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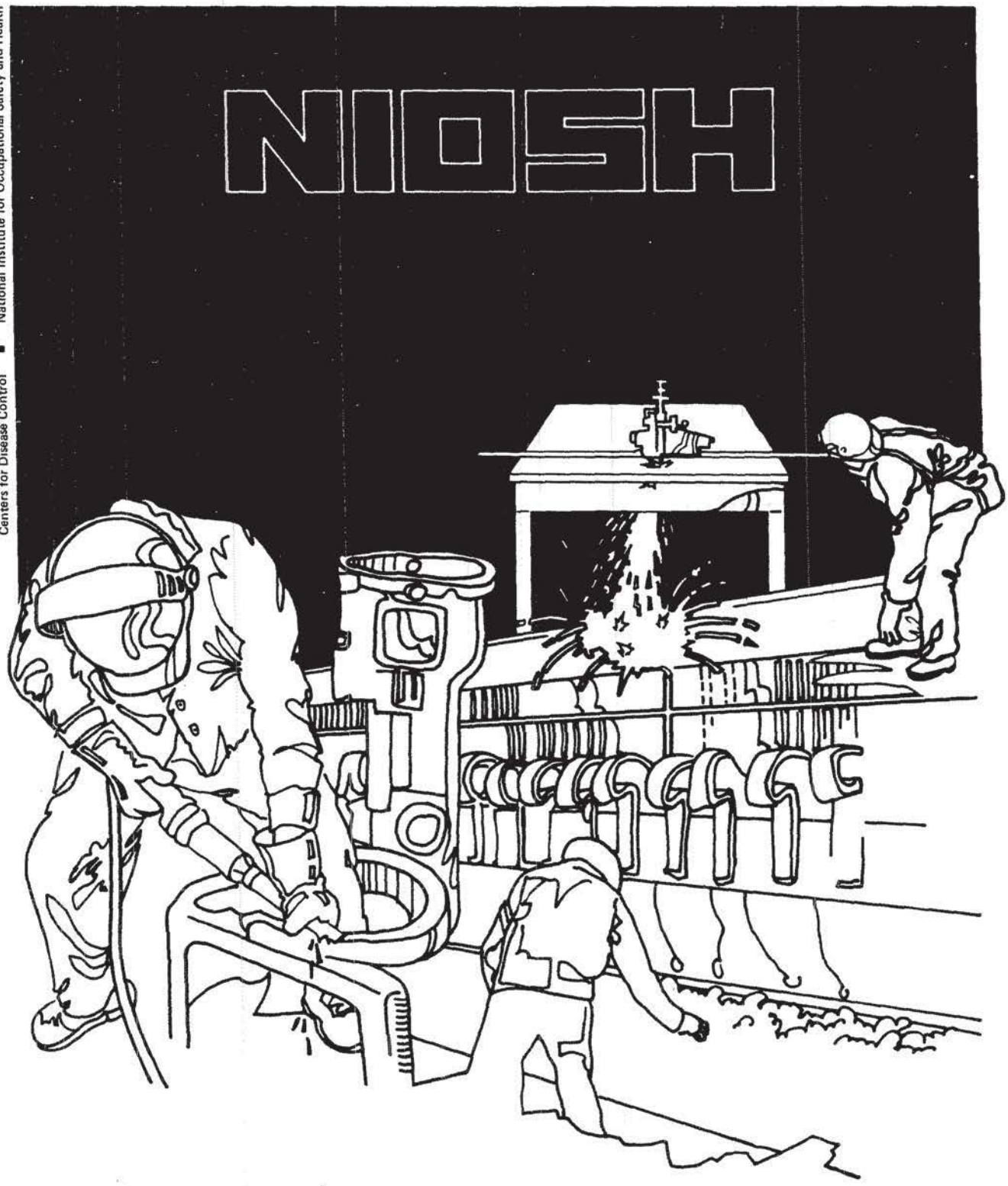

Health Hazard Evaluation Report

HETA 81-053-876
GEORGIA DEPT. OF HUMAN RESOURCES
DRUG ABUSE LABORATORY
ATLANTA, GEORGIA

PREFACE

The Hazard Evaluations and Technical Assistance Branch of 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.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) 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.

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DRUG ABUSE LABORATORY
ATLANTA, GEORGIA

NIOSH INVESTIGATORS:
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I. SUMMARY

On November 20, 1980, the National Institute for Occupational Safety and Health (NIOSH) conducted a health hazard evaluation at the Georgia Department of Human Resources' Drug Abuse Laboratory, in Atlanta, Georgia to evaluate exposures to solvent vapors during solvent extraction and thin layer chromatography analyses of urine samples. Personal and general area air samples were collected on activated charcoal sampling tubes to evaluate the exposures to airborne vapors of methylene chloride, isopropyl alcohol, acetone, and ethyl acetate.

