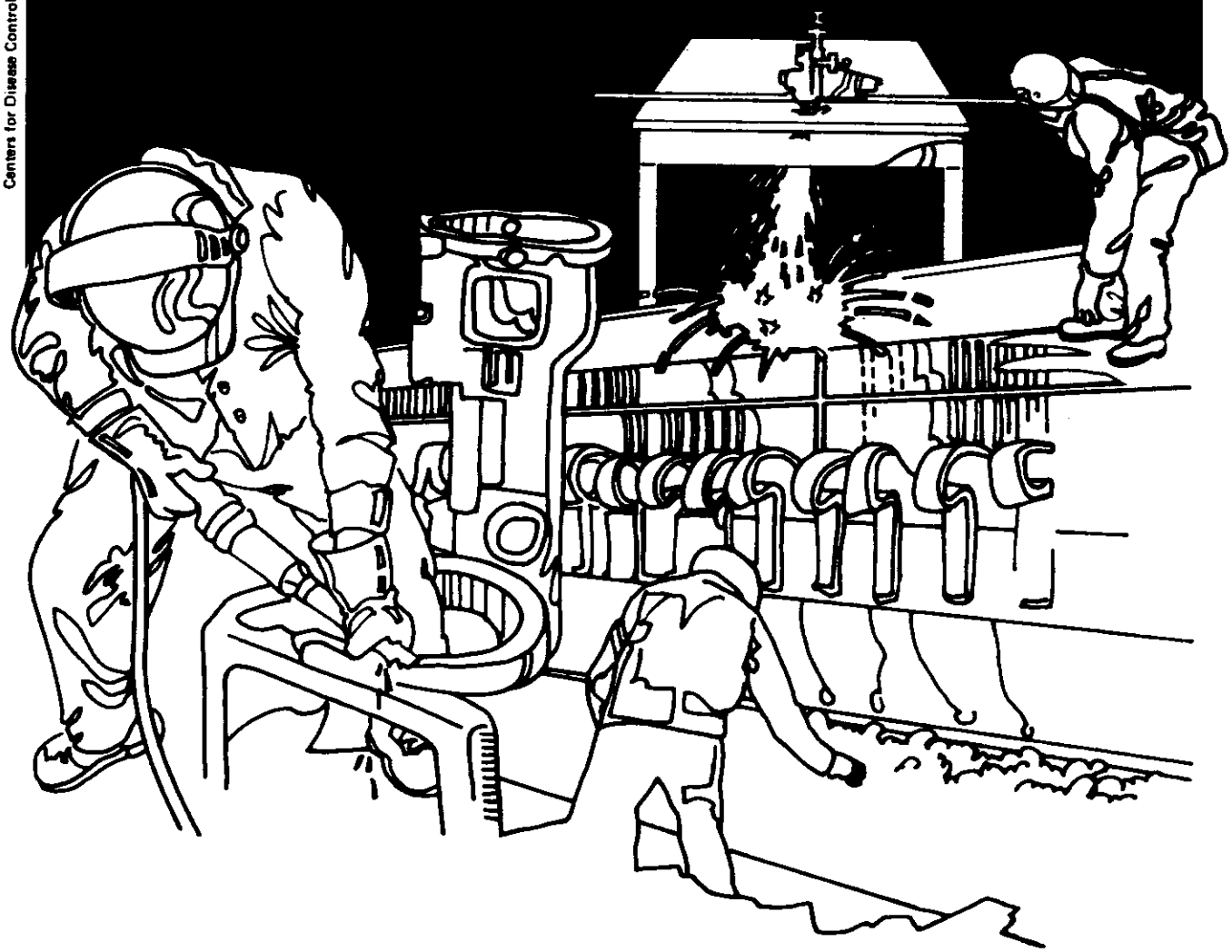
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health

NIOSH



Health Hazard Evaluation Report

HETA 89-222-2098
CORNELL UNIVERSITY
ITHACA, NEW YORK

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 and 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 89-222-2098
FEBRUARY 1991
CORNELL UNIVERSITY
ITHACA, NEW YORK

NIOSH INVESTIGATOR:
Edward A. Kaiser, Ph.D.

