IX. RECOMMENDED PREVENTIVE MEASURES

Preventive measures to reduce exposures and promote adequate surveillance for health effects can be organized into three main areas: engineering controls, surveillance activities, and work practices/education. Based upon staff surveys and recommendations of others, a number of much-needed improvements in the design and operation of solvent degreasers is necessary to provide for adequate worker protection. Many of the recommendations provided in this section can be implemented with little expense and effort by industry. Not only will improved emission controls reduce worker exposures, but an economic savings can be realized by the companies involved by a reduction in the amount of solvent required for usual operations. Particularly useful references for operating procedures are the Handbook of Vapor Degreasing, prepared by the American Society for Testing and Materials (ASTM, 1976), and Recommended Work Practices for Vapor Degreasing Operations prepared by the Industry Task Force on Solvent Vapor Degreasing (1976).

1. Permissible Exposure Limit: It is recommended that the permissible limit for occupational exposure to trichloroethylene be reduced and that TCE be controlled as an occupational carcinogen. Current information regarding engineering feasibility indicates that personnel exposures of 25 ppm, on a time-weighted-average, can be readily attained using existing engineering control technology. However, we do not feel that this should serve as a final goal. Rather, industry should pursue further reductions in worker exposure as advancements in technology research allow.

2. Engineering Controls: Proper design and operation of process equipment can substantially reduce emissions and is the most desirable method of achieving a safe work environment. Proper design and operation would include such items as full or partial process enclosures including covers, temperature control of vapor to include condensation coils or freeboard chiller, local exhaust ventilation, part removal rate from degreasing or cleaning tank, and proper part drainage. Federal regulations on certain aspects of equipment design and operation, including ventilation and the use of baffles and covers, are found in 29 CFR 1910.94. Further, NIOSH has developed criteria for the design of local exhaust ventilation systems which would assure the effective capture and removal of toxic contaminants emanating from open surface tanks (Flanigan et al., 1974). Other useful documents dealing with the subject of ventilation include: references NIOSH (1976f), ANSI (1971), Committee on Industrial Ventilation (1977), and EPA (1977). Engineering control

technology and recommendations for further research on open surface tank-use have been made by NIOSH (Hagopian and Bastress, 1976). Adherance to the recommendations of those documents and to the degreaser manufacturers' operating instructions should further aid in controlling TCE exposures. Industry should take a leadership role in improving engineering control technology to control exposures to not only TCE but any solvent, especially where vaporization occurs.

3. Additional Exposure Control Measures: Workers may be exposed to toxic concentrations of TCE when engineering controls are not effective, when there is a need for open transfer of the liquid, when there is leakage from process equipment, and when maintenance or repair work on equipment or transfer systems is needed. Because of these exceptions, additional control measures are necessary. These additional control measures could include the following:

a. Location of degreasing equipment in large rooms with good general ventilation but no cross drafts, and away from sources of high temperature and high energy.

b. Use of personal protective clothing and respirators (when engineering controls fail).

(1) In operations where splashing, spilling, spraying, or skin contact with TCE may occur, employees should wear protective coveralls or other full-body protection, as opposed to bib-type aprons.

(2) If respirators are used, they should be selected from the following types only: (a) self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode, or (b) combination respirator which includes a type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous flow mode and an auxiliary self-contained breathing apparatus operated in pressure demand or positive mode. Where escape respirators are provided, any escape self-contained breathing apparatus is appropriate. Additional information concerning the above types of respirators for TCE can be found in reference: NIOSH (1976g).

c. Instituting procedures for cleanup of spills and disposal of chemical waste.

d. Establishing good general housekeeping and sanitation practices, e.g., food storage, preparation, and consumption should be prohibited in areas where TCE is handled, processed, or stored.

e. Establishing emergency procedures, including those necessary for fire fighting.

f. Instituting procedures for safe entry into such confined spaces as tanks, pits, process vessels, and trenches should be restricted to authorized personnel only and the following precautionary measures should be instituted:

(1). Confined spaces which have contained TCE should be inspected and tested for oxygen deficiency, TCE and other contaminants and should be thoroughly ventilated, cleaned, neutralized or washed, and then retested for TCE.

(2). Possible buildup of TCE vapor in the confined space while work is in progress should be prevented by positive means (e.g., forced-air ventilation of closed spaces during repair of leaks or equipment maintenance; securing intake valves or disconnecting intake lines).

(3). Individuals entering confined spaces where they may possibly be exposed to TCE should be equipped with the respiratory protective equipment outlined above. Each individual should also wear a suitable harness with a lifeline tended by another employee outside the space who should also be equipped with the necessary protective equipment, including the aforementioned respiratory apparatus. Communications (visual, voice, signal line, telephone, radio, or other suitable means) should be maintained by the standby person with the employee inside the enclosed space.

4. Recordkeeping and the Surveillance for Medical Effects and Exposures:

a. Keeping records on all measurements taken which pertain to worker exposure to TCE. Medical records, and personnel records relating to employee exposure should be retained for 30 years following termination of employment.

b. Medical surveillance should be conducted to detect symptoms related to TCE exposure.

c. Monitoring of environmental levels of TCE in the work area.

5. Warning of Potential Hazards:

a. Employees should be informed of the hazards of TCE, including the results from animal carcinogenicity or mutagenicity tests, as well as other forms of toxicity.

b. Labeling of containers and posting signs in TCE work areas which warn of its hazardous properties.

6. Substitution of less harmful solvents: NIOSH recommends against substitution of other materials because all known current replacements have associated health-related or environmental hazards of major concern. Hazard reviews or criteria document updates are to be prepared on the two main replacement chemicals, methyl chloroform and tetrachloroethylene.

One option which may be exercised by industry in order to comply with restrictive regulation on TCE is to switch to substitute chemicals for which regulations are either less stringent or are nonexistent. Past experience shows that chemical substitution for TCE has been a favored alternative for industry. This was demonstrated in California in 1966 when under the Los Angeles County Rule 66, TCE was placed on a list of restricted solvents which were held responsible for photochemical smog problems. As a result, some industries promptly switched from TCE to the use of exempt solvents such as methylene chloride, tetrachloroethylene, and methyl chloroform.

The decision by industry to substitute another solvent for TCE will likely come if the cost of compliance with regulations supersedes the benefits of continued use. The cost of compliance should vary among industries and will depend primarily upon their individual control technology needs in order to meet a lower environmental exposure limit. Analysis of the impact of such costs on industry and society in general does not fall within the immediate scope of this document.

While substitution must be considered a viable alternative in reducing TCE exposures, NIOSH recommends against substitution by chemicals which are not sufficiently well characterized for potential hazards and may unknowingly lead to further endangerment of worker health. Regarding chemicals for which preliminary data indicates positive carcinogenic, mutagenic or teratogenic activity, deferring their use as a substitute for TCE until further test data are available is the recommended course of action.

Of particular concern is the possibility that tetrachloroethylene and methyl chloroform may both possess carcinogenic and/or mutagenic potential based upon recent research results. As of this time, there is no assurance that these compounds represent less risk to workers than TCE. Concern is also expressed for their potential for having greater environmental effects than TCE. Like TCE, these two chemicals have demonstrated chronic effects of the liver and kidney, and may be degraded into hazardous substances, such as phosgene. An evaluation of these two chemicals will be undertaken in hazard reviews similar to this or by updating NIOSH criteria documents

for recommended occupational standards (NIOSH, 1976b; NIOSH, 1976c).

Rather than to substitute other chemicals for TCE, NIOSH recommends that industry exert a concerted effort to reduce exposures, not only to TCE but to all solvents, according to recommendations of this report and other references cited.

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