SUMMARY PLANT OBSERVATION REPORT AND EVALUATION FOR 1,1,2,2-TETRACHLOROETHANE

Only two plant visits were made in preparation for the 1,1,2,2-tetrachloroethane criteria document. After an extensive effort to identify manufacturers and users of this chlorinated hydrocarbon solvent (detailed in the Plant Visit Schedule Report), it was apparent that the extent of use of 1,1,2,2-tetrachloroethane is very limited in the U.S. today. Because of its high toxicity (TLV of 5 ppm), it has been replaced by other less toxic solvents for many of its previous uses. Hooker Chemical and Plastics Corporation, the only domestic manufacturer of 1,1,2,2-tetrachloroethane, provided us valuable data and information on its current limited use and users. Besides manufacturing it, Hooker is also the only company that still uses 1,1,2,2-tetrachloroethane in the production of trichloroethylene and tetrachloroethylene. SRI personnel visited this Hooker Chemicals and Plastics Corporation plant in Taft, Louisiana on February 6, 1976. A detailed description of the processes involving 1,1,2,2-tetrachloroethane at this plant is included in Appendix A.

Several companies use 1,1,2,2-tetrachloroethane as a carrier or reaction solvent in various chemical manufacturing processes, mainly because of its high boiling point (147C). Even though White Chemical Corporation in Bayonne, New Jersey is by far the largest user of this solvent in this manner, they only use it sporatically during the year. This plant was visited by SRI personnel on May 7, 1976; the specific process is detailed in Appendix B.

The only other current use of 1,1,2,2-tetrachloroethane is as an analytical reagent used in polymer characterization. A known quantity of the polymer is dissolved in a 60:40 blend of phenol to tetrachloroethane, and a relative drop-time to the blend by itself is determined using a viscosmeter. Fifty-100 ml of the blend is used per determination. Approximately 30 companies use up to 30 gallons per month in this way. All measurements and transfers of the solvent are done under a hood; the actual tests are not. Because of the small quantities used and the nature of the operation involved in analytical laboratories, it was decided that a plant visit for this use was not justified.

There were no health problems nor any serious handling problems associated with 1,1,2,2,-tetrachloroethane reported by Hooker or White Chemical despite this solvents high toxicity. This is consistent with the fact that there is very little current information or literature available on health problems associated with 1,1,2,2-tetrachloroethane in the U.S. One of the reasons is that the use has been drastically reduced with only the chemical industry still utilizing it. In addition to this, industry is, and has been for some time, aware of the toxic hazards from tetrachloroethane exposure even at low concentrations. The operations involving tetrachloroethane at these two plants are located almost totally outdoors in closed systems. Few workers are employed in the immediate areas and as a result, there is not a great deal of possibility for worker exposure.

At the White Chemical plant, the entire operation involving 1,1,2,2-tetrachloroethane is in a closed system, even the liquid-transferring steps from the tank car to the portable tanks to the storage tanks. Even so, their personnel admitted that there was a distinct odor of 1,1,2,2-tetrachloroethane detectable when the process was in operation. At the Hooker plant, the only open transferring occurrs at the tank car-filling and drum-filling operations. The tank cars are filled outside, but the drums are filled inside a large one-room building. Neither filling operation was actually observed during our visit, but it was obvious that there was no local exhaust ventilation in the drum-loading area.

Also at the Hooker plant, an auxiliary use of 1,1,2,2-tetrachloroethane was observed as a sealant liquid in a Nash compressor. The compressor is used to increase the acetylene pressure before it enters the reaction vessel. There was a steady dripping of 1,1,2,2-tetrachloroethane from the compressor into a sink which was clogged overflowing onto the ground. Even though this was outdoors, there was a distinct odor of 1,1,2,2-tetrachloroethane in the area and the concentration was obviously quite high. Although employees do not normally work in this immediate area, this is an example of poor engineering control and maintenance, and poses a potential health hazard.

Neither plant visited utilized a monitoring system that specifically analyzed for airborne 1,1,2,2-tetrachloroethane. The only monitoring at Hooker is by a nonspecific combustion meter and at White Chemical by trichloroethylene detector tubes that are not recalibrated for 1,1,2,2-tetrachloroethane. It was apparent that the companies had no idea of the actual employee exposure to 1,1,2,2-tetrachloroethane. Both companies indicated that they are ready to institute a monitoring system for 1,1,2,2-tetrachloroethane in accordance with the NIOSH recommended method involving gas chromatography.

Further information received in the areas of "medical aspects", "labeling and posting", "personal protective equipment and clothing", "employees informed of hazards", and "work practices and sanitation" are detailed in the two individual plant observation reports (Appendices A and B).

Substance: 1,1,2,2-Tetrachloroethane

CDM: Stan Futagaki

Visit by: Eugene G. Wood, SIH
Stan Futagaki, CDM

Date: February 6, 1976

Plant Observation Report and Evaluation (PORE)

Name of Plant: Hooker Chemicals & Plastics Corporation
Address: Hahnville, Louisana 70057
Phone Number: (504) 783-6661

Plant Contacts and Titles

Charles H. Carr, Technical Supervisor
Robert J. Schuttler, Section Manager - Environmental Monitoring
Wilbert P. Fremin, Safety Engineer

1. Description of Process

This particular plant is currently the only manufacturing location of tetrachloroethane in the U.S., A great percentage of the quantity produced is used captively to manufacture tri- and perchloroethylene. The entire process is located outdoors in a "closed system" except for the drum-loading operation which is performed indoors.

Tetrachloroethane is manufactured here by the chlorination of acetylene. The exothermic reaction of the undiluted gases, acetylene and chlorine, necessitates various diluents and catalysts to enable a production scale possible. The reaction vessel is a large vertical cylinder with the two gases piped separately into the bottom section. The reaction products are directed into two separate holding tanks; one contains tetrachloroethane that is 95-98% pure with dichloro-, pentachloro-, and hexachloroethane being the contaminants. Part of this high grade tetrachloroethane is drummed and sold. The other holding storage tank contains a less pure solvent mixture with tetrachloroethane making up anywhere from 50 to 90%.

Tetrachloroethane is further reacted in a chlorination-dehydrochlorination process. The products are perchloroethylene and hydrochloric acid, which is recovered as muriatic acid and used internally. In another process tetrachloroethane is dehydrochlorinated to form trichloroethylene with hydrochloric acid again coming off as a by-product.

An auxiliary use of tetrachloroethane was observed as the sealant liquid in a Nash Compressor. This compressor is used to increase the acetylene pressure before it enters the reaction vessel.

2. Medical Aspects

Preplacement and annual periodic examinations are standard procedures for everyone that works in the solvent plant. The medical histories are examined to prevent the hire of anyone who has had a poor health record. Some of the specific blood parameters checked are SGOT, SGPT, bilirubin-direct, bilirubin-total, total protein, albumen, alkaline phosphatase, lactodehydrogenase, WBC, RBC and hemolysis. A full-time nurse, located in the dispensory, draws the blood samples and these are then sent to an outside lab for analysis.

This plant has been in operation since April 1967. The solvent plant includes 18 workers and 3 supervisors. Six or seven of these workers have been employed since 1967; eight have been employed a year or so. No one has ever had to be removed from the solvent working area due to health reasons.

3. Labeling and Posting

There are no specific tetrachloroethane warning labels or posters in use during the manufacturing processes. A copy of the warning label used on the shipping drums is enclosed.

4. Personal Protective Equipment and Clothing

Everyone is required to carry an "escape respirator" when in the solvent plant. This is mainly a protection against chlorine which is also manufactured in this plant. Scott Air Packs, respirators with a self-contained air supply, are available in a central location for emergency purposes. There are no sustained conditions when it is normal or standard operating procedures to wear respirators.

Hard hats, safety glasses, neoprene gloves, and rubber safety shoes are normal protective equipment. More stringent requirements are used when the possibility of exposure, especially splashes, are increased. A full faceshield and an "acid suit" are used by the maintenance crew when they are required to break into a line. The company does not feel it is necessary to provide coveralls or a change of clothes to the employees on a regular basis.

Individuals are expected to maintain their own routine protective equipment. Emergency equipment are inspected once a week by a competently trained person.

5. Employees Informed of Hazards

All new hires are given 6-8 hours of safety indoctrination which includes the proper use of all safety equipment, processes and the specific hazards, and emergency situation protocol.

There are operating manuals at various locations including the MCA #34 Safety Data Sheet and Hooker's Material Safety Data Sheet, both specifically on tetrachloroethane (both enclosed). Every 3 months, it is the responsibility of the foreman or department head to review these safety manuals with the other employees.

