HETA 98-0249-2773
Grove Park Inn
Asheville, North Carolina

Lynda M. Ewers

PREFACE

The Hazard Evaluations and Technical Assistance Branch (HETAB) of the National Institute for Occupational Safety and Health (NIOSH) conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from 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.

HETAB also provides, upon request, technical and consultative assistance to Federal, State, and local agencies; labor; industry; and other groups or individuals to control occupational health hazards and to prevent related trauma and disease. Mention of company names or products does not constitute endorsement by NIOSH.

ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Lynda M. Ewers, of HETAB, Division of Surveillance, Hazard Evaluations, and Field Studies (DSHEFS). Analytical support was provided by Data Chem Laboratories. Desktop publishing was performed by Denise Ratliff. Review and preparation for printing was performed by Penny Arthur.

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Highlights of the NIOSH Health Hazard Evaluation

Perchloroethylene (perc) Exposures and Safety Issues

NIOSH investigators responded to a confidential employee request for a health hazard evaluation (HHE) at the Grove Park Inn, Asheville, North Carolina. There were concerns about possible health problems due to perc vapors from a dry-cleaning machine and about possible slips and falls due to water near an ice machine.

What NIOSH Did

Tested the air for perc vapor.

Tested the air when a dry-cleaning machine operator opened the door.

Watched how the ice machine was used.

What NIOSH Found

When averaged over an entire workshift, levels of perc in the dry-cleaning area were low.

High peaks of perc occurred when the dry-cleaning machine operator opened the door.

High peaks of perc occurred when maintenance was done on a stuck valve.

Ice spilled on the floor near an ice machine when workers shoveled it into buckets.

What the Grove Park Inn Managers Can Do

Establish a safety and health committee of top management and workers.

Write standard operating procedures for hazardous tasks.

Reduce solvent use and exposures by laundering uniforms.

Replace the 10-year old dry-cleaning machine with a new one or with a newer technology.

Isolate solvent-based machines away from workers.

Maintain dry-cleaning machines.

Move the ice machine to a less congested area, and install a floor drain.

Buy an ice machine with a gravity-fed ice dispensing system.

What the Grove Park Inn Employees Can Do

Keep the dry-cleaning machine door closed whenever possible.

Keep your head away from the door of the dry-cleaning machine when adding or removing clothing.

Follow written standard operating procedures.

Promptly clean up spills near the ice machine.

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NIOSH

Health Hazard Evaluation Report 98-0249-2773
Grove Park Inn
Asheville, North Carolina
November 1999

Lynda M. Ewers

SUMMARY

On June 3, 1998, the National Institute for Occupational Safety and Health (NIOSH) received two confidential requests for a health hazard evaluation (HHE) at the Grove Park Inn in Asheville, North Carolina. The requesters expressed concerns regarding (1) worker exposures to perchloroethylene (perc) leaking from a dry-cleaning machine in the laundry/dry-cleaning area and (2) potential slips, falls, or electrical shock from a leaking ice machine. A site visit was conducted at the Grove Park Inn during September 2-3, 1998, to assess perc exposures and to observe the use of the ice machine.

The dry-cleaning facility at the inn contained a 10- year old machine with a refrigerated condenser to recover perc. Inhalation exposures to perc can cause central nervous system depression (producing symptoms of vertigo, dizziness, narcosis, uncoordination, headache, and unconsciousness, if exposures are sufficient). Direct contact with the liquid may impair the mucous membranes, eyes, and skin. Chronic exposure to perc has been reported to cause liver damage, and peripheral neuropathy. NIOSH considers perchloroethylene to be an occupational carcinogen and recommends that exposures be reduced to the lowest feasible concentration.

Personal breathing zone (PBZ) time-weighted average (TWA) exposures for perc ranged from 0.17-5.8 parts per million (ppm) for the individual workers at this facility. The worker with the highest perc exposure was the machine operator and lowest was the spotter. All airborne TWA concentrations were well below the Occupational Safety and Health Administration's (OSHA) permissible exposure limit (PEL) of 100 ppm and the American Conference of Governmental Industrial Hygienists (ACGIH®) Threshold Limit Value (TLV®) of 25 ppm. However, real-time measurements taken with a hand-held photoionization detector, calibrated for perc, indicated high perc peaks (greater than 2000 ppm, well over the maximum concentration of 300 ppm allowed by OSHA). Most of the peaks were recorded near the machine operator when the dry-cleaning machine door was open and garments were being added or removed from the machine. One peak was related to a small perc spill resulting from a stuck machine valve.

