

COMPANY CONFIDENTIAL

PRELIMINARY
INDUSTRIAL HYGIENE SURVEY
OF
THE TEXAS CITY PLANT

Monsanto Company
Department of Medicine & Environmental Health
Industrial Hygiene Section
St. Louis, Mo.

Conducted November, 1975

Written by S.A. Roberts

MAP 004927

LAM000753

Distribution

1. P.E. Brubaker
Plant Manager,
Texas City Plant
2. George Roush, Jr., M.D.
Medical Director
Dept. of Medicine & Environmental Health
3. E. N. Brasfield
Director, Manufacturing
MPPC
Petrochemicals Division
4. Harry M. Keating
Manager - Environment and Energy Affairs
MPPC
St. Louis, Mo.
5. E.W. Jones
Superintendent - Personnel
Texas City Plant
6. J.E. Fox
Industrial Hygienist
Texas City Plant
7. R. L. Miller
S&PP
St. Louis, Mo.
8. File Copy

MAP 004928

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INTRODUCTION

At periodic intervals an Industrial Hygiene Survey is conducted by the Medical Department to determine if possible occupational exposure problems exist in a given plant. The results of such a survey are contained in this report.

The survey includes an examination of the job classifications and materials a worker might handle or be exposed to in each classification along with a notation on protective equipment provided to prevent or lessen exposure. The survey also includes a walk-thru examination of each operating unit with recommendations to eliminate exposure problems observed.

This report is based upon conditions and practices observed and information supplied by management personnel at the time of the visit. It does not purport to list all hazards nor to indicate that other hazards do not exist. If there is an error or omission, please send the correction to:

Steven A. Roberts
Monsanto Company
Medical Department
St. Louis, Missouri

MAP 004929

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MAP 004930

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MONSANTO COMPANY
INDUSTRIAL HYGIENE SURVEY
POSSIBLE EXPOSURE INVENTORY

COMPANY MPPC

DIVISION Petrochem.

PLANT Texas City

DEPARTMENT: Ethylbenzene and styrene

Products: Ethylbenzene

Styrene

- | | |
|---|---------------------------|
| 1 <u>Ethylbenzene (to styrene)</u> | 1. <u>Styrene monomer</u> |
| 2 <u>Aluminum chloride (27% solution)</u> | 2. <u>Toluene</u> |
| 3 <u>Hydrogen chloride (17% solution)</u> | 3. <u>Styrene Tar</u> |
| 4 <u>Flux oil</u> | 4. <u>Benzene</u> |
| 5 _____ | 5. <u>Ethylbenzene</u> |
| 6 _____ | |
| 7 _____ | |
| 8 _____ | |

Employee:

	<u>EB</u>	<u>Sty.</u>		<u>EB</u>	<u>Sty.</u>	
1st Shift	<u>5</u>	<u>8</u>	Hourly	<u>4</u>	<u>7</u>	Salaried
2nd Shift	4	7	Hourly			Salaried
3rd Shift	4	7	Hourly			Salaried
4th Shift	6		Hourly			Salaried
Totals	19	22	Hourly	4	7	Salaried

Buildings Involved:

- 1 _____
- 2 _____
- 3 _____
- 4 _____

MAP 004931

Supervisor:

J. P. Irwin (EB), S. E. Knipling (Sty.)

LAM000757

MONSANTO COMPANY
INDUSTRIAL HYGIENE SURVEY
MATERIALS DATA SHEET

Division MPPC
Plant Texas City
Department 13-14 Ethylbenzene
+ CT7 Operation

Supervisor J. P. Irwin
Date Nov. 14, 1975
Building

Raw Materials	Intermediates	Finished Products
Benzene Ethylene Aluminum granules Anhydrous HCl 50% NaOH solution Chlorine (CT7 only) MB-103 Biocide (CT7 only) Ethyl Chloride (Used only occasionally as HCl substitute) Calgon SL 500 Boiler Water Additive (Mixture of NTA and EDTA) Nitritotriacetic Acid (NTA)	Benzene Polyethylbenzenes (primarily diethylbenzene) Catalyst Complex (Aluminum chloride - organic complex ~75% AlCl ₃ by weight) Offgas (mainly CH ₄ & C ₂ H ₆ sent to Power Z for boiler feed)	Ethylbenzene 27% AlCl ₃ Solution (BP) 17% HCl Solution (BP) Flux Oil (Heavy ends used in 15/16 or as boiler fue

Miscellaneous Materials:

Various lab reagents used for (1) water hardness and pH analysis
(2) boiler control - SL-500, Sulfite, Cond. measurements

MAP 004932

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MONSANTO COMPANY
INDUSTRIAL HYGIENE SURVEY
MATERIALS DATA SHEET

MAP 004933

Division MP&P
Plant Texas City
Department Dept. 15 & 16 (Styrene)

Supervisor S. E. Knipling
Date 11/17/75
Building 16D

Raw Materials	Intermediates.	Finished Products
Ethylbenzene Molten Sulfur 85% Tertiary Butyl Catechol in Methanol Flake Caustic) Na ₂ SO ₃) Water NaNO ₃) Treating 2-4 Dinitro Phenol (DNP or NSI) future Shell 105 Dehydrogenation Catalyst 50% NaOH 17% Muriatic Acid	Department 15 Off Gas DM-Mixture of EB, SM, Toluene, Ba, High Boilers 15% DNP in DM 25% DNP in DM 10% Na Salt of DNP Waste water containing traces of DNP	Styrene Monomer inhibite Tert. Butyl Catechol Ethylbenzene Toluene Benzene Styrene Tars

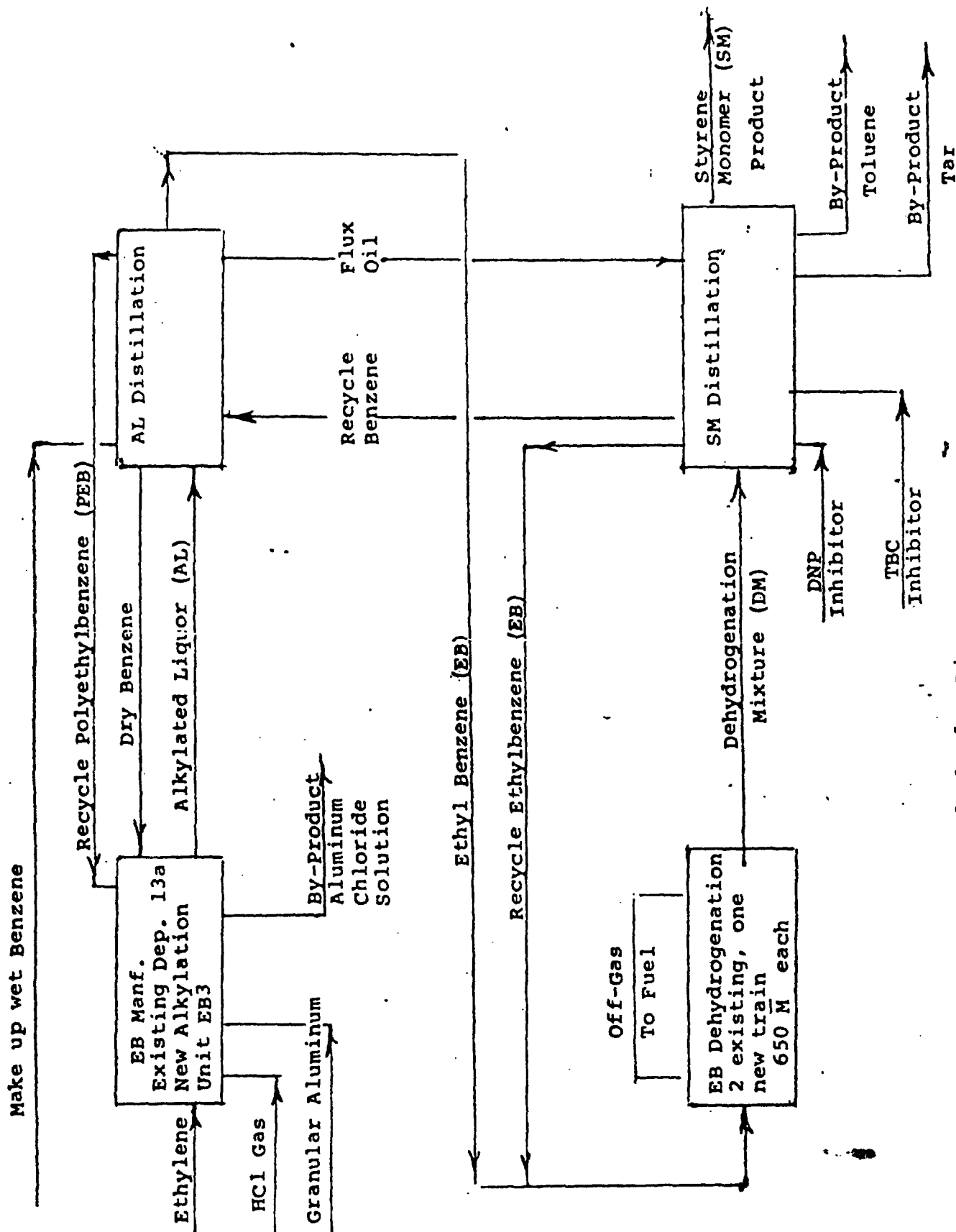
Miscellaneous Materials:

Analytical Chemicals

Starch
HCL (25%)
1/30 N HCL
Potassium Iodide Solution (10%)
Potassium Iodate Solution
Neutral Barium Chloride (10%)

Phenolphthalein
Phosphate Reagent #2 (Colorimetr
 Phosphate Determination)
Phosphate Reagent #3 (Colorimetr
 Phosphate Determination)
Conductivity Reagent A (Conducto
 metric Solids Determination)

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Block Flow Diagram

Figure 1

MAP 004935

ALCANTARA
LAWSON

JOS
9-11-73

FIGURE 1
BLOCK FLOW DIAGRAM OF EA PLANT AFTER EA-3

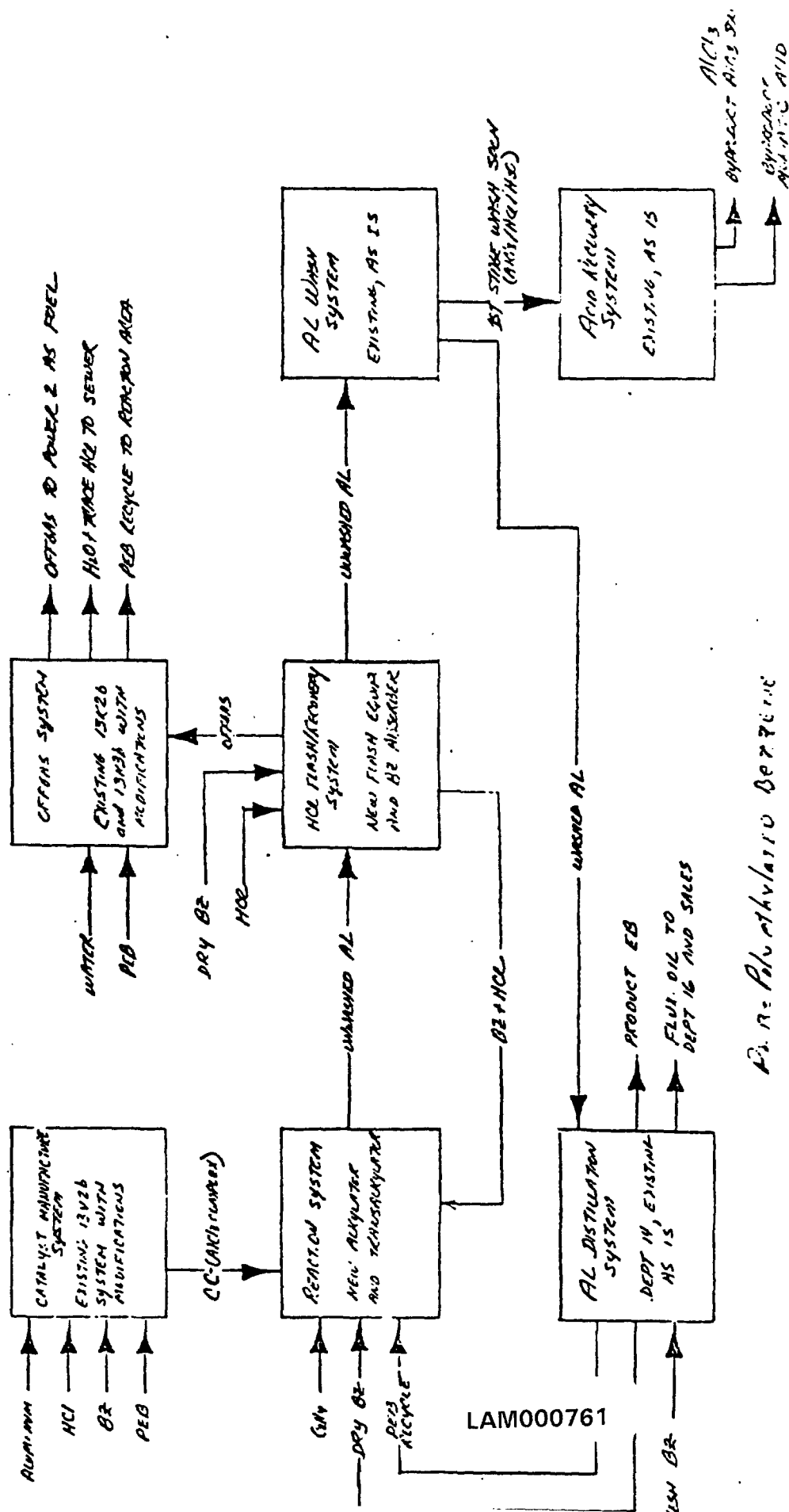
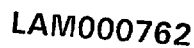


Fig. 1: Phthalic Anhydride



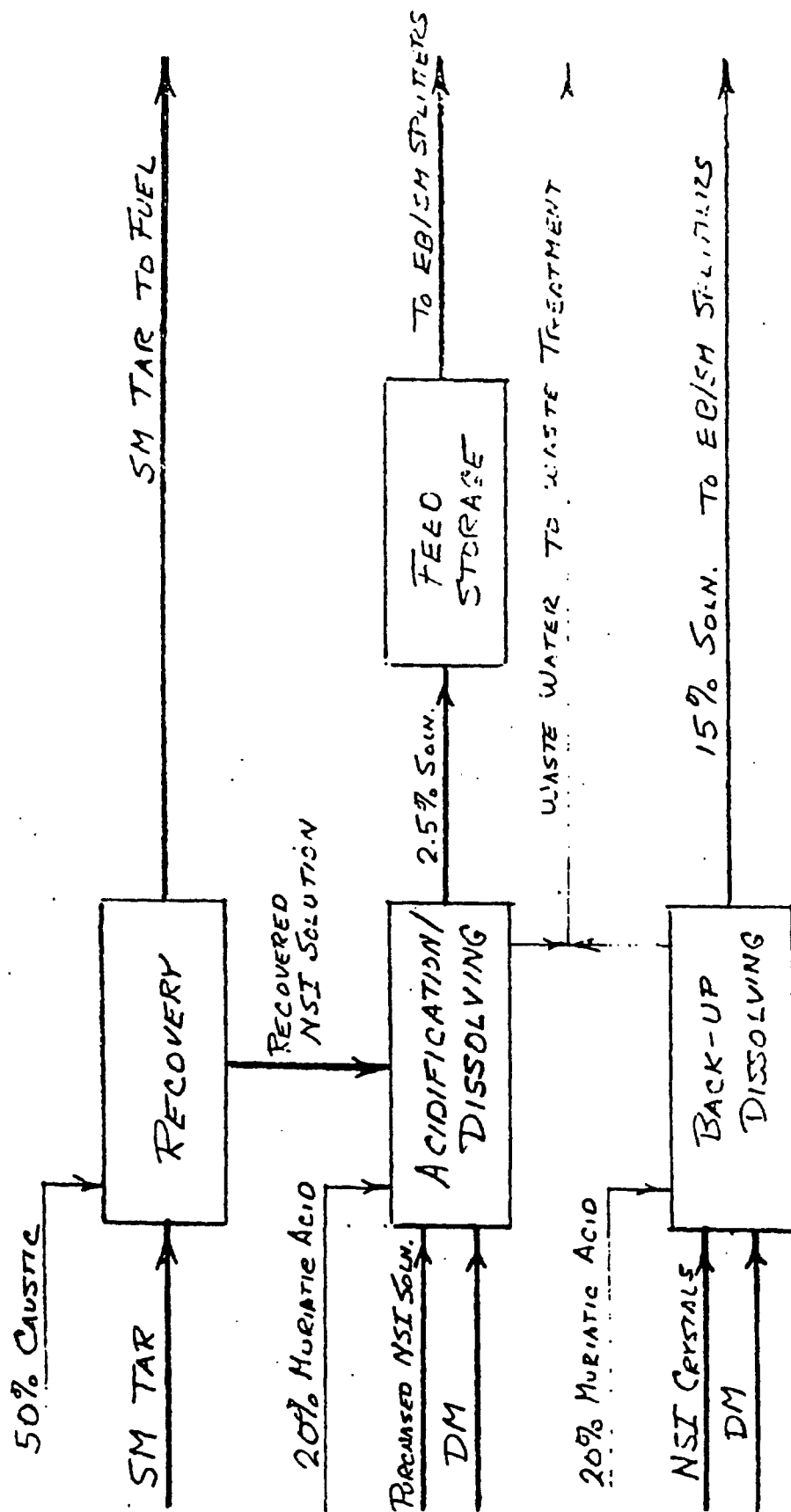
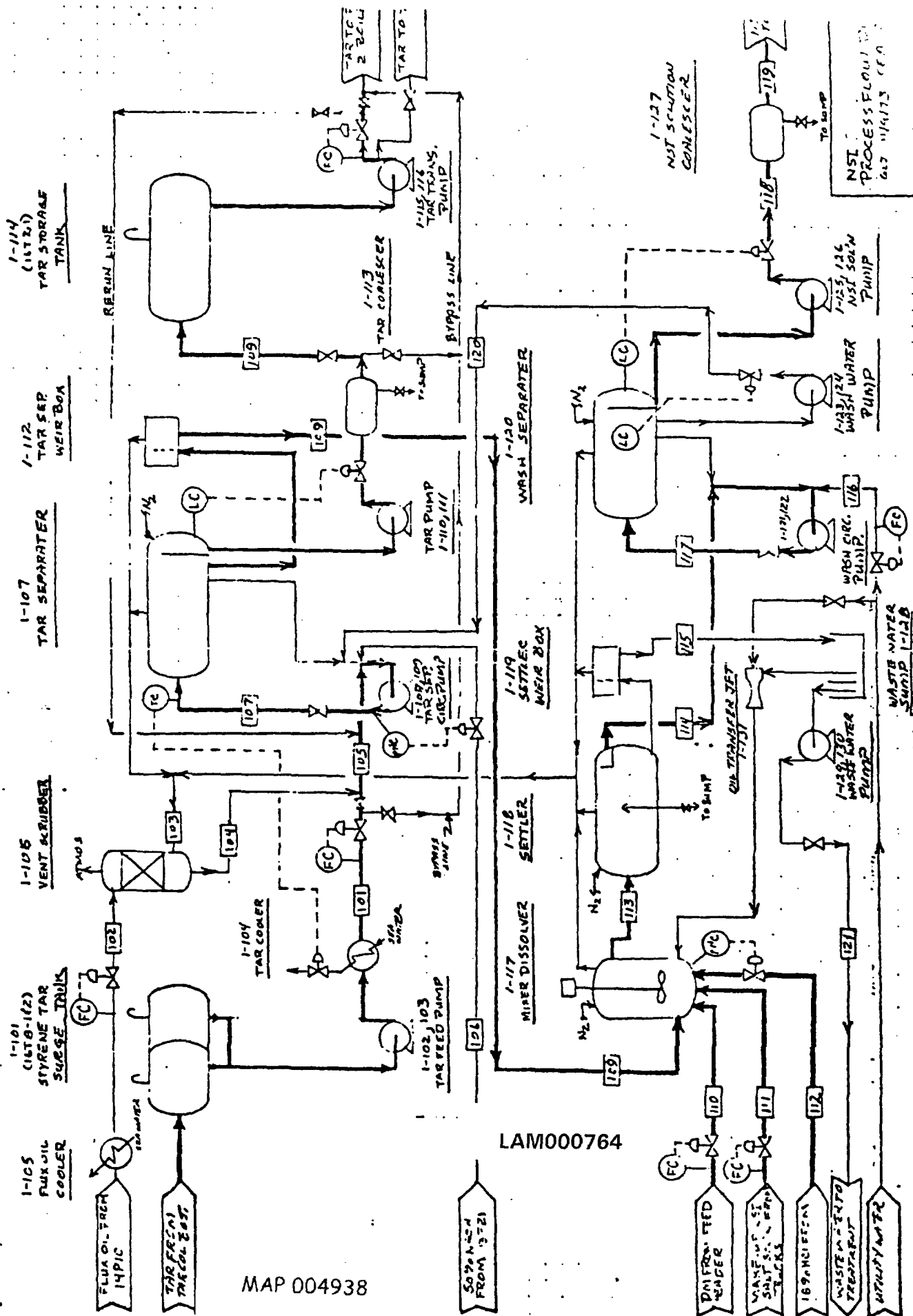


FIG 1, NSI SYSTEMS

MAP 004937

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PROCESS DESCRIPTION

The four major steps in the process are:

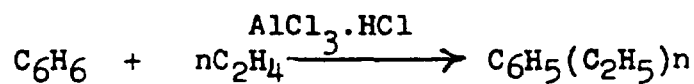
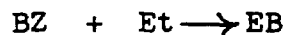
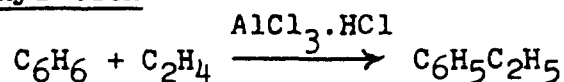
1. Manufacture of ethylbenzene by the alkylation of benzene with ethylene (Dept. 13).
2. Purification of ethylbenzene by distillation from the alkylated liquor (Dept. 14).
3. Dehydrogenation of ethylbenzene to styrene (Dept. 15).
4. Distillation of the dehydrogenated reaction mixture to recover the styrene product (Dept. 16).

