

INDUSTRIAL HYGIENE REPORT  
PERCHLOROETHYLENE

AT

Bradlin Cleaners  
649 Randolph Corner  
Detroit, Michigan 48226

*IWS-71.38*

SURVEY CONDUCTED BY:  
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DATE OF SURVEY:  
May 18, 1979

REPORT WRITTEN BY:  
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## ABSTRACT

An industrial hygiene survey of a Michigan dry cleaning facility using perchloroethylene (PCE) was conducted in May 1979. Air samples were collected using battery-operated pumps and charcoal tubes. The dry cleaner/spotter's average exposure to PCE was 51 ppm and his 5-minute peak exposures during clothing transfer ranged from 74 to 145 ppm of PCE; a 15-minute peak sample was 52 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.<sup>1</sup> 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.<sup>2</sup> 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 on humans from long-term low level exposure to PCE is unknown.

In January 1978, NIOSH recommended that PCE in the work place be handled as if it were a human carcinogen (see Attachment I).<sup>3</sup> This was an interim recommendation, pending further study of the carcinogenic potential of PCE in the work place. 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 WORK FORCE

Bradlin Cleaners has been using PCE as a dry cleaning solvent since dry cleaning began in this facility in 1949. The facility is housed in a one-story building with dimensions of approximately 40 feet by 70 feet. About 50 gallons of PCE are consumed each week during the dry cleaning of about 3400 lbs of clothing. The work force of eleven includes the dry cleaner/spotter (manager), two seamstresses, three pressers, four counter persons, and one driver.

## DESCRIPTION OF PROCESS

Process equipment includes a 50 lb capacity washer and a 50 lb capacity dryer. Clothing is loaded into the washer and agitated in PCE for 10 minutes. After the 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 dryer. The

transfer operations takes about a minute and the clothes are dried for 10 minutes. There are about 120 washing-drying cycles per week. PCE extracted following the washing cycle is piped to a solvent maintenance system where filtering takes place. All process equipment is vented through a charcoal adsorber. Bulk deliveries of PCE are made by truck when needed.

#### DESCRIPTION OF PAST EXPOSURES

Air samples for PCE have previously been collected by the Michigan Department of Health but the results were not available. The dry cleaner felt that exposures to PCE are probably lower today 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, and the manager (dry cleaner) has had military first aid training. There is a routine maintenance program one a week to inspect gaskets and seals and check for leaks. 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 and presser using 150 milligram SKC, Inc. activated charcoal tubes. Area samples were collected at the front counter, in the sewing area, and in the spotting area. Peak samples were also collected in the breathing zone of the dry cleaner over 5-minute and 15-minute periods. During this time, about a minute was spent loading and unloading the washer; the remainder of the time was spent doing spotting or hanging clothes. 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 100 milliliters per minute for peak samples. The air samples were analyzed using NIOSH Method Number P&CAM 127.<sup>4</sup> The samples were desorbed with carbon disulfide and analyzed by 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 Tectonic Corporation Model CP-147 Psychrometer. Ventilation air velocities were measured with an Alnor type 8100 velometer.

#### RESULTS AND DISCUSSION

The day of this survey was fairly typical at this facility. Twenty loads of clothing were processed with dry cleaning completed at 1:44 p.m. The results of air samples collected for PCE are reported in Table 1. During

the 360 minutes of dry cleaning, the dry cleaner/spotter's average exposure was 51 parts of PCE per million parts of air (ppm). The average exposure to PCE of a presser during 270 minutes of sampling was 3.3 ppm. Average exposures to PCE at the spotting station, sewing area, and front counter was 35, 21, and 18 ppm, respectively. The PCE concentrations of five peak samples, four 5-minute, and one 15-minute collected during garment transfer were 74, 75, 145, and 115 ppm for the 5-minute samples and 52 ppm for the 15-minute. The exhaust ventilation through the washer measured 100 feet per minute with the door open. Leaks around the washer door were detected with the halide torch with the door closed. Temperature and relative humidity readings are reported in Table 2. Dry bulb temperatures ranged from 21.5 to 29.7°C with the relative humidity varying between 22 and 50 percent.

### CONCLUSIONS AND RECOMMENDATIONS

The current Occupational Safety and Health Administration (OSHA) standard for occupational exposure to PCE was originally adopted in August 1977. The permissible eight hour time-weighted average (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 3-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 day, 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. 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 18, 1979 indicate that exposures to PCE are 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. Preplacement 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 Bradlin Cleaners  
(Detroit, Michigan) on 5/18/79

Sampling Time	Sample Description	Concentration (ppm)
0744-1344	Dry Cleaner/Spotter	51
0905-1335	Presser	3.3
0747-1348	Area - Front Counter	18
0802-1354	Area - Sewing Station	21
0919-1400	Area - Spotting Station	35
0809-0814	Peak Sample During Transfer	74
0832-0837	Peak Sample During Transfer	75
0944-0949	Peak Sample During Transfer	145
1051-1056	Peak Sample During Transfer (Average of 5-minute peak samples is 102 ppm)	115
0847-0902	Peak Sample During Transfer	52

Table 2

Temperature and Relative Humidity Readings at  
Bradlin Cleaners (Detroit, Michigan) on 5/18/79

Time	Temperature, °C		% Relative Humidity
	Dry Bulb	Wet Bulb	
0730	23	15.3	40
0830	21.5	15.0	50
0930	23.8	15.5	41
1030	28.3	16.7	30
1130	29.7	17.4	29
1230	29.0	15.8	22
1330	29.3	18.0	31

ATTACHMENT II  
BRADLIN DRY CLEANERS  
PLANT LAYOUT

