

INDUSTRIAL HYGIENE SURVEY REPORT
PERCHLOROETHYLENE

at

Pine Cleaners
15920 Puritan Street
Detroit, Michigan 48227

JWS-71.31

SURVEY CONDUCTED BY:
Howard R. Ludwig

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REPORT WRITTEN BY:
Dennis R. Roberts

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Industrial Hygiene Section
Industry-wide Studies Branch
Division of Surveillance, Hazard Evaluations and Field Studies
National Institute for Occupational Safety and Health
Cincinnati, Ohio

ABSTRACT

An industrial hygiene survey of a Michigan dry cleaning facility using perchlorethylene (PCE) was conducted in May 1979. Air samples were collected using battery operated pumps and charcoal tubes. The average PCE exposure to the dry cleaner during 5.5 hours of processing was 17 ppm. Four 5-minute peak samples collected during clothing transfer indicated PCE levels ranging from 36 to 72 ppm; a 15-minute peak sample was 34 ppm.

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH) is required under Section 20(a)7 of the Occupational Safety and Health Act of 1970 to conduct and publish industrywide studies of the effect of chronic or low level exposure to industrial materials, processes, and stresses on the potential for illness, disease, or loss of functional capacity in aging adults. The industrywide study of workers using perchloroethylene (PCE) was initiated in response to a long-term study reported by the National Cancer Institute (NCI) in October 1977 demonstrating PCE to be carcinogenic in laboratory mice.² The results of this experiment were similar to those seen in studies with trichloroethylene, i.e., an increase in hepatocellular carcinoma in mice. Substances that cause cancer in experimental animals must be considered potentially capable of inducing cancer in man. Although a safe threshold limit for exposure to carcinogenic substances has not been shown, the probability of cancer development may be lessened by decreasing exposure. To date, the effects of humans from long-term low level exposure to PCE is unknown.

In January 1978, NIOSH recommended that PCE in the workplace³ be handled as if it were a human carcinogen (see Attachment I).³ This was an interim recommendation, pending further study of the carcinogenic potential of PCE in the workplace. This study will assess the health effects from exposure to PCE by analysis of cause specific mortality among an identified group of dry cleaning workers. A cause of death for each individual in the cohort will be determined retrospectively and the observed deaths will be compared to those expected based on a matched control population. The industrial hygiene evaluation at this facility will supplement the mortality study by documenting the extent of exposure to PCE and historic changes in dry cleaning techniques and work practices.

DESCRIPTION OF THE FACILITY AND WORKFORCE

Pine Cleaners has been using PCE as a dry cleaning solvent at this location since about 1960. The facility is housed in a one-story building with dimensions of approximately 40 feet by 60 feet with a 10-foot ceiling (see Attachment II). About 55 gallons of PCE are consumed each month during the dry cleaning of about 9300 lbs of clothing. The workforce of seven includes two pressers, three counter persons, a seamstress, and the dry cleaner-spotter.

DESCRIPTION OF PROCESS

Process equipment includes a 30 lb capacity washer and a 50 lb capacity reclaimer (dryer). Clothing is loaded into the washer, and agitated in PCE for 15 minutes. After PCE is drained, excess PCE adhering to the garments is extracted by centrifugal spinning for 5

minutes and is also drained. The dry cleaner then manually transfers the clothes into the reclaimer. The transfer operation takes about a minute and the clothes are dried for 15 minutes, followed by a 10-minute cooling cycle. There are about 80 washing-reclaiming cycles per week. PCE extracted following the washing cycle is piped to a solvent maintenance system of cartridge type charcoal filters and the process equipment is vented through a charcoal adsorber. Every 3 to 4 weeks the cartridge filter sections are placed in the reclaimer (dryer) with the heat turned off to evaporate PCE from them. These sections are then disposed of and new cartridges are installed in the solvent maintenance system. There is a 25-inch diameter exhaust fan located in the back wall of the plant. Bulk deliveries of PCE are made by truck when needed.

DESCRIPTION OF PAST EXPOSURES

Air samples for PCE have never previously been collected. The owner felt that PCE exposures were probably lower currently than in the past due to newer dry cleaning equipment now in use.