I. SUMMARY

On April 24, 1989, the National Institute for Occupational Safety and Health (NIOSH) received a request from Local 2300, The United Auto Workers Union, Ithaca, New York, to conduct a Health Hazard Evaluation (HHE), in assessment of employee exposures to wax fume, glue solvent and adhesive vapors. In particular, the request sought to determine if charcoal filter respirators were providing adequate protection against exposure to wax fume and organic hydrocarbon vapors among employees monitoring book binding operations and printing press procedures.

On August 30, 1989, a NIOSH industrial hygienist conducted a site visit to gather background information and conduct environmental air-monitoring. Paraffin fume concentrations in the book binding room ranged from 0.2 milligrams per cubic meter (mg/M^3) to 1.3 mg/M^3 (criterion - OSHA - 2.0 mg/M^3). A trace amount of aliphatic hydrocarbons was also detected but was at levels below the limit of quantitation of 0.8 mg/M^3.

Airborne concentrations of hydrocarbons (petroleum distillates) in the printing room ranged from 186 mg/M^3 to 210 mg/M^3, (criterion - NIOSH - 350 mg/M^3).

Based on the results of the environmental survey, it was concluded that a health hazard does not exist from employee exposure to paraffin wax fume or petroleum solvents. However, recommendations are included in the body of this report, which are designed to further reduce employee exposure to these fumes and vapors.

KEYWORDS: SIC 2752 (printing, lithographic), naphtha, letter-press, petroleum-distillates, paraffin, wax.

II. INTRODUCTION

On April 24, 1989, the National Institute for Occupational Safety and Health (NIOSH) received a request from a representative of the United Auto Workers Union (UAW), Local 2300, Ithaca, New York, to conduct a Health Hazard Evaluation (HHE) to investigate employee exposures to waxes, organic solvents, glues and adhesives, in the University book binding room and printing shop at Cornell University. Employees complained of frequent and excessive exposures to these toxic agents; in particular to "smoke" released from the glue pot, and organic vapor from agents used in the printing shop. Specifically, the requester was interested in whether improvements should be made to remove the smoke produced by the glue pot operations, and if management-supplied air purifying respirators were adequate in protecting employees from potential health effects associated with wax fume and organic vapor exposures. NIOSH conducted a site visit on August 30, 1989, to gather background information and to conduct an environmental air-monitoring survey.

III. BACKGROUND

The structure housing both the book binding room and the printing room was built in the early 1930's, and is constructed of brick and concrete block. There is no mechanical ventilation in the binding room except for two portable fans which are placed at the door entrance to this room and in a window opening. The fans are used whenever the book binding operation occurs, which is approximately 1 or 2 times a month for approximately 6 to 8 hours. The book binding room (#47) is 188 square feet in area with 12 foot ceilings. One full-time employee operates the book binding press, a Ros Back, 8-80 Perfect Binder.

The printing room has between 3 and 6 full-time employees. Printing presses are Davidson 702 Perfecter presses. The ventilation consists of an air-conditioning unit, Liebert Corporation, which only recirculates conditioned room air. Air filters on this unit are changed annually. There is also a dehumidification system associated with the air-conditioning unit. The drip pan associated with this unit had standing stagnant condensate (exit holes for the condensate to the drainage system were plugged).

Initially the product used in book binding operations was termed hot melt adhesive, produced by U.S. Adhesives Company, product code HM-611 Adh. The use of this product was discontinued in May, 1989; a substitute product, HM 2448, produced by H.B. Fuller Company, has been used since May. This product is called a thermoplastic adhesive, which contains petroleum wax.

