VI. WORK PRACTICES

The principal method for manufacturing ethylene dichloride is by reacting chlorine with ethylene. [1] Other chlorinated ethanes may be co-products of ethylene dichloride manufacture and caution must be taken to avoid exposure to these substances as well.

Further information concerning specific work practices for ethylene dichloride can be found in the Manufacturing Chemists Association's Safety Data Sheet SD-18. [7]

(a) Transport, Handling, and Use

The addition of small amounts (0.1% by weight) of alkylamines acts to stabilize ethylene dichloride, and in this form, ethylene dichloride can be transported in unlined tank cars and stored in steel drums or cans for indefinite periods of time. Without the addition of aklylamines, containers for storage and transportation should be of plain, galvanized, or lead lined, mild steel because ethylene dichloride may be corrosive to iron and other metals, especially if in contact with moisture at elevated temperatures. [7] Rubber is not resistant to ethylene dichloride.

Ethylene dichloride decomposes slowly, becoming acidic and darkening in color. In the presence of strong ultraviolet light, air, and moisture, or in contact with open flame or hot surfaces, ethylene dichloride decomposes rapidly and toxic quantities of phosgene, hydrogen chloride, carbon monoxide, carbon dioxide, acetylene, and vinyl chloride may be formed. [1,6] Because of this possibility, ethylene dichloride should be stored in cool, dry, well-ventilated areas, away from direct sunlight.

Damaged drums or other storage or transporting containers may not be welded until thoroughly purged with steam, flushed with water and air-dried. [7]

All piping and valves at the loading or unloading station should be of ethylene dichloride resistant material and should be carefully inspected prior to connection to the transport vehicle and periodically during the operation. Personal protective clothing must be provided during both inspection and connection. Eye wash and safety shower installations should be readily available in the immediate area. Signs indicating the location of safety showers and eye wash facilities should be prominently displayed throughout the work area. Unloading areas must be posted "Danger: loading or unloading ethylene dichloride".

Due to the toxicity of ethylene dichloride, processes in which it is used in large quantities should be carried out in closed systems. Well-designed hoods and ventilation systems should be used to maintain exposures at or below concentrations specified by this standard. Further protective measures include the use of personal protective equipment and clothing and purging of equipment prior to and during servicing and maintenance.

Ethylene dichloride is a component in many insecticidal fumigants and conventional work practice guidelines are inappropriate to protect agricultural workers from the hazards of exposure. For these uses, fumigants containing ethylene dichloride must be used in a manner consistent with their labeling requirements. These usually specify allowable time limits before a fumigated field may be reentered, and safe practices for the application of the particular pesticide. Consideration must be given to the wearing of personal protective equipment including long-sleeved shirt, long-legged pants (or suitable coveralls), a hat,

shoes, socks, and gloves. Specific requirements of worker protection standards for agricultural pesticides may be found in 40 CFR 170.

Where a fumigant is applied to a crop in confined storage, hazardous concentrations may be encountered and entry to such areas must not be made without proper personal protective equipment including self-contained breathing apparatus.

Safety showers and eye wash facilities are necessary in areas where ethylene dichloride is handled. In locations where such facilities are not available, a container of water for emergency use must be kept with the first aid supplies.

(b) Equipment Maintenance

All equipment used for handling ethylene dichloride must be emptied and purged prior to entry or disassembly. Steaming followed by washing with water is recommended for purging tanks and other containers which have held ethylene dichloride. [7] Pipe lines should be disconnected and capped. Under conditions where it is necessary to enter or otherwise work with ethylene dichloride contaminated equipment, maintenance personnel must use either a self-contained breathing apparatus of the pressure-demand mode, with an impervious protective suit, or a combination supplied-air suit with auxiliary self-contained air supply. Ventilation should still be continued during this time by blowing or drawing fresh air through the system. Safety precautions for emergency rescue require that all maintenance personnel be informed of the toxic properties of ethylene dichloride, and be instructed on the necessity of wearing personal protective equipment. [7] Constant observation of anyone entering a tank should be maintained in case rescue work is necessary.

(c) Emergencies

Spills must be anticipated. Storage tanks should be diked to contain the contents of the tank. Drum storage areas must also be diked to contain the volume of ethylene dichloride present in the drums, so as to prevent release to other areas. Areas where major spills are likely to occur should be constructed so that they may be closed until properly protected personnel can ventilate, enter, and clear the area. Warning signs shall be posted so that no unauthorized personnel will enter the area. Normal work should not be continued until the concentration of ethylene dichloride has been reduced to that prescribed by this standard. Any combustion operations must be stopped until the spill is cleared. Disposal of ethylene dichloride should be done in compliance with local, state, and federal waste disposal regulations. Consideration should be given to pumping the diked spill to another tank. In addition, it is advisable to have facilities for transfer of the contents of a leaking tank to another suitable tank.

Areas in which small spills have occurred shall be evacuated and well-ventilated. Small portable sparkproof fans may be used in confined areas where local exhaust ventilation is not feasible. Workers should not return to any work area if the odor of ethylene dichloride is still perceptible.

Ethylene dichloride is flammable, and products of combustion include extremely noxious gases such as phosgene, hydrogen chloride, acetylene, and vinyl chloride. Firefighters should be equipped with self-contained breathing apparatus of the pressure-demand mode and an impervious suit, or a combination supplied-air suit with auxiliary self-contained air supply.