The interconnection of these processing steps is shown in the block-flow diagram in Figure 1.

Further process description is as follows:

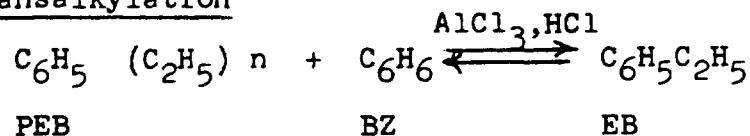
1. Alkylation: The chemistry of the alkylation process is involved with the following reactions:

Alkylation



polyethylbenzenes (PEB)

Transalkylation



MAP 004939

LAM000765

PROCESS DESCRIPTION (continued)

In the alkylation process, alkylation (and some transalkylation) is accomplished in the alkylator. Part of the fresh dry benzene feed to the unit, benzene bottoms from the benzene absorber (contains fresh make-up and recycle HCl), and aluminum chloride catalyst are fed to the highly back mixed reactor. Ethylene is introduced through a sparger. Heat of reaction is removed in an external pumped cooling loop.

Off-gas from the reactor (ethane impurity in ethylene) is cooled to remove aromatics, combined with off-gas from the benzene absorber, scrubbed with PEB to recover aromatics and HCl, scrubbed with water to remove remaining HCl and used as fuel gas.

Alkylate (including unreacted benzene) from the alkylator is combined with recycle PEB (from distillation) and transalkylated in the transalkylator (plug flow hold tank). Both alkylation on transalkylation are conducted at 160-180° C.

Total liquid from the transalkylator is flashed to remove some of the unreacted benzene and recycle benzene. Flashed vapor is condensed in a partial condenser and a benzene absorber column. Condensate from the partial condenser is rich in EB and is combined with the liquid alkylate from the flash.

Vapor from the partial condenser is scrubbed with benzene in the benzene absorber to condense recycle HCl and aromatics. Fresh make-up HCl (or ethylchloride) feed to the unit is also fed to the benzene absorber. The small amount of unabsorbed gas from the top of the benzene absorber column (mostly ethane impurities in ethylene feed) is combined with reactor off gas for PEB and water scrubbing and use as fuel gas. Benzene feed to the benzene absorber is part of the fresh cold benzene feed to the unit. Benzene along with absorbed HCl (recycle and fresh make-up) and aromatics from the bottom of the column is pumped to the alkylator.

MAP 004940

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PROCESS DESCRIPTION (continued)

Liquid alkylate from the flash is cooled, combined with alkylate and spent catalyst complex from the old alkylation unit and washed (aqueous AlCl_3 , caustic, water).

In the old alkylation dry benzene is mixed with ethylene, recycle polyethylbenzenes (PEB) from the alkylated liquor (AL) distillation area and aluminum chloride catalyst complex (CC) promoted with HCL. The mixture is pumped through line orifice alkylators and a transalkylation vessel. The reaction is conducted at 100-120° C. The resulting AL is cooled, degassed, separated from the CC, and combined with alkylate from the new alkylation unit for washing.

MAP 004941

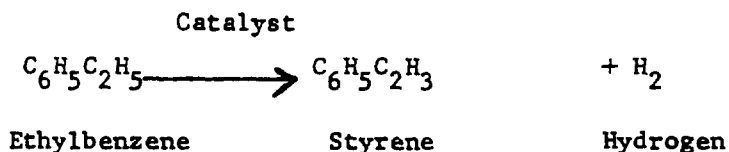
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PROCESS DESCRIPTION (continued)

2. AL Distillation: The alkylated liquor (AL) from the Alkylation is fractionated in five distillation steps. In the first step recycle benzene is recovered as the overhead product. This recycle benzene, combined with fresh make-up and recycle benzene from SM distillation, is dried in an azeotropic column and fed to Alkylation. The bottoms from the recycle benzene fractionation is fed to ethylbenzene columns where ethylbenzene is recovered as the overhead product. Ethylbenzene is fed to Dehydrogenation. Bottoms from the ethylbenzene columns is further fractionated in two more columns in series. The combined overhead from these columns is the recycle polyethylbenzenes (PEB) which are recycled to Alkylation. By-product flux oil from the bottoms of this last column is fed to SM Distillation where it is used to dilute styrene tar. Excess beyond requirements for styrene tar dilution is sold as a fuel blending stock.

AL Distillation shares a circulating dilute caustic system with SM Distillation. If efficiency of the alkylate wash system decreases, caustic is sprayed into the overhead of the recycle benzene column to decrease corrosion.

3. Dehydrogenation: In the ethylbenzene dehydrogenation area the major chemical reaction is:



Side reactions produce benzene, toluene, CO₂, and high boilers (principally alpha-methyl styrene).

Fresh EB from the AL distillation area combined with recycle EB from SM distillation is vaporized, superheated, mixed with superheated steam and catalytically dehydrogenated in a series of two fixed-bed, radial flow reactors. Since the reaction is endothermic, the effluent from the first reactor stage is reheated with incoming superheated steam in a heat exchanger before entering the second reactor stage. High steam dilutions are used because the steam supplies a "heat sink" in the reaction zone and reduces the partial pressure of the reaction products. Low pressure and high temperature are favorable to the reaction equilibrium, thus sub-atmospheric pressures are used in addition to the steam dilution.

The reactor effluent is cooled by generating steam and then partially condensed. The noncondensable off-gas is compressed cooled, scrubbed with ethylbenzene and chilled to recover the aromatic hydrocarbons and utilized as a fuel.

The condensed material is separated into an organic and an aqueous phase. The organic phase (DM) which contains styrene, EB and lesser amounts of benzene, toluene and high boilers is sent to the DM distillation area. The aqueous phase is pumped to condensate strippers where organics and dissolved CO₂ are stripped with steam. The stripped condensate is filtered and returned to the boiler plant.

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MAP 004942

4. SM Distillation: Product styrene monomer is recovered from the dehydrogenated mixture (DM) by fractionation. In the EB/SM splitters the DM is distilled to take overhead the EB and lighter components. DNP inhibitor is added to the column feed to inhibit polymerization of styrene. The styrene and heavier components (including DNP) leave the bottom of the first column and are then distilled to separate the styrene product as overhead. Tertiary butylcatechol (TBC) inhibitor is added in the overhead of this column in order to prevent polymerization of the product styrene monomer. Product styrene monomer is chilled and pumped to storage. The bottoms from the styrene product column are stripped in a separate column to maximize styrene recovery. Overheads from the stripping column are recycled to the styrene product column. Flux oil from the AL distillation area is added to the lower portion of the stripping column to keep the styrene tars fluid. The bottoms from the stripping tower may be sold or used as a fuel.

The overheads from the EB/SM splitter are fractionated in a series of three columns. In the first of these three columns (EB Recovery Column) toluene and lighter components are taken overhead and most of the recycle EB is taken out the bottom. In the second and third column recycle benzene and by-product toluene are separated from the remaining EB.

TBC inhibitor solution is prepared for use by batch mixing with styrene monomer.

DNP inhibitor will probably (details not yet firm) be recovered in a continuous unit that extracts the DNP from the styrene tar as the sodium salt with an aqueous caustic wash. Then the aqueous solution is acidified (HCl) and dissolved in a slip stream of the DM feed to the EB/SM Splitter. Make-up DNP will probably be added to the acidification step as the aqueous sodium salt solution.

MAP 004943

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Process Facilities Description - NSI (Non-Sulfur Inhibitor)

Acidification/Dissolving System

Acidification and dissolution of NSI in DM takes place in a continuous stirred pot. Feeds are NSI sodium salt solution, 20% Muriatic Acid, and DM.

Overflow from the stirred pot flows to a continuous settling tank. Water phase from the settler is the aqueous waste from the unit. It flows to the area sump. organics are skimmed and returned to the process and the waste is pumped to the plant waste treatment plant.

Organic phase from the settler (NSI/DM solution) is water washed in a circulating pump mixer/settler system. Unwashed NSI/DM solution and make-up utility water are introduced into the suction of the water circulating pump. Effluent from the pump is separated in the continuous separator tank. Most of the water phase is recirculated. A portion of the water phase is pumped as make-up water to the Recovery System.

Washed NSI/DM Solution from the separator is pumped through a coalescer/settler (to remove entrained water phase) to storage from which it is pumped to the EB/SM Splitter feeds.

NSI Recovery System

SM tar from SM distillation is contacted with caustic solution in a continuous mixer/settler system. The caustic solution converts the NSI to the water soluble sodium salt.

Mixing of SM tar, 50% caustic, and salt solution is in the salt solution circulating pump. The mixture is separated in hold tank. Most of the aqueous salt solution is recirculated to contact SM tar feed. A portion of the aqueous salt solution is recovered NSI feed to the Acidification/Dissolving system.

The SM tar phase from the separator is pumped through a coalescer and separator to remove entrained caustic solution (required to meet ash specification) and then to storage for subsequent use as fuel.

Back-up Dissolving System

This batch dissolving system provides a back-up feed of 15% NSI solution in DM from purchased 86% NSI crystal when normal aqueous salt solution feed is not available or when the Acidification/Dissolving or normal feed systems are inoperable.

Two dissolvers are provided -- a batch being prepared in one while the other is used for feed to distillation. The 15% solution is prepared by stirring crystals (dumped from drums) with DM at 80° C (steam on jacket) and pH less than 1.0 (20% Muriatic acid added). After settling, water phase is pumped to hold tank and the batch is ready for feed to distillation. Organic phase separated in the hold tank is added to the next batch and aqueous phase is pumped to waste treatment.

Storage/Feed System

This system provides inventory of NSI as 2.5% solution in DM and feed pumps to distillation.

MAP 004945

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MAP 004946

Monsanto Corporate Medical
St. Louis, MissouriINDUSTRIAL HYGIENE SURVEY
WORKROOM DATA

Facility: Texas City Page of

Division: MPPC Department: 13-14 Ethylbenzene Building:

Date Source: J. P. Irwin Surveyed by: Date: 14 Nov. 1975

OCCUPATION Shifts (1)	NATURE OF JOB (2)	RAW MATERIALS AND BY-PRODUCTS (3)	CONTROL MEASURES (4)						REMARKS AND Hazard Potential (5)	Air Sampling
			LOCAL EXH.	MECHANICAL VENTILATION	WET METHODS	PROTECTIVE EQUIPMENT	RESPIRATOR	BAF BOB		
Chief Operator (1/Shift)	Directs & controls activities of opera- tors on his shift.	All							Goggles required in acid area	
Board Operator (1/Shift)	Operates control in- strumentation in con- trol room and logs data inside entire shift.	None								
Outside Oper. "A"	Operates all Dept. 13 (alkylation) equip. as reqd.	Samples 50% All								
Outside "B"	All Dept. 14 and OSBC tankage & Ct&	75% in control room All								
Straight Day operator (Mon-Fri.) Shift 1 only	Prepares equipment for and coordinates with maint. as required.	All								
Mfg. Foremen 3/days Mon-Fri.	Supervision of above	All								
Mfg. Supv.	Supervision of above	All								

LAM000772

Monsanto Corporate Medical
St. Louis, Missouri

INDUSTRIAL HYGIENE SURVEY
WORKROOM DATA

Facility: Texas City Page 1 of 3
Division: MP&P Department: Styrene Mfg. Building: 160
Date Source: S. E. Knippling Surveyed by: Date: Nov. 1975

OCCUPATION (1)	NATURE OF JOB (2)	RAW MATERIALS AND BY-PRODUCTS (3)	CONTROL MEASURES (4)							REMARKS AND Hazard Potential (5)	Air Sample	
			LOCAL EXH.	MECHANICAL VENTILATION	WET METHODS	PROTECTIVE EQUIPMENT	RESPIRATOR	OTHER	DO		Gn	Pe
Chief Oper. 1/Shift	Supervision of 6 shift operators	All listed on previous page								Cover goggles reqd. when in Boiler Chem. area or NSI areas. Cover goggles. dust mask, coveralls and gloves when in NSI warehouse during loading operations.		
15 Board Operator	Operates controls	Board job							None			
16 Board Operator	Same	Same							None			
15 Outside Operator	Does necessary things to adjust conditions in Dept. 15 area outside. Takes various samples for local and lab anal.	Dept. 15 off-gas in DM Ethylbenzene Boiler chemicals								Cover goggles required when in Boiler Chem. area-respirator when inside reactor during catalyst rodding every 9 months.		
16 Outside Operator	Does things to adjust conditions 16 outside Make up NSI batches & watch NSI unit outside Takes various samples	Styrene monomer, toluene, benzene, SM Tar, 15% NSI in DM, 2.5% NSI in DM, Ethylbenzene Tert Butyl for Catechol 85% in								NSI unit-cover goggles, gloves, coveralls boots when batches in progress. Cover goggles at other times. Tert Butyl Cate-		

MAP 004948

Monsanto Corporate Medical
St. Louis, MissouriINDUSTRIAL HYGIENE SURVEY
WORKROOM DATA

Facility: Texas City Page 2 of 3
 Division: MP&P Department: Styrene Mfg. Building: 160
 Date Source: S.E. Knipling Surveyed by: Date: Nov. 1975

OCCUPATION (1)	NATURE OF JOB (2)	RAW MATERIALS AND BY-PRODUCTS (3)	CONTROL MEASURES (4)							REMARKS AND Hazard Potential (5)	Air Sampling	
			LOCAL EXH.	MECHANICAL VENTILATION	WET METHODS	PROTECTIVE EQUIPMENT	RESPIRATOR	ISOLATION	BO		Gn	Pe
16 tank operator	Line up transfers and storage tanks	Styrene monomer, toluene, smtars.								None - hard hat only.		
Straight day operator	Mostly line up of maint. work - all areas	May be exposed to any								As needed in various areas		
SUPS area Operator	Operate condensate strippers, operate salt water pumps & chlorination of salt water.	Stripped (clean condensates) DM contaminated condensate salt water for cooling								None - hard hat Respirator reqd. in filter precoat tank area		
Foreman - Dept. 16	Supervise Dept. 16 operations and maintenance	See Dept. 16 Board & outside								As required - see above		
Foreman - Dept. 15	Supervise Dept. 15 operations & maintenance	See Dept. 15 Board & outside								As required - see above		
Foreman Sups	Supervise Sups area operations and maintenance	See Sups area operator descr.										

LAM000774

Monsanto Corporate Medical
St. Louis, Missouri

INDUSTRIAL HYGIENE SURVEY
WORKROOM DATA

Facility: Texas City Page 3 of 3
Division: MP&P Department: Styrene Mfg. Building: 160
Date Source: S.E. Knipling Surveyed by: Date: Nov. 1975

OCCUPATION (1)	NATURE OF JOB (2)	RAW MATERIALS AND BY-PRODUCTS (3)	CONTROL MEASURES (4)							REMARKS AND Hazard Potential (5)	Air Sampling	
			LOCAL EXH.	MECHANICAL VENTILATION	WET METHODS	PROTECTIVE EQUIPMENT	RESPIRATOR	BIOL. HOD			Gn	Pe
Foreman Projects	Pit improvement, additions, and liscensing projects											
Foreman Projects	Pit improvement, additions, and liscensing projects.											
Mfg. Super- visor	Supervision of all of above	all of above							as required	-		

LAM000775

OBSERVATIONS

ETHYLBENZENE

Department 13 is the alkylation unit, Department 14 is the distillation unit - together known as the ethylbenzene unit.

Aluminum dust is dropped into a hopper in which polyethylated benzene is added to flow the aluminum into the catalyst manufacturing system.

A benzene sample is taken from the process about once a day. Organic process samples are taken about 10-15 times a day. Samples are generally obtained by placing a jar under a faucet-type unventilated top. (Sample overflow is directed into an open flushed sewer.)

The SL (alkylated liquor) is composed of approximately 40% benzene, 40% ethylbenzene and 20% diethylbenzene.

Note: During the walk-thru of this unit contract personnel under indirect Monsanto supervision were observed tearing out old piping by pulling the pipe lengthwise out of the pipe supports. This action stripped the old insulation from the pipe. The insulation appeared to be asbestos. The insulation was scattered on the roadway and was evident as much as 100 feet from the actual stripping. Contract personnel were sweeping the material in its dry state. The dust level appeared very excessive. Prompt action by Monsanto employees resulted in the curtailment of this operation until the material could be wetted down and personal protective equipment obtained.

STYRENE

Department 15 is the Dehydrogenation unit; Department 16 is the styrene monomer unit.

During the time of the survey sulfur was still being used as the styrene monomer inhibitor. Sulfur-type odors were easily noticed. This department plans to use another inhibitor (NSI-non-sulfur inhibitor: 2,4 dinitrophenol) in the near future. The process description and block-flow diagram precede this page. Tert.-butyl Catechol is presently used to inhibit stored styrene monomer. Two maintenance foremen are normally assigned to the styrene unit. The odor of styrene was prevalent throughout the unit. Each train is turned around every nine months for about two weeks. Some of the styrene tars are sewered. The bottoms pumps are sampled once daily. Odors were easily apparent around the 14D2 column. The odors were characteristic of sulfur

STYRENE (continued)

compounds but I was told the odors were primarily toluene. The salt water pump system (SWPS) is a high noise area with exposure approximately one hour/shift. Filter-aid (J-M Hydroflo) is shoveled manually into the filter. Styrene tars are stored prior to disposal in a large tank located next to the condensate stripper. Personnel indicated a new condensate stripper area was being planned because of the poor access and layout of the present stripper. A musty odor was noticeable in the control room.

MAP 004951

LAM000777

RECOMMENDATIONS - Ethylbenzene and Styrene

It is recommended personnel exposure to the following substances be determined:

- benzene
- ethylene
- hydrogen chloride
- chlorine
- ethyl chloride
- NTA
- sulfur compounds (H_2S , SO_2 , etc.)
- dinitrophenol
- sodium hydroxide
- iodine
- barium
- toluene
- styrene
- silica, crystalline and amorphous

MAP 004952

LAM000778

MONSANTO COMPANY
INDUSTRIAL HYGIENE SURVEY
POSSIBLE EXPOSURE INVENTORY

COMPANY MP&P
DIVISION Petrochemicals
PLANT Texas City

DEPARTMENT: Acetic Acid

Products:

- 1 Glacial Acetic Acid
- 2 Propionic Acid
- 3 _____
- 4 _____
- 5 _____
- 6 _____
- 7 _____
- 8 _____

Employee:

1st Shift	4 Hourly	Salaried
2nd Shift	4 Hourly	Salaried
3rd Shift	4 Hourly	Salaried
4th Shift	4 Hourly	Salaried
St. days	1 Hourly	1/2 Non exempt-cler
Totals	17 Hourly	4 Exempt 5 Salaried 4-1/2

Buildings Involved:

- 1 133
- 2 131
- 3 153
- 4 154

Supervisor:

B. L. Johnson

MAP 004953

LAM000779

MONSANTO COMPANY
INDUSTRIAL HYGIENE SURVEY
MATERIALS DATA SHEET

Division
Plant
Department

Supervisor
Date
Building

Raw Materials	Intermediates	Finished Products
Carbon Monoxide Methanol Rhodium catalyst Iodine catalyst Condensate	Methyl Iodide Hydrogen Iodide	Acetic Acid Propionic Acid

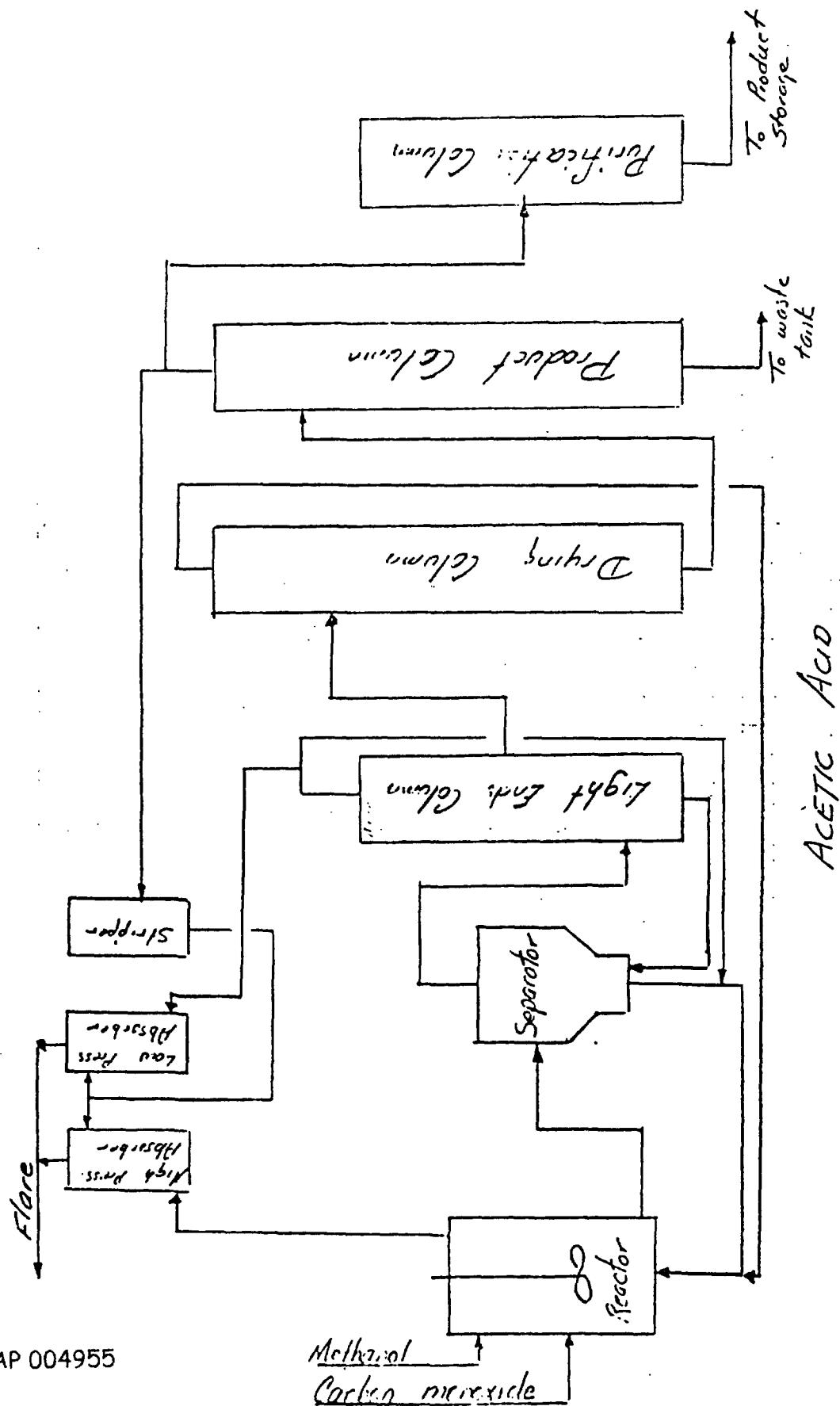
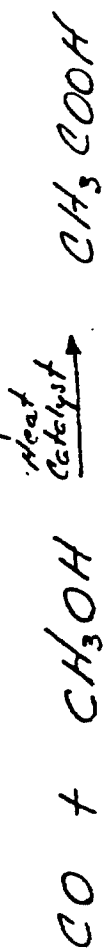
Miscellaneous Materials:

Potassium Hydroxide) Chelating agents for process
Hypo phosphorous acid)

MAP 004954

LAM000780

Basic Chemistry



MAP 004955

LAM000781

Observations - Acetic Acid

Carbon monoxide is obtained from the methanol department. Rhodium is in powder form and iodine is in crystal form. The waste stream with the chelates are sold for its low grade propionic acid content. The potential for carbon monoxide exposure exists as indicated by previous environmental sampling conducted by John Fox. A method is needed to determine iodine exposure. Blood tests are conducted on the one iodine handler every six months to check for iodine accumulation in the body. Iodine is added to the process about three times per year with about four hours exposure required. The employee is required to wear complete body protection. The iodine is dissolved in methanol to make methyl iodide. A carbon monoxide monitor is located outside of the control room with remote sensors in the control room, analytical building and the catalyst building. The iodine is partially exhausted through a scrubber to the atmosphere. Rhodium is added to the process in a similar manner with local exhaust control. The main reactor is sampled from an open tap into a portable jug. Off-spec product is reworked thru the process. Waste streams are usually trickled thru a limestone bed.