In all areas surveyed employee smoking was observed. In the printing room a flammable liquid storage cabinet was observed which contained more than 60 gallons of flammable liquid, which exceeded Underwriters Laboratory specifications.

Employees in both the book binding room and the press room are supplied with 3M - 9913 dust/mist respirators (NIOSH Certification No. TC 21 C 234). However, there is no comprehensively written respirator program, and no determinations have been made as to the employee's fitness to wear these respirators.

There have been two environmental studies conducted in these areas, performed by Galson Laboratories, East Syracuse, N.Y. on January 10, 1989, and again on January 17, 1989. The January 10th study evaluated wax fume and total volatile organics exposures during book binding operations in room #47. Wax fume exposures were all below 0.7 mg/M^3. Sampling included one personal breathing zone sample (PBZ) and two area samples. Sampling for total volatile organics also included one PBZ sample and one area air sample. Total volatile organic exposures were below 0.03 part per million (PPM). The January 17th study reported to Cornell University on March 23, 1989, involved total volatile organic sampling in the Print Shop (room #37). All four charcoal tube samples were area samples. Values for total volatile organics ranged from a low value of 70 PPM to a high value of 135 PPM. The major compound present in the total volatile organics analyzed was petroleum naphtha.

In summation, air sampling performed in the book binder room indicated non-detectable airborne paraffin wax or organic solvents. Air sampling performed in the print shop indicated measurable concentrations of hydrocarbon solvents which were approximately one-third of the Permissible Exposure Limit established by OSHA.

IV. MATERIALS AND METHODS

NIOSH conducted an initial site visit on August 30, 1989. Those in attendance at the opening conference were the Cornell University Director of Environmental Health and the President of Local 2300, UAW. During the opening conference, NIOSH procedures and activities were discussed, and all pertinent information and past air-monitoring reports were obtained.

Following the opening conference, a walk-through tour of the book binding area and printing press shop was conducted.

Air sampling for paraffin was then performed by drawing a known amount of air through a 37 millimeter diameter glass fiber filter with calibrated battery powered vacuum pumps at a flow rate of 2 liters/minute (L/min.). Any airborne paraffin would collect on the

glass filter. Laboratory analysis of the amount of paraffin collected on the filter was accomplished by using gravimetric analysis according to NIOSH Method 0500. Following total particulate weight analysis and using this value along with the amount of air volume drawn through the filter necessary to collect this sample, a calculation was made to determine the airborne concentration of paraffin. It should be noted that this is not specific for paraffin (i.e., all airborne particulate/aerosol is measured via gravimetric analysis).

Sampling for airborne hydrocarbon (petroleum based) solvents was also done with calibrated battery operated vacuum pumps operating between 50 - 100 cubic centimeters of air per minute (cc/min).[1] These pumps were connected to glass tubes containing activated charcoal. Activated charcoal adsorbs (capturing and holding) airborne hydrocarbon solvents in sample air. These samples were then analyzed via gas chromatography in accordance with NIOSH Method 1500.

In the binder room and the print shop room, two different sampling strategies were used to evaluate worker exposure, by collecting both personal breathing zone (PBZ) samples and area air samples. PBZ samples were collected by clipping a battery operated pump on the belt of a worker and securing the collection device (either glass fiber filter or charcoal tube) to the shirt lapel. Locating the collection device close to the nose or mouth is termed a breathing zone sample. This type of sample collection is believed to produce the most accurate estimate of inhalation exposure.

V. EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for 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 if 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 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 evaluation 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, thus, such contact may contribute to the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent becomes available.

The primary sources of environmental evaluation criteria for the workplace are: 1) NIOSH Criteria Documents and recommendations,[1,2] 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLVs),[3] and 3) the United States Department of Labor/Occupational Safety and Health Administration (OSHA) occupational health standards Permissible Exposure Limits (PELs).[4] The OSHA standards may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended exposure limits (RELs), by contrast, are based primarily on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels, it should be noted that industry is required by the Occupational Safety and Health Act of 1970 (29 CFR 1910) to meet those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentrations of a substance during a normal 8- to 10-hour workday. Some substances have recommended short-term exposure limits (STELs) or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high, short-term exposures.