Results of air sampling indicate exposures to solvent vapors during the sampling period were below levels that would be expected to cause adverse health effects. The highest exposures were to methylene chloride during methylene chloride/isopropanol extraction of 212 urine samples, requiring approximately 2 hours. This number was reported to be the maximum number of samples that would be analyzed on any given day. Average methylene chloride concentration during extraction was 110 parts per million (ppm). Assuming no exposure to methylene chloride would occur during the remainder of the shift, this concentration would be equivalent to 28 ppm as an 8-hour time weighted average (TWA). The recommended NIOSH exposure limit is 75 ppm. Under the exposure conditions as found during the NIOSH survey, the NIOSH exposure limit would not be exceeded unless extraction was performed for over 5.5 hours. Exposures to the other solvents evaluated were not significant.

Based on the air sampling results and the short duration of exposure (2 hours), NIOSH has determined that personal exposures to solvent vapors during the extraction and analyses of urine samples in the Drug Abuse Laboratory do not present a health hazard to laboratory technicians. NIOSH does, however, recommend more extensive use of laboratory hoods and proper disposal of waste solvents.

KEYWORDS: SIC 8071, methylene chloride, acetone, isopropyl alcohol, ethyl acetate, laboratory hazards, solvent vapors, solvent extraction

II. INTRODUCTION

On October 27, 1980, an epidemiologist with the Georgia Department of Human Resources, Division of Physical Health, requested a NIOSH health hazard evaluation for their Drug Abuse Laboratory. The lab used methylene chloride, isopropyl alcohol, acetone, and ethyl acetate in the process of preparing urine specimens for examination for evidence of drug abuse. Due to the limited exhaust hood space, some of the work using these organic solvents was done in the open laboratory. The laboratory supervisor had expressed concern whether the exposures to any of these solvents might exceed recommended limits.

NIOSH conducted an industrial hygiene survey at the laboratory on November 20, 1980. The purpose of the study was to collect air samples to measure personal exposures to solvent vapors during normal procedures employed in extraction and analysis of urine samples.

III. BACKGROUND

Personnel assigned to the Drug Abuse Laboratory include the lab supervisor, two lab technicians, one lab associate, and one part-time secretary. The drugs to be analyzed are extracted from urine samples using a mixture of 90% methylene chloride and 10% isopropanol. Two extractions with 12 ml of solvent mixture are required for each sample. Urine samples are contained in plastic elution tubes which are mounted in a support rack holding up to 49 tubes. Each tube contains a cellulose acetate gauze which serves as the adsorbing matrix for the aqueous phase of the urine sample. The non-aqueous phase (solvent extract) is collected in a 30 ml beaker placed under each elution tube. As many as 4 sets of samples (49 samples/set) plus 16 controls are extracted during a 2-hour period requiring a total of 5,088 ml of methylene chloride/isopropanol solvent. The extractions are air dried in the open lab because only one lab hood is available.

The concentrated eluted extracts are then subjected to thin layer chromatography. Two solvent systems are used to give optimum separation of many different drugs. The first (solution A) is 83% ethyl acetate, 13% methanol, and 4% ammonium hydroxide. The second (solution B) is 98% ethyl acetate and 2% methanol. The extracts are placed on 20 X 20 cm silica gel plates. Each plate is placed in a glass rectangular tank containing 150 ml of solution A for 20 minutes and then in a tank containing 150 ml of solution B for 47 minutes. After separation, the plates are air dried and the tanks are emptied in a sink. The separated constituents on the plates are visualized by spraying the plates with special reagents dissolved in acetone and viewed under UV light. All acetone spraying is performed in an exhaust ventilated laboratory hood.

IV. METHODS AND MATERIALS

The extraction procedure was sampled for methylene chloride and isopropanol. The thin layer chromatographic procedure was sampled for acetone and ethyl acetate. Solvent vapor concentrations were determined by collecting personal and area samples on 150 mg charcoal tubes using personal sampling pumps operating at 50 cc/minute flow rates. The samples were analyzed by gas chromatography following a modification of NIOSH P&CAM 127[1] using a Hewlett-Packard gas chromatograph with a flame ionization detector. The limit of detection for methylene chloride and isopropanol was 0.01 mg/sample and for ethyl acetate and acetone, 0.02 mg/sample.

Using a Kurz Model 441 air velocity meter, the efficiency of the laboratory hood used for acetone spraying was checked by measuring the air velocity at nine points along the face of the opening. The door of the hood had been lowered to one foot above the bench, its normal position.