DESCRIPTION OF MEDICAL, INDUSTRIAL HYGIENE, AND SAFETY PROGRAMS

There are first-aid supplies on the premises, but there is no one with formal first-aid training. There is a routine maintenance program to inspect gaskets and seals, check for leaks, clean or replace filters as necessary, clean traps, and lubricate parts. Respiratory protection is available for use during emergency situations, however the respirator components are not NIOSH-approved.

DESCRIPTION OF SURVEY METHODS

Personal air samples were collected in the breathing zones of the dry cleaner, presser, and seamstress using 150 milligram SKC, Inc. activated charcoal tubes. Peak samples were collected in the breathing zone of the dry cleaner during 5-minute and 15-minute periods. During this time about a minute was spent either in loading the washer or in the transfer of clothes into or out of the reclaimer. The remainder of the time was spent spotting or hanging clothes. Area samples were also collected at the front counter and near the spotting table. The sampling pumps used were MDA Accuhalers, which were calibrated at a flow rate of 20 milliliters per minute for personal and area samples and at 100 milliliters per minute for peak samples. The air samples were analyzed using NIOSH Method P&CAM 127. The samples were desorbed with carbon disulfide and analyzed for PCE by using a gas chromatograph equipped with a flame ionization detector. No other substances were observed in significant quantities in the analysis. A Turner

Model L9-1157 halide torch was used to detect sources of PCE leaks. Temperature and relative humidity measurements were made with an Environmental Tectonics Corporation Model CP-147 Psychrometer. Ventilation air velocities were measured with an Alnor type 8100 velometer.

RESULTS AND DISCUSSION

The day of the survey was typical at this facility from a standpoint of the volume of clothes dry cleaned. The results of air samples collected for PCE are reported in Table 1. The average exposure of the dry cleaner over the 5.5 hours of processing was 17 parts of PCE per million parts of air (ppm). The average exposure to the presser over an 8-hour work period was 6.7 ppm of PCE. The time-weighted average (TWA) exposure to PCE of the seamstress was 7.8 ppm. The average PCE exposure in the spotting area near the dry cleaning equipment was 13 ppm during the processing of clothes and 2.5 ppm for the remainder of the day. The average exposure to PCE at the front counter was 0.9 ppm during clothes processing and 0.7 ppm for the rest of the sampling time. The PCE concentrations of four 5-minute peak samples collected during garment transfer were 36, 46, 62, and 72 ppm and one 15-minute peak sample was 34 ppm. Exhaust ventilation measured 600 feet per minute (fpm) through the washer and 150 fpm through the dryer with the doors open. Temperature and relative humidity readings are reported in Table 2. Dry bulb temperatures ranged from 20.6 to 27.7°C with the relative humidity varying between 32 and 57%.

CONCLUSIONS AND RECOMMENDATIONS

The current Occupational Safety and Health Administration (OSHA) standard⁵ for occupational exposure to PCE was originally adopted in August 1971. The permissible eight-hour TWA concentration is 100 ppm. The acceptable ceiling concentration is 200 ppm, not to exceed a maximum peak of 300 ppm for 5 minutes in any three-hour period. In July 1976, NIOSH recommended that no employees be exposed to PCE in excess of 50 ppm, determined as a TWA for up to a 10-hour workday, 40-hour work week, and also recommended that a ceiling concentration of 100 ppm as determined by 15-minute samples, twice daily, not be exceeded.⁶ The OSHA standard or the NIOSH recommendation may not provide adequate protection from the potential carcinogenic effects because they were selected to prevent toxic effects other than cancer (i.e. liver and kidney damage, irritation of the eyes and upper respiratory tract, central nervous system depression, etc.).

The results of the sampling conducted on May 15, 1979 indicate that exposures to PCE are well within current standards. However, since the question of PCE being a carcinogen has not as yet been answered,

it is recommended that exposure to PCE be limited as much as possible. Also, all requirements of the Michigan Department of Public Health for Class IV Dry Cleaning Establishments should be followed.

