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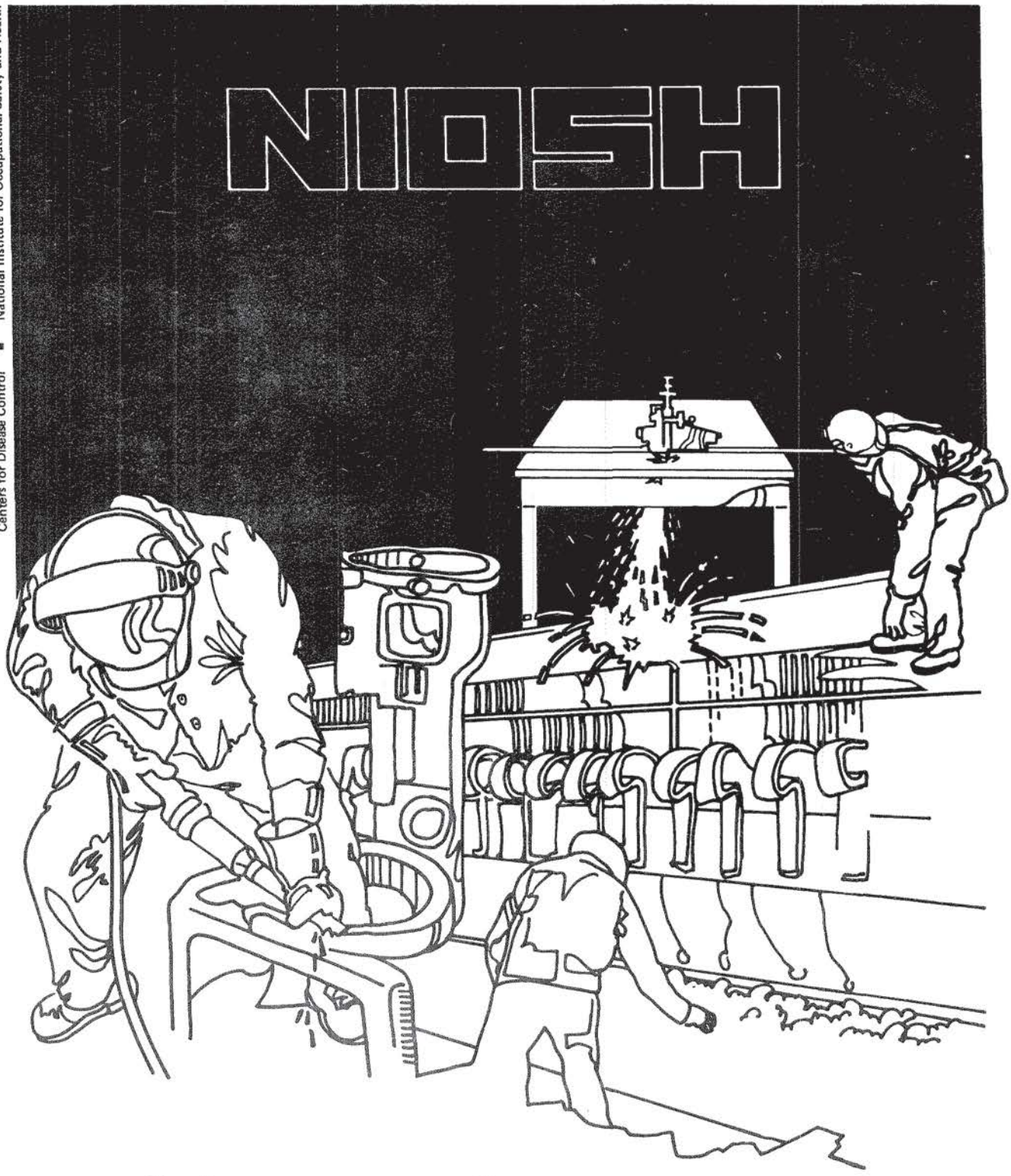

Health Hazard Evaluation Report

HETA 81-189-929
SCHOOL OF DENTAL MEDICINE
UNIVERSITY OF PENNSYLVANIA
PHILADELPHIA, PENNSYLVANIA

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.

HETA 81-189-929
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School of Dental Medicine
University of Pennsylvania
Philadelphia, Pennsylvania

NIOSH Investigators:
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I. SUMMARY

In February, 1981, the National Institute for Occupational Safety and Health (NIOSH) received a request from dental students at the School of Dental Medicine, University of Pennsylvania, to evaluate possible health hazards from student exposures to methyl methacrylate vapor (during bridge work) and mercury vapor (during filling work). The students (160 potentially exposed) believed that the percent ventilation system in preclinical laboratories B-1 and B-2 may not be effective in removing air contaminants.

Personal air samples for methyl methacrylate (4 samples) and mercury (6 samples) were collected on March 26, and May 4, 1981, respectively. Methyl methacrylate concentrations were found to range from 0.02 to 0.19 ppm. Mercury vapor concentrations ranged from 0.016 to 0.127 mg/M^3. One mercury air sample was above and the rest were well within the environmental criteria used in this report.