MAP 004956

LAM000782

MAP 004957

Monsanto Corporate Medical
St. Louis, Missouri

INDUSTRIAL HYGIENE SURVEY
WORKROOM DATA

Facility: Texas City Page 1 of 1
Division: Petrochemicals Department: Acetic Acid Building: 131-133-153-154
Date Source: B. L. Johnson Surveyed by: Date: Nov. 17, 1975

OCCUPATION (1)	NATURE OF JOB (2)	RAW MATERIALS AND BY-PRODUCTS (3)	CONTROL MEASURES (4)						REMARKS AND Hazard Potential (5)	Air Sampling
			LOCAL EXH.	MECHANICAL VENTILATION	WET METHODS	PROTECTIVE EQUIPMENT	RESPIRATOR	BOI. YES		
Chief Operator 1/Shift	Responsible for di- recting shift opera- tors	90% in C. R.							Goggle area throughout. Rubber gloves special	
Board Operator 1/Shift	Responsible for con- trol room - operations of unit.	100% in C. R.								
"A" Outside Operator 1/Shift	Responsible for opera- tions of equip. asso- ciated with HoAc prod.	3/hr. per day in unit.								
"B" Outside Operator 1/Shift	Responsible for utility and off battery equipment	3 hours								
Day oper. Foremen 2-St.days	2 hr./day Supervise the above 2 hr./day	Methyl Iodide and cat. addition and iodine							Blood tests for iodine buildup.	
Supervisors 2-St.days	Supv., plan, coordinate 3 hr./week									

Weekly Rotation

LAM000783

Recommendations - Acetic Acid

It is recommended personnel exposure to the following substances
be determined:

Carbon monoxide
Methanol
Rhodium catalyst
Iodine catalyst
Methyl iodide
Acetic acid
Potassium hydroxide

MAP 004958

LAM000784

Form 1 - 11/1/68

MONSANTO COMPANY
INDUSTRIAL HYGIENE SURVEY
POSSIBLE EXPOSURE INVENTORY

COMPANY MP&P

DIVISION Petrochemical

PLANT Texas City

DEPARTMENT: Methanol-Syn/GAS

Products:

- 1 Methanol (ship & in-plant (95%) C.B., PP, Spfld, Eugene)
- 2 CO (all to Acetic Acid Dept.)
- 3 H₂/CO (50/50 - to Oxo ROH)
- 4 H₂ (To Oxo ROH - HDPE)
- 5 _____
- 6 _____
- 7 _____
- 8 _____

Employee:

1st Shift	*10 Hourly	6 Salaried
2nd Shift	6 Hourly	Salaried
3rd Shift	6 Hourly	Salaried
4th Shift	6 Hourly	Salaried
Totals	28 Hourly	6 Salaried

Buildings Involved:

*includes 4-5 trainees

- 1 _____
- 2 _____
- 3 _____
- 4 _____

Supervisor:

C. M. Hancock/ T. L. Nelson

LAM000785

MAP 004959

MONSANTO COMPANY
INDUSTRIAL HYGIENE SURVEY
MATERIALS DATA SHEET

Division Petrochemical
Plant Texas City
Department MEOH - Syn/Gas

Supervisor C. M. Hancock
Date 11/76
Building

Raw Materials	Intermediates	Finished Products
Natural Gas Carbon Dioxide Steam NiO Catalyst ZnO " CuO/ZnO " (ICI 51-1) Hydrazine Sodium Nitrate Trichelok (NTA based chelator by Calgon) Chlorine Santobrite Hercules HF 502 Sodium Hydroxide Freon 22 Compressor Oil	Syn Gas - H ₂ , CO, CO ₂ , CH ₄ Resid Gas - H ₂ , CO, CO ₂	Methanol CO H ₂ /CO H ₂

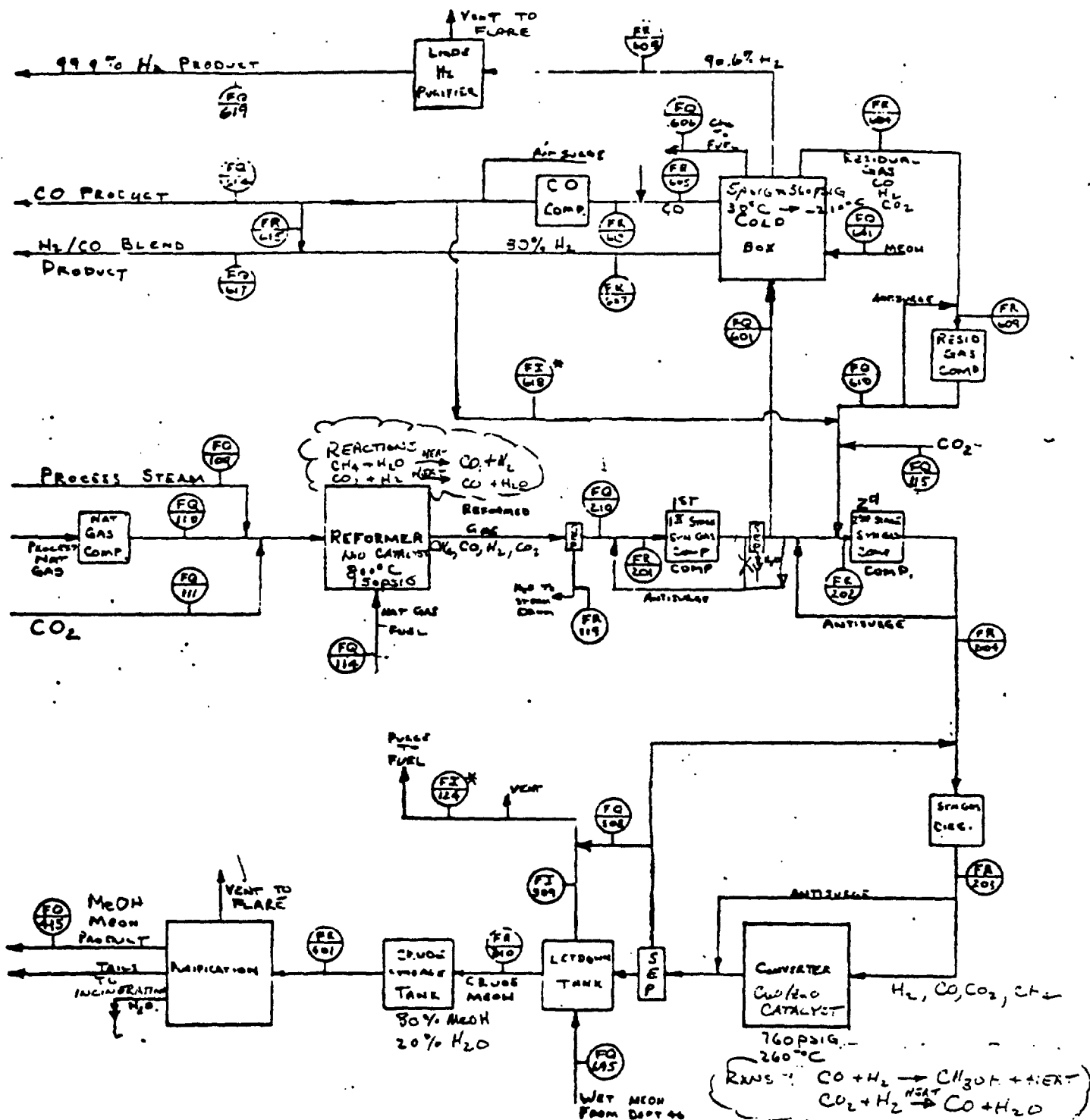
Miscellaneous Materials:

MAP 004960

LAM000786

TEXAS CITY

METHANOL SYN GAS PLANT PROCESS FLOW DIAGRAM



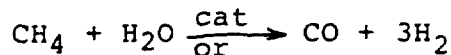
MAP 004961

LAM000787

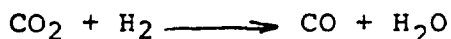
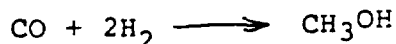
- BOARD METER
- LOCAL METER
- COMPUTER TOTALIZED

OBSERVATIONS - Methanol

The process consists of two basic sections: reformer and synthesis. In the reformer section two reactions are possible:



In the synthesis section these reactions occur:



The crude methanol therefore consists of about 20% water. Two flares consumes impure CO/H₂ gas.

The two major industrial hygiene concerns of the MeOH department are carbon monoxide and noise. At the time of the survey plant personnel did not feel they could meet the NIOSH proposed standard of 35 ppm time-weighted average over a 8 hour workday (200 ppm ceiling). Plant personnel indicated they were going to install CO monitors to sequentially sample 7-8 locations in the unit. Most CO samples recorded to date were said to have less than 100 ppm.

The "Cold Box" operation requires special precautions: radio-contact between operators, hearing protection, and cryogenic insulation of process equipment.

The NiO catalyst bed is replenished every 2-3 years and the ZnO catalyst is changed every 1-2 years (for sulfur removal). Another catalyst is used in the Converter Section. The catalyst is a ZnO/CuO with an all aluminum base (ICI No-51-1) There may be some dust exposure during loading and unloading of the catalyst pellets.

The chelating agent used is Nitriloacetic acid (NTA) based.

MAP 004962

LAM000788

MAP 004963

Monsanto Corporate Medical
St. Louis, Missouri

INDUSTRIAL HYGIENE SURVEY
WORKROOM DATA

Facility: Texas City Page of
Division: Petrochemicals Department: MeOH-Syn. Gas Building:
Date Source: C. M. Hancock Surveyed by: S. A. Roberts Date: 11/75

OCCUPATION (1)	NATURE OF JOB (2)	RAW MATERIALS AND BY-PRODUCTS (3)	CONTROL MEASURES (4)						REMARKS AND Hazard Potential (5)	AIR Sampling	
			LOCAL EXH.	MECHANICAL VENTILATION	WET METHODS	PROTECTIVE EQUIPMENT	RESPIRATOR	COLD BOX			
Chief Opr 1/Shift	Inside - C.R. 1-2 tours of plant/ shift.										
Board Opr 2/Shift	100% in control room										
Reformer Opr 1/shift	50% of time in unit. samples boiler water monitors burner										
Cold Box/ Syn Loop Opr 1/shift	50% of time in unit; Monitors compressor operator	Most potential CO exposure							CO monitor; SCBA on upper Cold Box deck		
Distillation/ off sites opr. 1/shift	40% of time in unit at storage tanks and cooling tower	Samples MeOH, Cooling Water							Goggles, gloves, with caustics and biozides		
Maint. Fore- man with 10 maint. personnel											

LAM000789

RECOMMENDATIONS

It is recommended employee exposures to the following substances be determined:

- Carbon Monoxide
- Methyl Alcohol
- Nickel Compounds
- Copper/Zinc Compounds
- Hydrazine
- NTA
- Chlorine
- Sodium Hydroxide
- Noise

MAP 004964

LAM000790

MONSANTO COMPANY
INDUSTRIAL HYGIENE SURVEY
POSSIBLE EXPOSURE INVENTORY

COMPANY MICC

DIVISION SCO/FFC

PLANT Texas City

DEPARTMENT: Lactic Acid

Products:

- 1 Lactic Acid - 88% USP
- 2 Lactic Acid - 50% Food Grade
- 3 Lactic Acid - 88% Technical Grade
- 4 Lactic Acid - 50% Technical Grade
- 5 _____
- 6 _____
- 7 _____
- 8 _____

Employee:

1st Shift /vac + 1 day + 1 C.O.2 op	Hourly	+ 1 sup + 1 Fr	Salaried
2nd Shift	1 2 Hourly		Salaried
3rd Shift	1 2 Hourly		Salaried
4th Shift	1 2 Hourly		Salaried
Totals		14 Hourly (non exempt)	1 Salaried (exempt foreman)

Buildings Involved:

- 1 _____
- 2 _____
- 3 _____
- 4 _____

Supervisor:

Alden R. Wilson

LAM000791

MAP 004965

MONSANTO COMPANY
INDUSTRIAL HYGIENE SURVEY
MATERIALS DATA SHEET

Division MICC
Plant Texas City
Department Lactic Acid

Supervisor Alden R. Wilson
Date 11-19-75
Building ---

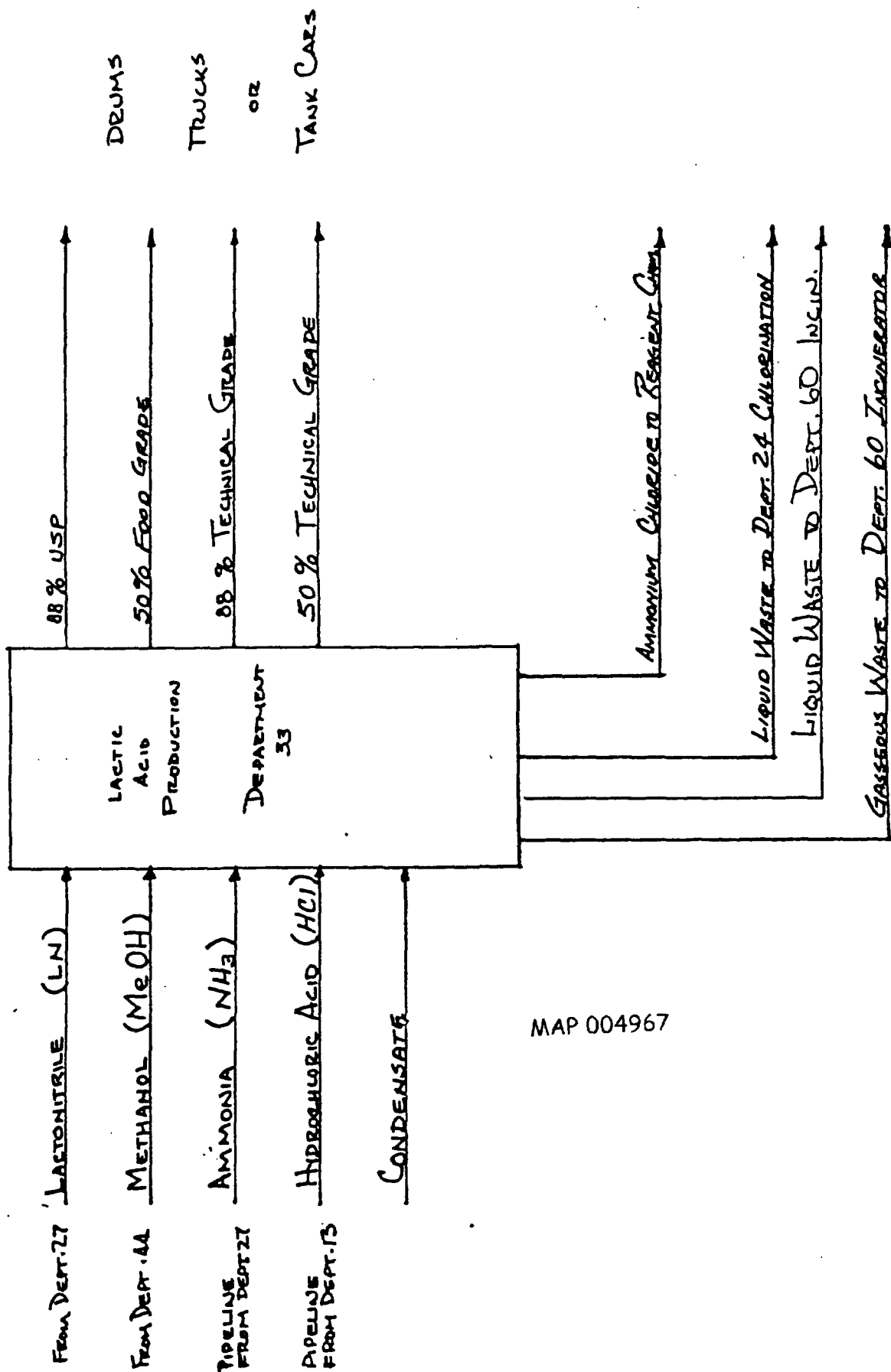
Raw Materials	Intermediates	Finished Products
Lactonitrile Methanol Steam Condensate Anhydrous HCl Ammonia Dow-Corning Antifoam FG-10 Sodium Hydroxide - 25% Muriatic Acid - 30% Anion Resin - Duolite A-4 Cation Resin - Duolite C-25 Activated Carbon	Methyl Lactate Ammonium Chloride	Lactic Acid 88% USP 50% Food Grade 88% Tech. Grade 50% Tech. Grade Ammonium Chlorine

Miscellaneous Materials:

SiO₂ (resin bed sand)

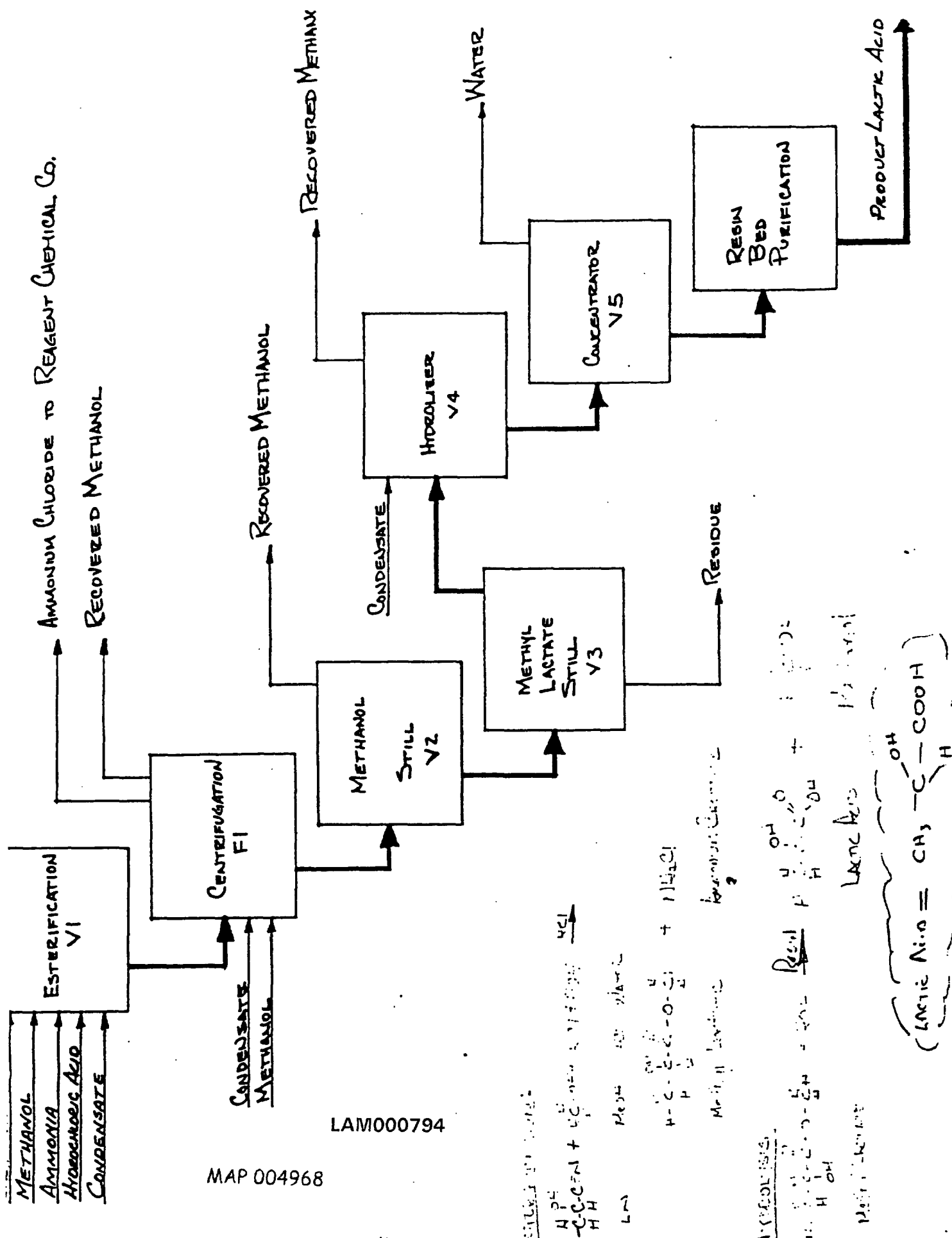
MAP 004966

LAM000792



MAP 004967

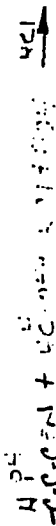
LAM000793



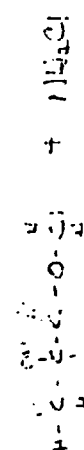
LAM000794

MAP 004968

SYNTHESIS OF LACTIC ACID



1.2.3.4.5.6.7.8.9.10.11.12.13.14.15.16.17.18.19.20.21.22.23.24.25.26.27.28.29.30.31.32.33.34.35.36.37.38.39.40.41.42.43.44.45.46.47.48.49.50.51.52.53.54.55.56.57.58.59.60.61.62.63.64.65.66.67.68.69.70.71.72.73.74.75.76.77.78.79.80.81.82.83.84.85.86.87.88.89.90.91.92.93.94.95.96.97.98.99.100.