Enclosed as Attachment III is the NIOSH Recommended Standard for Occupational Exposure to Tetrachloroethylene (PCE). Recommendations in this attachment as well as some of the Michigan Department of Public Health provisions include:

1. Placement physical examinations.
2. All dry cleaning machines and recovery units (dryer) should be equipped with a unit blower capable of providing an indraft velocity through the loading door of 100 feet per minute for each square foot of door opening. the blower should be ducted to a minimum point 5 feet above the roof of the building, and adjacent parapet walls or adjacent buildings. All dry cleaning systems should be installed so as to prevent escape of substantially any vapors into the atmosphere of the dry cleaning room.
3. Respiratory protection for use during emergencies, such as spill clean-up. A NIOSH-approved chemical cartridge respirator (see Attachment IV, NIOSH Certified Equipment List, DHEW (NIOSH) Pub. No. 79-107) should be obtained.
4. Protective clothing to prevent skin contact (i.e. gloves, which are impervious to PCE, worn during transfer of garments. An IAPA memorandum rates polyvinyl alcohol gloves as excellent for use with PCE).
5. Informing all employees as to the hazards, relevant symptoms, effects of overexposure to, and the precautions concerning the safe use and handling of PCE.
6. Storage containers, equipment, piping, and valves should be checked daily for leakage and repaired as needed such that no loss of solvent or solvent vapors may occur.
7. Recovered solvent should be piped directly to the base tank of the dry cleaning machine and all residues containing solvent should be disposed of so as not to create a health hazard or nuisance.

BIBLIOGRAPHY

1. Williams-Steiger Occupational Safety and Health Act of 1970, Public Law 91-596, 91st Congress, S.2193, December 29, 1970.
2. Bioassay of Tetrachloroethylene for Possible Carcinogenicity, DHEW Publication No. (NIH) 77-813, U.S. Department of Health, Education, and Welfare, Public Health Service, National Institute of Health, National Cancer Institute, October, 1977.
3. Current Intelligence Bulletin 20, Tetrachloroethylene (perchloroethylene) DHEW (NIOSH) Publication No. 78-112. U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, January, 1978.
4. NIOSH Manual of Analytical Methods, DHEW (NIOSH) Publication No. 77-157-A,C. U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, April, 1977.
5. General Industry Standards, U.S. Department of Labor, Occupational Safety and Health Administration, OSHA 2206, Revised November 7, 1978, GPO Stock No. 029-015-00054-6.
6. Criteria for a recommended standard . . . Occupational Exposure to Tetrachloroethylene (perchloroethylene). HEW (NIOSH) Publication No. 76-185. U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, July, 1976.
7. Technical Services Memorandum #8, Glove Selection Chart, Industrial Accident Prevention Association, Toronto, Canada.

Table 1

Perchloroethylene Exposures at Pine Cleaners
(Detroit, Michigan) on May 15, 1979

Sampling Time	Description	Concentration ppm
0630-1200	Dry Cleaner	17
0800-1600	Presser	6.7
0930-1225	Seamstress	13
1226-1430	Seamstress (TWA for Seamstress)	0.9 7.8
0730-1220	Area-Near Spotting Table	13
1221-1600	Area-Near Spotting Table (TWA for Spotting Area)	2.5 8.4
0745-1230	Area-Front Counter	0.9
1231-1600	Area-Front Counter (TWA for Front Counter Area)	0.7 0.8
0800-0805	Peak Sample During Transfer	36
0830-0835	Peak Sample During Transfer	46
0953-0958	Peak Sample During Transfer	72
1022-1027	Peak Sample During Transfer (Average of 5-minute peak samples is 54 ppm)	62
0900-0915	Peak Sample During Transfer	34

TWA - Time-Weighted Average exposure for period of time sampled.

Table 2

Temperature and Relative Humidity Readings at
Pine Cleaners (Detroit, Michigan) on May 15, 1979

Time	Temperature, °C.		% Relative Humidity
	Dry Bulb	Wet Bulb	
0730	21.5	16.0	55
0800	20.6	14.8	57
0900	21.0	14.5	50
1000	24.0	16.6	45
1100	25.0	16.2	40
1200	24.8	17.0	45
1300	26.7	16.6	35
1430	27.7	16.7	35
1500	27.5	16.5	32
1530	27.5	16.5	32
1600	27.5	17.0	35

Plant Layout of Pine Cleaners