A new worker on a specific job workswith an experienced person until he is sufficiently trained to work alone. There is an Employee Safety Committee that meets at least once a month that provides suggestions to be brought up with the management.

6. Work Practices

a. There are few occasions for workers to handle tetrachloroethane but in those operations, especially the filling and loading of drums, tank cars and other containers, proper precautionary measures are required. Samples of liquid tetrachloroethane are periodically taken for quality control in capped pint jars. Neoprene gloves are used to prevent any dermal contact.

b. The process for waste disposal is to incinerate in equipment designed to handle hydrochloric acid as a combustion product. Other alternatives are to submit to a contract disposal service or to contact the pollution control authority.

c. Personal protective equipment should be used in all attempts to clean up spills. Either the liquid should be soaked up in an absorbent material, or it should be contained and pumped into drums. The area should then be thoroughly flushed with water.

d. There are signs posted in various locations indicating that unauthorized personnel should avoid certain areas; however, there are no actual physical barriers.

e. Since most of the solvent plant is outdoors, no ventilation system is used. There is exhaust ventilation in the drum-filling building, and an exhaust fan is used before personnel enter any contaminated vessel or piping.

f. Even though tetrachloroethane and the other chlorinated solvents handled in this plant are relatively nonflammable, all materials are treated with the same precautions as if they were flammable.

g. The EPA has reduced the amount of allowable material disposed of into the water system from 1000 to 500 pounds per day and it will be further reduced to 47 pounds per day in the near future. Hooker will install carbon absorption units to clean up their waste water to meet these water pollution requirements. Air pollution is minimized by using carbon scrubbers on all exhausts vented to the atmosphere.

h. First aid procedures:

eyes - flush thoroughly with water
skin - remove contaminated clothing; wash affected area with soap and water
inhalation - remove to fresh air; apply artificial respiration and/or administer oxygen as necessary.

7. Sanitation

a. Employees provide their own work clothing; lockers and showers are not used on any regular basis.

b. Eye wash fountains and showers are located in several strategic locations in the plant.

c. There is no designated eating area; Employees eat in the control room.

8. Environmental Monitoring

Currently, the only monitoring performed is by a nonspecific combustion meter. A monitoring system is now under development to measure and distinguish the different chlorinated compounds including tetrachloroethane. Analysis will be performed by electron capture and flame ionization gas chromatography.

hooker®

$C_2H_2Cl_4$ TETRACHLOROETHANE

(ACETYLENE TETRACHLORIDE)

VOLATILE SOLVENT

DANGER! Vapor Extremely Hazardous

- USE ONLY IN COMPLETELY ENCLOSED SYSTEM
- DO NOT BREATHE VAPOR
- DO NOT GET IN EYES, ON SKIN, ON CLOTHING
- DO NOT TAKE INTERNALLY

NET WT. 700 LBS.

ELECTROCHEMICAL DIVISION — HOOKER CHEMICALS & PLASTICS CO
NIAGARA FALLS, NEW YORK

LT-37A2-74

hooker Industrial chemicals DIVISION

ADAPTED FROM USDL FORM NO. L50 - 005-4

MATERIAL SAFETY DATA SHEET

NFPA Designation

CHEMICAL NAME: Tetrachloroethane

PLANT CODE | MATERIAL CODE NO.

MANUFACTURER'S NAME: Hooker Chemical Corporation

EMERGENCY TELEPHONE NO.: (716) - 285-6655

ADDRESS: NUMBER, STREET, CITY, STATE AND ZIP CODE: 4700 Buffalo Avenue, Niagara Falls, New York 14302

CHEMICAL NAME AND SYNONYMS: 1,1,2,2-Tetrachloroethane; Acetylene Tetrachloride

TRADE NAME: Tetrachloroethane

CHEMICAL FORMULA	MOL. WT.	USES
$C_2H_2Cl_4$	167.9	Chemical intermediate, solvent

Physical Properties

BOILING POINT (°F)	295	SPECIFIC GRAVITY (H_2O=1)	1.6
VAPOR PRESSURE (mmHg) @ 70°F	5	PERCENT VOLATILE BY VOLUME (%)	100%
VAPOR DENSITY (AIR=1)	5.8	EVAPORATION RATE (Ether = 1)	0.03
SOLUBILITY IN WATER	Insol.	Melting Point (°F)	-44

APPEARANCE AND ODOR: Clear, slightly yellow-green liquid with chloroform-like odor.

Fire and Explosion Hazard Data

FLASH POINT	METHOD	FLAMMABLE LIMITS	AUTOIGNITION TEMP.
None °F		UEL -- LEL --	°F

EXTINGUISHING MEDIA: --

SPECIAL FIRE FIGHTING PROCEDURES: As appropriate for surrounding fire; use water to cool containers involved in fire.

UNUSUAL FIRE AND EXPLOSION HAZARDS: In open flame, vapors decompose to form toxic chlorocarbons and hydrogen chloride gas. Full protective equipment recommended for personnel involved.

Reactivity

INCOMPATIBILITY: Can react violently with sodium, potassium, or their alloys; reacts with sodium hydroxide or potassium hydroxide upon heating, to form spontaneously flammable chloro acetylene.

HAZARDOUS DECOMPOSITION PRODUCTS: Can form toxic chlorocarbons and hydrogen chloride gas.

CONDITIONS TO AVOID: Protect from moist air. Do not store in pits, basements or unventilated areas. Avoid open flames and open electric heaters. Avoid contact with skin, eyes or clothing. Do not breathe vapors.

Health Related Data

THRESHOLD LIMIT VALUE 5 ppm; 35 milligrams per cubic meter of air. Absorbed thru skin.

EFFECTS OF OVEREXPOSURE (SKIN, EYE, INHALATION, ETC.) Systemic poisoning can occur by oral intake, inhalation or absorption thru intact skin. Symptoms range from local irritation to headache, nausea, vomiting, drowsiness, unconsciousness and death due to disturbance of central nervous system. Chronic skin exposure can cause dermatitis due to defatting action. Irritating to eyes; hydrogen chloride from slow hydrolysis can cause severe eye damage if care neglected.

EMERGENCY AND FIRST AID PROCEDURES EYES: Flush thoroughly with water. SKIN: Remove contaminated clothing; wash affected area with soap and water. INHALATION: Remove to fresh air; apply artificial respiration and/or administer oxygen as necessary. INGESTION: Dilute by drinking large amount of water; induce vomiting then administer milk of magnesia or saline laxative.

SPECIAL MEDICAL PROCEDURES Get immediate medical attention for ALL eye exposures and any serious over-exposures. NEVER administer adrenalin or epinephrine to a person suffering from a tetrachloroethane exposure.

Special Protection Information

VENTILATION General ventilation designed to handle heavy vapors, plus local exhaust at points of potential fume emission.

RESPIRATORY (TYPE) Organic vapor - acid gas canister; self-contained breathing apparatus for emergencies.

GLOVES (TYPE) Rubber, neoprene, vinyl, etc.

EYE (TYPE) Chemical safety goggles, plus face shield where appropriate.

OTHER Rubber safety shoes; rubber suits, or aprons, for splash protection.

SPECIAL PRECAUTIONS FOR HANDLING AND STORAGE Avoid physical damage to drums. Store in ventilated areas, not in pits or basements. Protect storage tank vents with a dryer to prevent entry of moist air. Handle in closed systems. Vent indoor storages to outdoors.

STEPS TO TAKE IN EVENT OF SPILL OR RELEASE Get personnel protective equipment. Soak up spill in absorbent material (sand, clay, etc.), or contain spill and pump into drums. Finally flush spill area with water. Keep unprotected personnel away until area clear of vapors.

WASTE DISPOSAL Incinerate in equipment designed to handle hydrogen chloride as combustion product, or submit to contract disposal service, or contact pollution control authority.

REMARKS Odor not adequate warning of potential hazard since not detectable below 3 ppm.

REFERENCES (1) MCA Chemical Safety Data Sheet SD-34; Tetrachloroethane;
(2) Sax, N.I. - Dangerous Properties of Industrial Materials, 3rd Edition;
(3) Hooker Chemical Corporation Product Data Sheet No. 852; 1,1,2,2-Tetrachloroethane.

NAME G. W. Darling
LOC. Niagara-ICD
DATE May 1972

1,1,2,2 TETRACHLOROETHANE

Data Sheet No. 852

HOOKER SPECIFICATIONS

Appearance	Clear and essentially free from visible foreign material
	Color 100 APHA max
Boiling Range, °C at 760 mm	144 - 151
Specific Gravity at 25/15.5°C	1.585 - 1.595
Acidity, as % HCL*	.02 max
Moisture Content at -10°C	No Cloud
Residue on Evaporation at 105°C, %	0.005 max

*titration to pH of 7.0

DESCRIPTION

1,1,2,2 Tetrachloroethane is a clear, light yellowish green liquid which has no flash or fire point. Like all chlorinated hydrocarbons, it is somewhat toxic and must be used with the same precautions as other chlorinated hydrocarbons.