(d) Respiratory Protection

For adequate respiratory protection against the many conditions which may be encountered in individual operations, many types of respirators have been developed and approved. Each has a particular field of application and limitations from the viewpoint of protection, as well as advantages and disadvantages from the viewpoint of operational procedures and maintenance. Detailed information on the selection and use of respirators can be obtained from the Respiratory Protective Devices Manual [167] published by the AIHA and the ACGIH in 1963. The American National Standard: Practices for Respiratory Protection, ANSI Z88.2-1969, [168] also classifies, describes, and gives the limitations of respirators.

There are 3 categories of respirators: atmosphere-supplying respirators, air-purifying respirators, and combination atmosphere-supplying and air-purifying respirators.

One factor that affects the overall performance of demand-type (negative pressure) respirators is the variability of the face seal. Facepiece leakage is the major limitation of half-mask and quarter-mask facepieces operated with a negative pressure.

For purposes of uniform regulations covering the many face sizes and shapes of the US population, NIOSH recommends that the half-mask or quarter-mask facepieces operated with a negative pressure not be used for protection above 10x the TWA, although the majority of wearers can obtain protection in atmospheres of higher ethylene dichloride concentrations. On the same basis, NIOSH recommends that the full facepiece, operated with negative pressure, may be used up to 50x the TWA.

These maximum use concentration guides do not take into account the service life of the filters and/or absorbent canisters which also affect the performance of air-purifying respirators. The approval tests (under 30 CFR 11) for these 2 devices specify only carbon tetrachloride for the service life test. Based on recent studies by Nelson and Harder [169] who tested standard respirator cartridges against many types of industrial organic solvents, it is now possible to estimate the service life of approved organic vapor canisters or cartridges against ethylene dichloride. With a test concentration of 1,000 ppm of ethylene dichloride, they reported that the standard organic vapor cartridge has a service life of 54 minutes before a breakthrough of 10 ppm of ethylene dichloride. Under the same conditions, a service life of 77 minutes for carbon tetrachloride was obtained. The standard industrial size gas mask canister is tested against 20,000 ppm of carbon tetrachloride and it must have a service life of 12 minutes before a breakthrough of 5 ppm. Since it has been shown that charcoal can adsorb 1.5 times as much carbon tetrachloride as ethylene dichloride, it can be estimated that the service life for an industrial size canister is 160 minutes in an atmosphere of 1,000 ppm ethylene dichloride.

NIOSH periodically issues a list of approved or certified respiratory protective devices. All devices approved by the Bureau of Mines are listed in Information Circular 8559 and supplements. All types of devices certified by the Testing and Certification Laboratory of NIOSH are listed in a separate publication. These are available from the Testing and Certification Laboratory, NIOSH, Morgantown, West Virginia, 26505.

VII. RESEARCH NEEDS

The recommended standard is based entirely on human data since experiments with animals in the range of concentrations (1-25 ppm) of concern do not exist. Studies of animals chronically exposed over their lifetime are needed to provide microscopic and biochemical information relative to effects on the nervous and cardiovascular systems and on the liver. This information is needed in order to monitor exposed workers more intelligently.

The metabolism of ethylene dichloride is generally unknown. Only one study of its metabolism by intact animals was reported and this dealt with only one species, the mouse. Additional metabolism studies are needed with other species, including primates, in order to identify metabolites that are likely to occur in man. Medical researchers should be prepared to try to identify metabolites when patients are hospitalized with ethylene dichloride poisoning. This information is needed because, at higher concentrations and dosages, ethylene dichloride seems to be metabolized to more toxic substances and the significance of the phenomenon at lower concentrations is not known. If chloroacetaldehyde is a major intermediate metabolite, it may have significance to carcinogenicity or mutagenicity of ethylene dichloride, especially under some conditions.

The information of the carcinogenic potential of ethylene dichloride is not adequate. The one study by the National Cancer Institute has not been completed. In this study, rats and mice were used. In the absence of knowledge about other species differences in metabolism of ethylene dichloride, it is not known that information from these species is

adequate. In the Ames-test study of ethylene dichloride, 2-chloroethanol, chloroacetaldehyde, and monochloroacetic acid, the possible metabolites, 2-chloroethanol and chloroacetaldehyde, showed strong activity. There is no information about the potential of ethylene dichloride acting as a cocarcinogen with other substances with which it is commonly encountered such as vinyl chloride and lead.

The mechanism by which ethylene dichloride affects the blood clotting mechanism, and the cardiovascular system in general, is not known. Elucidation of this problem could lead to successful treatment of persons poisoned by ethylene dichloride. This is important because no matter how carefully exposures are controlled, work practices are adhered to, and proper engineering controls are used, accidents will occur. It is also important because the effects may be manifested in other ways that have not been studied such as affecting women during normal menses, during childbirth, and by aggravating menometrorrhagia.

Teratogenic studies have not been reported, and without them it is not possible to know that females of child bearing age should work with ethylene dichloride. The information available does not indicate a problem, but the studies were not specifically designed for studying teratogenicity, and the investigators may not have reported observed abnormalities.

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