MONSANTO COMPANY

ORGANIC DIVISION

W. G. KRUMMRICH PLANT

PROCESS SAFETY AUDIT

Department 246

Aroclors, Pyranols, Pydrauls, Inerteens

Supervisor D. E. Harris

Supt. P. E. Heisler

Written by: G. L. Judy
D. H. Sartor

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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. 70°C; B.P. 255° C.; Density .9910 @ $75°/4^{6}$ 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 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

Biphenyl is received in 10,000 or 20,000 gallon tank cars 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 is no temperature recorder or controller used during the biphenyl heatup. The pumping of the biphenyl to storage begins after the operator has visually inspected the car and has determined that all of the biphenyl has melted. The full 80 lb. steam is left on the coils unless there is a danger of overflowing the car. Since saturated 80 lb. steam is 324° F. (162° C.) it is possible to raise the biphenyl temperature above its flash point - 235° F. (113° C.). Since its melting point is 158° F. (70° C.) there is no need to heat this material to 324° F. It is recommended that either

1. A temperature recorder, controller and alarm be put on the tank car when melting and unloading biphenyl and the temperature maintained at or below 200° F. (93° C.) maximum or
2. The tank car & unloading system be properly equipped to handle a flammable liquid (grounding, flame arrestor, etc.)

The molten biphenyl is then transferred to the 25,000 gal. biphenyl storage tank where it is stored at 212 - 250° F. (100 - 120° C.) per operating instructions. There is a temperature recorder to indicate the biphenyl temperature but no alarm or control system. Since the

A. Biphenyl (continued)

biphenyl is being stored at and above its flash point it must be treated as a flammable liquid. It is recommended that either the storage temperature be controlled at or below 200° F. (93°C) or

1. A 3" breather vent with a traced flame arrestor having removable trays be installed. This will replace the undersized 2" vent now on the tank.
2. The tank be properly grounded per Standard E2.
3. A dip pipe be installed to introduce biphenyl into the tank per Standard D3.2 Std. 31.
4. A sign be placed on the biphenyl storage tank labeling it "BIPHENYL FLAMMABLE."
5. Installation of a fire protection system adequate for fire control at the biphenyl storage tank be investigated. Use of water will create no problems.

The biphenyl in the storage tank is pumped up to a 700 gal. measuring tank on the fifth level. There is a 1½" traced and insulated overflow back to the biphenyl storage tank to maintain a constant charge size to the chlorinators. The biphenyl is kept molten with 80 lb. steam reduced to 40 lb. A 60 lb. relief valve protects the jacket. Forty lb. steam at 286° F. (142° C.) keeps the head tank temperature above the flash point of biphenyl. There is no temperature recorder, controller or alarm on this system.

It is recommended that either 1. The biphenyl temperature be kept at or below 200° F. (93° C.) or 2. The biphenyl head tank be properly equipped to handle a flammable liquid.

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. 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.

5. Toxicology: (continued)

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 4" pipe line from the Chlorine Department. As it enters the department it passes through a Brink Demister which removes any entrained liquids. From there it passes through a chlorine vaporizer 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 50 lbs., the steam is automatically shut off thus preventing further pressure buildup.

However, if due to a plug in the Cl_2 line past the vaporizer, the chlorine pressure builds up to 50 lbs., and if the ambient temperature is below 30° F. (the liquifying temperature of chlorine at 50 lbs. pressure) there is a possibility that when the steam is automatically shut off liquid chlorine will be formed and sent on to the chlorinators. The immediate flash vaporization of the chlorine as it enters the hot chlorinator presents a potential hazard.

It is recommended that
1. A temperature controller be put on the vaporizer to maintain a chlorine temperature of 40-50° F. (5 - 10° C.). This would eliminate the possibility of liquid chlorine entering the chlorinators.

2. A pressure alarm be put on the vaporizer in case the steam valve fails to shut off when the Cl2 pressure reaches 50 lbs.

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 as a purge on the electrical grade Aroclor tanks and on the #1 blend tank system before making a 1254 and 10% Xylene mix. It is handled properly.

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 1254 and 10% Xylene mix. It is received in 50 gallon steel drums and stored on pallets on the east side of the department. Xylene is extremely flammab 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 1,24 TCB and possibly oiler isomers
2. Formula: $C_6H_5Cl_3$
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:

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   Acute local: 0
   Acute Systemic: Ingestion 2; Inhalation 2
   Chronic local; causes loss of hair of experimental animals.
   Chronic Systemic: Ingestion 2; Inhalation 2

E. Trichlorobenzene (Code 60200) (continued)

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 tank #6.

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. BP. 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.

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

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

Glycidal Phenyl Ether is used as a chlorine scavenger in produci Inerteen PPO & 54201KA a mixture of Aroclor 1260 and TCB. It is stored safely in drums.