Chemical Formula $C_2H_2Cl_4$

USES

1,1,2,2 is used primarily as a chemical intermediate.

PRECAUTIONARY INFORMATION

The following precautions for handling 1,1,2,2 tetrachloroethane are quoted from our drum label. This warning label has been prepared in accordance with a pattern established by the Manufacturing Chemists' Association.

TETRACHLOROETHANE
DANGER! VAPOR EXTREMELY HAZARDOUS

POISON

Use only in completely enclosed system.

Do not breathe vapor.

Do not get in eyes, on skin, on clothing.

Do not take internally.

For more complete data on physical properties, methods, equipment and precautions for handling and safety, refer to Chemical Safety Data Sheet SD-34 "Tetrachloroethane" issued by the Manufacturing Chemists' Association, Inc. Washington, D. C.

M11. 11-1720

Chemical Safety Data Sheet SD-34

ADOPTED 1949

TETRACHLOROETHANE

PROPERTIES

ESSENTIAL INFORMATION FOR SAFE HANDLING AND USE

Chemicals in any form can be safely stored, handled or used if the physical, chemical and hazardous properties are fully understood and the necessary precautions, including the use of proper safeguards and personal protective equipment, are observed.

MANUFACTURING CHEMISTS ASS

1825 CONNECTICUT AVENUE, N. W. WASHINGTON, D. C. 20009

TABLE OF CONTENTS

TETRACHLOROETHANE

Adopted August, 1949

1. NAME

Chemical Name: Tetrachloroethane (1,1,2,2, Tetrachloroethane)
Common Names: Tetrachlorethane, Acetylene Tetrachloride
Formula: $CHCl_2.CHCl_2$

2. PROPERTIES

2.1 Grade: Technical

2.2 Important Physical and Chemical Properties (For pure compound)

Physical State: Liquid at normal temperatures.
Color: Clear, slightly yellow.
Odor: Chloroform-like, pleasant.
Vapor Density: 5.79 (Air=1)
Boiling Point: 146.3°C. (295.3°F.) at 760 mm.
Freezing Point: — 42.5°C. (— 44.5°F.).
Solubility: Neither soluble in, nor miscible with, water.
Flash Point: None.

Corrosiveness: Suitably stabilized and moisture-free tetrachloroethane is relatively non-corrosive and causes little trouble. It may be stored and used in the absence of air and dissolved water up to 120°C. (248°F.). Undissolved water causes appreciable hydrolysis at room temperature. Hydrolysis and oxidation become comparatively rapid above 110°C. (230°F.).

Reactivity: Tetrachloroethane is very slightly reactive. On heating with solid potassium hydroxide, it yields dichloroethylene, trichloroethylene, tetrachloroethylene, and a spontaneously flammable gas which may be chloroacetylene. With sodium and potassium or their alloys, tetrachloroethane may explode under certain conditions.

Hygroscopic: Not hygroscopic.

Light Sensitivity: In the presence of air, ultraviolet light converts tetrachloroethane into hydrogen chloride and dichloroacetyl chloride, along with some octachlorobutane and a little oxalic acid.

Specific Gravity: 1.596 at 20°C. (68°F.) referred to water at 4°C. (39°F.).

VAPOR PRESSURE OF TETRACHLOROETHANE

Temperature °C.	Temperature °F.	Vapor Pressure mm. Mercury
32	89.6	10
45	113.0	19.5
60	140.0	40
70	158.0	62
91	195.8	140
104	219.2	220
118	244.4	350
128	262.4	470
138	280.4	620
146.3	295.3	760

2.3 Hazardous Properties

2.3.1 *HEALTH HAZARDS* (See 8. HEALTH HAZARDS AND THEIR CONTROL)

Tetrachloroethane is toxic by inhalation, by prolonged and repeated contact with skin or mucous membranes or by oral intake. Although toxic, tetrachloroethane may be handled safely if proper precautions are constantly observed. Prolonged or repeated exposures to the product in any form are hazardous. The generally recognized maximum allowable concentration is 5 parts per million by volume in air for an 8-hour working day.

2.3.2 *FIRE AND EXPLOSION HAZARDS*

Tetrachloroethane is non-flammable and non-explosive. (See 6.2 Fire and Explosion Hazards)

3. USUAL SHIPPING CONTAINERS

Tetrachloroethane is not specifically regulated by the Interstate Commerce Commission. Notwithstanding this fact, the following containers are recommended.

3.1 Type and Size

ICC Spec. 103 or 103W. Tank Cars.

ICC Spec. 17E. Non-returnable steel drums, 55 gallon maximum capacity.

3.2 Label or Identification

3.2.1 Each container should carry an identifying label or stencil.

3.2.2 The Manufacturing Chemists' Association recommends the label below in addition to, or in combination with, any label warnings or other statements required by statutes, regulations, or ordinances. This warning label is concurred in by the United States Public Health Service under agreements with the producers.

3.3 Disposal and Return Precautions

3.3.1 *TANK CARS.* Empty tank cars should be returned as promptly as possible in accordance with instructions received from the shipper. Shipper's routing instructions should always be followed strictly.

3.3.2 *DRUMS.* Before shipping containers are returned to suppliers, the usual precautions regarding the complete drainage of contents and the proper closing of all openings should be observed. (See M.C.A. Manual Sheets D-30 and D-31.)

4. UNLOADING AND EMPTYING

4.1 Health Hazards (See 8. HEALTH HAZARDS AND THEIR CONTROL)

Tetrachloroethane is toxic by inhalation, by prolonged and repeated contact with skin or mucous membranes, or by oral intake. Although toxic, tetrachloroethane may be handled safely if proper precautions are constantly observed. Prolonged or repeated exposures to the product

TETRACHLOROETHANE

DANGER! VAPOR EXTREMELY HAZARDOUS

Use only in completely enclosed system.

Do not breathe vapor.

Do not get in eyes, on skin, on clothing.

Do not take internally.

POISON

Call A Physician

First Aid

in any form are hazardous. The generally recognized maximum allowable concentration is 5 parts per million by volume in air for an 8-hour working day.

4.2 Fire and Explosion Hazards

Tetrachloroethane is non-flammable and non-explosive. (See 6.2 Fire and Explosion Hazards).

4.3 Tank Cars

4.3.1 Unloading operations should be conducted by carefully instructed, reliable employees under adequate supervision. (See 6.4 Employee Education and Training.)

4.3.2 The car should be spotted accurately, and the track should be level.

4.3.3 It is considered good practice that derails be placed at one or both ends of the unloading track approximately one car-length from the car being unloaded, unless the car is protected by a closed and locked switch or gate.

4.3.4 The hand-brake should be set and standard rail clamps installed to block the wheels at the time of unloading. Metal "caution" signs should be fastened to the track. Signs should be 12" x 15", painted light blue. The legend "STOP — TANK CAR CONNECTED," with the letters in "STOP" four inches high, should be used. Signs are available from safety equipment dealers.

4.3.5 The shipper's instructions for unloading should always be followed, and all caution markings on both sides of tank or dome should be read and observed.

4.3.6 In the event of a leak in the tank car or the fittings that cannot be stopped by following previous instructions from the supplier or by simple adjustment or tightening, the supplier should be immediately telephoned or wired for further instructions. The area around car should be evacuated, and only properly protected personnel should be allowed to enter the affected area.

4.3.7 Further details as to unloading of tank cars are set forth in M.C.A. Manual TC-1.

4.4 Drums

4.4.1 Drums should be unloaded carefully to prevent damage. They should not be dropped or bumped.

4.4.2 Each shipment should be examined carefully for leaking drums. If any are found, they should be handled with particular care. The leaking part should be turned up, and the drums removed to a safe place where the leakage can be stopped by tightening the plug. If the plug cannot be tightened sufficiently to plug the leak, the contents of the drum should be transferred to a sound container. (See 6.3.1 Spillage.)

4.4.3 Before their contents are emptied, the drums should be supported and blocked substantially to prevent movement.

4.4.4 A satisfactory method of removing tetrachloroethane from drums is by means of a rotary pump. If gravity methods are employed, a faucet should be inserted in the end bung and the drums placed on a rack. Faucets should have short shanks, threaded with Briggs standard straight iron pipe threads. A resilient gasket of suitable material such as a synthetic rubber should be used to insure a tight fit. Bung opening and faucet must have the same type and number of threads per inch (M.C.A. Manual Sheet D-32). Workmen should be protected from vapor and liquid. (See 6.5 Personal Protective Equipment.)