A brief discussion of the toxicity and evaluation criteria for wax fumes and petroleum distillate vapors is provided as follows:

Petroleum Distillates[2,5]

Petroleum distillates are composed principally of aliphatic hydrocarbons and are termed "close-cut" fractions. Further designations which have been applied to petroleum distillates are "medium-range" and "wide-range" fractions which are made up of 40 to 80 percent aliphatic hydrocarbons, 25 to 50 percent naphthenic hydrocarbons, 0 to 10 percent benzene, and 0 to 20 percent other aromatic hydrocarbons.

The OSHA PEL for petroleum distillates is 1,600 mg/M^3. The ACGIH TLV for petroleum distillates is 1,370 mg/M^3. The NIOSH REL for petroleum distillates is 350 mg/M^3.

Inhalation of petroleum distillate vapor is the primary route of entry. Percutaneous absorption of liquid petroleum distillate is probably not important in the development of systemic effects unless benzene is also present. Petroleum distillates are irritating to the skin,

conjunctiva, and the mucous membranes of the upper respiratory tract. Skin "chapping" and photosensitivity may develop after repeated contact with liquid petroleum distillate. If confined against the skin by clothing, the petroleum distillates may cause skin burns.

The petroleum distillates have a lower order of toxicity than naphthas derived from coal tar, where the major hazard is due to aromatic hydrocarbons. Sufficient quantities of naphthas cause central nervous system depression. Symptoms include inebriation, followed by headache and nausea. In severe cases, dizziness, convulsions, and unconsciousness occasionally result. Symptoms of anorexia and nervousness have been reported to persist for several months following an acute overexposure, but this appears to be rare. One fraction, hexane, has been reported to have been associated with peripheral neuropathy. If benzene is present, naphtha may produce blood changes such as leukopenia, aplastic anemia, or leukemia. The kidneys and spleen have also been affected in animal experiments.

Wax Fume

Paraffin is a white or slightly yellow, odorless solid, obtained from petroleum, consisting of a mixture of high molecular weight hydrocarbons. Its melting point is 47^{o} to 65^{o} C (depending on purity and grades).

Paraffin is insoluble in water or alcohol. It is soluble to some extent in most organic solvents and miscible with wax, spermaceti and fats when heated.

Paraffin has a wide variety of uses, such as in making candles, sealing or coating for paper and food products, extracting perfumes from flowers, and providing a base for chewing gum.

Paraffin is considered non-toxic, although possibly it may in the past have possessed some carcinogenic impurities.[6] Work around molten paraffin is reported uncomfortable and nauseating.[7] Paraffin spray in printing has been found objectionable because of its physical properties, but not on account of toxicity.

A concentration of 0.6 to 1.0 mg/M^3 of paraffin fume in a workroom where paraffin candles were poured was found to be mildly disagreeable in one plant,[8] but in other plants concentrations below 2.0 mg/M^3 produced no discomfort.

On the basis of these limited data, a TLV of 2.0 mg/M^3, as a time-weighted average, is recommended to prevent irritation of respiratory passages and other unpleasant effects.[4] This level (2.0 mg/M^3) is also the current OSHA PEL.

VI. RESULTS

The results of the environmental samples collected during air monitoring procedures are presented in Table I. Paraffin wax fume concentrations in the book binding room ranged from 0.2 mg/M^3 to 1.3 mg/M^3. A trace amount of aliphatic hydrocarbons was also detected but was at levels below the limit of quantitation of 0.8 mg/M^3.

Exposure to hydrocarbons (petroleum distillates) in the printing room ranged from 186 mg/M^3 to 210 mg/M^3.

