take longer before complete mixing is accomplished.	Samples for gravity and index are taken every 4 hrs. until the results are constant.	

MONS 055615