4.4.5 To remove the body plug, the bung should be placed up and a bung or plug wrench used. The operator should wear goggles, stand to one side, and face away during the operation. After the plug starts, one full turn should be made. If accumulated internal pressure is present, it should be allowed to vent; then only should the plug be loosened further or removed.

5. STORAGE

5.1 Hazards

5.1.1 *HEALTH HAZARDS* (See 8. HEALTH HAZARDS AND THEIR CONTROL)

Tetrachloroethane is toxic by inhalation, by prolonged and repeated contact with skin or mucous membranes, or by oral intake. Although toxic, tetrachloroethane may be handled safely if proper precautions are constantly observed. Prolonged or repeated exposures to the product in any form are hazardous. The generally recognized maximum allowable concentration is 5 parts per million by volume in air and for an 8-hour working day.

5.1.2 *FIRE AND EXPLOSION HAZARDS*

Tetrachloroethane is non-flammable and non-explosive. (See 6.2 Fire and Explosion Hazards.)

5.1.3 *CORROSION*

Under normal conditions, tetrachloroethane may be stored satisfactorily in galvanized iron, black iron or steel equipment. (See 2.2 Important Physical and Chemical Properties.)

5.1.4 *VOLATILITY*

Tetrachloroethane is less volatile than water. (See 2.2 Important Physical and Chemical Properties.)

5.2 Conditions of Storage

5.2.1 Each tank, whether vertical or horizontal, should have a top and bottom manhole, at least 22 inches in diameter with a vapor-tight closure; in addition to filling, vent, and measuring device openings, which should be 2-inch flanged connections in the top of the tank. A 2-inch or 2½-inch bottom outlet should be provided for emptying and for use as a drain during clean-out operations. Vertical tanks should be of the closed top design, and the top should be caulked or welded vapor-tight.

5.2.2 Each storage tank should have a vent large enough (usually 2-inch) to permit the escape of vapor during filling. The vent should conform to the N.F.P.A. Flammable Liquid Ordinance. Vents from indoor tanks should terminate outdoors, in such a location that escaping vapor will not contaminate any work space air. They should be protected against entry of moist air by being extended down over the side of the tank into a drying chamber filled with lump calcium chloride for removal of moisture in the air. It is recommended that a tee be inserted in this line above the drying chamber so that a mercury seal ½-inch deep may be installed as a safety vent in case the chamber plugs from excess moisture. (Mercury should not be spilled in any work space, and open mercury surfaces in work spaces should be avoided.)

5.2.3 Although tetrachloroethane is non-flammable, safe practice would indicate that tetrachloroethane storage tanks should be adequately grounded to discharge static electricity because of various possible hazards such as lightning or the proximity of other storage tanks containing flammable liquids. (See N.F.P.A. pamphlet "Static Electricity.") Local conditions should be taken into account in each case.

5.2.4 Drums of tetrachloroethane should be stored in a cool place with the bungs up. Bungs should be kept tight at all times.

5.2.5 Ventilation should be provided at the floor level, as well as in the usual higher locations. Note that vapor is 5.79 times heavier than air (see 2.2 Important Physical and Chemical Properties). Tetrachloroethane should not be stored in pits, depressions, basements, or unventilated areas.

6. HANDLING

6.1 Health Hazards (See 8. HEALTH HAZARDS AND THEIR CONTROL)

Tetrachloroethane is toxic by inhalation, by prolonged and repeated contact with skin or mucous membranes, or by oral intake. Although toxic, tetrachloroethane may be handled safely if proper precautions are constantly observed. Prolonged or repeated exposures to the product in any form are hazardous. The generally recognized maximum allowable concentration is 5 parts per million by volume in air for an 8-hour working day.

6.2 Fire and Explosion Hazards

Tetrachloroethane is non-flammable and non-explosive.

When exposed to high temperatures, such as open flames and electric heaters, tetrachloroethane vapor may be decomposed to toxic and corrosive substances, which should be vented to the outside of the building.

6.3 Spills and Leakage

6.3.1 Spills should be cleaned up immediately. Employees performing this work should wear adequate personal protective equipment. (See 6.5 Personal Protective Equipment.) All unprotected personnel should be evacuated until tetrachloroethane vapors have been cleared away from the area.

6.3.2 Rags or mops wet with tetrachloroethane should be placed in closed containers, or in a safe place out of doors until they can be dried safely.

6.3.3 Clothing wet with tetrachloroethane should be removed immediately. The wearer should then take a warm, soapy shower. The clothing should not be used again until it has been dried out of doors in a properly ventilated area and then laundered.

6.4 Employee Education and Training (See 8.2.3 Employee Education)

6.4.1 Safety in handling tetrachloroethane depends upon the effectiveness of employee education, training, and supervision.

6.4.2 The education and training of employees to work safely and to use the personal protective equipment or other safeguards provided for them are responsibilities of supervision.

6.4.3 Employee education and training should emphasize the need of handling tetrachloroethane according to the methods outlined in this manual.

6.4.4 Before new employees are placed on the job, they should be thoroughly instructed and quizzed concerning the proper handling of the product. Older employees should be reinstructed and quizzed periodically.

6.4.5 Each employee should be familiar with the location, purpose, use, and maintenance of personal protective equipment and be thoroughly trained in its use. (See 6.5 and 8.3 Personal Protective Equipment.)

6.4.6 Each employee should know the location of all emergency equipment such as safety showers, bubbler drinking fountains for flushing the eyes, and faucets for washing out hose lines.

6.4.7 Only reliable, dependable, and properly trained employees should be given the responsibility of operating valves which control the flow of tetrachloroethane to and from storage tanks, tank cars, and containers.

6.4.8 Employees should be trained to report to the proper authority all suspected leaks or equipment failures, and any signs of illness or skin disorders among plant personnel.

6.4.9 Each employee should knew what to do in an emergency (see 6.3 Spills and Leakage) and in rendering first aid measures (see 8.4 First Aid and Medical Treatment), and should realize the necessity for prompt administration of first aid in case of contact with tetrachloroethane or exposure to the vapor.

6.5 Personal Protective Equipment

6.5.1 *AVAILABILITY AND USE*

Personal protective equipment is not an adequate substitute for good, safe working conditions, adequate ventilation, and intelligent conduct on the part of employees working with tetrachloroethane. Such equipment may protect the individual wearing it while others in the area may be exposed to danger. The correct usage of personal protective equipment requires the education of the worker in the proper employment of the equipment available to him. (See 6.4 Employee Education and Training.) Under conditions which are sufficiently hazardous to require protective equipment, its use should be carefully supervised. In all cases, the type of protecting equipment selected should depend upon the degree of hazard existing.

The following personal protective equipment should always be used for the purposes mentioned and as specified in 8. HEALTH HAZARDS AND THEIR CONTROL and in other sections of this Data Sheet.

6.5.2 *EYE PROTECTION*

6.5.2.1 *Chemical Safety Goggles.* Cup type or rubber framed goggles equipped with approved impact resistant glass or plastic lens should be worn whenever there is danger of the material coming in contact with the eyes. Goggles should be carefully fitted by adjusting the nose piece and head band to insure maximum protection and comfort.

6.5.2.2 *Spectacle Type Safety Goggles.* Metal or plastic rim safety spectacles with unperforated side shields which can be obtained with prescription safety lens or suitable all plastic goggles may be used where continuous eye protection is desirable. These types, however, should not be used where complete eye protection against chemicals is needed.

6.5.2.3 *Face Shields.* Plastic shields (full length, 8 inch minimum) with forehead protection may be worn in lieu of, or in addition to, chemical safety goggles, where complete face protection is desirable. Chemical safety goggles should always be worn as added protection where there is danger of material striking the eyes from underneath or from around the sides of the face shield.

6.5.3 *RESPIRATORY PROTECTION*

Respiratory protective equipment must be carefully maintained, inspected, cleaned and sterilized at regular intervals, and always before use by another person. Personnel wearing such equipment must be carefuly instructed in its operation and limitations.

6.5.3.1 Air or oxygen supplied masks, equipped with full face pieces, must be worn for protection where an oxygen deficiency less than 16 per cent by volume or a concentration

of a harmful gas above 2 per cent by volume may be encountered, such as:

(a) In emergencies when the vapor concentration is not definitely known.

(b) When the harmful vapor concentration is over 2 per cent by volume or lacks a distinguishable odor.

(c) When the oxygen content of the air may be less than 16 per cent by volume.

(d) In tank and equipment cleaning and repair work.

(e) When the exposure period is to be over 30 minutes' duration.

