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A.W. CASH VALVE MANUFACTURING CORPORATION
DECATUR, ILLINOIS

NIOSH INVESTIGATOR:
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I. SUMMARY

On July 16, 1990, the National Institute for Occupational Safety and Health (NIOSH) received a request for a Health Hazard Evaluation (HHE) from a management representative of A.W. Cash Valve Manufacturing Corp., Decatur, Illinois. This plant manufactures precision brass and stainless steel valves. The request was made after previous HHEs (HETA 88-242 on June 14-15, 1988 and HETA 88-357-2042 on February 16, 1989) recommended ventilation improvements for similar degreaser operations.

On August 24, 1990, a NIOSH investigator visited the plant and collected personal breathing zone (PBZ) and area air samples to measure airborne trichloroethylene in the degreaser area. Two full-shift PBZ samples were 5.2 and 4.5 ppm. Five full-shift area samples ranged from 1.1 to 5.3 ppm. NIOSH considers **trichloroethylene** to be an occupational carcinogen and recommends that exposure be controlled to the lowest feasible level. A limit of 25 ppm was proposed in a 1978 NIOSH Technical Report based on engineering controls available at that time. Newer controls have shown that exposures can be controlled to much lower levels, and employers should apply these techniques to decrease potential exposures to the extent possible. The concentrations of the full-shift samples were below the OSHA Permissible Exposure Limit (PEL) of 50 parts per million (ppm). One short-term (15-minute) **trichloroethylene** sample was measured to be 91.8 ppm. This is below the Occupational Safety and Health Administration (OSHA) short-term criteria of 200 ppm.

Based on the results of this evaluation, it was determined that short-term exposures to trichloroethylene pose potential health hazards to degreaser operators at this plant. Personal protective equipment and ventilation controls are recommended.

KEYWORDS: SIC 3491 (Industrial Valves), trichloroethylene, degreasing, ventilation.

II. INTRODUCTION

On July 16, 1990, the National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation from a management representative of A.W. Cash Valve Manufacturing Corp., Decatur, Illinois. A.W. Cash manufactures precision brass and stainless steel valves. NIOSH was requested to evaluate airborne concentrations of trichloroethylene. No health effects were reported in the request.

On August 24, 1990, a NIOSH investigator conducted a sampling survey at the plant. Personal breathing zone (PBZ) and area samples for trichloroethylene were collected at an open-top vapor degreaser. This report will present the overall findings from this evaluation.

III. BACKGROUND

A.W. Cash Valve Corporation manufactures precision brass and stainless steel valves. After milling and lathing operations the valve parts are degreased in an open-top vapor degreaser using trichloroethylene (TCE). One worker operated the degreaser. This consisted of attaching metal baskets of valve parts to a mechanical lift and directing them to the degreaser via electronic controls. The baskets were lowered into the degreaser and then raised out after cleaning. There was a potential for exposure to TCE when the operator stood next to the degreaser tank and after the partially wet valve parts were removed from the tank.

IV. EVALUATION DESIGN AND METHODS

Seven full-shift samples were collected for TCE (five area and two PBZ). The two PBZ samples were from the degreaser operator and the five area samples were collected in the general area around the degreaser tank. One short-term sample was collected at the source of the contaminant, the degreaser.

Airborne TCE samples were collected on a solid sorbent tube (150 milligrams (mg) of activated charcoal) connected via Tygon™ tubing to battery-powered vacuum pumps calibrated at a flow rate of 0.05 liters per minute (ℓpm). The charcoal tubes were analyzed utilizing gas chromatography (GC) and a flame ionization detector (FID) according to NIOSH method 1022.[1] TCE was desorbed from the charcoal using carbon disulfide. The sample was separated using a 30 meter (m) x 0.32 millimeter (mm) fused silica capillary coated column. The limit of detection (LOD) was 0.01 mg per sample. The limit of quantitation (LOQ) was 0.03 mg per sample (0.24 parts per million (ppm) for a 23 ℓ sample).

