U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
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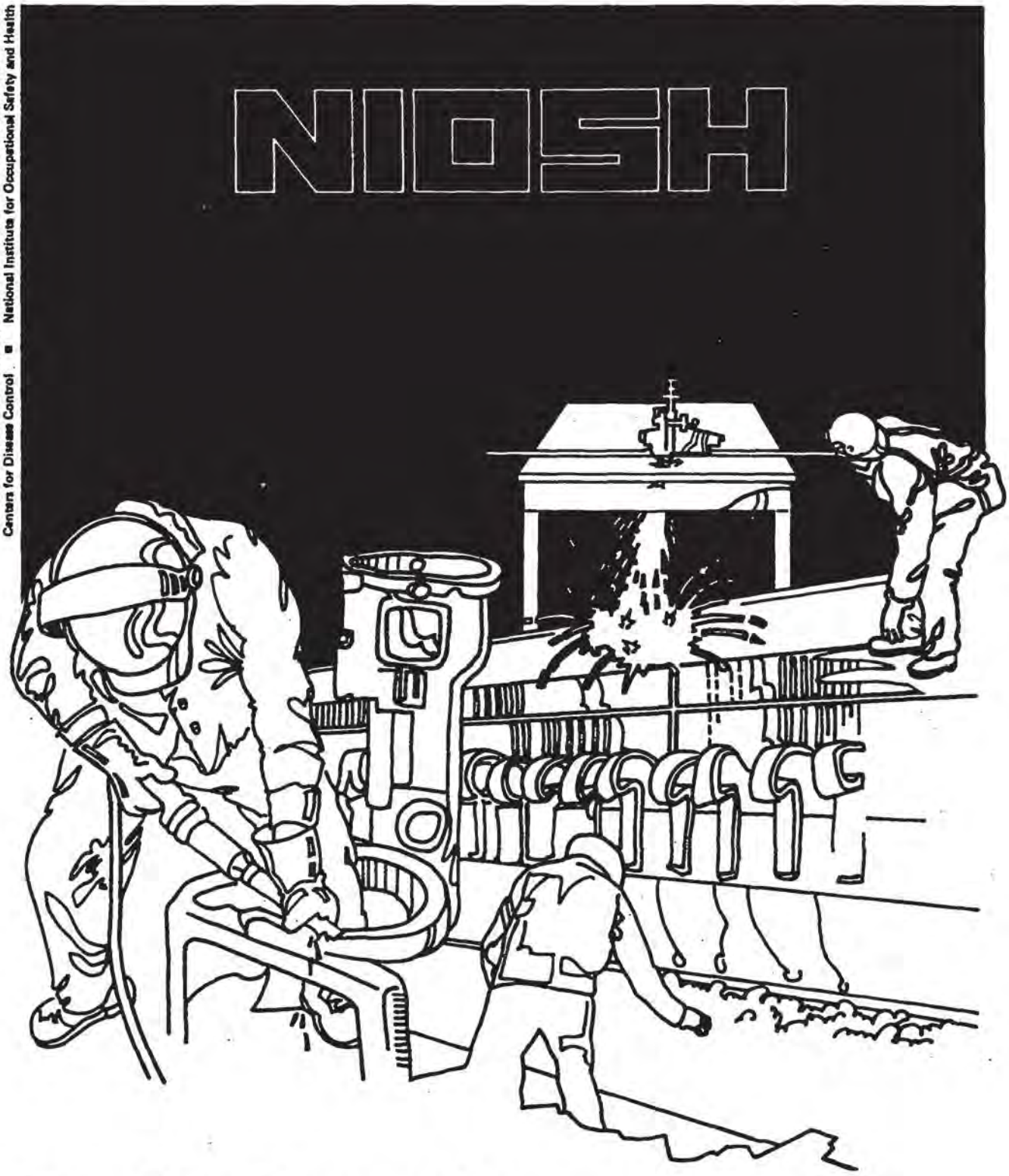

Health Hazard Evaluation Report

HETA 81-326-1247
COLUMBIA COLLEGE
COLUMBIA, MISSOURI

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 81-326-1247
JANUARY 1983
COLUMBIA COLLEGE
COLUMBIA MISSOURI

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I. SUMMARY

In May 1981, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Art Department at Columbia College to conduct a health hazard evaluation of their classes. In Fall 1981, a preliminary visit identified two classes (photography and sculpturing) and several compounds for follow-up evaluation. On May 11, 1982, NIOSH conducted an industrial hygiene evaluation of the photography class for airborne levels of 2-ethoxyethanol vapor and p-toluene sulfonic acid gas. On May 12, the sculpturing class was evaluated for airborne levels of styrene and methyl ethyl ketone peroxide vapors.