Only masks approved for this purpose by the United States Bureau of Mines should be used and the manufacturer's instructions must be carefully followed. Types generally available include:

(f) Air line masks supplied by plant compressed air are suitable for use only where conditions will permit safe escape in case of failure of the compressed air supply. Such masks should be used only in conjunction with a suitable reducing or demand type valve and filter. The compressed air should be checked frequently to make certain that harmful gases from the decomposition of the lubricating oil used in the compressor or from impure air supply are not present.

(g) Positive pressure hose masks supplied by externally lubricated blowers are usually preferred to the air line type. Since these masks also depend on a remote air supply, they should be used only where conditions will permit safe escape in the event of an air supply failure. Care must be taken to locate the blower or air source in an area which is free from air contaminants.

(h) Self-contained breathing apparatus which permits the wearer to carry a supply of oxygen or air compressed in a cylinder, or the self generating type which produces oxygen chemically, allow for greater mobility. The length of time a self-contained breathing apparatus provides protection varies according to the amount of air or oxygen supply carried. In tank work where small manholes are encountered, a self-contained breathing apparatus is usually unsuitable because of its bulk.

6.5.3.2 Industrial canister type gas masks, approved for this purpose by the United States Bureau of Mines, fitted with the proper canister for absorbing tetrachloroethane vapor, (or gas), and equipped with full face pieces, will afford protection against concentrations not exceeding 2 per cent by volume when used in accordance with the manufacturer's instructions. The oxygen content of the air must be not less than 16 per cent by volume. The masks should be used for relatively short exposure periods only, i.e., for less than 30 minutes.

6.5.4 *HEAD PROTECTION*

6.5.4.1 Safety, or "Hard" hats should be used to provide protection against accidental liquid leaks, falling tools, or other objects.

6.5.4.2 Brimmed felt hats may be substitued for safety hats where the danger of falling objects is remote.

6.5.5 *FOOT PROTECTION*

Leather or rubber safety shoes with built in steel toe caps are recommended. Rubbers may be worn over leather safety shoes.

6.5.6 *BODY, SKIN, AND HAND PROTECTION*

6.5.6.1 Aprons made of solvent-proof plastics, oil-resisting synthetic rubber, or other suitable protective material should be used for protection against accidental contact with tetrachloroethane. Complete suits of like material should be worn by men entering tanks or when similar exposures are encountered.

6.5.6.2 Gloves made of oil-resisting synthetic rubber or other suitable protective material should be worn to protect the hands from tetrachloroethane.

6.6 Engineering Controls

6.6.1 *LOCATION OF PROCESS*

Processes should not be located near open flames, open electric heaters, or high temperature operations, since tetrachloroethane vapor exposed to such high temperatures may be decomposed to toxic and corrosive substances such as phosgene. (See 6.2)

6.6.2 *DESIGN OF EQUIPMENT*

Tetrachloroethane should always be used in closed equipment. Processes should be designed so that the operator is not exposed to direct contact with tetrachloroethane or its vapor. The technical problems of designing equipment, pro-

viding adequate ventilation, and formulating operational procedures which promise maximum security and economy, can be handled best by engineers and safety experts. The manufacturers of tetrachloroethane, and of the equipment in which it is to be used, are always prepared to help with these problems, and to assist in maintaining safe working conditions. In most states, authoritative advice and assistance may also be obtained from the Industrial Hygiene Division of the State Health Department, or from the Labor Department.

6.6.3 *VAPOR MEASUREMENTS*

6.6.3.1 When checking concentrations of tetrachloroethane vapor in the atmosphere, care is required to make certain that the sample is representative of the air breathed by the workers, and of the daily fluctuations which may occur.

6.6.3.2 Continuous recording instruments, arranged to give audible and visible signals when a predetermined concentration of tetrachloroethane vapor in air is reached, are available.

6.6.3.3 Testing methods are described in the following references:

Flame Test Method, Using the Halide Torch:

V. A. Stenger et al., Ind. Eng. Chem., Anal. Ed., 11:121 (1939)

F. H. Goldman, J. Ind. Hyg. & Toxicol., 25:181 (1943)

Thermal Decomposition Method:

J. C. Olsen et al., Ind. Eng. Chem., Anal. Ed., 8:260 (1936)

H. F. Smyth, Ind. Eng. Chem., Anal. Ed., 8:379 (1936)

H. Elkins et al., J. Ind. Hyg. & Toxicol., 19:474 (1937)

B. D. Tebbens, J. Ind. Hyg. & Toxicol., 19:204 (1937)

W. F. von Oettingen, J. Ind. Hyg. & Toxicol., 19:413 (1937)

Vapor Pressure Method:

C. Couchman et al., J. Ind. Hyg. & Toxicol., 21:256 (1939)

K. Kay et al., J. Ind. Hyg. & Toxicol., 21:264 (1939)

L. Silverman et al., J. Ind. Hyg. & Toxicol., 21:270 (1939)

Gas Interferometer Method:

F. A. Patty, J. Ind. Hyg. & Toxicol., 21:469 (1939)

G. Harrold et al., J. Ind. Hyg. & Toxicol., 21:491 (1939)

Absorption Methods:

W. Cook et al., J. Ind. Hyg. & Toxicol., 18:194 (1936)

L. Cralley et al., J. Ind. Hyg. & Toxicol., 25:172 (1943)

Colorimetric Method:

P. M. Barrett, J. Ind. Hyg. & Toxicol., 18:341 (1936)

6.7 Ventilation

6.7.1 General ventilation should be adequate for processes conducted in closed equipment, but mechanical exhaust ventilation, preferably of the down-draft type, may be provided for clean-out and other special operations. When equipment is located in pits or depressions, separate mechanical exhaust ventilation should be installed at the lowest level.

6.7.2 Intakes to exhaust ventilating systems should be as close as possible to the point where the vapor escapes or to the source of contamination and designed to draw the vapor away from the operator but not across his face.

6.7.3 In building used for the storage of tetrachloroethane the ventilation should be such that the air is changed at least 12 times per hour and the concentration of tetrachloroethane kept below 5 parts per million of air.

6.8 Tank and Equipment Cleaning and Repairs

6.8.1 The hazardous nature of tank and equipment inspection, cleaning, and repairs requires that the foreman and crew be selected, trained, and drilled carefully. They should be fully familiar with the hazards, and the safeguards necessary for the safe performance of the work. Written approval should be secured from the Plant Management or Safety Department before such work is started. All tank work should be under the direct supervision of a trained foreman.

6.8.2 Wherever possible, vessels should be cleaned from the outside, using the cleanout doors.

6.8.3 Pipe lines into or out of the tank or other apparatus should be shut off, disconnected, preferably by removing a complete small section, and a blank flange should be installed on the open end to protect against human error and unsuspected leaks. Valves, cocks, and blanks in the pipe line should not alone be relied upon.

6.8.4 Suitable danger signs should be displayed to indicate when workmen are in the tank or other apparatus.

6.8.5 It should be assured that the tank can be left by the original entrance.

6.8.6 Electrical switches should be locked in the OFF position, and the drive belts removed. Provision should be made against accidentally starting the agitating equipment or other moving parts located inside the tank or adjacent to the entrance. Some state regulations require that the agitating equipment be disconnected.

6.8.7 Before directing men to enter a tank, the foreman should make an inspection of the interior. He should be equipped with a hose mask, an air-line mask, or self-contained breathing apparatus, together with rescue harness and life line. Another responsible person should be on guard during the inspection and at least two other persons should be nearby to aid in rescue work, if necessary.

6.8.8 Before a tank is entered, and during the course of the work, tests should be made by a qualified person to determine that no further drying is necessary, that no oxygen deficiency exists, and that no harmful gas or vapor is present.

6.8.9 Proper personal protective equipment should be worn by anyone entering a tank for inspection, cleaning, or repairs. (See 6.5 Personal Protective Equipment, and 8.3 Personal Protective Equipment.)

6.8.10 Special ventilation and a continuous fresh air supply are recommended during the entire time men are cleaning, inspecting or repairing the tank.

6.8.11 One man on the outside of the tank should keep the men in the tank under constant observation, and at least two other men should be available to aid in rescue if any of those in the tank are overcome.

6.8.12 A hose mask, an air-line mask, or self-contained breathing apparatus together with rescue harness and life line, should be located outside of the tank entrance. This equipment should be used for rescue, regardles of the type of respiratory protection or the air supply which is provided for employees inside the tank.

6.8.13 In addition to protecting the workmen actualiy engaged in cleaning and repairing the tank, attention should be paid to the protection of workers in nearby areas.