V. EVALUATION CRITERIA

Trichloroethylene is a colorless, volatile, nonflammable liquid that is nearly immiscible in water and has a boiling point of 87°C. It is a powerful degreasing and dry-cleaning agent and has commercial applications in paints, adhesives and textile processing. It is also used as an intermediate in the manufacture of other chemicals.[2]

TCE is absorbed rapidly by the lungs following inhalation and eliminated to only a small degree by exhalation.[3] The predominant physiological response is one of central nervous system depression. This is particularly true as a response from acute or short-term exposure. Effects include drowsiness, dizziness, disturbances of vision, impairment of the senses of smell and touch, tremor, impaired coordination, anxiety, confusion, insomnia, and loss of consciousness. Other effects of TCE include vomiting, abdominal cramps, cardiac arrhythmias, and respiratory tract irritation. Respiratory distress has been observed often, especially following intermittent inhalation exposures, with such symptoms as chest tightness and labored breathing.[4] Liver and kidney injuries in humans attributable to over exposure to TCE are rare.[5] The effects of chronic exposure to humans have not been extensively studied, and thus are not well characterized.

Prolonged skin contact can cause local irritation and blister formation. Repeated immersion of the hands in TCE has caused paralysis of the finger.[6] Although the absorption of toxic quantities of TCE is not generally thought to occur by this route[7], a recent case report suggests otherwise. In 1988, McCunney reported a finding of toxic encephalopathy, characterized by irritability, short-term memory loss, feelings of inebriation, and personality changes in a degreaser operator at a jewelry company.[8] Skin absorption from repeated skin contact with TCE, was thought to be the primary contributor, since air measurements were reportedly less than 25 ppm.

TCE reduces tolerance to alcoholic beverages. Some individuals who have been exposed to TCE experience "degreaser's flush" after consuming alcohol. This apparently benign condition is typically of short duration, and consists of red areas of skin on the face, neck, shoulders, and back.[9]

On March 21, 1975, the National Cancer Institute (NCI) reported preliminary results of a carcinogen bioassay which indicated the induction of hepatocellular (liver) carcinomas in mice. No carcinogenic effects were observed in rats. After reviewing the NCI study, NIOSH recommended that TCE be considered a suspect human carcinogen and transmitted this message to industry in a Special Occupational Hazard Review with Control Recommendations.[4] Since there is no known safe level of exposure to a carcinogen, NIOSH recommends that exposure be minimized to the lowest extent possible. A limit of 25 ppm was proposed in a 1978 technical report based on engineering controls available at that time.[10] Newer controls have shown that exposures can be controlled to much lower levels.[11] It would be prudent for employers to apply these techniques to decrease potential worker exposures. The current American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) for TCE is 50 parts per million (ppm) as an 8-hour time weighted average (TWA).[12] The current Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) is 50 ppm as an 8-hour TWA, with an acceptable short-term exposure limit (STEL) of 200 ppm.[13] The STEL is a 15-minute TWA exposure that should not be exceeded at any time during the workday.

VI. RESULTS

PBZ and area sample results for TCE are presented in Table 1. The NIOSH Recommended Exposure Limit (REL), ACGIH TLV, OSHA PEL and STEL[14] are referenced at the bottom of the table.

The two PBZ samples collected concurrently from the degreaser operator showed concentrations of 4.5 and 5.2 ppm. The five area samples ranged from 1.1 ppm at a point far from the degreaser (at the workbench) to 5.3 ppm near the top of the degreaser. The area samples showed a general decline in concentration of airborne TCE moving away from the degreaser. A 15-minute sample was collected directly above the open-top of the degreaser. This sample showed an airborne TCE concentration of 91.8 ppm.

Table 1

Airborne Exposure Concentrations for
Trichloroethylene
A.W. Cash Valve Manufacturing Corporation
Decatur, Illinois
August 24, 1990

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Sample Type	Sample Time (min)	Sample Volume (liters)	Conc.★ (ppm)
PBZ (degreaser operator)	476	23.8	5.2
PBZ (degreaser operator)	476	23.8	4.5
Area (near top of degreaser)	460	23.0	5.3
Area (handrail near degreaser)	462	23.1	2.1
Area (near degreased parts)	462	23.1	1.5
Area (at beam near table)	464	23.2	1.2
Area (on pole by workbench)	460	23.0	1.1
STEL (above degreaser)	15	0.75	91.8
Evaluation Criteria:		NIOSH REL	LFL★★
		OSHA PEL	50
		ACGIH TLV	50
		OSHA STEL	200

★Averaged over the duration of the sample time
★★LFL = Lowest Feasible Level

VII. DISCUSSION

The concurrent PBZ samples collected from the degreaser operator (4.5 and 5.2 ppm) are slightly less than the area sample collected near the top lip of the degreaser (5.3 ppm). The operator is exposed to airborne TCE in the degreaser area but especially when standing adjacent to the degreaser. The short-term sample collected directly above the degreaser showed an airborne concentration of 91.8 ppm. Although not observed standing next to the degreaser for any consecutive period of 15 minutes, the operator was next to the degreaser for 5-minute periods 4-5 times an hour. While this exposure is below the OSHA STEL of 200 ppm, it is a potential hazard to the degreaser operator. TCE concentrations were lower as area samples were collected farther from the degreaser, which indicates dilution of TCE into the general work environment.