V. EVALUATION CRITERIA

A. Environmental Criteria

The environmental criteria described below are airborne concentration limits of toxic substances and represent conditions under which it is believed that nearly all workers may be exposed without adverse effect. Because of wide variation in individual susceptibility, a small percentage of workers may experience discomfort from some substances at concentrations at or below the permissible limit.

The time-weighted average (TWA) exposure limit refers to the average concentration during a normal 8-hour workday or 40-hour work-week, to which nearly all workers may be repeatedly exposed, without adverse health effects.

The short-term limit should be considered a maximum allowable concentration, or ceiling limit, to which workers can be exposed during a excursion period of up to 15 minutes, without suffering from adverse health effects, provided that no more than four excursions per day are permitted, with at least 60 minutes between excursion periods.[2]

The primary sources of environmental evaluation criteria considered for this study were: 1) NIOSH criteria documents and recommendations, 2) the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV's), and 3) the U.S. Department of Labor (OSHA) federal occupational health standards. The criteria judged most appropriate for this study are as follows:

Substance	Short Term Exposure Limits (15 Min.) (ppm)	8-Hour Time Weighted Average (ppm)	Source
Methylene Chloride	500	75	NIOSH
Isopropyl Alcohol	800	400	NIOSH
Acetone	---	250	NIOSH
Ethyl Acetate	---	400	ACGIH

NOTE: PPM = parts per million parts of air

B. Toxicity

The adverse health effects from excess exposure (exposures to airborne concentrations above the evaluation criteria) are summarized below:

Methylene Chloride

Repeated skin contact with methylene chloride may cause dry, scaly and cracked skin. At high airborne concentrations, vapors are irritating to the eyes and upper respiratory tract. Direct contact with the liquid can cause skin burns. Methylene chloride is a mild narcotic. Effects from intoxication include headache, giddiness, stupor, irritability, numbness, and tingling in the arms and legs. At extremely high concentrations it has caused liver and kidney damage in laboratory animals. Exposure to methylene chloride may cause elevated carboxyhemoglobin levels which may be significant in smokers or workers with anemia or heart disease, and those exposed to carbon monoxide.[3]

No central nervous system or behavioral effects have been reported among workers exposed to concentrations ranging from 100-280 ppm.[4] Various authors have reported different odor thresholds ranging from 25-350 ppm. Sensitivity to the odor is evidently dependent on individual adaptability. The NIOSH recommended exposure limit of 75 ppm was established to prevent interference with oxygen transport in the bloodstream and to prevent abnormalities in the central nervous system.[5] The current OSHA permissible exposure limit is 500 ppm.[6]

Isopropyl Alcohol

Vapors are mildly irritating to the conjunctiva and mucous membranes of the upper respiratory tract. Isopropyl alcohol is potentially narcotic at high concentrations. However, no cases of poisoning from industrial exposure have been recorded for either normal or isopropyl alcohol.[3] The odor threshold is reported to be 40-200 ppm.[3] The NIOSH recommended exposure limit was established to prevent narcosis, although slight upper respiratory irritation may still be experienced.[7] The current OSHA permissible exposure limit is 400 ppm.[5]

Acetone

Acetone has been considered to be a low hazard to health, since few adverse effects have been reported, despite widespread use for many years. Awareness of mild eye irritation occurs at airborne concentrations of about 1000 ppm. Very high concentrations (12,000 ppm) depress the central nervous system, causing headache, drowsiness, weakness, and nausea. Repeated direct skin contact with the liquid may cause redness and dryness of the skin.[4] However, at least 6 studies have been reported in the literature which have documented possible adverse effects on humans at exposures below 1000 ppm. Furthermore, the available evidence indicates that occupational exposure to acetone may lead to its accumulation in the body. NIOSH has therefore recommended lowering the current exposure limit from 1000 ppm to 250 ppm.[8] The current OSHA permissible exposure limit is 1000 ppm.[6]

Ethyl Acetate

Ethyl acetate vapor is irritating to the eyes and respiratory passages of man at concentrations above 400 ppm. In animals it has a narcotic effect at concentrations of over 5000 ppm. Due to its irritating properties, employees will not voluntarily remain in such high concentrations. Animals exposed to lethal concentrations died with pulmonary edema and hemorrhage. This substance is a defatting agent, and prolonged skin contact with the liquid may cause irritation of the skin. Painful conjunctival irritation may occur from splashes in the eye. No chronic systemic effects have been reported in humans. Most reported effects of ethyl acetate are caused by its irritant properties.[9] The ACGIH TLV was established to prevent systemic effects but concentrations at this level may be mildly irritating for some workers unaccustomed to the exposure. The current OSHA permissible exposure limit is 400 ppm.[6]