6.8.14 Although tetrachloroethane is nonflammable, safe practice would indicate that the portable electric lights and power tools should be of the three-wire, grounded, explosion-proof type approved for use in hazardous locations. They should be maintained in excellent condition.

6.8.15 Cleaning or making repair inside a tank may be hazardous even though the tank contained a non-toxic, non-flammable material. The following additional precautions with respect to tank work are recommended:

(a) Before anyone enters a tank, it should be emptied, steamed out, dried, and cleared of tetrachloroethane vapor by sweeping with air.

(b) Since tetrachloroethane vapor is 5.79 times heavier than air, the tank may be ventilated through openings in the bottom, or by a mechanical exhaust with intake at the lowest part of the vessel.

(c) Ventilation should be continued during inspection, cleaning, or repairing.

6.9 Repackaging and Blending

6.9.1 The repacker should carefully review this entire manual and become familiar with the hazardous properties of tetrachloroethane and the safeguards which should be taken to handle it safely. Only ICC specification containers should be used (see 3.1) and they should be labeled properly (see 3.2).

6.9.2 Repackaging should be done with adequate attention to the health hazards involved. (See 8. HEALTH HAZARDS AND THEIR CONTROL and 6.7 Ventilation.)

6.9.3 Special labeling on small containers may be required by state statutes, regulations, or ordinances. (See 3.2 Label or Identification.)

6.9.4 When tetrachloroethane is added to other solvents, the hazards of the various components of the mixture must be given careful consideration.

7. WASTE DISPOSAL

7.1 Waste disposal of tetrachloroethane and materials containing it depends to a great extent upon local conditions. All Federal, State, and local regulations regarding health and pollution should be followed. The supplier will be able to furnish considerable information along this line.

7.2 The residue from distillations of tetrachloroethane may be poured on dry sand, earth, or ashes at a safe distance from occupied areas and allowed to evaporate.

7.3 Tetrachloroethane or wastes containing it should not be poured down sewers or drains.

8. HEALTH HAZARDS AND THEIR CONTROL

This section includes not only recognized first aid procedures and information of interest to the laymen, but also suggestions which may be of value to the attending physician.

8.1 Hazards

8.1.1 Tetrachloroethane is toxic by inhalation, by prolonged and repeated contact with skin or mucous membranes or by oral intake. Although toxic, tetrachloroethane may be handled safely if proper precautions are constantly observed. Prolonged or repeated exposures to the product in any form are hazardous. The generally recognized maximum allowable concentration is 5 parts per million by volume in air for an 8-hour working day.

8.1.2 The signs and symptoms of excessive absorption usually appear gradually and only after repeated exposures. In order of appearance they commonly are unusual fatigue, loss of appetite and weight, sick stomach and vomiting, constipation, abdominal pain, jaundice, drowsiness, going on in severe cases to unconsciousness and death. Some cases show marked involvement of the nervous system with headache, numbness and tingling in fingers and toes, trembling and twitching of muscles and even paralysis of some muscles.

8.1.3 The signs and symptoms of tetrachloroethane poisoning given in 8.1.2 are due to systematic poisoning characterized by marked damage to the liver, kidneys, heart, blood cells, and nervous system. The clinical picture varies with the type of exposure and the amount of the material which has been absorbed, either at one time or at repeated times. Most serious effects are usually on the liver and the blood. The principal route of absorption is by breathing the vapor, although it may be absorbed by the skin. Tetrachloroethane is currently considered the most toxic of the chlorinated hydrocarbon solvents in industrial use.

8.1.4 *TOXIC EFFECTS AFTER INHALATION*

The maximum allowable concentration now generally accepted is 5 parts per million by volume in air for an 8-hour day. Exposure to much higher concentrations leads to local irritation of the eyes and nose. There may be sick stomach and vomiting, but as tetrachloroethane is less volatile than other hydrocarbon solvents it does not as often have an anesthetic effect.

8.1.4.1 *Acute Poisoning*

8.1.4.1.1 Few cases of acute poisoning from inhalation have been reported. The first reaction is irritation of the eyes and nose which may be followed by headache, sick stomach and vomiting. If exposure was severe, within a few hours deep dusky color of skin may appear, followed by unconsciousness and death. If promptly removed from exposure the workman may recover completely but should be under observation in case late symptoms appear.

8.1.4.1.2 Some conditions under which acute poisoning may occur are as follows:

(a) By accident, such as equipment failure,

(b) When workers enter enclosures or tanks without having taken adequate precautions (see 6.8),

(c) When tetrachloroethane is handled carelessly (see 6.4),

(d) When large quantities of tetrachloroethane are exposed to the atmosphere.

8.1.4.2 *Subacute Poisoning*

8.1.4.2.1 Subacute tetrachloroethane poisoning is the form usually encountered and develops gradually as a result of prolonged or repeated work in an atmosphere containing more than 5 parts of tetrachloroethane per million parts of air, but under conditions where the amount absorbed causes no immediate reaction. Repeated exposure even to low concentrations seems to increase sensitivity, and may lead to subacute poisoning.

8.1.4.2.2 Workers with subacute poisoning for some time may show only such signs and symptoms as unusual fatigue, loss of appetite and weight, constipation and abdominal distress or pain. At any time they may develop more severe evidence of absorption such as vomiting, dizziness, tenderness and pain over the liver, and jaundice. Even if removed from further exposure the illness may persist and grow worse over a period of days, weeks or even months, and finally end in death. If after a few months there has been steady improvement, complete recovery is the rule.

8.1.4.2.3 Some conditions under which subacute poisoning may occur in employees are as follows:

(a) Where the ventilation is inadequate, resulting in high concentrations of more than 5 parts of tetrachloroethane per million of air,

(b) Where the vapor concentrations are high intermittently, due to faulty handling of the liquid,

(c) Failure of the individual to observe precautionary measures.

8.1.4.3 *Chronic Poisoning*

8.1.4.3.1 Chronic poisoning by tetrachloroethane does not seem to occur. Poisoning develops readily and slowly as a rule, and though long after effects are not unusual, the subacute case either shows increasingly severe symptoms and goes on to death, or the symptoms steadily grow less severe and complete recovery follows.

8.1.5 *TOXIC EFFECT FROM EXTERNAL CONTACT*

8.1.5.1 Tetrachloroethane is absorbed through the skin so that by this route systemic poisoning can occur with the same signs and symptoms as described in 8.1.4.2.2.

8.1.5.2 *Skin.* Tetrachloroethane may cause dermatitis after repeated or prolonged contact with the skin, as occurs in the prolonged or repeated handling of rags wet with the chemical product, dipping hands into the liquid, and wearing clothing saturated with it. Reddening, burning and, rarely, blisters may follow such exposure. In certain rare cases, the dermatitis may be caused by hypersensitivity to tetrachloroethane. The skin becomes rough, red and dry due to the removal of skin oils. It cracks easily and is readily susceptible to infection. The skin has a chapped appearance.

8.1.5.3 *Eyes.* Tetrachloroethane may enter the eyes either as a vapor or a liquid (spray or splash). The resultant irritation produces lacrimation, burning and other symptoms of inflammation. It can cause serious eye damage if immediate care is neglected.

8.1.6 *TOXIC EFFECTS AFTER ORAL INTAKE*

8.1.6.1 The first symptoms after toxic amounts of tetrachloroethane are taken by mouth are those of irritation of stomach and bowels, such as sick stomach, vomiting and diarrhea with bloody stools. It is absorbed very rapidly and even a small amount may go on to produce unconsciousness and a deep flushing of the skin. Death is apt to occur before such systemic changes as liver and kidney damage occur.

8.2 Prevention and Control

8.2.1 *VENTILATION*

8.2.1.1 The most important factor in preventing toxic effects is to handle tetrachloroethane in a closed system. Where this is impracticable, sufficient ventilation should be provided to keep the concentration of vapor in the air below 5 parts per million. The odor of tetrachloroethane is distinct and noticeable even in relatively safe concentrations.

8.2.2 *STORAGE AND LABELING*

Containers should be labeled properly and closed tightly to minimize the danger of evaporation and spillage.

8.2.3 *EMPLOYEE EDUCATION* (See 6.4 Employee Education and Training)

8.2.3.1 Employees should be instructed to report any signs or symptoms of a substandard physical condition and receive medical attention.

8.2.3.2 Those working regularly with tetrachloroethane may well be provided with a folder explaining the dangerous properties of this material and a statement of proper precautions to observe.

8.2.4 *PREPLACEMENT PHYSICAL EXAMINATIONS*

Certain individuals have been found who are unduly susceptible to various chlorinated hydrocarbons as shown by previous experiences. The exposure of such individuals can be minimized by a careful preplacement physical examination. Exposures to tetrachloroethane even in con-

centrations known to be nonhazardous to normal individuals should be prohibited in the following cases.