The ice machine of concern was in a service hallway. To obtain ice, a worker latched the machine's door open and used a large shovel to scoop ice into carts. Most of the water in the hall was due to ice spilling during this task. In-house staff had tried to correct this problem by placing a metal tray under the machine's door to collect spilled ice and placing a ribbed mat on the floor. The manufacturer of the machine recommends that a floor drain with a grate be recessed in the floor in front of the machine.

A site visit to the Grove Park Inn revealed low full-shift personal breathing zone air concentrations of perc in the dry-cleaning area. However, high episodic air concentrations were associated with opening the machine door to add or retrieve garments and with a stuck valve. Recommendations are made in the report to reduce perc exposures through improved maintenance, increased reliance on laundering rather than dry-cleaning, and replacement of the existing machine. To prevent water accumulation around the ice machine, the machine should be moved to another location where a floor drain can be installed and where fewer people pass.

Keywords: SIC 7011 (Hotels and Motels), perchloroethylene, tetrachloroethylene, chlorinated solvents, dry cleaning, slips and falls.

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INTRODUCTION

On June 3, 1998, the National Institute for Occupational Safety and Health (NIOSH) received two confidential employee requests for a health hazard evaluation (HHE) at the Grove Park Inn in Asheville, North Carolina. The requesters expressed concerns regarding (1) worker exposures to perchloroethylene (perc or tetrachloroethylene) leaking from a dry-cleaning machine in the laundry/dry-cleaning area and (2) slips and falls or possible electrical shock from water on the floor near an ice machine.

NIOSH conducted a site visit during September 2-3, 1998, beginning with an opening conference attended by a NIOSH investigator, Grove Park Inn management, and employee representatives. After the conference, a walk-through survey of the site was conducted. Full-shift personal breathing zone (PBZ), area, and real-time sampling for airborne perc and observations of the ice machine area occurred on the following day. This report presents results, conclusions, and recommendations for minimizing worker exposures to perc during dry-cleaning operations and possible solutions to the leaking ice machine problem.

BACKGROUND

The Grove Park Inn is a large hotel, employing about 900 workers. The inn is one of the oldest in the southern United States. Many improvements to the Inn facilities are in progress, including plans for a new dry-cleaning and laundry area.

The current dry-cleaning facility is located within the main building, and serves the needs of the employees and guests. Management reported that most of the dry-cleaned clothing consisted of polyester work uniforms. The dry-cleaning machine was a 10-year old, 35-pound capacity, VIC model 1035, with a refrigerated condenser. According to management, before the HHE request was initiated by employees, a corroded valve in this machine had stuck open and leaked perc. The valve was changed before the NIOSH site visit.

Boilers supplying the dry cleaning machine were activated early each morning, and routine maintenance was performed by the engineering staff before most of the dry-cleaning employees arrived. Work schedules for the five employees directly involved in dry cleaning were generally from 7:30 a.m. to 4:30 p.m. but could be much longer, depending upon the workload. On a rotating basis, one person served as the machine operator each day and, between machine loadings, that person assisted the others in pressing, spotting, and sorting garments. Written records for the machine suggested that a typical day included four to five loads, weighing about 30 pounds each.

The ice machine of concern, a Model 2250P Module 115 manufactured by Follett Corporation (Easton, Pennsylvania), was in a service hallway located in a different wing of the inn than the dry-cleaning operation. It was one of several similar machines within the facility but was the only one identified as a problem. The machine was approximately four feet high by five feet wide by three feet deep. Two access doors, hinged on the top, were about two feet from the floor. To obtain ice, a worker latched the machine's door open and used a large shovel to scoop ice. In-house staff had modified the machine by constructing a metal tray under both doors for collecting any spilled ice. As ice melted in the tray, water drained through a metal pipe to the rear of the machine. A rubber mat was placed on the floor under the doors. This ice machine was used by many workers.

METHODS

Perchloroethylene

Full-shift PBZ sampling for perc was accomplished for all five people who worked near the dry-cleaning machine. In addition, full-shift area air samples were collected above the door of the dry-cleaning machine and behind it. Each sample was collected on a 100/50 milligram (mg) solid sorbent charcoal tube connected via Tygon® tubing to a battery-powered sampling pump, calibrated to provide a volumetric air flow rate of 100 millimeters per minute (ml/min). Analysis was by gas chromatography using flame ionization detection (FID) in accordance with NIOSH Methods 1003.[1] Exposure estimates listed

in this report are based on periods of actual sampling.

