U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45202

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 73-86-114

SWISS CLEANSING COMPANY
PROVIDENCE, RHODE ISLAND
MARCH 1974

I. TOXICITY DETERMINATION

It has been determined that the dry cleaner and possibly marker employees are exposed to potentially toxic levels of tetrachloroethylene (perchloroethylene-PERK) vapors. This conclusion in the case of the dry cleaner is based upon: (1) exposure to an 8-hour time-weighted-average (TWA) concentration of PERK which exceeded 100 parts per million (ppm)- the occupational health standard promulgated by the U.S. Department of Labor; (2) consistent medical symptomatology evidenced in worker interview and examination. Marker employees, although normally exposed to relatively lower levels of PERK reported that medical symptomatology consistent with overexposure to PERK was experienced during high production periods.

Urinary test results were not utilized as a basis for the determination because the information proved inconclusive due to the experimental nature of this parameter.

II. DISTRIBUTION AND AVAILABILITY OF THE DETERMINATION REPORT

Copies of this Determination Report are available upon request from the Hazard Evaluation Services Branch, NIOSH, U.S. Post Office Building, Room 508, 5th and Walnut Streets, Cincinnati, Ohio 45202. Copies have been sent to:

a) Swiss Cleansing Company - Providence, Rhode Island
b) U.S. Department of Labor - Region I
c) NIOSH - Region I

For the purposes of informing the approximately 4 "affected employees" the employer will promptly "post" the Determination Report in a prominent place(s) near where affected employees work for a period of 30 calendar days.

III. INTRODUCTION

Section 20 (a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S. Code 669(a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found. The National Institute for Occupational Safety and Health (NIOSH) received such a request from an employer regarding exposure to the tetrachloroethylene (PERK) vapors from dry cleaning machines at the Swiss Cleansing Company, Providence, Rhode Island.

IV. HEALTH HAZARD EVALUATION

A. Description of Process - Conditions of Use

This facility presently performs both laundering and dry cleaning procedures. In May 1972 the dry cleaning operation was moved to its present location consolidating the laundry and dry cleaning operations under one roof. This facility employs approximately 120 persons; 16 with administrative responsibilities and 104 non-union production workers in a one-shift operation.

The alleged hazard was stated to be overexposure to PERK vapors emitted from dry cleaning operations. The health hazard evaluation request stated that, "when we moved our dry cleaning plant into our present location we changed over from trichloroethylene to PERK (tetrachloroethylene); the smell at times was more than what we feel is necessary. We have taken steps to correct everything but would welcome any outside survey."

The PERK vapors are emitted into the air each time batches of clothes are removed from any one of four dry cleaning machines. This operation involves a single employee, the "dry cleaner." It was suggested that the dry cleaner as well as the three garment markers, who work at tables in close proximity to the machines may be exposed to hazardous PERK vapor levels.

The solvent is stored in containers outside of the building and piped to the machines.

Approximately fifteen gallons of make-up solvent is added to the process each day to compensate for evaporation. The machines are vented directly to the outside, and the used solvent is reclaimed in a closed distillation system. The filter of the distillation apparatus is cleaned daily towards the end of the shift. This procedure takes approximately twenty minutes. During this time the perk odor is

generally more apparent, particularly to the dry cleaner who cleans the filter.

Ventilation in the dry cleaning area is primarily dependent on general dilution, a few standup fans, and open windows - weather permitting. On many days, however, particularly on humid days in summer open windows have only a limited effect.

B. Evaluation Design

Following a preliminary observational survey (September 7, 1973), it was deemed necessary to return to the plant to conduct a more in-depth evaluation of employee exposure to PERK. This follow-up evaluation was conducted on November 26, 1973.

Procedures used to assess the alleged hazard included on-site interviews with the management, a walk-through inspection of the work-place, use of general area and personal air sampling industrial hygiene techniques in the dry cleaning area, admistration of medical questionnaires to all workers potentially exposed to PERK in the dry cleaning operation, as well as a selected group of workers from other departments, and urinary sampling of all workers completing the questionnaire to determine Trichloroacetic acid levels. Trichloroacetic acid is a known metabolite of Tetrachloroethylene.