(a) Alcoholics

(b) Exceedingly fleshy individuals

(c) Undernourished individuals

(d) Those with pulmonary diseases, stomach ulcers, high blood pressure, diseases of the liver, kidney or heart

(e) Individuals under treatment with arsenical drugs.

8.2.5 *PERIODIC PHYSICAL EXAMINATIONS*

Employees who are exposed regularly to tetrachloroethane should be examined monthly by a physician acquainted with the occupational hazards involved. Physical examinations should be required also when any symptoms of poisoning, such as enumerated above are present in employees. Discovery of symptoms of tetrachloroethane poisoning may indicate some defect in operation. This would serve as an indication to examine other exposed employees for early signs of poisoning. Examination of the blood should be included. Tetrachloroethane absorption causes marked increase in mononuclear leucocytes with corresponding reduction in polynuclear leucocytes and lymphocytes. Mononuclear leucocytes if more than 12 per cent and especially if accompanied by broken cells, immature cells, and an increase in platelets can be considered evidence of early poisoning.

8.3 Personal Protective Equipment (See also 6.5 Personal Protective Equipment)

8.3.1 Personal protective equipment is not a permissible substitute for good safe working conditions nor for adequate ventilation. Such equipment may protect the individual wearing it while others in the operation may be exposed to high concentrations of vapor. Equipment requires regular inspection, cleaning and replacement. This is especially true of industrial gas masks, since the canister contents and oxygen tanks become exhausted. The correct use of personal protective equipment requires education of the worker and careful supervision whenever such equipment is utilized. (See 6.4 Employee Education and Training.)

8.3.2 Employees who may be subjected to severe exposures to tetrachloroethane vapor as in tank cleaning and repair work (see 6.8 Tank and Equipment Cleaning and Repairs), in intermittent operations where general ventilation is not practical, in cases of failure of piping or equipment, and in cleaning up spills, should be provided when indicated with proper eye and respiratory protection as follows:

(a) Suitable gas-tight chemical safety goggles and/or face shields (see 6.5.2 Eye Protection),

(b) Rescue harness and life line for those entering a tank or enclosed storage space. An outside attendant should maintain constant observation (see 6.8 Tank and Equipment Cleaning and Repairs),

(c) Air or oxygen supplied masks (see 6.5.3 Respiratory Protection),

(d) Industrial gas masks, (see 6.5.3.2 and note), with canisters approved by the United States Bureau of Mines for use in tetrachloroethane vapor, should be used only when it is certain that the concentration of vapor is less than 2 per cent (20,000 parts per million) and there is no atmospheric oxygen deficiency, and then only for exposures not exceeding one-half hour.

8.3.3 To prevent dermatitis or other effects of direct contact of tetrachloroethane with the skin, employees should be provided with:

(a) Aprons (see 6.5.6.1)

(b) Gloves (see 6.5.6.2)

(c) Acid-type goggles where there is danger of splashing (see 6.5.2.1)

CAUTION: *Protective creams cannot be relied upon to afford any protection.*

8.3.4 Facilities for personal cleanliness should be provided and provision made for thorough washing before lunch and at the end of the work day.

8.3.5 Careful cleansing with mild soap, followed by the use of an oily cream containing lanolin to replace skin oils which may have been dissolved by tetrachloroethane, is an important aid in preventing dermatitis.

8.3.6 Reliable safety equipment manufacturers can supply appropriate protective equipment if they are informed accurately of the particular product in use.

8.4 First Aid and Medical Treatment

8.4.1 *GENERAL PRINCIPLES FOR ACUTE EXPOSURES*

8.4.1.1 Most important in the case of any poisoning is quick removal from exposure. In the case of tetrachloroethane poisoning, this means first removing the patient from the contaminated atmosphere and, insofar as possible, removing the tetrachloroethane from the patient's skin, or gastro-intestinal tract, if these areas are involved.

8.4.1.2 The patient should be given fresh air by moving him to a well ventilated room and by dispersing any crowd. If breathing has ceased, artificial respiration should be started at once.

8.4.1.3 The patient should be kept quiet and comfortably warm, but not hot.

8.4.1.4 A physician should be called immediately. He should be told briefly and clearly what has happened and the exact location of the patient.

CAUTION: *Nothing should be given by mouth to an unconscious patient.*

8.4.2 *SPECIFIC ACTIONS FOR ACUTE EXPOSURE*

8.4.2.1 *Inhalation.* A person showing symptoms of tetrachloroethane vapor poisoning should be removed promptly from the contaminated area. In case breathing has stopped, effective artificial respiration, such as that obtained by the prone pressure method or the Eve rocking method should be started immediately. If oxygen inhalation apparatus is available, oxygen should be administered, but only if one familiar with the operation of the apparatus is present to administer it. If the patient is conscious, hot tea or coffee may be given as a stimulant. Adrenalin should never be given to a person suffering from tetrachloroethane poisoning. A physician should be called at once.

8.4.2.2 *Skin Contact.* All contaminated clothing should be removed at once. Clothing, including shoes, soaked in tetrachloroethane should be removed and not worn again until thoroughly free from tetrachloroethane. All affected areas should be washed thoroughly with warm water and soap. After this an ointment containing lanolin should be applied in order to help in replacing the natural skin oils. For serious or persistent cases of skin trouble and for signs and symptoms of generalized poisoning, a physician should be consulted.

8.4.2.3 *Contact With Eyes.* If liquid tetrachloroethane has entered the eyes, they should be washed promptly with copious quantities of water for at least 15 minutes. (It is advisable to irrigate the eyes gently with water at room temperature in order to minimize additional pain or discomfort.) Medical attention should be obtained in all cases involving contact with the eyes.

8.4.2.4 *Taken Internally.* If a person has swallowed tetrachloroethane he should be made to vomit, if conscious, by having him drink a glassful or more of lukewarm water in which a teaspoonful of salt to the glassful has been dissolved; or a similar amount of warm soapy water may be used. If necessary, the patient should be encouraged to stick his finger down his throat to induce vomiting. When possible, vomiting should be induced at least three times. Following this a tablespoonful of Epsom Salt dissolved in a glass of water should be given. A physician should be called at once.

8.4.3 *SUGGESTIONS FOR MEDICAL TREATMENT*

8.4.3.1 Acute poisoning by tetrachloroethane is rare. Most cases of poisoning are of the subacute type and of relatively slow development. Workers having any of the signs and symptoms given in 8.1.2 and 8.1.4.2.2 should be referred to a physician familiar with such cases for examination and treatment. A blood examination is strongly recommended as the blood cell changes are very characteristic and usually appear very early in tetrachloroethane poisoning. (See 8.2.5) Treatment to protect and improve liver function is indicated, including such measures as diet high in carbohydrate and proteins and low in fats. Intravenous injection up to 3000 cc. per day of 5 to 10 per cent dextrose in saline solution has been found useful.

The medical information in this publication has been supplied by the Medical Advisory Committee of the Manufacturing Chemists' Association.

For assistance in the event of any emergency involving this chemical in transportation, call MCA's Chemical Transportation Emergency Center.

CHEMTREC

(800) 424-9300 * *(Use 483-7616 in District of Columbia)*

Toll-free, day or night

*** Use long distance access number if required.**

In CANADA, call Canadian Chemical Producers Association's TEAP (Transportation Emergency Assistance Plan)

OTHER CHEMICAL SAFETY DATA SHEETS AVAILABLE

(Date of latest available edition, as of April 1973, given in parentheses)