Interviews with various students revealed that several individuals who had eye irritation and fatigue from working with or around methyl methacrylate. In work done with mercury it was felt by the students that there the ambient air was "stuffy" and hot due to insufficient ventilation, overcrowding and the use of "hot" lamps to illuminate their work.

Based on the data obtained in this study, NIOSH determined that a health hazard of methyl methacrylate exposure did not exist at the time of our environmental sampling. However, a potential health hazard may exist with regard to mercury vapor exposure. Recommendations for work practice, hygiene, clean-up procedures and ventilation control to help improve the workers' environment are included at the end of this report.

KEYWORDS: SIC 8221 (Dental School), Methyl Methacrylate, Mercury

II. INTRODUCTION

Under the Occupational Safety and Health Act of 1970, NIOSH investigates the toxic effects of substances found in the workplace.

On February 23, 1981, NIOSH received a request from the students at the University of Pennsylvania, Medical Dental School in Philadelphia, Pennsylvania, for a health survey of the Preclinical Laboratories B-1 and B-2. Methyl methacrylate and mercury are used quite frequently in classes where bridge work and filling work is studied and practiced. The students are concerned with the potential health effects from use of these substances.

III. BACKGROUND

Crown and Bridge Class - involves the construction or reconstruction of the tooth crown and/or bridge using an acrylic material. Free methacrylate monomer and pre-polymerized methacrylate polymer is used to form an acrylate polymer structure that is then cut, ground and polished.

Cutting, Preparation and Polishing of Fillings Class - mercury is used in an amalgam with tin, copper, and zinc metals. These fillings are then cut and ground to a desired configuration.

Mercury and its amalgamate components are stored in a small ampoule with separate compartments. A center barrier is broken to mix the separate parts in the ampoule. This configuration minimizes exposure to mercury vapor and prevents spillage. Used ampoules are placed in a container of water to minimize vaporization of mercury.

On the day of air sampling for methyl methacrylate (March 26, 1981), Preclinical Labs B-1 and B-2 were one room. However, on the day of mercury vapor sampling (May 4, 1981) Preclinical Lab B-1 (center doors closed) was closed off from Lab B-2. One-hundred and sixty (160) students occupied the B-1 and B-2 Labs on 3-26-81 and 65 students occupied B-1 on 5-4-81. The B-1 and B-2 Labs measure about 50' x 75' x 10' together and are half that with the center door closed.

IV. EVALUATION DESIGN AND METHODS

A. Design

On March 26, 1981 and April 4, 1981, ventilation and environmental measurements were taken in the Preclinical Laboratories B-1 and B-2 for methyl methacrylate and mercury vapors, respectively. Personal and area samples were taken throughout the classroom based on equal distribution locationally; the most poorly ventilated areas and in the breathing zone of student volunteers.

Environmental

1. B-1 and B-2 Preclinical Laboratory - bridge and crown work done using methyl methacrylate polymer offers potential exposure to the monomer vapor. On March 26, 1981, four personal air samples and one area sample were taken over an approximate three-hour period.

2. B-1 Preclinical Laboratory - filling and cutting work done using mercury and its amalgamate offers potential exposure to mercury vapor. On April 4, 1981, six personal air samples were taken over an approximate two-hour period.

B. Evaluation Methods

Environment

1. Methyl Methacrylate - was sampled using porous polymer tubes and personal air sampling pumps at a flow rate of 100 cc/minute.

Porous polymer tubes were analyzed according to NIOSH Method S-43 (modified) using a Hewlett-Packard 5830A gas chromatograph with a flame ionization detector.

The samples were separated into A and B sections and desorbed in 1 mL carbon disulfide containing 1 uL/mL benzene as internal standard. A 6' x 1/8" stainless steel column packed with 5% FFAP on 40/60 Chromosorb T was used at an oven temperature of 80°C (isothermal).

The limit of detection for methyl methacrylate was 0.01 mg/sample.

2. Mercury - was sampled using personal passive mercury vapor dosimeters. These devices contain a thin gold foil which forms an amalgamate with the mercury in the air. The pre-weighed gold foil is weighed after sampling to determine the amount of mercury amalgamated with the foil. Using the time of exposure and the weight plus a contamination index, a concentration in mg/m^3 is determined as an eight-hour time weighted average.

Ventilation

Air velocity measurements taken on both sampling days revealed less than 25 feet/minute of air movement at the face of the ventilation air supply lowers. However, on the day of methyl methacrylate sampling an air draft was created by opening a rear door entry to the outside air; this was not normal practice and would create a very cold environment during the winter season. For all intents and purposes a "stagnant" air quality exists with the current general ventilation system.

V. EVALUATION CRITERIA (Refer to Table 1) 4-6

The environmental evaluation criteria used for this study and the current OSHA standards, are presented in Table 2.

Toxicology 1-3

Mercury (Exposure may occur through inhalation, skin absorption or ingestion)

Mercury is a primary irritant of skin and mucous membranes. It may occasionally be a skin sensitizer.

Systemic -

Acute poisoning due to mercury vapors affects the lungs primarily, in the form of acute interstitial pneumonitis, bronchitis, and bronchiolitis.