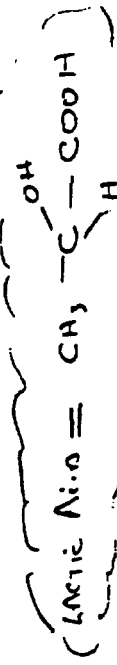


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1.2.3.4.5.6.7.8.9.10.11.12.13.14.15.16.17.18.19.20.21.22.23.24.25.26.27.28.29.30.31.32.33.34.35.36.37.38.39.40.41.42.43.44.45.46.47.48.49.50.51.52.53.54.55.56.57.58.59.60.61.62.63.64.65.66.67.68.69.70.71.72.73.74.75.76.77.78.79.80.81.82.83.84.85.86.87.88.89.90.91.92.93.94.95.96.97.98.99.100.



LACTIC ACID



Lactic Acid

OBSERVATIONS

Lactic Acid is a colorless, odorless liquid used as a food acidulent, and in food emulsifiers, in pH adjustment for leather tanning and as an intermediate for making the acid's esters and salts.

The process is 7 step Batch process:

1. Esterification
2. Centrifugation
3. Methanol distillation
4. Methyl Lactate distillation
5. Hydrolysis
6. Concentration
7. Resin Bed purification

There is no routine vessel opening. The Resin Bed is regenerated about every 2 weeks. Resin is received via truck monthly.

The area is considered a high hazard area because of the Cyanide exposure potential.

Sand is present on the resin bed.

MAP 004969

INDUSTRIAL HYGIENE SURVEY
WORKROOM DATA

Facility: Texas City Page of
Division: MICC Department: Lactic Acid Building: ---
Date Source: Alden R. Wilson Surveyed by: Date: Nov. 19, 1975

OCCUPATION (1)	NATURE OF JOB (2)	RAW MATERIALS AND BY-PRODUCTS (3)	CONTROL MEASURES (4)							REMARKS AND Hazard Potential (5)	Air Sampling	
			LOCAL EXH.	MECHANICAL VENTILATION	WET METHODS	PROTECTIVE EQUIPMENT	RESPIRATOR	BOIL OFF	Gn		Pe	
Chief Oper. (1/shift)	In charge of shift									goggle area		
Operator (2/shift)	Operates board and outside 30% o/s											
Operator (days)	Operates cooling tower and incinerator 80% o/s											
Foreman (days)	Supervision of above											
Supervisor (days)	Supervision of above											

Lactic Acid

Recommendations

It is recommended that personnel exposure levels to the following chemicals be documented:

- Methanol
- Hydrogen chloride
- Ammonia
- Sodium Hydroxide
- Carbon dust
- Lactonitrile
- Crystalline Silica

MAP 004971

MONSANTO COMPANY
INDUSTRIAL HYGIENE SURVEY
POSSIBLE EXPOSURE INVENTORY

COMPANY MICC
DIVISION _____
PLANT Texas City

Oxo Alcohol

DEPARTMENT: Dept. 48/56

Products:

- 1 Oxo Alcohol
- 2 HOE (Heavy Oxo ends)
- 3 LEOB (Light Ends Oxo Bottoms)
- 4 LEOH (Light Ends OXo Heads)
- 5 S-711
- 6 S-790
- 7 DUP (Diundecyl Phthalate)
- 8 _____

Employee:

1st Shift	10 Hourly	6 Salaried
2nd Shift	6 Hourly	-0- Salaried
3rd Shift	6 Hourly	-0- Salaried
4th Shift	6 Hourly	-0- Salaried
Totals	28 Hourly	6 Salaried

Buildings Involved:

- 1 _____
- 2 _____
- 3 _____
- 4 _____

Supervisor:

L.J. Povse

MAP 004972

LAM000798

MONSANTO COMPANY
INDUSTRIAL HYGIENE SURVEY
MATERIALS DATA SHEET

Division MICC
Plant Texas City
Department Oxo/Ester

Supervisor L.J. Povse
Date Nov. 1975
Building

Raw Materials	Intermediates	Finished Products
<u>Solids</u> Activated Carbon Bisphenol A Cobalt Catalyst Filter Aid Copper chromite catalyst* Oxalic Acid Nickel catalyst Stannous Oxalate Pumice Soda Ash Cobalt Oxide	<u>Liquids</u> Aldehydes Sodium Cobalt Carbonylate	<u>Liquids</u> Oxo Alcohol Plasticizers - S-711 - S-790 - DUP HOE LEOB LEOH
<u>Liquids</u> Mixed Olefins Sulfuric Acid Phthalic Anhydride Oxo Alcohol & Fractions	<u>Gases</u> Cobalt Hydrocarbonyl	
<u>Gases</u> Carbon Monoxide Hydrogen		

Miscellaneous Materials:

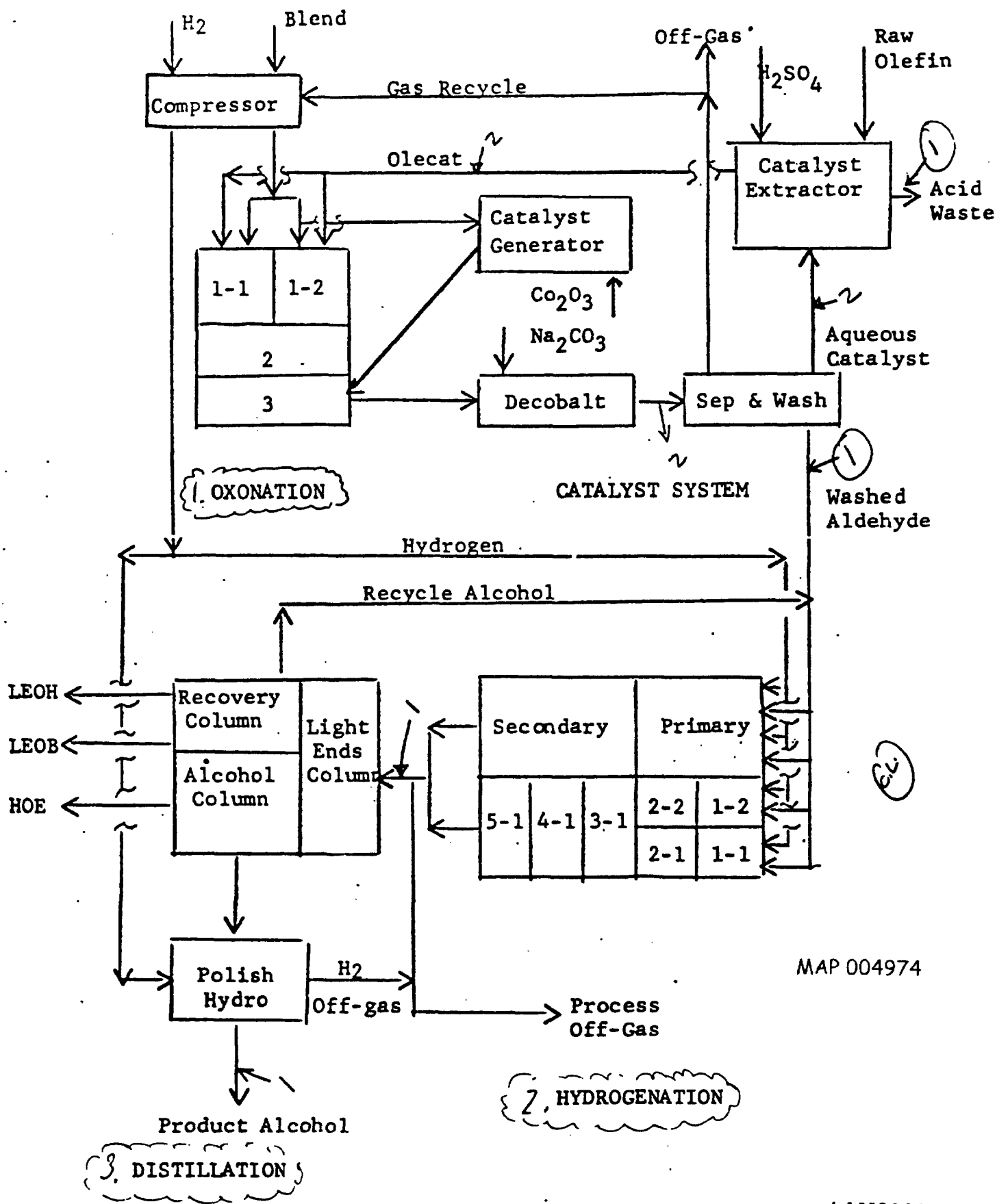
Micro Cel T-38 Now being tested for acidity control in ester unit.

* Barium stabilized

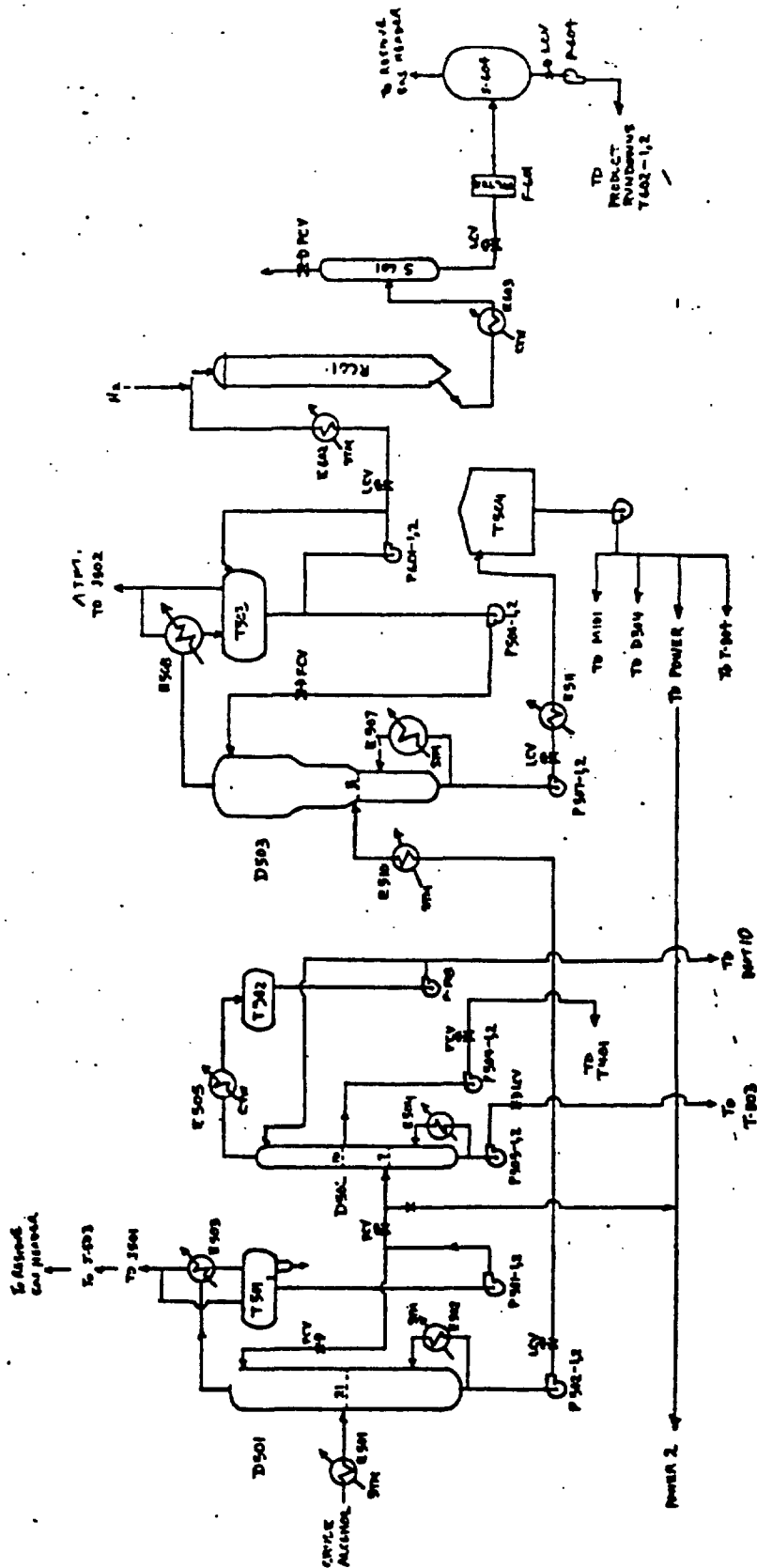
MAP 004973

LAM000799

OXO PROCESS

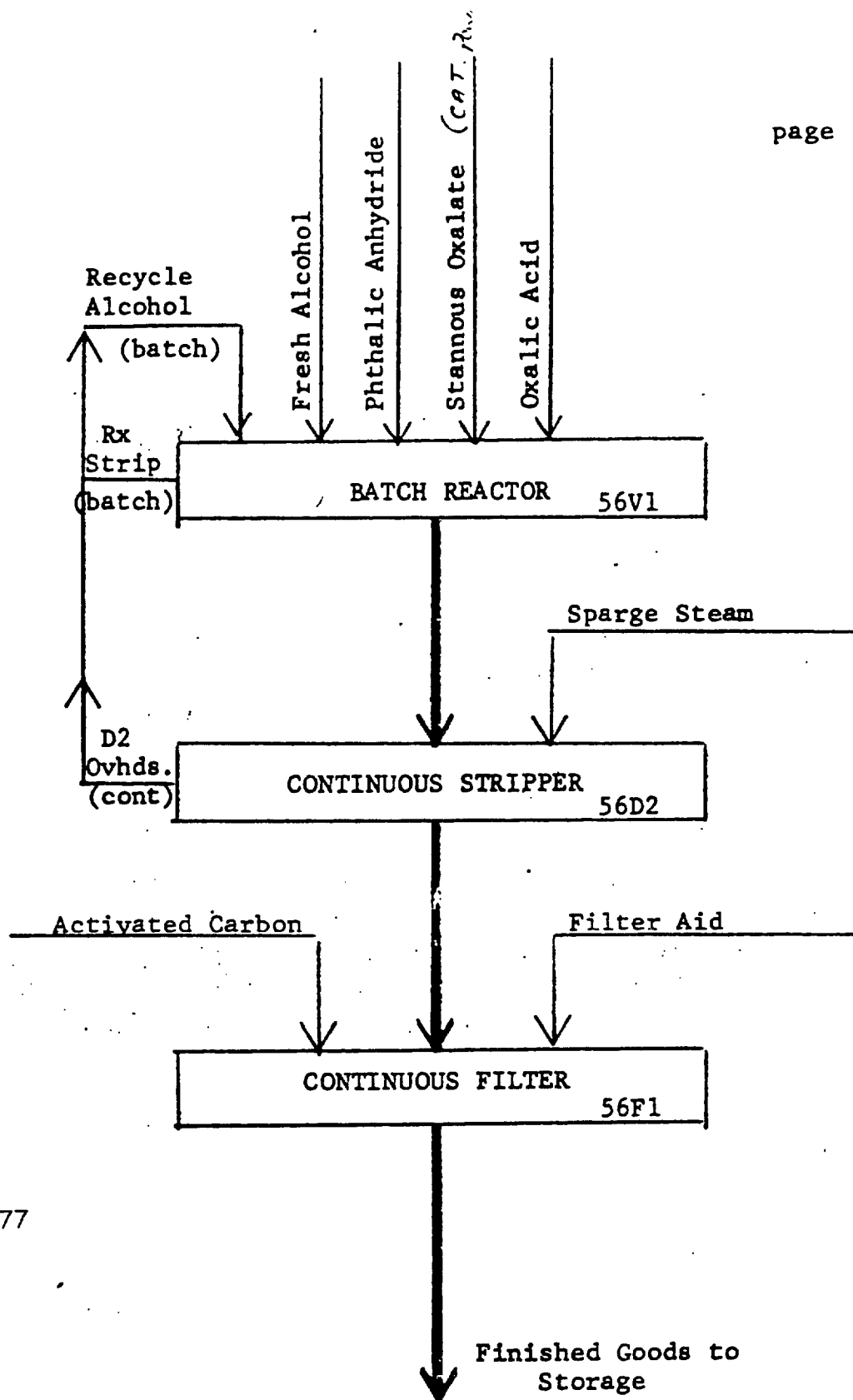


MAP 004974



MAP 004976

LAM000802

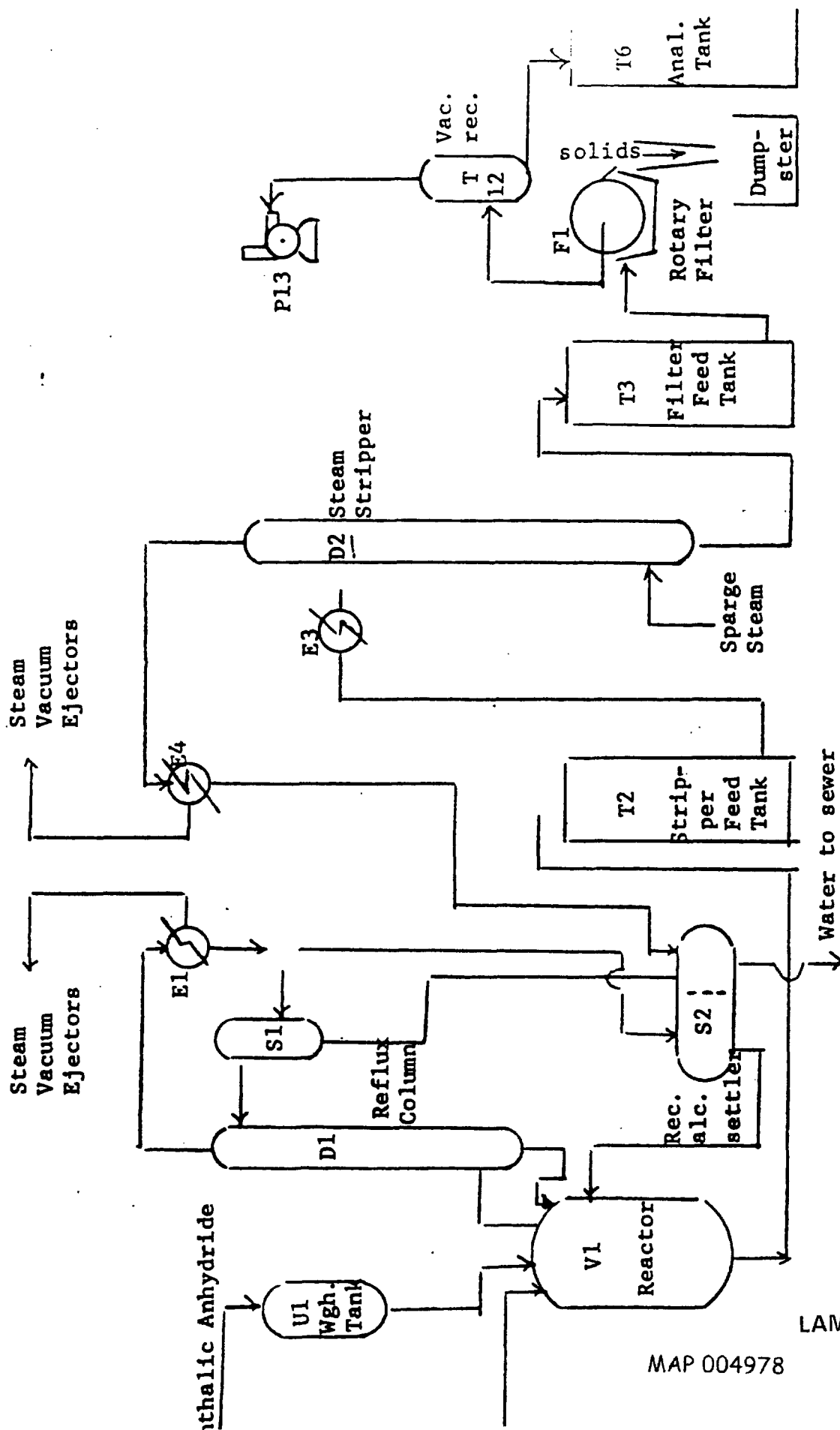


MAP 004977

ESTER PROCESS - SIMPLIFIED BLOCK FLOW DIAGRAM

LAM000803

SIMPLIFIED FLOW - ESTER PROCESS



PROCESS AND FACILITIES DESCRIPTION

There are four main process steps in the production of Oxo alcohol:

1. Oxo reaction
2. Catalyst recovery
3. Hydrogeneration
4. Distillation

1. Oxo Reaction

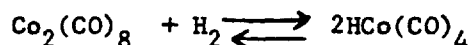
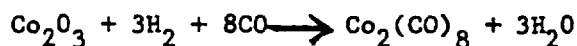
a. Catalyst Generation

The function of this step is to replace normal cobalt losses by generating cobalt hydrocarbonyl from cobalt oxide and introducing it into the process. This allows the catalyst concentration in the olefin feed to the oxo reactors to be maintained at 0.2 wt. % cobalt.

Catalyst is lost in three streams:

- 1) Extractor bottoms stream to the sewer, 50-100 ppm cobalt.
- 2) In the aldehyde stream to the hydrogenerators, 10 ppm cobalt.
- 3) As carryover to the residue gas header from the top of the vent on the olecat hold tank scrubber.