VI. RESULTS

Two one-hour air samples and one two-hour air sample were taken from the lab technician who was extracting urine samples with the methylene chloride/isopropanol mixture. The average personal exposure during this procedure (2 hours) to methylene chloride was 110 ppm and to isopropanol, 6.4 ppm. The estimated 8-hour time weighted average (TWA) exposure to these solvents was 28 and 1.6 ppm respectively. These exposures were below the evaluation criteria (recommended exposure limit based on a 10-hour time weighted average) of 75 ppm for methylene chloride and 400 ppm for isopropanol. However, the evaluation criteria for methylene chloride would have been exceeded had the extraction procedure been performed for longer than 5.5 hours. The exposures to acetone and ethyl acetate during the thin layer chromatography procedure were not significant.

Acetone spraying was performed inside the lababoratory hood and no exposure was detected on these samples. The average face velocity for this hood of 175 feet per minute was more than adequate for controlling solvent vapor exposures. Ethyl acetate (the major solvent component in the plate tanks) was detected but exposures were well below the evaluation criteria, 19.5 ppm vs. 400 ppm. The results as discussed above are presented on the attached table.

VII. DISCUSSION AND CONCLUSIONS

Based on the air sampling results from this evaluation, NIOSH has determined that personal exposures to solvent vapors during the extraction and analysis of urine samples in the Drug Abuse Laboratory do not present a health hazard to laboratory technicians

VIII. RECOMMENDATIONS

1. An adequate number of laboratory hoods would eliminate the need for a large window exhaust fan and reduce solvent vapor exposures to concentrations below the odor thresholds.

2. Although only small amounts of waste solvents are being dumped down the sink, it is considered good laboratory practice to dispose of these solvents in some other manner. For example, waste solvents from the NIOSH laboratories are hauled away by a solvents reclaiming company.

IX. AUTHORSHIP AND ACKNOWLEDGEMENTS

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X. DISTRIBUTION AND AVAILABILITY

Copies of this report are currently available upon request from NIOSH, Division of Technical Services, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After ninety (90) days the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from the NIOSH Publications Office at the Cincinnati, Ohio address.

Copies of this report have been sent to:

a) Georgia DHR, Division of Physical Health
b) U.S. Departmant of Labor, Region IV
c) NIOSH Region IV
d) Designated State Agencies

For the purpose of informing the approximately 5 "affected employees", the employer will promptly "post" this report for a period of thirty (30) calendar days in a prominent place(s) near where the affected employees work.

XI. REFERENCES

1. NIOSH Manual of Analytical Methods, Second Edition. DHEW (NIOSH) Publication No. 77-157-A, Cincinnati, Ohio: NIOSH; 1977

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5. Criteria for a Recommended Standard, Occupational Exposure to Methylene Chloride. DHEW (NIOSH) Publication No. 76-138, Cincinnati, Ohio: NIOSH; 1976.

6. Occupational Safety and Health Administration "General Industry Standards" (29 CFR 1910)

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9. NIOSH/OSHA Standards Completion Program, Draft Technical Standard and Supporting Documentation for Ethyl Acetate, Appendix C, Medical Surveillance Guidelines.

DRUG ABUSE LABORATORY
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ATLANTA, GEORGIA
HETA 81-053

SOLVENT VAPOR CONCENTRATIONS

November 20, 1980

Methylene Chloride Extraction

Type Sample	Sampling Time	Sample Volume (liters)	Airborne Concentration Methylene Chloride (ppm)	Isopropanol (ppm)
area	9:27am-11:11am	5.3	173	5
personal	9:16am-11:18am	6.7	116	6
personal	9:16am-10:26am	3.5	131	12
personal	10:26am-11:18am	2.6	68	ND
Average personal exposure for duration of sampling period =			110	6.4
8 hour time weighted average (TWA) = (assuming zero exposure for remainder of work shift)			28	1.6
Evaluation Criteria: Short Term Exposure Limit (STEL) =			500	800
8-hour time weighted average =			75	400

Thin Layer Chromatography Procedure

Type Sample	Sampling Time	Sample Volume (liters)	Airborne Concentration Acetone (ppm)	Ethyl Acetate (ppm)
area	9:37am-10:45am	3.7	ND	ND
personal	9:34am-10:43am	3.5	ND	19
personal	9:34am-10:43am	3.5	ND	20
Average personal exposure for duration of sampling period =			NONE	19.5
8 hour time weighted average (TWA) = (assuming zero exposure for remainder of work shift)			NONE	2.8
Evaluation Criteria: Short Term Exposure Limit (STEL) =			---	---
8-hour time weighted average =			250	400

ppm = parts of vapor per million parts of air
ND = none detected

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