For the photography class, the airborne levels of 2-ethoxyethanol and p-toluene sulfonic acid were all non-detectable. For the sculpturing class the concentrations of methyl ethyl ketone peroxide were non-detectable, while the levels of styrene ranged from 0.81 to 3.02 ppm. The permissible exposure levels for these substances are: 2-ethoxyethanol [50 parts per million (ppm)], methyl ethyl ketone peroxide (0.2 ppm), styrene (50 ppm). Currently, there is no exposure level criterion for p-toluene sulfonic acid.

Students in the photography class reported having previously experienced eye, nose, and skin irritation, and occasional headaches. Students in the sculpturing class reported having experienced nausea, dizziness, and headaches.

The discrepancy between reported symptoms and the apparent low levels of contaminants may be explained by several factors. First, there were fewer students in class because final exams were being taken at the time of this hazard evaluation. Fewer students mean fewer sources of contaminant generation. Second, although there were no overexposures to the four sampled chemicals, there may be other unidentified substances or mixtures of chemicals which may be causing irritation. Finally, because only one student was sampled in each class and because of inherent variability in sampling results, the measured levels of airborne contaminants may not be representative.

Based on the results of this study, students and faculty were not found to be exposed to excessive levels of 2-ethoxyethanol and p-toluene sulfonic acid in the photography class, nor to styrene and methyl ethyl ketone peroxide in the sculpturing class. Recommendations for improving work practices, personal protective equipment and controls for exposure to airborne contaminants are made in Section VII of this report.

KEYWORDS: SIC 8221 (colleges, universities, and professional schools); 2-ethoxyethanol, p-toluene sulfonic acid, styrene, methyl ethyl ketone peroxide, art

II. INTRODUCTION

In May, 1981, NIOSH received a request from the Art Department at Columbia College to conduct a hazard evaluation of their classes. In fall, 1981, a preliminary visit identified two classes (photography and sculpturing) and several compounds for follow-up evaluation. During the follow-up study, in May 1982, the photography class was evaluated for airborne levels of 2-ethoxyethanol and p-toluene sulfonic acid. Airborne levels of styrene and methyl ethyl ketone peroxide were measured in the sculpturing class.

III. BACKGROUND

A. Photography Class

The photography class was evaluated for exposure to 2-ethoxyethanol and p-toluene sulfonic acid during color print-making using Kodak's Cibachrome™ color process. The Cibachrome™ color process involves four-three minute steps: 1. developing, 2. bleaching, 3. fixing, and 4. washing. The first three steps require the mixing of packages of dry chemicals with water. The fourth step is a water rinse only. The mixing of chemicals and the four step color processing are performed in a non-ventilated darkroom. Normally, there is one student working in the darkroom, once or twice per week for about 2 hours, on film-developing projects.

The sculpturing class was evaluated for styrene and methyl ethyl ketone peroxide during sculpting using a polyester resin compound containing styrene. The sculpturing process involved the hand molding of this compound into the final form. The molding is performed in a small ventilated room. Usually, two to three students work in this room, twice per week for about 3 hours, on sculpture projects.

Several methods of hazard control were being used to reduce exposure in the styrene sculpturing class. First, the styrene sculpturing process was enclosed in a small (8' x 12') room, thereby isolating the process from the main sculpture room. In addition, the small styrene sculpture room was ventilated using a window fan to exhaust vapors to the outside air. Also half-mask respirators with organic vapor cartridges and dust filters were worn during the sculpturing process to reduce the inhalation of contaminants. Finally, protective eye-wear and gloves were worn to minimize exposure.

IV. EVALUATION DESIGN AND METHODS

Environmental air sampling was conducted in the photography class on May 11, 1982, and in the sculpturing class on May 12, 1982. In the photography class, four area and one personal breathing zone air samples for p-toluene sulfonic acid were collected for approximately 2 hours using impingers with sodium hydroxide solution at a flowrate of 2.0 liters per minute (lpm). Five area and one personal breathing zone air samples for 2-ethoxyethanol were collected for approximately 2 hours on charcoal tubes at flowrates between 50 and 100 cubic centimeters per minute (cc/min). The p-toluene sulfonic acid samples

were analyzed by a contract laboratory utilizing liquid chromatography with an ultraviolet detector. The 2-ethoxyethanol samples were analyzed by gas chromatography according to NIOSH Method S-361.