Environmental Evaluation Methods

In order to determine environmental levels of PERK, low volume MSA pumps were placed at various points at and in the vicinity of the cleaning machines and on the marking tables. Samples were collected throughout the shift in charcoal tubes at the rate of 0.5 cubic feet per hour. Personal breathing zone air samples were collected via similar equipment from the dry cleaner and the markers. Since the preliminary survey indicated that the dry cleaner's exposure averaged 126 ppm a high volume charcoal tube personal sample was also collected periodically from him at the rate of one liter of air per minute for ten minutes. To quantitate maximum exposure, a high volume breathing zone sample was collected from the dry cleaner when the batches were changed and when the distilling filter was cleaned.

Medical Evaluation Methods

All six employees (1 machine operator, 3 markers, 1 maintenance man and 1 supervisor) in the dry cleaning machine area agreed to participate in the study. In addition, five workers in other areas of the plant were selected to serve as a control population (i.e., a group of workers not exposed to significant quantities of tetrachloroethylene). Both groups of workers were investigated in a similar manner.

On the days of the study, each worker was individually administered a questionnaire by a NIOSH medical officer. Sex, age, length of employment at the plant and a complete occupational history were recorded. A brief past medical history was also elicited. Each employee in the study was requested to indicate the presence or absence of several specific symptoms, including burning or redness of the eyes, dizziness, weakness, skin rashes, tiredness, burning of the nose, throat, or chest and sneezing. A positive response for any symptom was followed by a question regarding the number of times the symptom had occurred monthly or weekly.

Each participant in the study provided the NIOSH investigating team with three urine samples. The urine samples were taken on Monday, Tuesday, and Wednesday mornings (Nov. 26, 27, 28), shortly after the workday commenced. A few crystals of thymol were added to each sample to prevent bacterial contamination and the samples were transported to the NIOSH Clinical Laboratories in Cincinnati for analysis. The thirty-three urine samples were analyzed for trichloroacetic acid and creatinine. Trichloroacetic acid was analyzed by the method of Tanaka and Ikeda (British Journal of Industrial Medicine, 25, 214 (1968). Creatinine levels were determined to provide a biologic standard against which adjustments in trichloroacetic acid excretion can be made. This allows a more accurate comparison of trichloroacetic acid levels to be made among individuals or groups of individuals.

C. Evaluation Criteria

1. Environmental Standard

The Occupational Health Standard promulgated by the U.S. Department of Labor (Federal Register, October 18, 1972, Title 29, Chapter XVII) for environmental exposure to tetrachloroethylene (PERK) is 100 parts per million. This represents the limit for an 8-hour time-weighted-average (TWA) exposure.

2. Toxic Effects

The major response to PERK at high concentrations is central nervous system depression. Irritation of the eyes, nose, and throat may also be observed at high concentrations. Humans exposed to 106 ppm were very much aware of the odor and of a very slight irritation of the eyes. At 260 p.p.m., they observed slight dizziness and some sleepiness. At 280 p.p.m. they were lightheaded. The eyes were irritated and there was definite impairment of motor coordination. Dizziness, inebriation, and incoordination have been observed in industrial exposure. The possible hazard to the man himself or to his associates because of poor mechanical coordination should be considered in exposure to perchloroethylene. (Industrial Hygiene and Toxicology, Volume II, Frank A. Patty, Interscience Publishers, N.Y. pp. 1314-15.)

D. Evaluation Results and Discussion

1. Environmental

The following tables present results of personal and general area charcoal tube air sampling in the dry cleaning area of the Swiss Cleansing Company November 26, 1973.

TABLE 1

SWISS CLEANSING COMPANY

NOVEMBER 26, 1973

General Area Environmental Samples for Exposure to Tetrachloroethylene

Location*	Number of Samples	Time Period of Sample hours, minutes	Range	Concentration for Period Sampled (Parts Per Million)
a	1	7 hrs. 1 min.	-	21 ppm
b	1	7 hrs. 0 min.	-	48 ppm
c	1	6 hrs. 45 min.	-	29 ppm

*locations a and c were on marking tables and b was on the side of a dry cleaning machine.