Exposure to lower levels over prolonged periods produces symptom complexes that can vary widely from individual to individual. These may include weakness, fatigability, loss of appetite, loss of weight, insomnia, indigestion, diarrhea, metallic taste in the mouth, increased salivation, soreness of mouth or throat, inflammation of gums, black line on the gums, loosening of teeth, irritability, loss of memory, and tremors of fingers, eyelids, lips, or tongue. More extreme irritability, excitability, anxiety, delirium with hallucinations, melancholia, or manic depressive psychosis. In general, chronic exposure produces four classical signs: gingivitis, sialorrhea, increased irritability, and muscular tremors. Rarely are all four seen together in an individual case.

Either acute or chronic exposure may produce permanent changes to affected organs and organ systems.

Methyl Methacrylate -

Inhalation of the vapor causes salivation, conjunctual irritation, and marked respiratory irritation or pulmonary edema at high concentrations. It is an irritant to the eyes, mucous membranes and skin dermatitis has occurred from skin contact with the liquid.

VI. RESULTS AND DISCUSSION

A. Environmental (Refer to Table 2)

Results of the methyl methacrylate air sampling show concentration values ranging from 0.02 ppm to 0.19 ppm of vapor. The limit of detection is 0.01 mg.

Results of the mercury vapor air samples show time-weighted average concentration values ranging from 0.016 mg/m^3 to 0.127 mg/m^3 with no contamination problems.

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All air samples were well within the environmental standards and criteria except for one personal mercury dosimeter reading at 0.127 mg/m^3.

Why this one sample was an order of magnitude above the others is speculative at this point. A heavier work load involving the mercury and the amalgamate or point source contamination of mercury at this particular bench location are probable factors.

VII. RECOMMENDATIONS

1. Bottles of methacrylate monomer should be closed when not in use to minimize vaporization into the ambient air.

2. Waste and scrap mercury and mercury analgamate should be disposed of quickly in a container of water to minimize vaporization into the ambient air.

3. Spills of methyl methacrylate and mercury should be cleaned up with appropriate absorbing agents and placed in closed containers; all work should be done on smooth stainless steel work surfaces to prevent absorption in the event of a spill.

4. When compounding and preparing these substances, protective and impervious gloves should be used to prevent skin absorption. Where this is not feasible, the student should wash the affected skin areas with soap and water as soon as possible.

5. General ventilation in the B-1 and B-2 Preclinical Labs is not sufficient for the operations performed and should be increased to about ten changes of air per hour.

VIII. AUTHORSHIP AND ACKNOWLEDGEMENTS

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6. Health Hazard Evaluation Determination Report HETA 81-189

IX. REFERENCES

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3. Occupational Diseases - A Guide to Their Recognition, Revised Edition, June 1977, U.S. HEW, PHS, CDC, NIOSH.

4. Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes for 1980, American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio.

5. General Industry, OSHA Safety and Health Standards, 29 CFR 1910, OSHA 2206, revised January 1976.

6. Industrial Ventilation - A Manual of Recommended Practice, 15th Edition, 1978, American Conference of Governmental Industrial Hygienists.

X. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

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

Copies of this report have been sent to:

1. University of Pennsylvania Medical Dental School, Philadelphia, Pennsylvania

2. Students Requesters of the University of Pennsylvania Medical Dental School

3. NIOSH, Region III

4. OSHA, Region III

For the purpose of informing the affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees, for a period of 30 calendar days.

TABLE I

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School of Dental Medicine
University of Pennsylvania
Philadelphia, Pennsylvania

Evaluation Criteria
Permissible Exposure Limits

Substances	NIOSH	OSHA	ACGIH
Mercury	0.05 mg/m^3 - HR TWA*	0.1 mg/m^3 - 8 HR TWA	0.05 mg/m^3 - 8 HR TWA 0.15 mg/m^3 - STEL**
Methyl Methacrylate	--	100 ppm - 8 HR TWA	100 ppm - 8 HR TWA 125 ppm - STEL

*TWA = Time-Weighted Average

**STEL = Short-term Exposure limit

TABLE 2

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University of Pennsylvania
Philadelphia, Pennsylvania

Substance	Location/Operation	Sampling Time	8 Hr. TWA* Concentration
Mercury (3-26-81)	SEAT 21	1.93 HRs.	0.016 mg/m^3
	SEAT 146	2.15	0.019
Personal air samples Filling, cutting and preparation operations using mercury and the amalgamates for tooth fillings.	SEAT 4	2.13	0.017
	SEAT 15	2.17	0.023
	SEAT 32	2.07	0.127 +
	SEAT 38	2.25	0.032
Methyl Methacrylate (5-4-81)			
Three unit bridge work done in acrylic.	Personal - SEAT F-70	161 mins.	0.03 ppm
	Personal - SEAT 31	174	0.03
	Personal - SEAT 161	167	0.19
	Personal - SEAT 76	168	0.02
	Area - Rows-Middle	161	0.02

*TWA = Time-Weighted Average (based on 8-HR Exposure)

**PPM = Parts per million

\+ = Two HR plus exposure corrected for 8 HR TWA - Can assume no further exposure for six HRS since class is only held for a two-hr. period.

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