In the sculpturing class, four area and one personal breathing zone air samples were collected for methyl ethyl ketone peroxide for approximately 2 hours using impingers with dimethylphthalate solution at a flowrate of approximately 1.5 lpm. Four area and two personal breathing zone air samples for styrene were collected for approximately 2 hours on charcoal tubes at flowrates between 50-100 cc/min. The methyl ethyl ketone peroxide samples were analyzed by colorimetric technique according to NIOSH Method 331. The styrene samples were analyzed by gas chromatography according to NIOSH Method S-30.

V. EVALUATION CRITERIA

The environmental evaluation criteria considered in this report as related to airborne exposures to toxic substances are: 1. NIOSH recommended standards, 2. Federal Occupational Health Standards (as promulgated and enforced by the Occupational Safety and Health Administration (OSHA), U.S. Department of Labor (29 CFR 1910.1000), and/or 3. American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV's). Listed below are the evaluation criteria for the sampled substances in this evaluation.

Substance	Environmental Exposure Limit	Source	OSHA Standard
p-toluene sulfonic acid	-	-	-
2-ethoxyethanol	50 ppm	ACGIH	200 ppm
methyl ethyl ketone peroxide	0.2 ppm	ACGIH	-
styrene	50 ppm	ACGIH	100 ppm

Currently there is no environmental evaluation criterion for p-toluene sulfonic acid. However, the "1980 Registry of Toxic Effects of Chemical Substances"[1] indicates an oral LD_{50} for rats of 2480 mg/kg. By ingestion, this substance is considered slightly toxic.[2]

VI. RESULTS AND DISCUSSION

In the photography class, a total of five air samples were collected for p-toluene sulfonic acid. The one personal and four area samples showed non-detectable (<7.5 ug levels per sample) of p-toluene sulfonic acid for all five samples. These non-detectable levels correspond to air concentrations of less than 0.01 ppm. Also, a total of six air samples were collected for 2-ethoxyethanol and showed non-detectable (<0.01 mg per sample) levels. These non-detectable levels correspond to air concentrations of less than 0.5 ppm (environmental limit - 50 ppm). The environmental results for these substances are presented in Table I.

In the sculpturing class, a total of six air samples were collected for styrene. The two personal samples showed concentrations of 2.9 and 3.0 ppm, while the four area samples ranged from 0.87 to 1.1 ppm (environmental limit - 50 ppm). Also, a total of five air samples was collected for methyl ethyl ketone peroxide. The one personal and four area samples showed non-detectable (<30 mg per sample) levels. For all five samples, these levels correspond to air concentrations of less than 0.02 ppm (environmental limit - 0.2 ppm). The environmental results for styrene and methyl ethyl ketone peroxide are presented in Table II.

The student interviewed from the photography class has experienced eye, nose, and skin irritation, and occasional headaches. Both students interviewed from the sculpturing class indicated that they and other members of the class have experienced nausea, dizziness, and headaches.

The discrepancy between reported symptoms and the apparent low levels of contaminants may be explained by several factors. First, there were fewer students in class because final exams were being taken at the time of this hazard evaluation. Fewer students mean fewer sources of contaminant generation. Second, although there were no overexposures to the four sampled chemicals, there may be other unidentified substances or mixtures of chemicals which may be causing irritation. Finally, because only one student was sampled in each class and because of inherent variability in sampling results, the measured levels of airborne contaminants may not be representative. In addition to sampling variability, there is inherent variability in human sensitivity to contaminants.

VII. CONCLUSIONS

The data collected during this study indicate that students and faculty in the photography class were not exposed to excessive airborne levels of 2-ethoxyethanol and p-toluene sulfonic acid. However, skin, eye, nose, and respiratory irritations have been commonly noticed among people working with Cibachrome™ film developing materials. This irritation probably results from exposure to a mixture of substances in the Cibachrome™ process. 2-ethoxyethanol and, presumably, p-toluene sulfonic acid can enter the body by inhalation and through the skin.

In animal experiments, 2-ethoxyethanol has caused liver, kidney, and lung damage, anemia, and eye irritation.[3] Therefore, even though air concentration values for both substances were low, every effort should be made to reduce exposure as a result of inhalation and skin contact.

The data from this study also indicate that students and faculty in the sculpturing class are not exposed to excessive airborne levels of styrene and methyl ethyl ketone peroxide. However, eye, nose, throat, and skin irritation are common effects from over-exposure to both substances.[3] Also, excessive exposure to styrene vapors may cause headaches, dizziness, nausea, and light-headedness. These symptoms will be exacerbated by alcohol consumption. Consequently, every effort should be made to reduce exposure as a result of inhalation and skin contact.