Acetaldehyde ... (1952) SD-43
Acetic Acid ... (1951) SD-41
Acetic Anhydride ... (1952) SD-15
Acetone ... (1962) SD-67
Acetylene ... (1957) SD-7
Acrolein ... (1951) SD-85
Acrylonitrile ... (1964) SD-31
Allyl Chloride ... (1973) SD-60
Aluminum Chloride ... (1956) SD-62
Ammonia Anhydrous ... (1959) SD-8
Ammonia Aqua ... (1947) SD-13
Ammonium Dichromate ... (1952) SD-45
Aniline ... (1963) SD-17
Antimony Trichloride (Anhydrous) ... (1957) SD-66
Arsenic Trioxide ... (1959) SD-60
Benzene ... (1960) SD-2
Benzoyl Peroxide ... (1959) SD-81
Benzyl Chloride ... (1957) SD-69
Betanaphthylamine ... (1949) SD-52
Boron Hydrides ... (1951) SD-84
Bromine ... (1958) SD-49
Butadiene ... (1954) SD-55
n-Butyllithium in Hydrocarbon Solvents ... (1966) SD-91
Butyraldehydes ... (1960) SD-78
Calcium Carbide ... (1957) SD-23
Carbon Disulfide ... (1967) SD-12
Carbon Tetrachloride ... (1953) SD-3
Caustic Potash ... (1958) SD-10
Caustic Soda ... (1968) SD-9
Chlorine ... (1970) SD-89
Chloroform ... (1962) SD-59
Chlorosulfonic Acid ... (1958) SD-33
Chromic Acid ... (1952) SD-44
Cresol ... (1952) SD-48
Cyclohexane ... (1957) SD-68
Diethylamine ... (1971) SD-97
Diethylenetriamine ... (1959) SD-76
Dimethyl Sulfate ... (1956) SD-19
Dinitrotoluenes ... (1956) SD-93
Ethyl Acetate ... (1972) SD-51
Ethyl Chloride ... (1953) SD-50
Ethyl Ether ... (1955) SD-29
Ethylene Dichloride ... (1971) SD-18
Ethylene Oxide ... (1971) SD-38
Formaldehyde ... (1953) SD-1
Hydrochloric Acid ... (1970) SD-30
Hydrocyanic Acid ... (1961) SD-67
Hydrofluoric Acid ... (1970) SD-25
Hydrogen Peroxide ... (1969) SD-53
Hydrogen Sulfide ... (1968) SD-36
Isopropyl Alcohol ... (1972) SD-98
Isopropylamine ... (1959) SD-72
Lead Oxides ... (1956) SD-64
Maleic Anhydride ... (1962) SD-85
Methanol ... (1970) SD-22
Methyl Acrylate and Ethyl Acrylate ... (1950) SD-79
Methylamines ... (1955) SD-67
Methyl Bromide ... (1968) SD-35
Methyl Chloride ... (1970) SD-40
Methylene Chloride ... (1962) SD-95
Methyl Ethyl Ketone ... (1951) SD-83
Mixed Acid ... (1956) SD-65
Naphthalene ... (1956) SD-58
Nitric Acid ... (1951) SD-5
paraNitroaniline ... (1969) SD-94
Nitrobenzene ... (1967) SD-21
Nitrocellulose (Wet Types) ... (1970) SD-95
Ortho-Dichlorobenzene ... (1953) SD-51
Paraformaldehyde ... (1960) SD-6
Perchloroethylene ... (1971) SD-24
Perchloric Acid Solution ... (1965) SD-11
Phenol ... (1964) SD-4
Phosgene ... (1967) SD-95
Phosphoric Acid ... (1958) SD-70
Phosphoric Anhydride ... (1948) SD-28
Phosphorus, Elemental ... (1947) SD-16
Phosphorus Oxychloride ... (1968) SD-26
Phosphorus Pentasulfide ... (1953) SD-71
Phosphorus Trichloride ... (1972) SD-27
Phthalic Anhydride ... (1956) SD-61
Propylene ... (1956) SD-59
Sodium Chlorate ... (1952) SD-42
Sodium Cyanide ... (1967) SD-30
Sodium, Metallic ... (1952) SD-47
Sodium and Potassium Dichromates ... (1952) SD-46
Styrene Monomer ... (1971) SD-37
Sulfur ... (1959) SD-74
Sulfur Chlorides ... (1960) SD-77
Sulfur Dioxide ... (1953) SD-52
Sulfuric Acid ... (1963) SD-20
Tetrachloroethane ... (1949) SD-54
Toluene ... (1956) SD-63
Toluidine ... (1951) SD-82
Toluene Diisocyanate ... (1971) SD-73
1, 1, 1-Trichloroethane ... (1965) SD-99
Trichloroethylene ... (1956) SD-14
Vinyl Acetate ... (1970) SD-75
Vinyl Chloride ... (1972) SD-56
Zirconium and Hafnium Powder ... (1956) SD-92

For free Publications list and prices, write or phone

Publications Service

MANUFACTURING CHEMISTS ASSOCIATION

1825 Connecticut Avenue, Washington, D. C. 20009

Phone: 202--483-6126

Substance: 1,1,2,2-Tetrachloroethane
Visit by: Don Rumsey, SIH
Stan Futagaki, CDM
Report by: Stan Futagaki
Date: May 7, 1976

PLANT OBSERVATION REPORT AND EVALUATION (PORE)

Name of Plant: White Chemical Corporation
Address: Bayonne, NJ
Phone Number: (201)437-0050

Plant Contacts and Titles:

Mr. W.A. Richardson, Plant Manager
Mr. David Regenbogen, Technical Supervisor
Mr. Vic Thompson, Safety and Training Director

1. Description of Process

Tetrachloroethane is used as a carrier solvent in a bromination process to manufacture a fire-retardent intermediate compound. This intermediate compound is used to manufactere a product that eventually goes into television cabinets. Even though White Chemical Corporation is one of the major users of tetrachloroethane, the specific process is in operation only intermittantly during the year. The entire process is outdoors in a "closed system".

This plant receives tetrachloroethane in 10,000-gallon tank cars. The solvent is transferred by gravity from the tank car to 300-gallon portable tanks using polyethylene piping. The portable tanks are weighed and then the tetrachloroethane is transferred by vacuum to the storage tank. As needed tetrachloroethane is delivered, again by vacuum, to the reactor vessel where the bromination process occurs. After the reaction is complete, the fire-retardent compound, a solid, is separated from tetrachloroethane by centrifugation. The solvent goes into another tank where it is washed, neutralized, and distilled. This purified tetrachloroethane is then sent back to the storage tank to complete the recycling process.

2. Medical Aspects

All employees are given pre-employment and yearly physical examinations. These include chest x-rays, pulmonary function, blood analysis (SMA 12), as well as the routine physical examination tests. All examinations are performed at a local clinic; there is no physician, nurse or dispensory located on the plant grounds. White Chemical Corporation has operated for 14 years while tetrachloroethane has only been in use for the past year and one-half. There have not been any adverse health effects that have been attributed to tetrachloroethane exposure.

Labeling

There were no labels or posters specifically warning against the hazards of tetrachloroethane in this plant.

Personal Protective Equipment and Clothing

Work uniforms (coveralls) as well as aprons are provided by the employer. Two sets of the uniforms are provided per week and they are laundered by the company. Rubber gloves, goggles, and hard hats are also standard equipment.

The standard organic vapor cannister type respirators and Scott Air Paks are readily available to the employees when situations requiring their use arise. There are no routine duties that require respirators. The Safety and Training Director is in charge of periodically checking and maintaining the respirators

5. Employees Informed of Hazards

There is an initial training program to apprise each new employee of the physical and chemical hazards found in the plant. There are also monthly safety meetings which include all the employees and supervisors. The MCA's Chemical Safety Data Sheet is used as part of the educational material for tetrachloroethane. White Chemical Corporation does not print any safety or informational data sheets of its own.

6. Work Practices

a. The methods of transferring tetrachloroethane from one container to another have been simplified (gravity and vacuum methods) to prevent breakdowns and reduce maintenance operations. This is an attempt by the company to reduce worker exposure to the toxic substance.

b. The waste sludge that accumulates in the bottom of the still in the tetrachloroethane repurification process is transferred by gravity to drums and taken to an authorized landfill.

c. The reactor vessel is steam-cleaned periodically. The maintenance worker does not have to enter the container but he is still required to use complete protective clothing and a respirator.

d. The only exhaust system for tetrachloroethane vapor is in the centrifugation step. This had been a source of relatively high exposure levels before, so the exhaust system was developed. A scrubber (recirculating water system) is used to prevent the release of the solvent to the atmosphere. White Chemical Corporation attempts to recycle as much tetrachloroethane as possible and therefore, contributes very little of this solvent to air and water pollution.

7. Sanitation

a. Each employee is assigned a single locker so that he can change into the company-provided work uniforms at the beginning of each shift. Shower facilities are provided and their use is encouraged at the end of each shift, but not mandatory. The change of clothes and shower facilities are mainly because of the many different hazardous chemicals handled in this plant and not specifically because of tetrachloroethane.

b. There is a designated lunch room with hand washing facilities. All workers are instructed to wash their hands before eating.

c. Eye wash fountains and emergency showers are located in several locations in the working areas.

8. Environmental Monitoring

Currently there is no monitoring system specifically to measure tetrachloroethane concentrations in this plant. The Safety and Training Director uses a Matheson-Kitagawa detector tube for trichloroethylene to qualitatively test for tetrachloroethane. This is done once a month or more frequently if deemed necessary. The company is in the process of developing a monitoring system that will be specific for tetrachloroethane.

When the process is in full operation, tetrachloroethane can be distinctly smelled in several locations by a person familiar with its odor.