H. Lime (Code 38800) (Calcium oxide)

1. Description: Fine white or slightly gray powder, Rhomeric Trigonal crystals.

2. Formula: CaO

3. Toxic Hazard Rating:
   Acute local: Irritant 3; Ingestion 1; Inhalation 3.
   Acute Systemic: Ingestion 2; Inhalation 3;
   Skin Absorption 0
   Chronic local: Irritant 3, Inhalation 2
   Chronic Systemic: Ingestion 2, Inhalation 3;
   Skin Absorption 0.

4. Toxicology:
   Has a caustic reaction and therefore is irritating to the skin. As a dust it can cause dermatitis and 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.

   Lime is added to the still to neutralize any liberated HCl and prevent sublimation of the $FeCl_3$ catalyst.

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. This is a mixture of trichlorobenzene and tetra chlorobenzene. It is similar in properties to TCB and should be handled in the same way.

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K. Unox Epoxide (Code 61320)

Handled in drums and used in production of Pyranol A13B3B. Purchased from Union Carbide; This material is didyclo 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 clothin 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 70 (Code 81787)

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 anhydride 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.

O. Blue A Dye and AZO Oil Black Dye

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.

P. General Comments

1. All raw materials used are stable under the present operating conditions and would remain stable using any 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 knowledgable and trained to carry out the available emergency procedure in the event of a spill.

5. Adequate fire control is available in storage areas with the exception of biphenyl.

II. Process

A. Chlorination

Aroclor is produced by the batchwise chlorination of biphenyl (from the biphenyl head tank) with snift gas chlorine (delivery pressure 20 to 25 psig) at a pressure of 2 - 4 psig. Normal operating temperatures are between 120 and 170° C. Hydrogen chloride gas is liberated during the reaction and is piped to the muriatic acid department.

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 tempera ture of 150° C. In order to remove this heat, the reaction mass is continuously circulated at an average flow rate of 200 - 220 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 over the catalyst bed. Maximum 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 temperature of the batch is recorded at four different points:

1. In the center of the chlorinator
2. Just below the chlorine sparger in the chlorinator.
3. At the discharge of the chlorinator pump.
4. At the discharge of the air-cooled heat exchanger.

Point 1 is alarmed for high temperatures (170° C.+) and point 4 is alarmed for low temperatures. As a safety device, a high temperature sensing element is positioned at point 2 to shut off the chlorine gas flow if the reaction temperature exceeds 190° C.

Each chlorinator is protected by a 8" - 20 lb. carbon rupture disc with a 3" discharge to the roof. 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.

In addition to the rupture system, the 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.

The chlorination system is well controlled. However, it is recommended that all temperature alarms and automatic cut-offs be checked. It does not require shut down and has not been done since November, 1965.

Contamination of reactants with water of 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. It is recommended that some means of chlorine detection be provided in the off-gas system to prevent such an occurrence.

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 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. 80 lb. steam is used on the coils for all Aroclors except 1242. 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's 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.

2. Procedures be included in the Operating Instruction to check this tank level before dropping a chlorinator.

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.

C. Distillation

The straight take-over vacuum distillation is carried out in a 1100 gal. and a 2200 gal. steel still. Feed is continuous to each still from #1 blow tank and feed rate is controlled automatically to maintain a set level in the still pots. The still contents are circulated continuously through a gas fired furnace (1 for each still). These furnaces are uninsulated and are in a position where personnel contact is possible. It is recommended that:

1. The still furnaces be insulated and properly guarded.

2. A warning sign be placed on the furnaces.

Vacuum (30 - 50 mm Hg abs.) is maintained by two - 2 stage Worthington jets and one - 2 stage Kulati porcelain jet with condenser. The porcelain jet is always in operation whereas use of the Worthington jets is alternated. The porcelain jet is grounded but the grounds are weather worn and most likely have a greater than 1 ohm resistance (Monsanto standard). The jet is not guarded. It is recommended that:

1. The adequacy of the grounding on the porcelain jet be checked and the indicated repairs made.

2. A guard be installed around the jets in case an explosion occurs.

Each still is equipped with a 30 lb. rupture disc and 4" discharge line. There are sufficient temperature recorders on the still system to insure safe operation. Overheating of the still contents causes formation of a tar-like substance but presents no safety hazard.