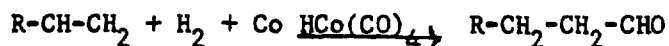
Catalyst slurry is made by mixing cobalt oxide with heavy oxo ends to form a 10% slurry. The slurry is pumped to the catalyst generator where it is mixed with syn gas (1.1 - 1.3 H_2/CO MOL ratio) at a temperature of 120-130°C. and about 3300 psig which converts cobalt oxide to cobalt hydrocarbonyl which is a gas. Effluent from the generator is injected into the third stage oxo reactor. Temperature of the catalyst transfer line must be kept at 70°C or above to prevent the catalyst from crystallizing.



Cobalt hydrocarbonyl is a gas at 2000 psig and is a toxic material.

b. Oxo-Reaction

Carbon monoxide and hydrogen (syn gas) added to an ethylenic bond (olefin) compound in the presence of cobalt hydrocarbonyl forms the aldehyde.



The reaction takes place between 3000-3300 psig and 118-140°C in oxo reactors called oxodromes. They operate on a density gradient principle similar to a thermo syphon reboiler and behave kinetically as back mixed reactors with materials entering at the bottom of one leg and disengaging at the top U bend.

Heat of reaction is removed by heat exchangers in the downward leg of the oxodrome.

MAP 004979

LAM000805

PROCESS AND FACILITIES DESCRIPTION (cont.)

Conversion is 64% in the first stage by controlling temperature at 118-125°C. In the second stage conversion is increased to 90% by controlling temperature at 124-138°C. In the third stage conversion is increased to 97% by controlling temperature to 128-140°C.

Composition of the effluent stream from the final oxodrome is:

Aldehydes	75-81%
Low Boilers	3-7% (paraffin and olefin)
Alcohol	3.5-5%
Formate	3-4%
Residue	5-12% (heavy ends and acetal)

2. Catalyst Recovery

a. Decobaltation

This step changes the catalyst to a water soluble form to allow for separation, recovery and recycle. This is done by mixing a 2½% aqueous solution of sodium carbonate into the effluent stream from the oxodrome. The temperature is 120-130°C and pressure 3100 psig. Residence time is 30 minutes.

b. High/Low Pressure Separation

The effluent stream is cooled to 40°C then flows to the high pressure separator where unreacted feed gas is separated from the aldehyde and aqueous carbonylate solution.

Liquid from the high pressure gas separator is let down to the low pressure separator. Gas flashes to the residue gas header and liquid flows down into the decanter where the organic (aldehyde) phase separates from the aqueous phase (carbonylate).

c. Wash Column

The wash column provides a means for washing the organic phase free of carbonylate. Carbonylate is reduced in the organic stream from 750 ppm to 50 ppm.

60°C condensate enters the upper part of the column while the aldehyde stream flows upwards through the column. Steam is sparged at the bottom for temperature control.

MAP 004980

LAM000806

PROCESS AND FACILITIES DESCRIPTIONS (cont.)

d. Cobalt Extraction

The extractor regenerates the catalyst to the active form, cobalt hydrocarbonyl, from the sodium cobalt carbonylate and maintains a constant concentration of 0.25% - 0.27% cobalt in olefin.

Carbonylate is mixed at the top of an extractor column with 3% sulfuric acid which converts the carbonylate to cobalt hydrocarbonyl. Olefin is introduced into the bottom of the extractor column along with syn gas for mixing. Olecat, olefin and catalyst, overflows from the top of the column to the olecat feed tank.

3. Hydrogenation

Hydrogenation of the aldehyde to alcohol is done in the liquid phase by passing the aldehyde over fixed bed catalysts. The aldehyde stream is filtered through a pumice filter fed to remove dissolved cobalt catalyst. Hydrogen is mixed with the aldehyde stream before the pumice filters.

Primary reaction is carried out at 900-750 psig and 140-210°C and the secondary reaction is carried out at 750-500 psig and 160-210°C.

The primary reactors are filled with a barium-stabilized copper chromite catalyst, the secondary reactors with cobalt-on-refractory oxide.

4. Distillation

Distillation removes light and heavy ends from the crude alcohol. Distillation consists of three sections, each with one distillation column.

The first section column and auxiliaries removes light ends from the oxo alcohol. The second section column and auxiliaries enriches the light ends in heptanol such that it can be recycled within the process. The third section column and auxiliaries separate the heavy ends from the light ends - free alcohol.

OBSERVATIONS - Oxo

Operators rotate daily in the unit. Maintenance workforce usually consists of 2 each of pipefitters, machinists, and I. & E.

Carbon monoxide is monitored in the work area by an "Ecolyzer" direct-reading instrument next to the synthesis gas compressors.

The principal raw materials are olefin supplied by Ethyl Corp. and feed gas ($H_2 + CO$) and hydrogen supplied from the Texas City methanol unit. The principal product from the unit is oxo-alcohol which is a mixture of $C_7C_9C_{11}$ alcohols. It is pumped to bulk storage and then to Department 56, to tank cars (10-20K gallons), to tank trucks (6K gallons) or to ships for overseas shipment.

Major by-products include:

- LEOB - The heavy ends of the alcohol recovery column which are DECANE with 3-10% HEPTANOL. LEOB is trucked to Chocolate Bayou and used as ethylene cracking feed.
- LEOH - The overhead vapors from the alcohol recovery columns which are light paraffins (mostly heptane and octane) and 1-5% heptanol. LEOH is used as ethylene cracking stock in either Texas City or Chocolate Bayou.
- HOE - The heavy ends of the alcohol product column which contain heavy ends and 3-7% C_{11} Alcohol. This product is sold under the name HOE.

MAP 004982

LAM000808

OBSERVATIONS - S-711

There are four process steps in the production of S-711.

1. Raw material storage
2. Esterification
3. Finishing
4. Finished product storage.

Phthalic anhydride (PA) and oxo-alcohol (OA) are supplied by pipeline from storage tanks. PA is charged through a weigh tank while OA is metered in to the reactor.

A pre-weighted catalyst charge is manually dumped into a charging vessel and washed into the reactor with alcohol. The reactants are agitated, heated, vacuum applied and reflux commences. The water-alcohol azeotrope is condensed and separated with the alcohol phase returning to the column as reflash and the aqueous phase passing to a storage tank. A sample is taken and titration made to determine if the reaction is complete. Oxalic acid is then added from pre-weighed bags after the reactor is vented. The batch cycle is about 6 hours.

The crude ester is pumped thru an interchanger for steam stripping to remove excess alcohol and impurities, to precipitate remaining catalyst and to lower product acidity. The ester is fed to a rotary vacuum filter which has been precoated with filter-aid, a scraper blade continuously removes the outer layer of the cake.

The finished product (after filtering) is pumped to storage tanks. The filtrate is landfilled.

MAP 004983

LAM000809

Observations - Phthalic Anhydride

Phthalic Anhydride is produced from o-xylene by vaporizing the xylene by injecting it into a hot air stream which passes thru a catalyst-filled fixed bed reactor. The resultant crude PA desublimates in a condenser and any phthalic acid present is dehydrated in the treatment (predecomposer) vessels. The crude is finally purified in two distillations. Sulfur dioxide is used to activate the vanadium pentoxide catalyst. The catalyst is charged every 6 years with about one week required for the packing of fresh catalyst. By-products such as maleic anhydride, benzoic acid, and phthalic acid are flared or reconverted in the process.

MAP 004984

LAM000810

Monsanto Corporate Medical
St. Louis, Missouri

MAP 004985

INDUSTRIAL HYGIENE SURVEY WORKROOM DATA

Facility: Texas City Page: 1 of 2
 Division: MICC Department: Oxo/Ester Building: _____
 Date Source: L.J. Povse Surveyed by: L.J. Povse Date: NOV. 1975

OCCUPATION (1)	NATURE OF JOB (2)	RAW MATERIALS AND BY-PRODUCTS (3)	CONTROL MEASURES (4)						REMARKS AND Hazard Potential (5)	Air Sampling	
			LOCAL EXH.	MECHANICAL VENTILATION	WET METHODS	PROTECTIVE EQUIPMENT	RESPIRATOR	BO HOLD		Gn	Pe
Chief Oper. (1/shift) 5(total)	Supervision & coordi- nation of 5 to 6 men per shift. 90% of time in control room.	All materials on ex- ception basis									
Oxo outside oper. (1/shift)	Handles outside work in oxo unit. 50% of time spent in unit.	Olefin, olecat, sodium cobalt carbonylate samples twice/shift	X		X	X	X				
Oxo Board oper. (1/shift)	Controls oxo unit equip- ment from control room. 100% of time in control room.	none									
Ester outside oper. (1/shift)	Handles outside work in ester unit. 50% of time spent in unit.	Stannous oxalate, oxalic acid, carbon, micro cel, filter aid, esters as need. ;	X		X	X					
Ester Board oper. (1/shift)	Control ester unit equipment from control room. 100% of time spent in control room.	None									
Half Man oper. (1/shift)	Handles transfers, some samples, tank farms for oxo and esters. 60% of time spent in field.	Oxo, soda ash, cobalt oxide, S-711, S-790, DUP, samples per sample schedule	X		X	X					

Rotate Daily

LAM00011

Monsanto Corporate Medical
St. Louis, Missouri

MAP 004986

INDUSTRIAL HYGIENE SURVEY
WORKROOM DATA

Facility: Texas City Page: 1 of 2
Division: MICC Department: Oxo/Ester Building: _____
Data Source: L.J. Povse Surveyed by: L.J. Povse Date: Nov. 1975

OCCUPATION (1)	NATURE OF JOB (2)	RAW MATERIALS AND BY-PRODUCTS (3)	CONTROL MEASURES (4)						REMARKS AND Hazard Potential (5)	Air Sampling	
			LOCAL EXH.	MECHANICAL VENTILATION	WET METHODS	PROTECTIVE EQUIPMENT	RESPIRATOR	Other			
Chief Oper. (1/shift) 5 (total)	Supervision & coordination of 5 to 6 men per shift. 90% of time in control room.	All materials on exception basis									
Oxo outside oper. (1/shift)	Handles outside work in oxo unit. 50% of time spent in unit.	Olefin, olecat, sodium cobalt carbonylate samples twice/shift	X			X	X		gas mask provided		Air sample for CO limits 1/shift
Oxo Board oper. (1/shift)	Controls oxo unit equipment from control room. 100% of time in control room.	none									
Ester outside oper. (1/shift)	Handles outside work in ester unit. 50% of time spent in unit.	Stannous oxalate, oxalic acid, carbon, micro cel, filter aid, esters as need. ;	X			X	X		Dust mask and fresh air systems provided.		
Ester Board oper. (1/shift)	Control ester unit equipment from control room. 100% of time spent in control room.	None									
Half-Man oper. (1/shift)	Handles transfers, some samples, tank farms for oxo and esters. 60% of time spent in field.	Oxo, soda ash, cobalt oxide, S-711, S-790, DUP, samples per sample schedule	X			X	X		Dust mask and fresh air system provided.		

Rotate Daily

LAM000812

Monsanto Corporate Medical MAP 004987
St. Louis, Missouri

INDUSTRIAL HYGIENE SURVEY
WORKROOM DATA

Facility: Texas City Page 2 of 2
Division: MICC Department: Oxo/Ester Building:
Data Source: L. J. Povse Surveyed by: L. J. Povse Date: Nov. 1975

OCCUPATION (1)	NATURE OF JOB (2)	RAW MATERIALS AND BY-PRODUCTS (3)	CONTROL MEASURES (4)						REMARKS AND Hazard Potential (5)	Air Sampling	
			LOCAL EXH.	MECHANICAL VENTILATION	WET METHODS	PROTECTIVE EQUIPMENT	RESPIRATOR	BOILER			
Day Man (Days) (1)	Checks equipment and readies equipment for maint. 70% of time in field.	All materials in pro- cess as equipment is readied for maint.									
Foreman (Days) (2)	Supervision of oxo and ester operations. 25% of time spent in field.	On Exception Basis									
Maint. Fore- man (days) (1)	Supervision of craft persons in oxo/ester units. 30% of time spent in field.	On exception basis									
Secretary (days)	All paper work for three units. 98% of time spend in control room/office area.	none									
Supervisor (days)	Supervision of above. 95% of time spent in control room/office area.	On exception basis									

LAM000813

RECOMMENDATIONS - Dept. 48/56

It is recommended employee exposure and environmental levels be determined to the following compounds:

Crystalline Silica
Amorphous Silica
Cobalt compounds
Copper compounds
Oxalic Acid
Nickel compounds
Stannous Oxalate
Sulfuric Acid
Phthalic Anhydride
Carbon Monoxide

MAP 004988

LAM000814

MONSANTO COMPANY
INDUSTRIAL HYGIENE SURVEY
POSSIBLE EXPOSURE INVENTORY

Shut down
Discontinued

COMPANY MPPC
DIVISION _____
PLANT Texas City
DEPARTMENT: Ethylene

Products:

- 1 Ethylene (99.8%, 98.0 high rates)
- 2 Propylene (92%-C₃H₆, 7%-C₃H₈, 1% Allene, 1% Methyl Acetylene)
- 3 Ethane
- 4 Offgas (67%-methane, 30%-H₂, 1% Ethylene, 2%-CO₂)
- 5 Acetylene
- 6 C₄+ Oils
- 7 _____
- 8 _____

Employee:

1st Shift	6 Hourly	3 Salaried
2nd Shift	6 Hourly	0 Salaried
3rd Shift	6 Hourly	0 Salaried
4th Shift	6 Hourly	0 Salaried
Vacation	1 Hourly	
Totals	25 Hourly	3 Salaried

Buildings Involved:

Non-exempt

Exempt

- 1 _____
- 2 _____
- 3 _____
- 4 _____

MAP 004989

Supervisor:

D. D. Kos

LAM000815

MONSANTO COMPANY
INDUSTRIAL HYGIENE SURVEY
MATERIALS DATA SHEET

Division MPPC
Plant Texas City
Department Ethylene

Supervisor D. D. Kos
Date Nov. 14, 1975
Building

Raw Materials	Intermediates	Finished Products
Snifo Condensate (Gas Oil) LEOH (hexane, octane) * (Light ends overhead) Caustic (50%) ➔ DMF (Dimethyl formamide) * Sodium Nitrite Ethylene Propylene Steam	Ethane	Ethane-recycle, crack Ethylene-Dept. 13 Propylene - C. B. Offgas (CH₄, H₂)-fuel Acetylene (HDPE, flare C₄ + Oils (C.B. Quench Col)

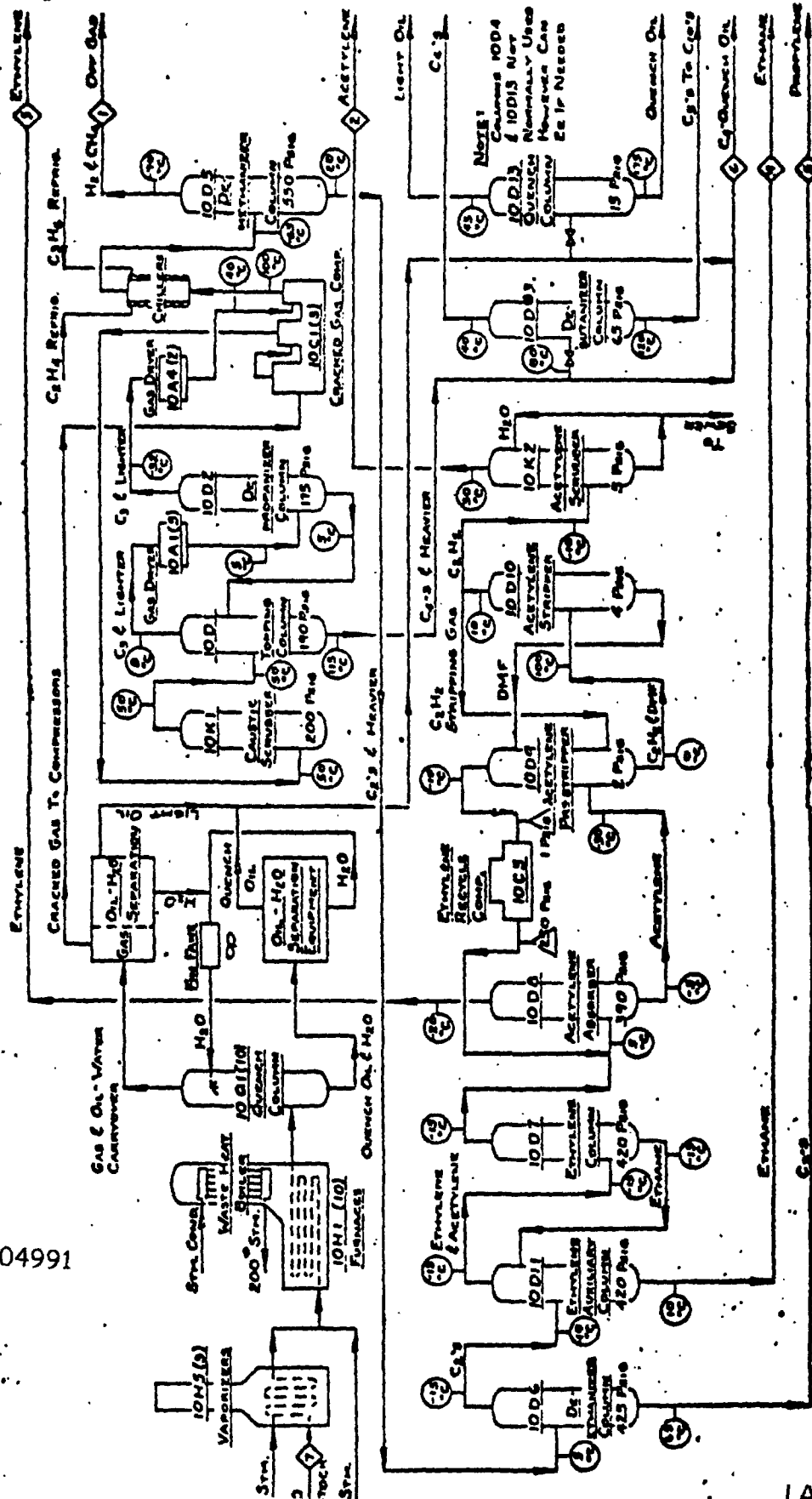
Miscellaneous Materials:

MAP 004990

LAM000816

MAP 004991

TEXAS CITY ETHYLENE FLANT FLOW DIAGRAM



STANLEY H. S. FLOOR RESEARCH
TEXAS CITY HOSP., MO

LAM000817

Observations - Ethylene

The ethylene unit uses Kellogg type furnaces. Special No. 1 fuel oil (SNIFO) is the primary raw material. There is a typical "sour gas" odor throughout much of the department. Operating personnel rarely spend over 2-3 hours out in the production unit as most of the shift time is spent in the control room.

Process waste and condensates drain to a central condensate pit which is about 50° C and open to the atmosphere.

Caustic pellets are added in a room adjacent to the Gravitometer shed.

There are several high noise areas designated in the process area; most noticeable areas include the SNIFO preheater (1 hour/shift) and the cooling tower compressors (2 hrs./shift).

The compressor area has 3 crack gas compressors and 6 refrigeration compressors. The noise level appears quite high and of predominantly low frequency noise.

Sampling is conducted at the caustic scrubber. Dimethyl formamide (DMF) is pumped from drums into the process. The odor of DMF was very pronounced on the windward side of the 10K2 water scrubber. The water scrubber removes the DMF from the process stream. Operating personnel indicate the amine odor is common in this area.

Maintenance personnel normally assigned to Dept. 10 include one maintenance foreman, two pipefitters, two machinists, two boiler-makers, two insulators and 1-2 I. & E. technicians.

MAP 004992

LAM000818

Monsanto Corporate Medical
St. Louis, Missouri

INDUSTRIAL HYGIENE SURVEY
WORKROOM DATA

Facility: Texas City Page of
Division: MPPC Department: Ethylene Building:
Date Source: D. D. Kos Surveyed by: Date: Nov. 14, 1975

OCCUPATION (1)	NATURE OF JOB (2)	RAW MATERIALS AND BY-PRODUCTS (3)	CONTROL MEASURES (4)							REMARKS AND Hazard Potential (5)	AIR Sampling Gn Pe	
			LOCAL EXH.	MECHANICAL VENTILATION	WET METHODS	PROTECTIVE EQUIPMENT	RESPIRATOR	TOOL CLOS.				
Cracking Operator	Logs data, catches samples, switches equipment.	All materials produced (except DMF)										
Compression Operator	Operates compressors (logs, control), shut- down, startup	All materials produced (except Cond., LEOH, DMF)										
Purification Operator	Operates distillation, logs data, catches samples	All materials prod. except (Condensate, LEOH)										
Rover/Tank Farm Operator	Monitors tanks, logs data, switches tanks, helps in other areas when needed.	All materials produced										
Boardman	Logs data, operates controls inside the control room	Inside: 100% No exposure										
Chief Operator	Directs activity of other operators. In charge of unit operation.	All materials produced										

LAM000819

Recommendations - Ethylene

It is recommended

That area and personnel monitoring be conducted to determine the potential for dimethyl formamide exposure.

That applicable recommendations contained in the NIOSH recommended sodium hydroxide standard be instituted.

That workplace exposures be characterized, especially at condensate sumps.

That noise dosimeters be utilized to determine the extent of noise exposure.