Real-time measurements were made using a Photovac 2020 photoionization air monitor to check for perc releases in the vicinity of the dry-cleaning machine. Specific tasks that were suspected of resulting in high short-term exposures were monitored (e.g., morning start up exposures, representative loading/unloading of the dry-cleaning machine throughout the day, and maintenance procedures). The Photovac 2020 measures the concentration of airborne photoionizable gases, which includes perc. It displays the concentrations in parts per million (ppm) on a meter that is updated every second, and these data were later downloaded on a personal computer. The Photovac 2020 was pre-calibrated using room air and a 200 ppm perc standard (Scott Speciality Gases) in the laboratory the day before sampling.

Ice Machine

Observations of the ice machine were made periodically. The manufacturer of the machine was called to learn if similar situations had arisen at other locations which may have resulted in engineering controls for the machine.

EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for the assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects even though their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy). In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and this potentially increases the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: (1) NIOSH Recommended Exposure Limits (RELs),[2] (2) the American Conference of Governmental Industrial Hygienists' (ACGIH®) Threshold Limit Values (TLVs®),[3] and (3) the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs).[4] Employers are encouraged to follow the OSHA limits, the NIOSH RELs, the ACGIH TLVs, or whichever are the more protective criteria.

OSHA requires an employer to furnish employees a place of employment that is free from recognized hazards that are causing or are likely to cause death or serious physical harm.[5] Thus, employers should understand that not all hazardous chemicals have specific OSHA exposure limits such as PEL's and short-term exposure limits (STEL's). An employer is still required by OSHA to protect their employees from hazards, even in the absence of a specific OSHA PEL.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended STEL's or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from higher exposures over the short-term.

Perchloroethylene

Perc is a non-flammable liquid used as the cleaning solvent in most dry-cleaning machines.[6] Inhalation exposures to perc can cause central nervous system depression (producing symptoms of vertigo, dizziness, narcosis, uncoordination, headache, and unconsciousness, if exposures are sufficient). Direct contact with the liquid may impair the mucous membranes, eyes, and skin.[6,7]

Chronic exposure to perc has been reported to cause liver damage and peripheral neuropathy.[8] In 1995, the International Agency for Research on Cancer concluded that perc is probably carcinogenic to humans.[9] This conclusion was based, in part, on several human epidemiology studies indicating increased risks for esophageal cancer, non-Hodgkin's lymphoma, and cervical cancer. NIOSH considers perchloroethylene to be an occupational carcinogen and recommends that exposures be reduced to the lowest feasible concentration.[10] The OSHA PEL is an 8-hour TWA of 100 ppm, with a ceiling concentration of 200 ppm for 5 minutes in any 3 hours and a maximum allowable peak of 300 ppm. The ACGIH recommends a TWA of 25 ppm averaged over an 8-hour period and a 15-minute STEL of 100 ppm.

RESULTS

Perchloroethylene

As can be seen in Table 1, the full-shift PBZ-TWA exposures for perc ranged from 0.17-5.8 ppm for the individual workers. The worker with the highest perc exposure was the machine operator and the lowest was the spotter. Two area samples collected near the dry-cleaning machine, above the door and behind the machine were 7.4 and 5.6 ppm, respectively.

While the full-shift TWA concentrations were well below the PEL and TLV, real-time measurements (Table 2) show that there were very high excur-sions of perc concentrations, above the maximum peak of 300 ppm allowed by OSHA. During the start-up procedure on the monitoring day, the replacement valve again wedged open requiring that the machine pump be primed. During priming, a small perc leak occurred and was mopped up with a rag. Five high real-time peaks were observed during the cleanup of the perc spill and start-up. An attempt was made to locate leaks near machine gaskets, but no large leaks were found. Eleven high peaks after 7:35 a.m. (three of which exceeded the instrument's maximum of 2000 ppm) were all associated with measurements collected near the breathing zone of the operator when the dry-cleaning machine door was open and garments were being added to or removed from the machine.