D. Earth Treating

The distilled Aroclor is transferred from the 2 product receivers to blend tanks #1 and #2 for earth treating. Attapulgus earth is added to the distilled Aroclor (0.1 - 0.2% by weight) to absorb moisture and improve electrical properties. The mixture is agitated for 1 hour and transferred to a 33" Sparkler filter. The earth is removed by the filter and the processed Aroclor transferred to the finished product tanks (2 - 2000 gal. tanks). The jacketed filter is heated with 80# steam. The jacket has a relief but the filter doesn't. It is possible to overheat the material in the filter. It is recommended that:

1. A rupture system be installed on the filter to release any excess pressure buildup.

2. The jacket relief be tested. Specs. for this filter show a 30 lb. tested jacket. It is important that this maximum not be exceeded.

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.

General Comments on the Process (continued)

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.

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 earth treated in the blend tanks and transferred to the finished product tanks, it is transferred to an appropriate storage tank.

1. Aroclor for Sales

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

a. Aroclor 1242 - Underground storage tank #3 (15,000 gal.), tanks #9 and 11 (20,000).

b. Aroclor 1248 - Storage tank #7 (20,000 gal.)

c. Aroclor 1254 - Underground storage tank #5 (15,000 gal.) and #10 stg. (20,000 gal.)

d. Aroclor 1260 - Storage tank #8 (20,000 gal.)

All storage tanks are equipped with the proper breather or conservation vents. Storage temperatures 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 then transferred to finished product containers. This system is adequately protected.

III. Finished Goods (continued)

Two pyranols - Inerteen PPO 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 Pyranol - 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 and 54201KA be taken after the Ether has been added and a flash point determined. If storage temperatures are within 15° 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 a 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 classifies 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 all smoking in the department is stopped and signs are put up in the department to that effect. Electrical cigarette lighters are removed from their receptacles. #1 still is allowed to run as usual by permission of the fire insurance inspector but #2 still furnace is shut off and kept off until the batch is complete, any spills cleaned up, the tank closed off and a gas test of the area made. These provisions are a must.

The tank itself is inadequately equipped to handle this liquid, however. There is a 2" vent line that follows an adjacent building and then discharges at the northeast corner about 3 feet from the ground. The vent from #2 blend tank is also tied into this line. This system is unsafe and reflects improper design. It is recommended that:

III. Finished Goods (continued)

1. A proper vent and flame arrestor be put on #1 blend tank.

2. The tank be grounded.

3. A separate vent be provided for #2 blend tank.

4. The flash point of the Aroclor 1254 and Xylene Mix be determined.

5. Storage temperature be kept as low as possible.

After blending is completed the mix is drummed off at the regular drumming station. This system is not grounded or equipped to handle flammable liquids. It is recommended that the Xylene drumming operation be altered 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 some hydrogen is collected in a common header and flows to the central HCl absorption unit for the production of Muriatic Acid in Dept. F-218. If Dept. F-218 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 well within the explosive limits. Therefore, it is necessary to either dilute this gas going up the vent stack or increase its velocity past the flame propagation rate (15 ft./sec.). This is accomplished by introducing a sufficient quantity of steam in the vent stack. At present there is no means to guarantee that there is sufficient steam going up the stack. It is recommended that an alarm be put on the steam supply to the stack to detect loss of flow.

B. Loading Facilities

All loading facilities are adequate with the exception of the tank car loading dock on #11 track, Spot #4. It is recommended that the stairs be replaced and the guard rails be repaired.

III. Safety Equipment

All emergency equipment is in good condition and located in positions listed in Operating Instructions.

A. Fire Extinguishers

1. Dry Chemical - SW corner of building CR - main floor.
2. Two dry chemicals - W wall at top of stairs - 2nd floor.
3. CO_2 snow - Main floor by N lean to door.

B. Chlorine Masks

1. SW Corner - 2nd floor
2. Control room - 2nd floor
3. E - outside repair room
4. Wall - SW corner on sprinkler house

C. Scott Air Paks

1. Outside west wall of lean to.

D. Stretcher

1. NW corner of Building CQ.
2. South side of Dept. 254 by road.

E. Safety Showers and Eyebaths

1. Two showers and eyebaths SE corner of building - one unit on ground level and one on 2nd floor. These showers and eyebaths are equipped with temperature controllers which do not work. It is recommended that the temperature controllers be fixed.

F. 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 1966. It is recommended that more specific procedures be written to cover shutdown during the preparation of a xylene blend.

F. General Comments on Safety Equipment and Operations (continued)

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.

4. Fire protection is adequate for the hazard existing, however, a fire in the biphenyl storage system could not be controlled.

APPENDIX I

Definitions

A) Flash Point

The lowest temperature at which a flammable liquid will give off 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 flashpoint temperature is the lowest temperature at which a stable explosive mixture of the material vapor and air can exist, and is the lower explosive limit expressed as temperature.

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

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

B) Ignition Temperature (Fire Point)

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

C) Auto Ignition Temperature

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

D) References

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

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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.