Although all of the concentrations of TCE are below appropriate environmental guidelines, further reduction of potential exposure is possible. The automated Detrex® degreaser system that is already in place at this plant was shown to reduce the degreaser operators' exposure to TCE. PBZ samples collected from the degreaser loaders on June 15, 1988, show concentrations of 1.6, 2.5 and 2.8 ppm.[15] The PBZ concentrations in Table 1 of this report are as much as three times those of the workers using the automated Detrex® system.

When the operator removed the basket of cleaned metal parts from the degreaser there was a small amount of TCE that remained on the irregular surface of some of the valve parts. This residual TCE evaporates after the baskets are removed from the degreaser. This evaporation adds to the general concentration of TCE in the degreaser area and surrounding areas.

VIII. RECOMMENDATIONS

The following recommendations are made to help reduce the potential for exposure to TCE and to ensure the safety of the workers at A.W. Cash Valve Manufacturing Corporation. These recommendations are based on the environmental sampling results and observations made during the evaluation.

1. An enclosure similar to the automated Detrex® system already in operation in another section of the plant should be built to minimize TCE exposure from the degreasing operation to which this report refers.

2. Until an enclosure is built the degreasing operation should include a longer waiting period to allow the parts to dry before removing them from the degreaser.

3. The degreaser operator should minimize the amount of time spent on the platform directly next to the degreaser. Since this is the primary source of the contaminant the operator should be there only when necessary.

IX. REFERENCES

1. NIOSH [1989]. Trichloroethylene: Method 1022 (supplement issued 8/15/87). In: Eller PM, ed. NIOSH manual of analytical methods, 3rd ed. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 84-100.

2. Sax NI, Lewis, RJ [1987]. Hawley's Condensed Chemical Dictionary. 11th ed. New York, NY: Van Nostrand Reinhold Company, p. 1176.

3. NIOSH [1973]. Criteria for a recommended standard: occupational exposure to trichloroethylene. Cincinnati, OH: U.S Department of Health, Education, and Welfare, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. (HSM) 73-11025.

4. NIOSH [1976]. Special occupational hazard review with control recommendations--trichloroethylene. Cincinnati, Ohio: U.S. Department of Health, Education, and Welfare, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 78-130.

5. Steward, RD, Dodd, HC, Gay, HH, Duncan, SE [1974]. Experimental human exposure to trichloroethylene. Arch Environ Hlth 20:64-71.

6. McBirney RS [1954]. Trichloroethylene and dichloroethylene poisoning. Arch Ind Hyg Occup Med 10:130-133.

7. Steward RD, Dodd HC [1964]. Absorption of carbon tetrachloride, trichloroethylene, tetrachloroethylene, methylene chloride, and 1,1,1-trichloroethane through the human skin. Am Ind Hyg Assoc J 25:439-464.

8. McCunney RJ [1988]. Diverse manifestations of trichloroethylene. Br J Ind Med 45:122-126.

9. Steward R, Hake C, Peterson J [1974]. Degreasers flush. Dermal response to trichloroethanol and ethanol. Arch Environ Hlth 29:1-5.

10. NIOSH [1978]. Special occupational hazard review of trichloroethylene with control recommendations: trichloroethylene. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 78-130.

11. NIOSH [1990]. Hazard evaluation and technical assistance report: A.W. Cash Valve Manufacturing Corp., Decatur, IL. Cincinnati, OH: U.S Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, NIOSH Report No.
HETA 88-357-2042.

12. ACGIH [1991]. Threshold limit values for chemical substances and physical agents and biological exposure indices 1991-1992. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

13. NIOSH [1990]. NIOSH Pocket Guide to Chemical Hazards. Cincinnati, Ohio: U.S Department of Health and Human Services. Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 90-117.

14. Code of Federal Regulations [1989]. OSHA: Table Z-1. 29 CFR 1910.1000. Washington DC, U.S. Government Printing Office, Federal Register.

15. Kinnes GM [September 26, 1988]. Letter of September 26, 1988, to Donald L. Bright, A.W. Cash Valve Manufacturing Corporation, regarding findings and recommendations from an environmental evaluation conducted on June 14-15, 1988 in Decatur, Illinois. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, Health, Division of Surveillance, Hazard Evaluations, and Field Studies.

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