Ice Machine

Water on the floor around the ice machine was from melting ice despite a tray to catch ice spills in front of the doors. The inner doors or baffles to prevent ice from pressing against the outer door had been removed. While inner doors would not solve the ice spillage problem, they may have reduced it. A technical representative of Follette Corporation said that the machine had been modified over the years.[11] Follette Corporation advertisements for newer ice storage systems contained a statement recommending grates with underlying drains built into the floor in front of the machines. More modern systems allow carts to slide under the storage bin doors. Thus, ice is transferred to the carts using gravity feed, eliminating the need for shoveling.

DISCUSSION AND CONCLUSIONS

Perchloroethylene

The pattern of operator exposures to high concentrations of perc when loading or unloading a dry-to-dry, refrigerated machine has been observed frequently in the dry-cleaning industry.[12] In general, engineering control measures are the most effective means of reducing these exposures. Modern perc-based machines, so-called 4th and 5th generation machines, are available.[13] These machines are equipped with fans to evacuate perc from the machine drum at the end of the dry cycle. Also, they recover more of the solvent vapors than older machines because they contain both a refrigerated condenser and a large, rechargeable carbon absorber. A 5th generation machine differs from a 4th in that it has a sensor to monitor perc levels in the drum and locks the machine door until the air concentration is below a set level. Perc concentrations within the machine cylinder during loading or unloading should be below 300 ppm in these machines.

Substitution of other chemicals or technologies for traditional perc-based cleaning is another option. Grove Park Inn management indicated that they were considering changing to petroleum-based solvent cleaning. Newer petroleum-based solvents have been formulated that have higher

flashpoints than the petroleum solvents used in the past, which were explosion hazards. Dry-cleaning machines designed for petroleum products have been improved, with better control of machine operating parameters and methods to remove the air needed for combustion from the cleaning drum. Never-theless, petroleum solvents are still flammable.[14] If choosing to use petroleum solvents, the building should have a fire-resistant partition for the machine, floors and ceiling made of fire resistant materials, two remote means of escape, a sprinkler system, an emergency drainage system, and fire extinguishers. Routine procedures must be estab-lished because lint or other flammables must be regularly removed, petroleum containers must be kept covered, and smoking must not be permitted. While petroleum solvents are considered to be less toxic than perc, the carcinogenicity of these compounds has not been established.[15] The NIOSH REL for petroleum solvents is a TWA of 350 milligrams per cubic meter of air (mg/m^3) (about 86 ppm), and a 15 minute ceiling of 1800 mg/m^3 based on irritation to the eyes, skin, respiratory system, and central nervous system effects (dizziness, drowsiness, nausea). NIOSH also recommends an immediately dangerous to life and health (IDLH) concentration of 1100 ppm, which is 10% of the lower explosive limit. The OSHA PEL for petroleum solvents is 500 ppm. Finally, petroleum solvents may allow bacterial growth which can cause garments to have unpleasant odors.

Other innovative technologies, such as substituting liquid carbon dioxide or a specialized wet-cleaning process for perc, are available but not yet widely used in the industry.[16] However, one simple substitution that could be implemented at the Grove Park Inn is to launder clothing whenever possible. Many of the uniforms that were being dry cleaned were made of polyester. Complaints that polyester uniforms tend to wrinkle excessively when water washed might be remedied by more careful handling, e.g., removing garments from the dryer before they are completely dry and hanging them immediately. Some uniforms were made of wool, which is not readily water washed. Substantial savings might be realized by the Grove Park Inn if consideration of the washability of uniforms and other fabrics were considered as part of the cost analysis before purchasing such items.

Isolation of a dry-cleaning machine from other work areas also reduces solvent exposures of workers. This approach is incorporated in some areas of the United States.[17] Vapor barrier rooms, lined in an impermeable foil, are large enough for only the machine and rolling carts and allow ventilation to be maximal around a machine. The room is continuously exhausted by fans that have a volumetric air flow rate of at least 1000 cubic feet per minute (cfm) and produce an air change rate of at least one air change every five minutes. All emissions are exhausted through a stack that extends a minimum of 5 feet above the roof. A comfortable temperature is maintained for the pressers and sorters working nearby but outside the room.

Personal protective equipment (PPE) should not be relied upon for routine protection against perc vapors. However, respiratory protection should be used for worker protection when engineering controls are not technically feasible, during the interim while controls are being installed or repaired, or when an emergency and other temporary situations arise. If a respirator is used for worker protection, the employer assumes responsibilities for a complete respirator program in accordance with OSHA regulations.[18]

Ice Machine

The problem of water on the floor near the ice machine was complicated by the machine's location in a busy service corridor. In addition to obtaining ice, workers rushed by carrying various supplies and rolling food carts through the area. Any permanent solution to the problem will have to accommodate the many uses of the corridor.