MAP 004994

LAM000820

Summer
Disinfect

DEPARTMENT: Polyethylene Polymerization (35P)

MAP 004995

LAM000821

MONSANTO COMPANY
INDUSTRIAL HYGIENE SURVEY
MATERIALS DATA SHEET

Division MPPC Supervisor R. W. Ceyanes
Plant Texas City Date Nov. 18, 1975
Department Polyethylene polymerization Building

Raw Materials	Intermediates	Finished Products
Hexane Methanol Ethylene Titanium tetrachloride* di-Isobutanol Aluminum hydride* Acetylene Hydrogen Butene Isobutanol 20% Caustic Lime Steam Condensate Ammonia	Catalyst Complex HCL	Polyethylene Calcium Chloride Ammonia (pumping station)
*Catalyst		

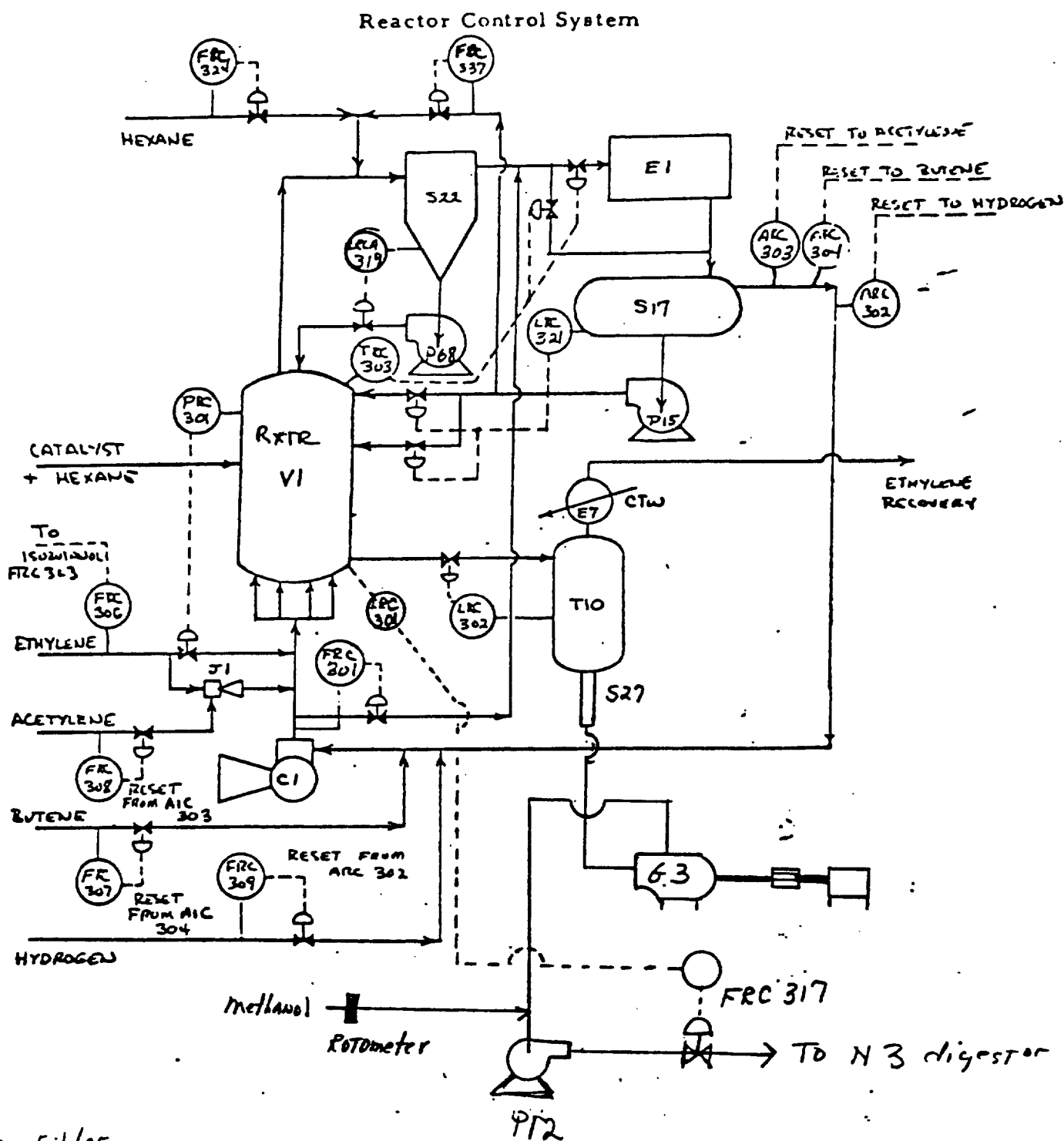
Miscellaneous Materials:

MAP 004996

LAM000822

LINE 3

Section 9.2

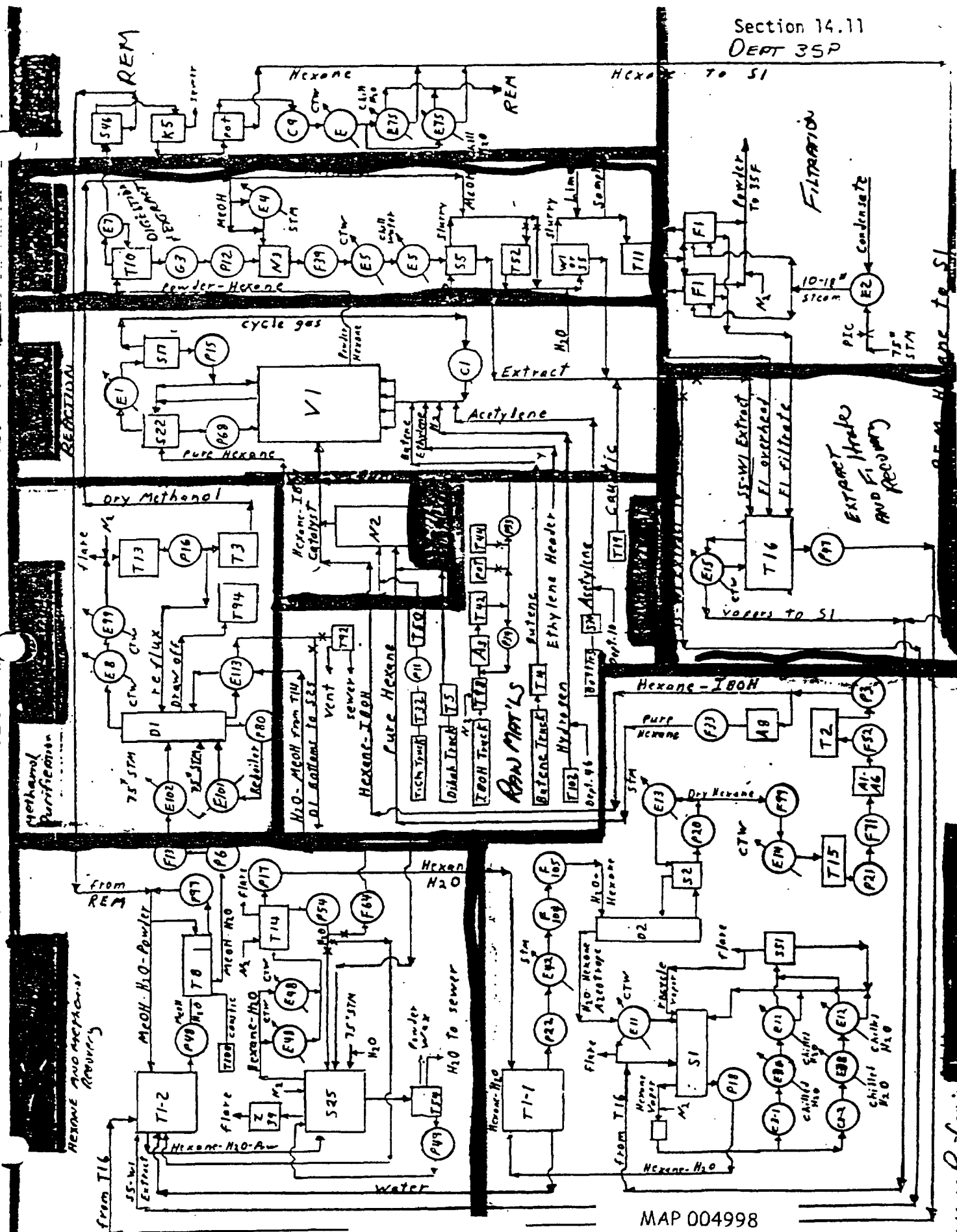


F = Filter
E = EXchanger
V = Valve
S = Separator
G = chopper
T = Tanks
P = pumps

MAP 004997

LAM000823

Section 14.11
DEPT 35P



MAP 004998

LAM000824

"0-2-1"

MAP 004999

Monsanto Corporate Medical
St. Louis, Missouri

INDUSTRIAL HYGIENE SURVEY WORKROOM DATA

Facility: Texas City Page of
Division: MPPC Department: Polyethylene Building:
Date Source: R. W. Ceyanes Surveyed by: Date: 11/18/75

OCCUPATION (1)	NATURE OF JOB (2)	RAW MATERIALS AND BY-PRODUCTS (3)	CONTROL MEASURES (4)							REMARKS AND Hazard Potential (5)	Air Sampling	
			LOCAL EXH.	MECHANICAL VENTILATION	WET METHODS	PROTECTIVE EQUIPMENT	RESPIRATOR	BOIL OFF	Gn		Pe	
Board Operator	Run unit 90% of time in control room	-----							Scott Air Paks & Breathing air mask available.	Goggles in RXTR and Ammonia area		
Polymeriza- tion Operator	Shut down & startup equipment in unit. Fill in log sheets. Troubleshoot problems prepare equip. for maintenance.	All listed							Cover goggles re- quired in reaction structure.			
	80% of time in re- action structure.									-		
Purification and storage area opera- tor	Shutdown & startup equipment. Fill in log sheets. Trouble- shoot problems. Pre- pare for maintenance.	All listed							Scott Air Paks Fire suits for DIBAH unloading			
Manufacturing Foremen (2)	Supervision of above											
Maintenance Foreman	Supervise maintenance activities 8 + 4 E&I											

LAM000825

RECOMMENDATIONS - Polyethylene Polymerization

It is recommended personnel exposure to the following substances be determined:

Hexane
Methanol
Sodium Hydroxide
Isobutanol
Calcium oxide
Ammonia
Hydrogen chloride

MAP 005000

LAM000826

MONSANTO COMPANY
INDUSTRIAL HYGIENE SURVEY
POSSIBLE EXPOSURE INVENTORY

25-10-77
mon. led

COMPANY MPPC
DIVISION Polymers
PLANT Texas City

DEPARTMENT: HDPE

Products:

- 1 H.D. Polyethylene Blow Molding
- 2 H.D. Polyethylene Inject. Molding

3 _____

4 _____

Note: H.D. = High Density

5 _____

6 _____

7 _____

8 _____

Employee:

1st Shift	8 Hourly	4 Salaried
2nd Shift	7 Hourly	0 Salaried
3rd Shift	7 Hourly	0 Salaried
4th Shift	7 Hourly	0 Salaried
Totals	29 Hourly	4 Salaried

Buildings Involved:

- 1 35F
- 2 35 Control Room
- 3 Penthouse
- 4 Packout

Supervisor:

MAP 005001

G.W. Hanks

LAM000827

MONSANTO COMPANY
INDUSTRIAL HYGIENE SURVEY
MATERIALS DATA SHEET

Division
Plant Texas City
Department H.D. Polyethylene

Supervisor G.W. Hanks
Date Nov. '75
Building 35

Raw Materials	Intermediates	Finished Products
Air 75 lb. steam 600 lb. steam Nitrogen Calcium Hydroxide, Lime Armostat 310 Carbowax Glycerol Monostearate Ional Chromate (water treatment) Methanol Hexane Ethylene Dilauryl thiodi propionate (DLTDP) Ziegler catalyst (ticl ₄ w/dialkyl aluminum) Diisobutyl Aluminum hydride (Dialkyl aluminum)	Blow Molding Powder Injection Molding Powder	Blow Molding Pellets Injection Molding Pel. (High Density Poly-ethylene)

Miscellaneous Materials:

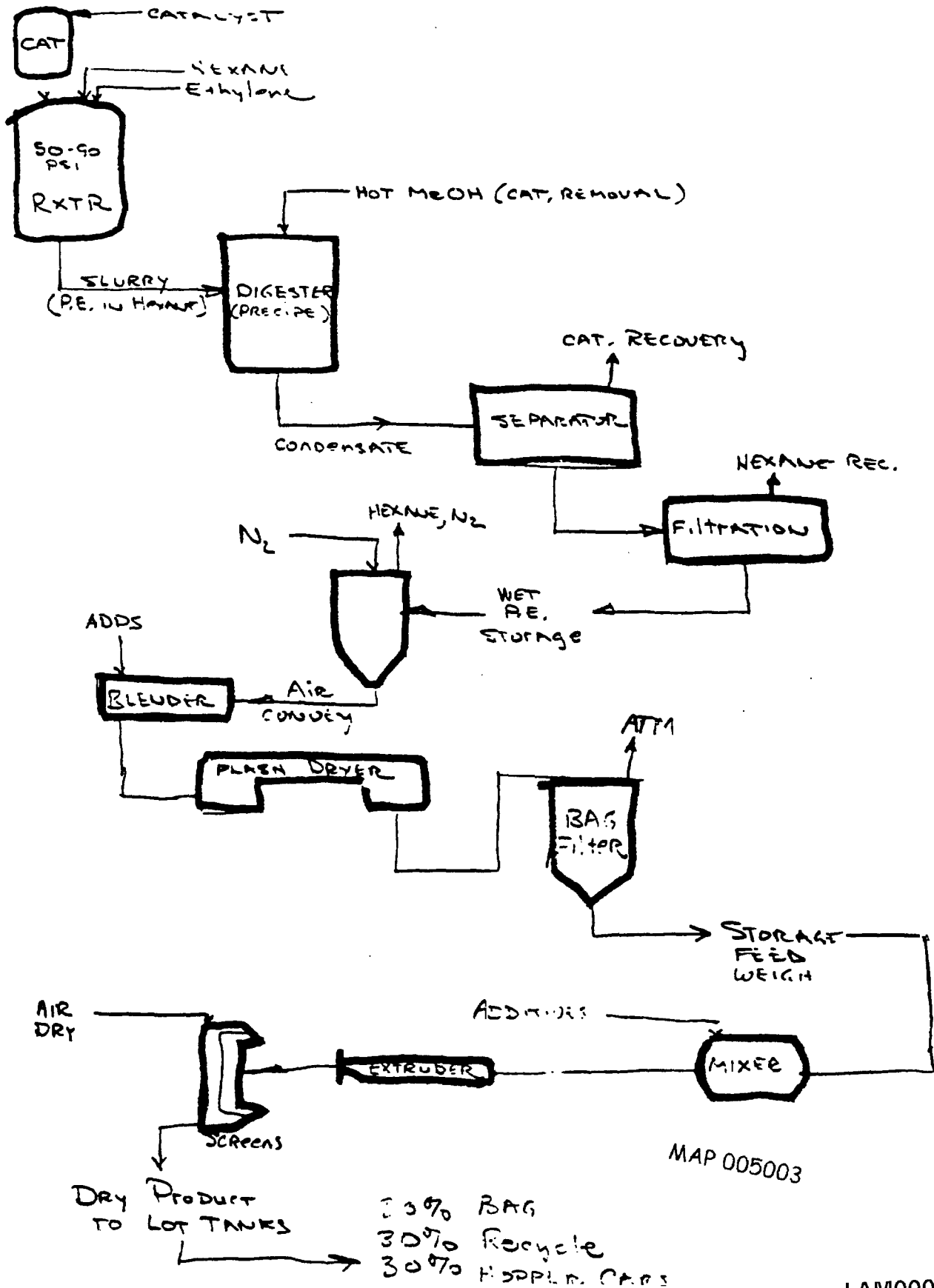
1. Ziegler catalyst residues in powder -
2. Special additives as required
 - anti-oxidants
 - cu inhibitor
 - per customer
 - Irganox 1010

MAP 005002

LAM000828

HIGH DENSITY POLYETHYLENE MODIFIED FLOW TEXAS CITY - NOV. 1975

There are 3 HDPE TRAINS: 2 small batch and 1 continuous.



OBSERVATIONS - HDPE

The most obvious health hazard potentials are noise, dust and Hexane exposure. Noise dosimetry has been obtained by John Fox (This writer has not seen the data). Noise levels are in the mid-90 dB(A) range.

The particle size distribution of the HDPE dust was reported as follows:

<u>micrometer</u>	<u>% weight retained</u>
88	12.5
75	27
62	18
53	14
44	11
under 44	17.5
	<u>100.0</u>

The housekeeping was not good even though the area was washed down daily.

Calcium hydroxide is added from 50 pound bags. Operators wear respirators for this operation.

MAP 005004

LAM000830

MAP 005005

Monsanto Corporate Medical
St. Louis, Missouri

INDUSTRIAL HYGIENE SURVEY
WORKROOM DATA

Facility: Texas City Page 1 of 2
Division: MPPC Department: HDPE Building: _____
Date Source: G.W. Hanks Surveyed by: _____ Date: _____

OCCUPATION (1)	NATURE OF JOB (2)	RAW MATERIALS AND BY-PRODUCTS (3)	CONTROL MEASURES (4)						REMARKS AND Hazard Potential (5)	Air Sampling Gn Pe
			LOCAL EXH.	MECHANICAL VENTILATION	WET METHODS	PROTECTIVE EQUIPMENT	RESPIRATOR	BIOL. MON.		
Chief Operator (1/shift)	Directs activities of all operators. Out in the operating area 50% of time	All except additives								
Line 1, 2 & 3 Board Operator (1/shift)	Runs mixer/extruder trains. In control room 85% of time	None except when outside, then only pellets, steam								
Line 1 & 2 Outside Operator (1/shift)	Checks, performs on line maintenance, and changes additives on mixer/extruder. Outside 60% of time.	All including addi- tives	X				X		when mixing addi- tives	
Line 3 Outside Operator (1/shift)	Checks, performs on line maintenance, mixes addi- tives on mixer extruder. Also lines up powder transfers. Outside 50% of time	All including additives								
Pellet Operator (1/shift)	Makes blends, trans- fers pellets, relo- cates cobra hoses Outside 25% of time	Pellets only								
Offsite Operator (1/shift)	Makes blends, transfers pellets relocates cobra hoses Outside 70% of time	Pellets only								

LAM000831

MAP 005006

Monsanto Corporate Medical
St. Louis, Missouri

INDUSTRIAL HYGIENE SURVEY
WORKROOM DATA

Facility: Texas City Page 2 of 2
Division: MPPC Department: HDPE Building: _____
Date Source: G.W. Hanks Surveyed by: _____ Date: _____

OCCUPATION (1)	NATURE OF JOB (2)	RAW MATERIALS AND BY-PRODUCTS (3)	CONTROL MEASURES (4)							REMARKS AND Hazard Potential (5)	Air Sampling	
			LOCAL EXH.	MECHANICAL VENTILATION	WET METHODS	PROTECTIVE EQUIPMENT	RESPIRATOR	BOILER	TOXIC		Gn	Pe
Packout Operator (2/shift)	Operates bagging Machine and palletizer	Pellets, Air										
Day Operator (1 man, 5 days per week)	Operates additive packaging systems. Performs misc. routine maintenance. Outside 50% of time	All	X									
Foreman (2/day)	Directs hourly activities. Outside 20% of time.											
2 Maint. Foreman (5-8 maint. personnel)												

RECOMMENDATIONS - HDPE

It is recommended exposure levels to the following compounds be determined:

Calcium Hydroxide
Methanol
Ethylene
Hexane
Polyethylene Glycol (Carbowax)
Dust
Noise

It is recommended a more environmentally acceptable substitute for water treatment chromates be utilized.

MAP 005007

LAM000833

MONSANTO COMPANY
INDUSTRIAL HYGIENE SURVEY
POSSIBLE EXPOSURE INVENTORY

COMPANY MICC
DIVISION Plasticizer
PLANT Texas City

DEPARTMENT: Phthalic Anhydride

Products:

1 Phthalic Anhydride
2 _____
3 _____
4 _____
5 _____
6 _____
7 _____
8 _____

Employee:

1st Shift	5 Hourly	4 Salaried
2nd Shift	4 Hourly	Salaried
3rd Shift	4 Hourly	Salaried
4th Shift	4 Hourly	Salaried
Swing Operator	1	
Extra Operator (vac. relief)	1	
Totals	19 Hourly	4 Salaried

Buildings Involved:

1 Dept. 53
2 _____
3 _____
4 _____

MAP 005008

Supervisor:

T. S. Hallen

LAM000834

MONSANTO COMPANY
INDUSTRIAL HYGIENE SURVEY
MATERIALS DATA SHEET

Division MICC-Plasticizer
Plant Texas City
Department 53

Supervisor T. S. Hallen
Date Nov. 17, 1975
Building -

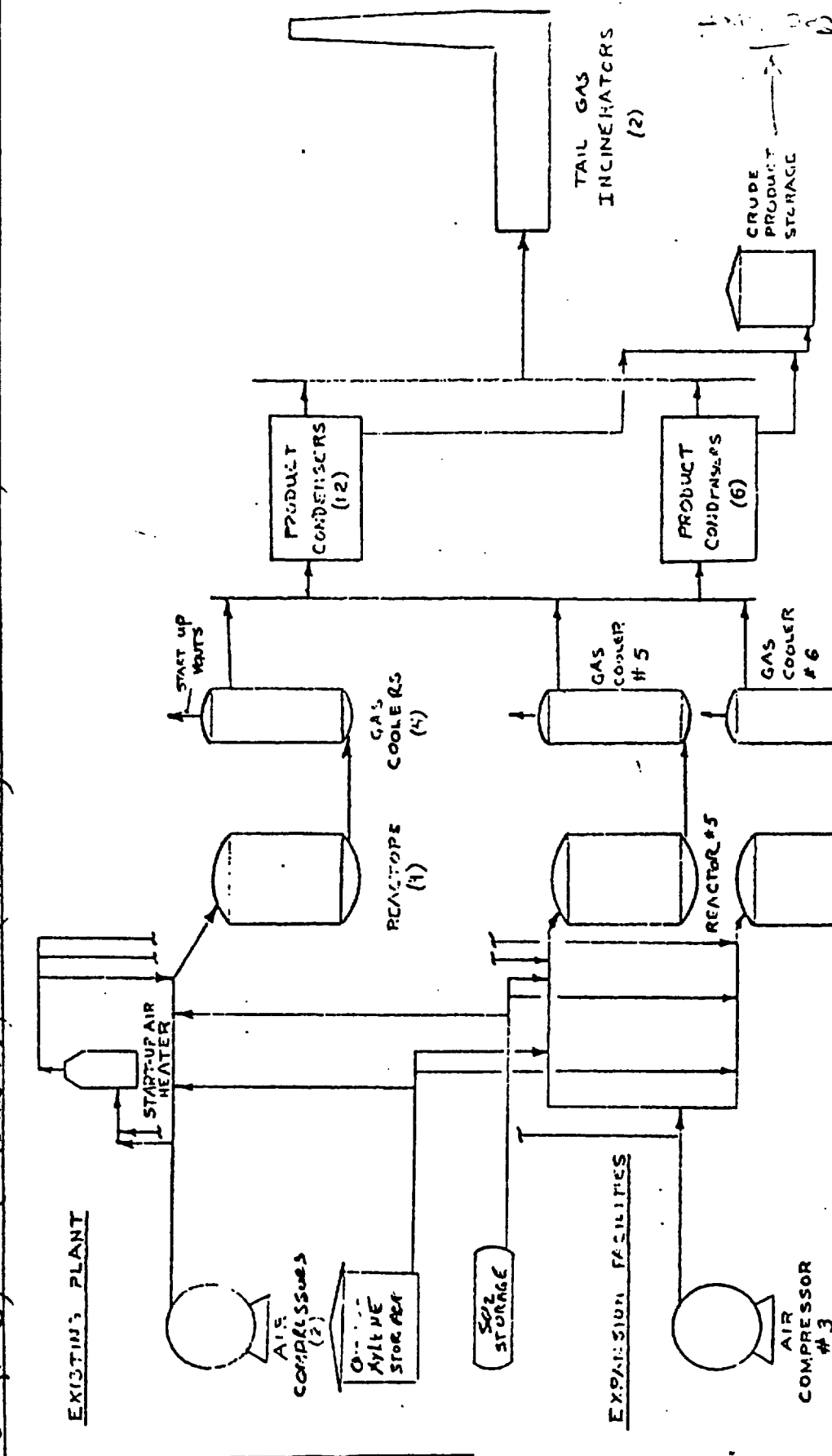
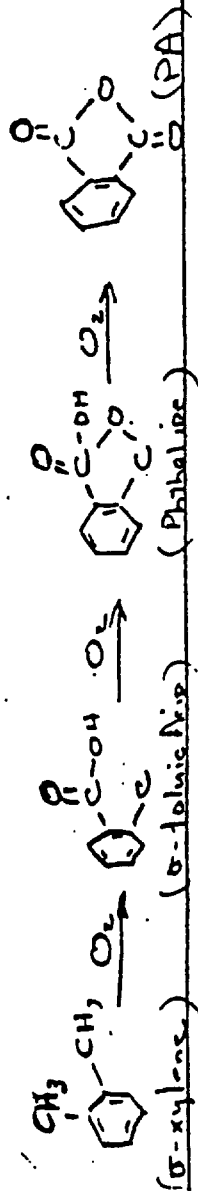
Raw Materials	Intermediates	Finished Products
1. Air 2. O-xylene (barge) ★ 3. SO ₂ (Tank Truck-Liq.) ★ 4. Vanadium Pentoxide ★ (Cat.) 5. Sodium Sulfide (BFW) 6. Hydrazine (BFW) ★ 7. Sodium Hydroxide (BFW) ★ 8. Sulfuric Acid (BFW) ★	1. Crude Phthalic Anhy- dride 98% Benzoic acid Maleic Anhydride ★ Phthalic acid o - Toluic Acid o - Toluic Aldehyde Phthalide	1. Phthalic Anhydride (99.5%+)

Miscellaneous Materials:

NOTE: BFW = Boiler Feed Water

MAP 005009

LAM000835



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 CCA 2155

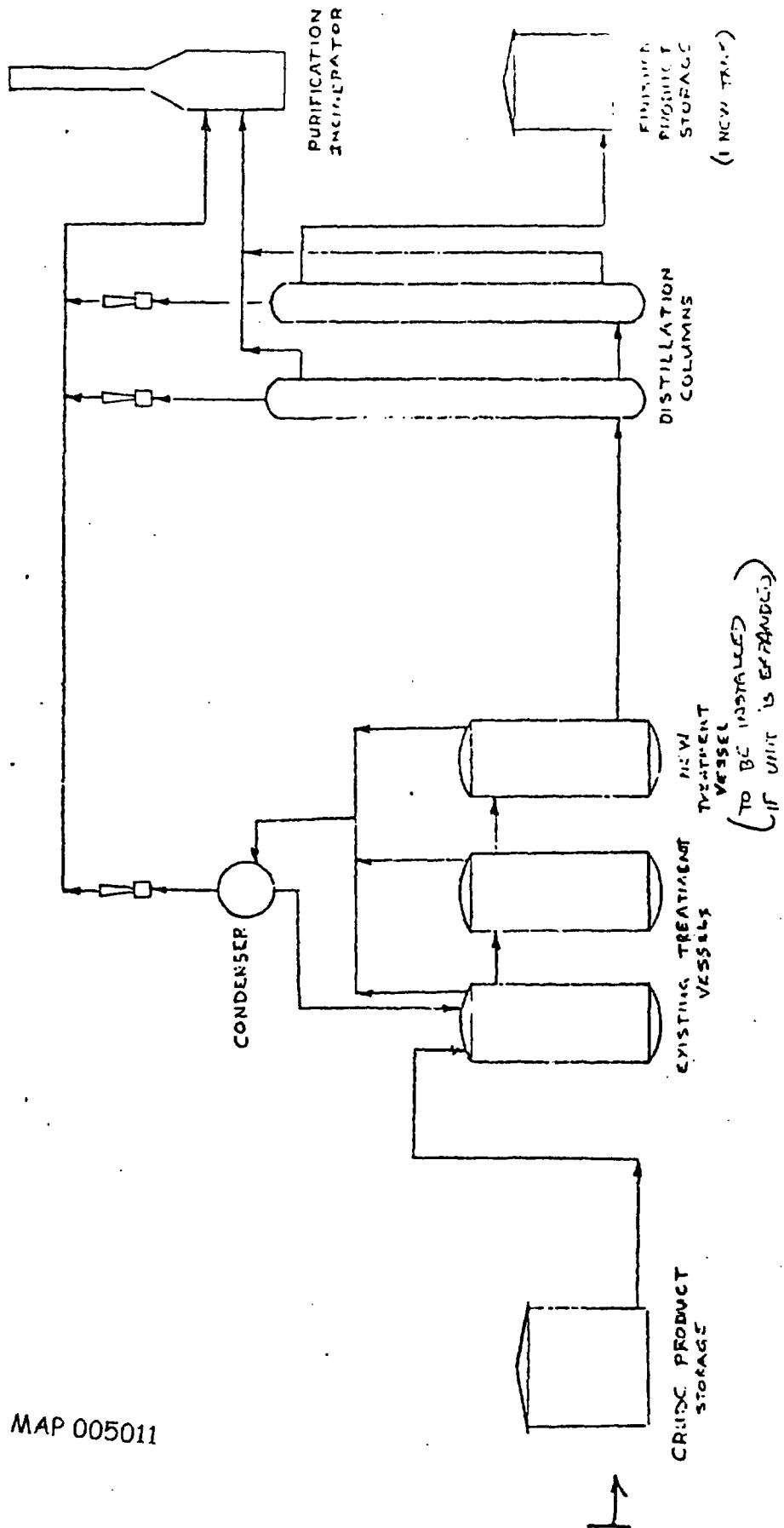
Monsanto

TSM 4/85/23
 CHECKED

MAP 005010

LAM000836

MAP 005011



(TO BE INSTALLED
IF UNIT IS EXHAUSTED)

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DESIGN	TSM 4/25/73	Monsanto COMPANY TEXAS CITY, TEXAS DIVISION OF AMERICAN BRIDGE	DESIGN NO	CCA 2515
CHECKED			PLANT	
DATE			DATE	
			TIME	

LAM000837

MAP 005012

Monsanto Corporate Medical
St. Louis, Missouri

INDUSTRIAL HYGIENE SURVEY
WORKROOM DATA

Facility: Texas City Page of
Division: MICC - Plasticizer Department: Phthalic Anhydride Building
Date Source: T. S. Hallen Surveyed by: Date: Nov. 17, 1975

OCCUPATION (1)	NATURE OF JOB (2)	RAW MATERIALS AND BY-PRODUCTS (3)	CONTROL MEASURES (4)							REMARKS AND Hazard Potential (5)	Air Sampling	
			LOCAL EXH.	MECHANICAL VENTILATION	WET METHODS	PROTECTIVE EQUIPMENT	RESPIRATOR	BOB.			Gn	Pe
Chief Opera- tor (1/Shift)	Direct operators and runs unit on shift. 1 hr/shift in unit.	All on occasion. Daily rotation				X	X			Prime hazard - temp. extremes		
Operators (3/shift)	Take prescribed read- ings, collect samples, make product & raw material transfers. 1 hrs./shift					X	X					
Day Operator (Days)	Prepares equipment for maintenance 70% in unit.					X						
Production Foreman	Supervision of above people and operations.											
Maintenance Foreman	Supervises maintenance											
Supervision	Supervises all of above.											

LAM000838

Recommendations - Phthalic Anhydride

It is recommended employee exposure to the following substances
be determined:

o-xylene
sulfur dioxide
vanadium pentoxide (dust and fumes)
phthalic anhydride
maleic anhydride
hydrazine
sodium hydroxide
sulfuric acid
heat

MAP 005013

LAM000839

MONSANTO COMPANY
INDUSTRIAL HYGIENE SURVEY
POSSIBLE EXPOSURE INVENTORY

COMPANY MICC
DIVISION Rubber Chem. & Food Products
PLANT Texas City
DEPARTMENT: HCN (19), TBA (25), LN (27)

Products:

- 1 Hydrogen Cyanide (99%+)
- 2 t-Butylamine (97%+; 99%+)
- 3 Lactonitrile (85%+)
- 4 _____
- 5 _____
- 6 _____
- 7 _____
- 8 _____

Employee:

1st Shift	7	Hourly	5	Salaried
2nd Shift	6	Hourly	0	Salaried
3rd Shift	6	Hourly	0	Salaried
4th Shift		Hourly		Salaried

Totals	19	Hourly	5	Salaried
	+3	Trainees)		

Buildings Involved:

- 1 _____
- 2 _____
- 3 _____
- 4 _____

Supervisor:

R. T. Hammann

MAP 005014

LAM000840

MORGANTO COMPANY
INDUSTRIAL HYGIENE SURVEY
MATERIALS DATA SHEET

Division
Plant
Department

Supervisor
Date
Building

Raw Materials	Intermediates	Finished Products
<u>HCN</u> Air Methane Ammonia Pt-Rh Catalyst H ₂ SO ₄ Water Monoammonium Phosphate		Hydrogen Cyanide (99%)
<u>TBA</u> Hydrogen Cyanide Isobutylene Water Sulfuric Acid Sodium Hydroxide Steam	t-Butyl Formamide Sulfate Sodium Sulfate Sodium Formate Water t-Butyl Alcohol Formic Acid Polyisobutylene	t-Butyl Amine (>97%) (>99%) (To Nitro for Santocure NS) (To C-G)
<u>LN</u> Hydrogen Cyanide Acetaldehyde Sodium Hydroxide Phosphoric Acid Water		Lactonitrile (>85%) (To LA)
<u>Miscellaneous Materials:</u>		

MAP 005015

LAM000841

DEPT. 19
HCN

BRIEF PROCESS DESCRIPTION

At Texas City, HCN is produced continuously using the Andrussov process (DuPont) in a plant made up of three parallel catalytic reactors, an ammonia recovery system, and an HCN fraction system. For the past 5 years, HCN demand has averaged from 10-20% of capacity. As a result, the unit runs on one reactor for approximately 10 to 15 days/month, building HCN inventory, then is down the remainder of the month. Although this mode of operation does not change the basic process, it has created many special problems.

The HCN reactor is fed a carefully ratioed mixture of air, natural gas, and ammonia vapor. Each gas must be temperature and pressure controlled for accurate meterings and be totally clean and dry to prevent damage to the catalyst (a thin platinum gauze). The feeds react while passing through the gauze forming a mixture of HCN vapor, unreacted NH_3 , residual N_2 , and combustion products. Oxidation supplies the heat necessary to convert NH_3 and CH_4 to HCN and heats the gauze up to 1100 to 1200 deg. C. The hot gas is cooled in a waste heat boiler, generating 150 psig steam, and then a CTW exchanger.

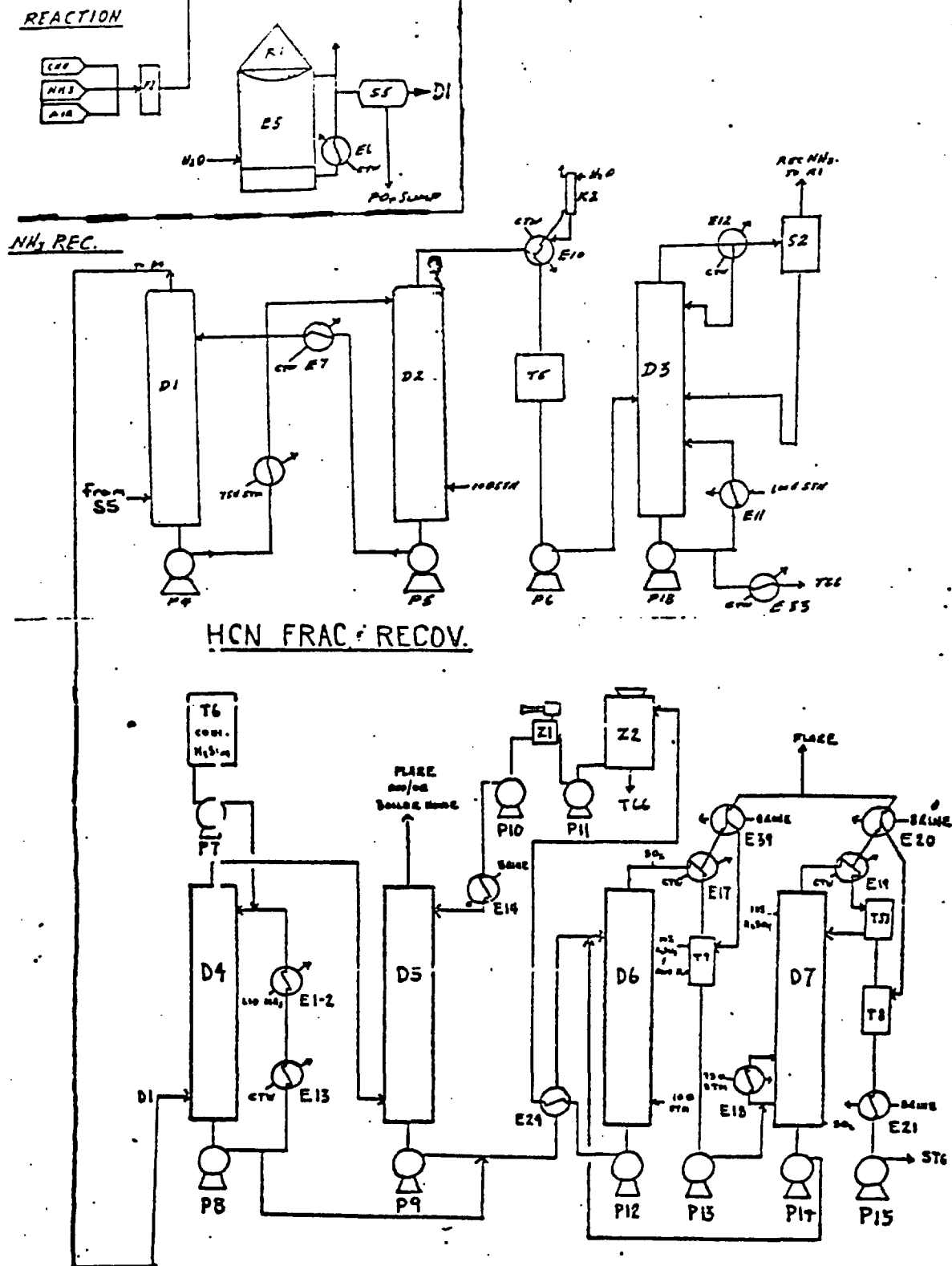
The cooled gases flow to the ammonia recovery system. The gas is scrubbed to remove unreacted ammonia. The absorbent (ammonium phosphate) is steam stripped to free the ammonia and regenerate the absorbent. The overhead from the ammonia stripper (NH_3 and H_2O) is then fractionated to produce NH_3 vapor for recycle to the HCN reactor and the column bottoms are pumped to chlorinat

The gases leaving the ammonia absorber still containing traces of NH_3 , and the HCN product are scrubbed first with dilute sulfuric acid to destroy any remaining NH_3 and then with chilled water to absorb the HCN. Gases from the HCN absorber go to Power 2 and are burned as a low Btu value fuel. The chilled water containing the HCN product is steam stripped, then fractionated and the HCN is pumped to storage. Water from the stripper bottoms is cooled by a process cooling tower, then chilled and returned to the absorber. Excess water is pumped to chlorination.

MAP 005016

LAM000842

Dept 19 Simplified Flow Sheet



MAP 005017

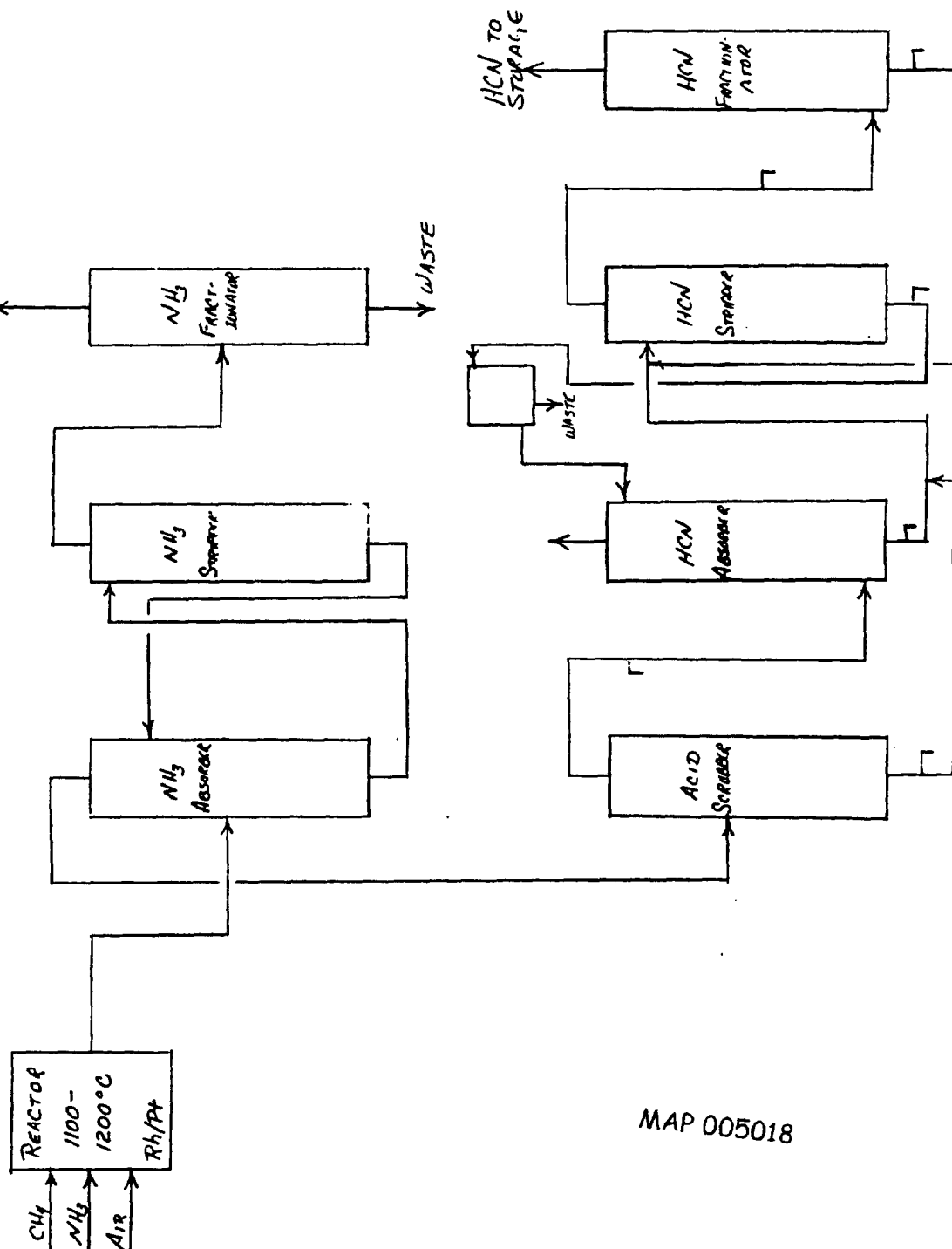
LAM000843

HYDROGEN CYANIDE MANUFACTURE

VAPOR PHASE REACTION OVER RHODIUM-PLATINUM CATALYST (EXOTHERMIC REACTION)



RECYCLE NH_3
TO REACTOR



MAP 005018

LAM000844

DEPT. 25 - TBA

Brief Process Description

Tertiary-butylamine (TBA) is produced in three process steps. The first two steps, reaction and hydrolysis, occur in two parallel trains of automatically sequenced batch equipment. The third step, purification, is continuous. The unit will produce in excess of 18M lbs/year, at over 84% yield, operating at a 90% OST.

The reaction step produces TBFA by reacting IBY, HCN, H_2SO_4 and water under temperature control. The HCN and IBY are measured by weight, premixed and fed as a liquid into the glass lined reactor, precharged with aqueous sulfuric acid. The feed rate is adjusted so that the external cooler can hold the reactor temperature at 75 throughout the IBY-HCN charge. In the hydrolysis step, the resulting tertiary- butyl formamide sulfate intermediate, by products and unreacted raw materials are transferred to a hydrolyzer precharged with H_2O and caustic. The NaOH neutralizes the TBFA sulfate to TBFA, neutralizes unreacted H_2SO_4 , and hydrolyzes TBFA forming TBA and sodium formate. The hydrolyzer is agitated to provide good mixing. The TBA is steam stripped from the hydrolysis mass to yield a crude TBA-water mixture. The hydrolyzer bottoms, containing HCN and various sodium salts is pumped to waste treatment. In the purification step, the crude TBA is continuously fractionated to produce specification grade TBA.