APPENDIX II

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. REMARKS
Aroclors 1142-1242	811.01	Chlorinated Biphenyl 42% chlorine	350°F. c.c.	325°C.	Slight fire hazard when exposed to heat or flame. Can become dengerous when heated to decomposition. Aroclors can emit highly toxic fumes. No problem operating temperatures.
1148-1248	811.02	Chlorinated Biphenyl -48% Chlorine.	382°F. c.c.	345	"
1154-1254	811.03	Chlorinated Biphenyl -54% Chlorine.	None	365°C.	"
1160-1260	811.05	Chlorinated Biphenyl -60% Chlorine.	None	385°C.	"
1162-1262	811.07	Chlorinated Biphenyl -62% Chlorine.	None	390°C.	
Pyranol 1488	810.94	60% Aroclor 1260 and 40% Trichlorobenzene	--	--	No particular hazard. Handle similar to Aroclor 1260 and TCB. Slight fire hasard if exposed to heat or flame.
Inerteen PPO	810.92	60% Aroclor 1260 plus 40% Trichlorobenzene plus 0.20% Glycidyl phenyl Ether (PPO)	Flash Pt. of TCB is 230° F.	--	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 phenol ether.	"	--	Same as above.

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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 A13838	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	33⅓% 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 Pt. of	--	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 problem at temperature handled in the dept.
Pydraul 200	811.19	15.9% Aroclor 1260, 61.9% Aroclor 1248 plus 21.8% Tricresyl phosphate and minor amounts of Santolube 70 (.40%) DCF and Blue A dye.	Flash Pt. of Aroclor 1248 is 382° F.	--	Same as above.
Santicizer 794	811.04	50% Aroclor 1248 and 50% Aroclor 1260.	Flash Pt. of Aroclor 1248 is 382° F.	--	Same as above. No problem at operating temperatures.
Montars	828.68	Still bottoms from Aroclor Process.	--	--	These materials are extremely hot and must be handled carefully. Fumes must not be inhaled. Present drum area is enclosed and should be adequate. Fume respirator should be worn.

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Dept. 246 - Group Equipment

Equip. Number (Item Number)	Service	Size	Capacity Gallons	Jacket Relief	Breather Vent	Flame Arrestor	Relief or Rupture Disc	Grounded
21-2210 (102)	Biphenyl Storage	10'6" x 40'6"	25,000	Coils No jacket	2"	No	None	No
21-0767 (103)	Biphenyl Head Tank	4'6" x 5'6"	700	Yes	1½" Vented to Biphenyl Stg. Tank	No	No	No
21-3261 (105)	Chlorinator #1	3' x 16'	850	No jacket	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 jacket	"	No	"	No
38-5487 (116)	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

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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 #	7' x 7'	2000		2" (manifold dischg. above control room)			
21-1400 (147)	Fin. Prod. Tank #2	7' x 7'	2000		2" conservation vent			

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Equip. Number (Item Number)	Service	Size	Capacity Gal.	Jacket Relief	Breather Vent	Flame Arrestor	Relief or Rupture Disc	Grounded
21-0768 (148)	Stg.Tank #3 1242	10' x 26'	15,000	No	2"	No	No	No
21-0769 (150)	Stg.Tank #4 Pydraul A-200	10' x 26'	18,000	No	Consv.Vent 2" " 2 oz.	"	"	"
21-1310 (152)	Stg.Tnk. #5 1254	10' x 26'	15,000	No	2 oz.	"	"	"
21-3526 (154)	Stg.Tnk. #8 1260	12'6" x 22'	20,000	No	3" Traced & Insulated	"	"	"
21-2404 (156)	Stg. Tnk. #7 1248	13' x 20'	20,000	No	2" Vent	"	"	"
21-0750 (167)	Blow Tnk. #1	7' x 7'	2000	No	18" Vent	"	"	"
	#1 Mix Pydraul		12500	No	2" Vent	No	"	"
	#2 Mix Pyranol		14580	No	3" traced	"	"	"
21-1396 (186)								
38-5328 & 38-5564 - 67	Air Cooled Heat Exchanger	1.2 M BTU						
35-3533 (205)	Steam Vac. Jet #3	2 Stage Porcelain	150# Stm 2 MM Abe.	--	--	--	--	Yes

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Equip. Number (Item Number)	Service	Size	Capacity Gal.	Jacket Relief	Breather Vent	Flame Arrestor	Relief or Rupture Disc	Grounded
14-0138 (207)	Stg. Tank #6 TCB		9,500	No	1½" - 3 ft. From Ground Level	No	No	No
	Stg. Tank #9 1242		20,000	No	3" Conserv. vent ± ½ oz.	No	No	No
	#10 1254		20,000	No	"	No	No	No
	#11 1242		20,000	No	3" Conserv. Vent ± ½ oz.	No	No	No

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