Several solutions had been attempted before the site visit. A tray had been attached under the machine doors, a rubber mat had been placed on the floor, and, according to management, the workers had been admonished to clean up any spilled ice. None of these had been totally successful. The tray collected most of the ice, but was subject to clogging if not cleaned regularly. The rubber mat placed under the ice machine door was smooth enough for carts but probably contributed to workers slipping, when it was wet. Spilled ice scattered across the corridor beyond the area of the mat. Items, such as mops or

brooms, to facilitate removing spilled ice were not in evidence.

Two engineering controls should be considered in this situation. The purchase of a new machine may aid in the efficient filling of the ice carts and thereby reduce the amount of spilled ice. However, the fact that the ice machine manufacturer recom-mends a floor drain, suggests that the problem may not be solved by the newer system. The installation of a drain would be likely to interfere with cart movement in the area. Moving the present ice machine to a less busy area, where a floor drain could be installed, may be a more practical solution. The selection of a convenient area would necessitate the input from those who regularly use the machine.

RECOMMENDATIONS

To Reduce Worker Exposures to Perchloroethylene

- Reduce the use of solvents by laundering any clothing not requiring dry cleaning. When purchasing new staff uniforms, consider buying ones that can be laundered.

- Maintain dry-cleaning machines properly, following maintenance recommendations available from the manufacturer.

- Replace the present perc-based dry cleaning machine, either with a 5th generation perc-based machine or with an alternate technology.

- Isolate any solvent-based machine from pressers or sorters working nearby.

- Educate workers so they understand that the highest perc exposures occur when clothing is being loaded or unloaded from the machine, even when a 5th generation machine is used. Workers should keep the machine door closed when the opening is not in use. During loading and unloading, an operator should take care to keep his or her head as far away from the door as possible. If perc odors are detected while operating the machine, maintenance personnel should be alerted, and repairs should be made.

- Carefully evaluate the substitution of petroleum-based dry cleaning for the present perc-based system. Newer petroleum products are more flammable than perc and must be handled carefully.

- Establish a management and worker health and safety team to produce written operating procedures to follow in case of accidental solvent spills or malfunctions of the dry-cleaning machine.

To Reduce Hazards Associated with Water on Floor Near Ice Machine

- Move the ice machine to a less heavily used area and install a floor drain. Consult with workers who use the machine to determine the most convenient site.

- Invest in a new ice machine with a gravity fed ice dispersal system.

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Table 1

Personal Breathing Zone and Area Perchloroethylene Air Concentrations

Grove Park Inn, Asheville, North Carolina
September 3, 1998
HETA #98-0249-2773

Task/Sample Location	Sampling Duration (min)	TWA Air Concentration (ppm)
Spotter	394	0.17
Presser	394	0.55
Presser	391	0.24
Presser	396	1.8
Operator	420	5.8
Above machine door	448	7.4
Behind machine	444	5.6

NIOSH regards perc as an occupational carcinogen; recommends lowest feasible concentration
OSHA TWA at 100 ppm
ACGIH recommends TLV-TWA at 25 ppm

Table 2

Real-time Perchloroethylene Air Peaks Greater than 300 ppm* Recorded During Specific Tasks

Grove Park Inn, Asheville, North Carolina
September 3, 1998
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Task/Monitoring location	Times of Peaks	Peak Air Concentrations (ppm)
Cleaning of perc spill and start-up procedures/ Behind dry-cleaning machine	7:25:56 7:26:11 7:27:11 7:32:53 7:33:08	865 1551 377 429 1648
Adding and removing items from the dry-cleaning machine/ Near machine operator's breathing zone in front of machine	7:50:12 7:50:27 7:51:12 7:51:27	477 409 1204 863
Adding and removing items from the dry-cleaning machine/ Near machine operator's breathing zone in front of machine	9:47:49 9:48:04 9:52:34 9:52:49	greater than 2000** greater than 2000** 360 306
Adding items to the dry-cleaning machine/ Near machine operator's breathing zone in front of machine	13:20:31 13:20:46	915 884
Removing items from the dry-cleaning machine/ Near machine operator's breathing zone in front of machine	14:05:52	greater than 2000**

*The OSHA maximum allowable peak is 300 ppm.
**The maximum reading on the PhotoVac 20/20 Meter is 2000 ppm.

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