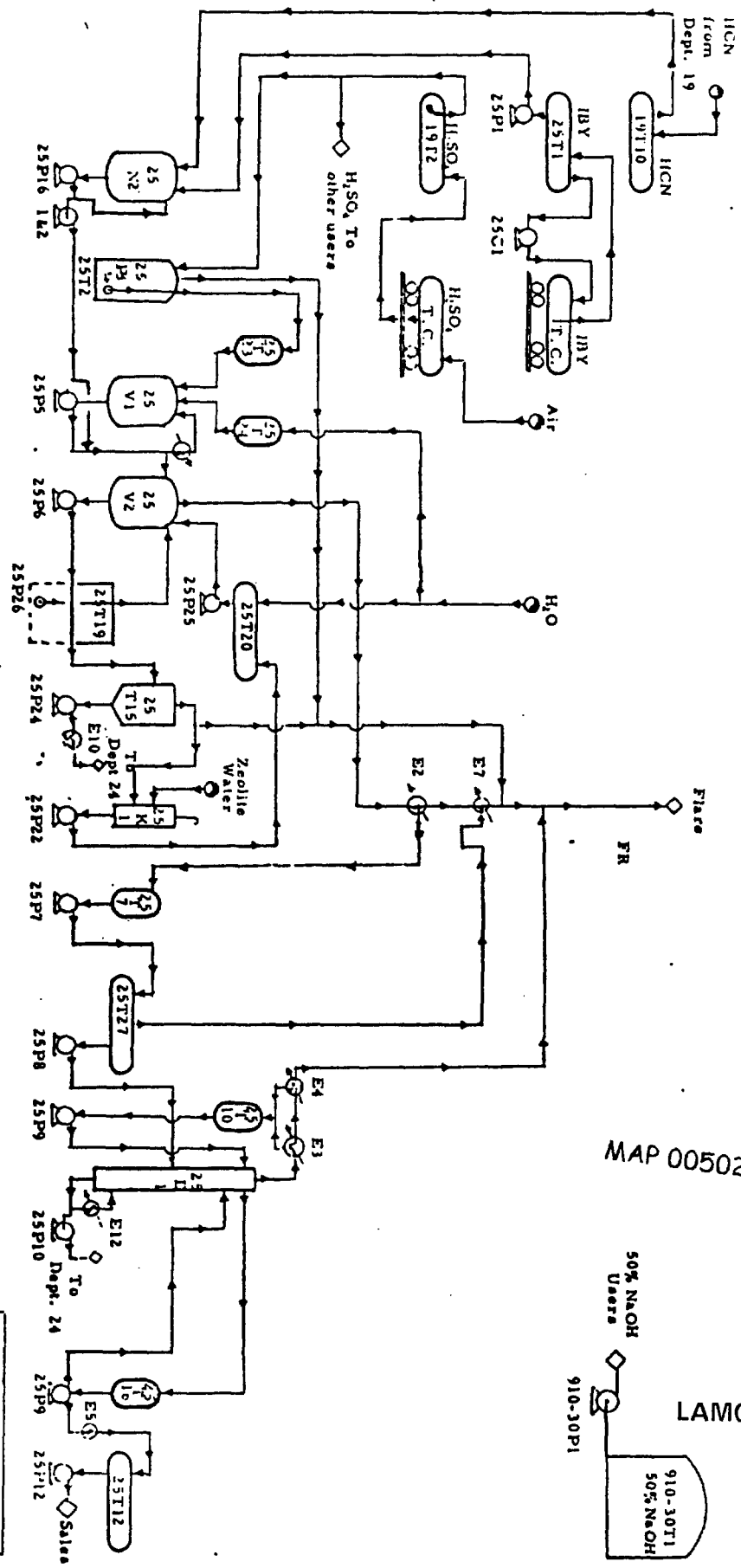
MAP 005019

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HCN
from
Dept. 19

HCN

19710

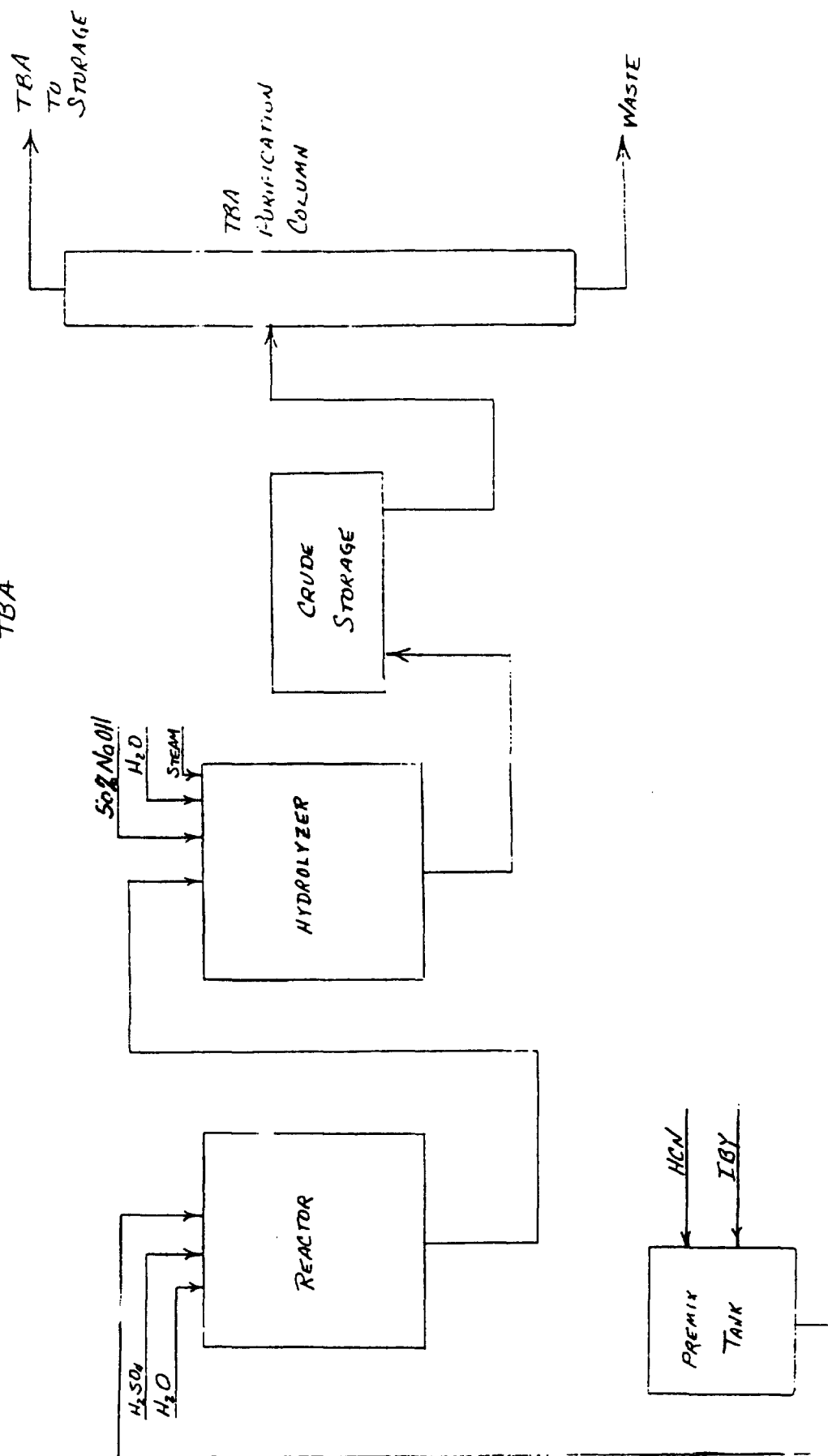
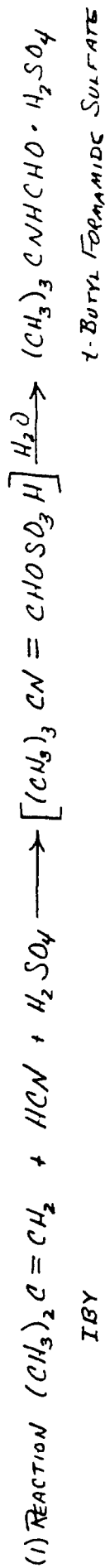


LAM000846

DEPT. 25
TBA - UNIT
SIMPLIFIED PROCESS
FLOW DIAGRAM
D.H.S. 4/22/75

t-BUTYL AMINE MANUFACTURE

LIQUID PHASE BATCH REACTION (EXOTHERMIC)



MAP 005021

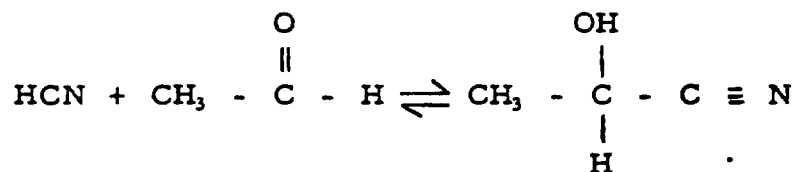
LAM000847

DEPT. 27 - LN

Brief Process Description

The lactonitrile (LN) plant has a demonstrated capacity of 18M lbs/year. Demand is captive to Lactic Acid. LN is produced from hydrogen cyanide (HCN) and acetaldehyde (AcH) in a single step continuous, pH controlled, externally cooled reactor.

The reaction is exothermic and pH dependent. The overall reaction is:



In practice all reactor feeds are continuously introduced into a circulating mass of 85 to 90% LN (water is used alone for startup). AcH and HCN are fed at a one to one mole ratio, sufficient water is fed to dilute the product LN to ~ 88%, caustic is fed under pH control to maintain a 5.2 pH. The mass circulates from the reactor through the external cooler which removes sufficient heat to hold the reactor at 48 deg. C.

The LN product is continuously drawn off by level control, stabilized with phosphoric acid, cooled, and sent to product storage via two rundown tanks.

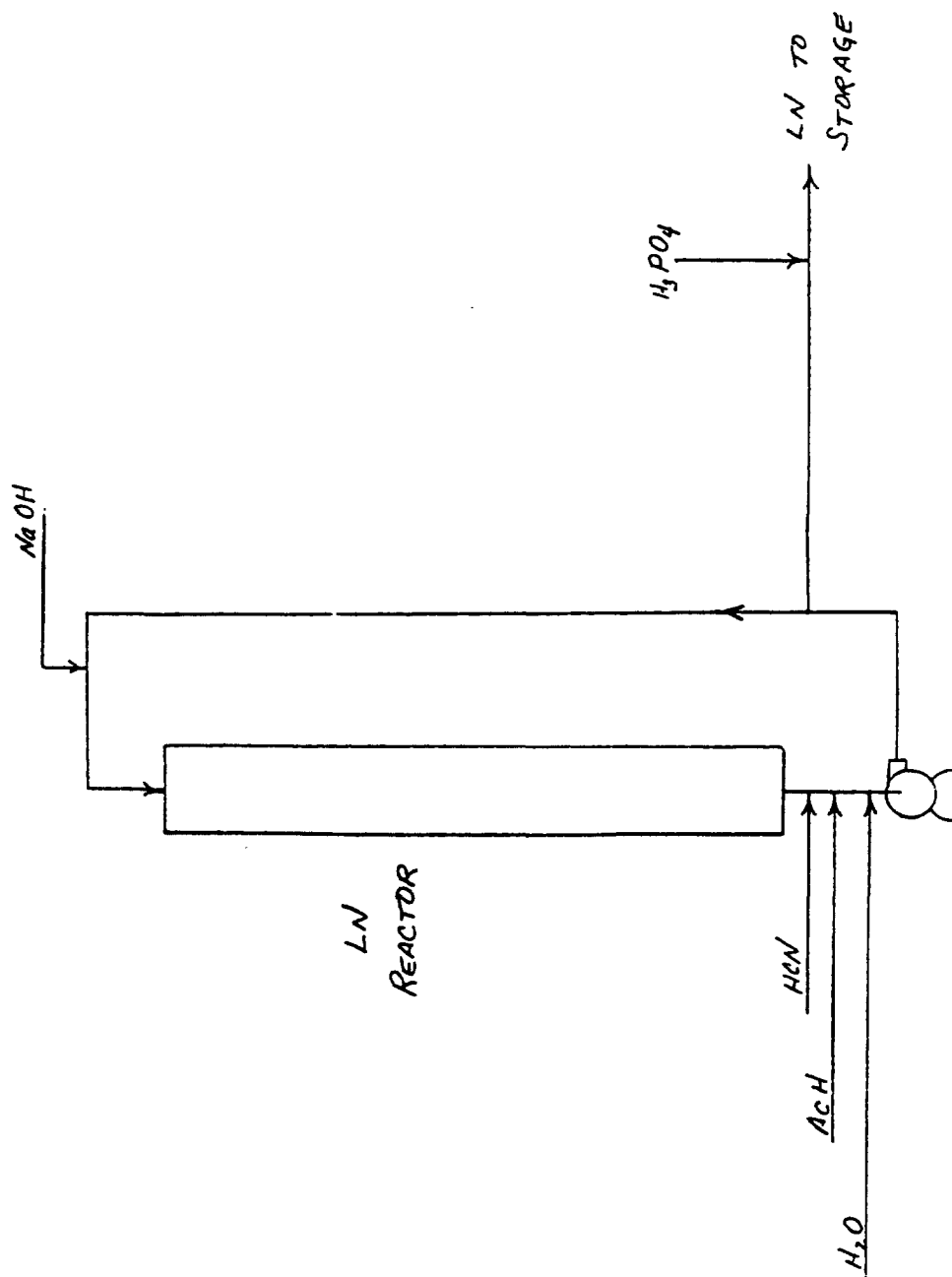
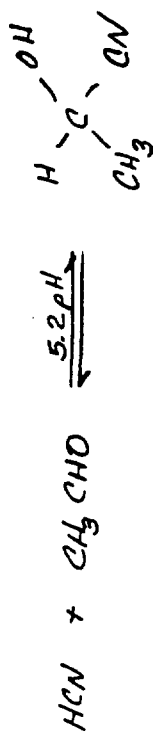
Standard process yields are over 95% of theory. No significant side products are formed.

MAP 005022

LAM000848

LACTONITRILE MANUFACTURE

LIQUID PHASE EXOTHERMIC REACTION



MAP 005024

LAM000850

OBSERVATIONS - HCN, TBA, LN

The three departments operate in one general area. The area is considered a high hazard area. There are alarms at the safety showers. A "buddy" system is utilized for sampling. The cyanide is refrigerated so its vapor pressure is low.

Sulfuric acid is received from tank cars while caustic is shipped in barges.

TBA wastes go to Department 24 (waste treatment).

HCN is sampled about twice daily into jugs from open taps.

Gloves and goggles are required throughout the units. Ammonia is pumped via Durco type pumps.

MAP 005025

LAM000851

MAP 005026

Monsanto Corporate Medical
St. Louis, MissouriINDUSTRIAL HYGIENE SURVEY
WORKROOM DATA

Facility: TEXAS CITY Page 1 of 2

Division: MICC Department: HCN (19, TBA (25), LN (27))

Date Source: R. T. Hammann Surveyed by: Date: 11/18/75

OCCUPATION (1)	NATURE OF JOB (2)	RAW MATERIALS AND BY-PRODUCTS (3)	CONTROL MEASURES (4)						REMARKS AND Hazard Potential (5)	Air Sampling	
			LOCAL EXH.	MECHANICAL VENTILATION	WET METHODS	PROTECTIVE EQUIPMENT	RESPIRATOR	BOGOL.		Gn	Pe
"A" Operator (1/shift)	Board Operator	0 time in field									
"B" Operator (1/shift)	TBA Outside Operator	t-Butylamine Sampling NaOH, 2 hrs/shift							Goggles		
"C" Operator (1/Shift)	Outside Operator (HCN & LN)	HCN & LN Sampling, MAP, NaOH, H ₂ SO ₄ On rare occasion 2 hr. p.s.							Gas Mask when sampling HCN Goggles		
"D" Operator (1/shift)	Compressor - Utility Outside Operator	Chlorine, Caustic on occasion 2 hr p.s.									
"E" Operator (1/shift)	Relief Operator (Rover)	All of above 2 hr. p.s.									
"F" Operator	Chief Operator	All of above 2 hr p.s.									

LAM000852

MAP 005027

Monsanto Corporate Medical
St. Louis, MissouriINDUSTRIAL HYGIENE SURVEY
WORKROOM DATA

Facility: Texas City Page 2 of 2

Division: MICC Building: _____

Date Source: R. T. Hammann Surveyed by: _____ Date: 11/18/75

OCCUPATION (1)	NATURE OF JOB (2)	RAW MATERIALS AND BY-PRODUCTS (3)	CONTROL MEASURES (4)							REMARKS AND Hazard Potential (5)	AIR Sampling	
			LOCAL EXH.	MECHANICAL VENTILATION	WET METHODS	PROTECTIVE EQUIPMENT	RESPIRATOR	BIOL. HOD.	Gn		Pe	
Operations Foreman (days)	Supervision of Operators											
Maintenance Prod. Fore- man (days)												
Clerk (days)	Data filing & Daily production records											
Tech. Foreman (days)	Process Control of Unit.											
Operating Supervisor	Supervision of Entire Area											
"G" Operator	Day Man (hourly) CT	Chlorine, Chromates, HCN										Gas mask when handling HCN

LAM000853

RECOMMENDATIONS - HCN, TBA, LN

It is recommended environmental levels and personnel exposure to the following substances be determined:

Ammonia
Sulfuric Acid
Platinum
Rhodium
Hydrogen Cyanide
Sodium Hydroxide
Acetaldehyde
Phosphoric Acid

MAP 005028

LAM000854

APPENDIX A
SUBSTANCES WITH ASSIGNED EXPOSURE STANDARDS

<u>SUBSTANCE</u>	<u>CSHA</u>		<u>OTHER</u>	
	<u>ppm</u>	<u>Mg/M³</u>	<u>ppm</u>	<u>Mg/M³</u>
Carbon dioxide	5000	9000		
Nickel	-	1		
Zinc oxide	-	5		
Hydrazine - skin	1	1.3	0.1	0.1 (D)
NTA				1
Chlorine	1	3		
Sodium hydroxide	-	2		2 (C) (B)
Methyl alcohol	200	260		
Carbon monoxide	50	55	35 (F)	-
Methane			simple asphyxiant (B)	
Ammonia	50	35	50 (C) (F)	
Platinum	-	0.002 (salts)		
Rhodium	-	0.1 dusts, fumes 0.001 salts		
Sulfuric acid	-	1		
Hydrogen cyanide - skin	10	11		
Acetaldehyde	200	360		MAP 005029
Phosphoric acid	-	1		
t-Butyl Alcohol	100	300		
Formic acid	5	p		
Butylamine - skin	5	15 (C)	5	15 (B)
Hexane	500	1800	100	360 (D)
Ethylene			simple asphyxiants (B)	

<u>SUBSTANCE</u>			<u>OTHER</u>	
	<u>ppm</u>	<u>Mg/M³</u>	<u>ppm</u>	<u>Mg/M³</u>
Acetylene			simple asphyxiants ^(B)	
Hydrogen			simple asphyxiants ^(B)	
Isobutyl alcohol	100	300	50	150 ^(D)
Calcium oxide	-	5	-	2 ^(E)
Hydrogen chloride	5	7 ^(C)		
Xylene (skin)	100	435		
Sulfur dioxide	5	13		
Vanadium pentoxide				
dust	-	0.5 ^(C)	-	0.5
fume	-	0.1 ^(C)		0.05 ^(C)
Phthalic anhydride	2	12	1	6 ^(D)
Maleic anhydride	0.25	1		
Dimethyl formamide(skin)	10	30		
Inert dust - total respirable		15 5		
Iodine	0.1	1 ^(C)		
Methyl Iodide (skin)	5	28		
Acetic acid	10	25		
Asbestos	2 fibers/cc (longer than 5 um) ^(G)			
Silica	see 1975 TLV book			

NOTES

- All values are 8-hour time weighted average (TWA) unless indicated with a (C).

Footnote Designation

- (A) - DMEH guideline
- (B) - 1975 TLV
- (D) - 1975 TLV Notice of Intended Change
- (E) - 1976 TLV
- (F) - NIOSH Recommended Standard
- (G) - Effective 7/1/76

MAP 005030

LAM000856

APPENDIX B

General Observations - Texas City

The plant is located within the city limits of Texas City, Texas bounded on the east by Galveston Bay, extensive industrial development on the south and west, and residential areas of Texas City to the north. The terrain is flat and subject to flooding during intense Gulf Coast rainstorms and hurricanes. The plant has been a manufacturing site since World War I, when a sugar refinery was built. The area is the location of a large refinery and petrochemical complex at the mouth of Galveston Bay.

At the time of the survey (Nov., 1975), there were 1571 employees, 465 exempt, 199 non-exempt and 907 wage-roll.

Distribution Department

Distribution Department employees load and unload all major raw materials and products at about 18 different locations from barges, cars, and trucks. There are 42 wage-roll pumper-gagers, 5 foremen, 1 clerk and 1 supervisor. Each shift (12/shift) has a chief operator. The chief assigns personnel who rotate job-to-job. There may be 4-5 months between job rotation. The pipefitters probably have the most potential chemical exposure during connect/disconnect operations at barges, cars, and trucks. Respirators are not presently required in any area. Some compounds are sampled by dip cups. Operators also gage and take temperatures. See the attached sheet for materials generally found in the Distribution Department.

MAP 005031

LAM000857

Distribution I-partment

SAMPLES

Condensate Snifo
Tech Grade 50% Lactic Acid
Food Grade 50% Lactic Acid
Tech. Grade 88% Lactic Acid
U.S.P. Grade Lactic Acid
Phthalic Anhydride Spec. #1
C7C9 Alcohol
Oxo Alcohol T13-2
LEOB 48D502 BTMS.
LEOB 48D501 OH
LEOB 48D502 OH
HOE 48 HOE
C11 Alcohol
Tertiary Butylamine 25D1 Prod.
Diundecyl Phthalate DUP
Dioctyl Phthalate
Santicizer 711
Santicizer 790
Acetic Acid
Acrylonitrile
Caustic Soda
Ethylchloride
Ethylbenzene
Isobutylene
Methanol
Styrene
Sulfuric Acid
Petroleum Naphtha (Toluene)
Vinyl Acetate (Lactonitrile)
Aluminum Chloride
Flux Oil
Propylene
Styrene Tar
HCN
Acetaldehyde
Benzene
Acetone
ACY
Butaneol
Hexane
Naphthalene
Phenol
Muriatic (HCl) acid
Olefins (mixed)
O-xylene
Aluminum granules
Polyethylene pellets

MAP 005032

LAM000858