TABLE II

SWISS CLEANSING COMPANY (NOV. 26, 1973)

Personal Breathing Zone Concentrations of Tetrachloroethylene (PERK)

Person Sampled	No. of Samples	Time Period of Sample Hours, Minutes	Average Concentration Range Over Period Sampled (Parts Per Million)	Eight-Hour-Time Weighted-Average (Parts Per Million)
Marker I	3	4 hrs. 43 min.	32- 35 ppm	less than 10 ppm
Marker II	3	6 hrs. 13 min.	42- 45 ppm	35-38 ppm
Marker III	3	6 hrs. 13 min.	33- 36 ppm	26-29 ppm
Dry Cleaner	5	6 hrs. 25 min.	175-178 ppm	168-171 ppm

TABLE III

SWISS CLEANSING COMPANY (Nov. 26, 1973)

Additional 10 Minute Breathing Zone Concentrations of PERK Taken From the Dry Cleaner

Time	Activity	Concentration (Parts Per Million)
8:25 am	Removing Clothes from Dry Cleaning Machine	133 ppm
8:58 am	"	124 ppm
10:04 am	"	67 ppm
11:13 am	"	55 ppm
12:15 am	"	57 ppm
1:35 pm	"	38 ppm
2:15 pm	Cleaning Distilling Filter	392 ppm

Table I represents the general environmental level of tetrachloroethylene in the area of the marking tables and on the side of a cleaning machine. Results indicate levels well below the established standard.

Table II presents results of personal breathing zone sampling of three garment markers and the dry cleaner. The "average concentration" represents an average of several samples taken throughout the shift. It was noted that samples taken in the morning were generally higher than in the afternoon. Samples taken from the markers indicate levels well below the established standard, and they correlate well with the general area samples.

The samples taken from the dry cleaner were consistently above the established standard and as Table III indicates peak concentrations occurred frequently when the machine door was open as batches of clothes were being changed. The highest peak occured when the solvent distiller was being cleaned - a 10 minute peak average PERK concentration of 392 parts per million being recorded at this time.

2. Medical

a. Questionnaires

The demographic data concerning the tetrachloroethylene workers in this study is shown in Table IV. For such a small sample population, the different variables such as age, sex and length of employment are fairly evenly matched.

All six (6) of those in the exposed population complained that when they first came to work in this particular facility in May 1972 they suffered adverse effects from the vapors emitted during the dry cleaning operation. These symptoms included dizziness, nausea, weakness and tiredness. These occurred on a daily basis for several months when during the summer of 1973 the complaints decreased appreciably. But currently, the dry cleaner operator occasionally feels nauseated, dizzy, and experiences swelling of the eyelids. The clothing marker women also related that they suffer from tiredness and dizziness. These symptoms are more prevalent when the work load is high and there is limited cross ventilation.

The control population didn't complain of adverse symptoms similar to those found in the exposed group, although they mentioned that occasionally they could detect the odor of PERK.

b. Urinary Test Results

These are shown in Table V. All the results appear to be very low based on previous studies although both the exposed and control populations did show an increase in TCA in their urine over the 50 hour sampling period.

The dry cleaning machine operator had the highest level of TCA of any individual in the study population (13 mg/g), but his level still does not appear to reflect exposure to be a toxic concentration of PERK.

Trichloroacetic acid (TCA) values in urine are dependent upon exposure to tetrachloroethylene and also to the timing for sample collection. Ikeda and Imamura (1973) have shown that the biological half life of tetrachloroethylene in man is about 144 hours, about 3 to 4 times that seen for trichloroethylene. Normal values and the correlation with atmospheric concentration of PERK remain to be fully defined.

3. Recommendations

From the adverse symptomatology reported by the workers in the dry cleaning area it is recommended that measures of providing additional ventilation in the dry cleaning area be considered. In addition, an adequate respirator should be provided for the dry cleaner for use when cleaning the solvent distiller filter.

VI. AUTHORSHIP AND ACKNOWLEDGMENTS

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TABLE IV

Demographic Data
Concerning 11 Individuals
with and without Exposure to Perchloroethylene

	Exposed (n = 6)	Control (n = 5)
Sex Distribution		
Male	3	3
Female	3	2
Mean Age (years)	54.6	40
Range	(35-62)	(28-62)
Mean Length of Employment (at this facility)	17 months	13 months
Range	(13-18 months)	(0-18 months)

TABLE V

Urinary Trichloroacetic Acid Levels from
Exposed and "Non-exposed" Dry Cleaning Workers

	Exposed	Control
Monday - a.m.	6.33 mg/g creatinine (Range 4-9)	3.50 mg/g creatinine (Range 0.7-6)
Wednesday - a.m.	8.41 mg/g creatinine (Range 4-13)	4.5 mg/g creatinine (Range 1-8)