VIII. RECOMMENDATIONS

A. Photography Class

1. Local exhaust ventilation should be installed to help control the vapors from chemical mixtures used in photography development. A hooded ventilation system would be particularly effective.

2. For those people particularly sensitive to the photographic chemicals, protective clothing may be necessary. For example, those with sensitive skin should wear protective gloves, while people suffering from respiratory irritation may require a half-mask respirator with organic vapor cartridges.

3. To minimize the possible ingestion of contaminants, there should be no eating, drinking, or smoking during film development.

B. Sculpturing Class

1. To help minimize the number of people exposed and the contaminant concentrations, time schedules should be arranged so that only one person, not the usual two to three people, is sculpturing in the room at one time.

2. To ensure proper functioning, respirators should be periodically inspected for mechanical integrity. Also, the respirator filter media should be changed periodically.

3. To reduce the level of vapor exposure, containers of organic materials should always be covered.

4. Because of flammability and the possible explosive nature of the materials, heaters should not be used inside the small sculpture room.

C. General

1. One faculty member should be assigned the responsibility for safety and health at the Art Department, Columbia College. This person would be responsible for monitoring and providing safe and healthful work practices, protective clothing, adequate engineering controls such as ventilation, and general hazard control methods.

2. Since faculty and staff are exposed to a variety of potentially hazardous materials, it is important that periodic physical examinations focus on the particular contaminants to which they are exposed. For example, if one were exposed to styrene vapors, analysis of urine samples for metabolites of styrene would be recommended.

IX. REFERENCES

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IX. AUTHORSHIP AND ACKNOWLEDGEMENTS

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XI. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from NIOSH Publications Office at the Cincinnati address. Copies of this report have been sent to:

1. Chairman, Art Department, Columbia College
2. NIOSH, Region VII
3. OSHA, Region VII

For the purpose of informing 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

Photograph Class

Columbia College
Columbia, Missouri
HETA 81-326

May 11, 1980

DATE	SAMPLE LOCATION	P-TOLUENE SULFONIC ACID SAMPLING PERIOD	CONCENTRATION
5/11/82	Student	16:17-18:20	<0.01[1]ppm
5/11/82	Area #1	16:18-18:17	<0.01[1]ppm
5/11/82	Area #2	16:18-18:13	<0.01[1]ppm
5/11/82	Area #3	16:55-18:15	<0.01[1]ppm
5/11/82	Area #4	16.18-18:16	<0.01[1]ppm

DATE	SAMPLE LOCATION	2-ETHOXYETHANOL SAMPLING PERIOD	CONCENTRATION
5/11/82	Student	16:17-18:20	<0.50[2]ppm
5/11/82	Area #1	16:18-18:20	<0.50[2]ppm
5/11/82	Area #2	16:18-18:15	<0.50[2]ppm
5/11/82	Area #3	16:18-18:16	<0.50[2]ppm
5/11/82	Area #4	16:18-18:13	<0.50[2]ppm
5/11/82	Area #5	16:18-18:17	<0.50[2]ppm

1 All samples less than limit of detection (7.5ug per sample)
2 All samples less than limit of detection (0.01mg per sample)

TABLE II

Sculpturing Class

Columbis College
Columbis, Missouri
HETA 81-326

May 12, 1982

DATE	SAMPLE LOCATION	STYRENE SAMPLING PERIOD	STYRENE CONCENTRATION
5/12/82	Student #1	10:38-12:19	3.0ppm
5/12/82	Student #2	10:38-12:19	2.8ppm
5/12/82	Area #1	10:39-12:19	1.1ppm
5/12/82	Area #2	10:39-12:19	1.2ppm
5/12/82	Area #3	10:39-12:19	0.81ppm
5/12/82	Area #4	10:39-12:19	0.87ppm

DATE	SAMPLE LOCATION	METHYL ETHYL KETONE PEROXIDE SAMPLING PERIOD	METHYL ETHYL KETONE PEROXIDE CONCENTRATION
5/12/82	Student #1	10:38-12:47	<0.02[1]ppm
5/12/82	Area #1	10:38-12:45	<0.02[1]ppm
5/12/82	Area #2	10:38-12:46	<0.02[1]ppm
5/12/82	Area #3	10:38-12:47	<0.02[1]ppm
5/12/82	Area #4	10:38-12:44	<0.02[1]ppm

1 All samples less than limit of detection (30ug per sample)