VII. DISCUSSION AND CONCLUSIONS

The environmental sampling results show that during the time period of this evaluation, personal inhalation exposures were less than the evaluation criteria. Although employees reported that no adverse health effects are currently being experienced, this response, even in conjunction with employee histories indicating no adverse health effects, does not eliminate the possibility of adverse health effects resulting from potential future exposures since solvents are used with no ventilation, and skin contact with solvents is commonplace.

The use of air purifying respirators provides additional protection against employee exposure to these chemicals. However, all respirator usage must be part of a comprehensive respirator program which includes medical monitoring and employee training.

VIII. CONCLUSIONS

Based on the results of this survey it was determined that a health hazard did not exist from employee exposure to paraffin wax fume or petroleum solvents.

IX. RECOMMENDATIONS

In order for the employer to effectively control employee exposures at this establishment the following recommendations are presented:

1) Provide appropriate storage and mechanical ventilation where solvents are used, and where the book binding operation occurs. Specific requirements for both storage and ventilation can be found in the Federal Occupational Safety and Health, General Industry Standards 29 CFR 1910.94 (Subpart G, Ventilation) and 1910.106 (Flammable and Combustible Liquids).

2) Management should enforce the mandatory use of gloves impervious to solvents. Employees use solvents when performing printing operations which can cause defatting of the skin, and do not always wear protective gloves, although they have been provided.

3) Although ingestion is not a major route of absorption of solvents, eating at the worksite should be discouraged. Smoking should be prohibited in areas where flammable liquids are used or stored.

   Management should regulate employee smoking at work stations by developing and implementing a smoking policy. Furthermore, eliminating or reducing cigarette smoke is a recognized method of improving the indoor environment. Restricting smoking to designated areas away from work areas, preferably in areas with separate exhaust to the outside environment is another means to attain and improve the indoor air quality.

   Smoking should be prohibited in all work areas where flammable solvents are either stored or in use, particularly in the printing room, since flammable vapors may accumulate and can cause a potential fire or explosion hazard.

4) Management should develop a Hazard Communication Program in accordance with OSHA Standard 29 CFR 1910.1200. The Hazard Communication Program will inform and train employees about the hazards associated with the chemicals used and stored at the work place. Containers of hazardous chemicals should also be appropriately labeled as required by the OSHA 1910.1200 Hazard Communication Standard. In particular, containers (5-gallon) of isopropyl alcohol should be properly labeled and also bear a flammable liquid designation.

5) Although the use of respirators is not warranted based upon the data collected during this evaluation, if respirators are issued by management, a comprehensive Respirator Protection Program should be developed which is in compliance with the OSHA 1910.134 enforcement standard. This program should specifically include employee medical evaluations and their suitability for respirator usage, as well as employee training, relative to respirator limitations and protection afforded by their usage.

6) The employer should obtain a flammable liquid safety cabinet to store and dispense flammable liquids. Currently flammable liquids are stored in an unprotected, unsecured area in the press room.

X. REFERENCES

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XI. AUTHORSHIP AND ACKNOWLEDGMENTS

Report Prepared By:

Edward A. Kaiser, Ph.D.
Regional Industrial Hygienist
NIOSH - Region I
Boston, Massachusetts

Originating Office:

Hazard Evaluations and Technical Assistance Branch
Division of Surveillance, Hazard Evaluations and Field Studies
Cincinnati, Ohio

XII. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this report are temporarily available upon request from NIOSH, Hazard Evaluations and Technical Assistance Branch, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days the report will be available through the National Technical Information Services

(NTIS), 5285 Port Royal, Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from the NIOSH Publications Office at the Cincinnati address. Copies of this report have been sent to the following:

A. Local 2300, United Auto Workers, Ithaca, New York
B. U.S. Department of Labor, OSHA - Region II.
C. NIOSH Regional Offices

For the purposes of informing the affected employees, copies of this report should be posted in a prominent place, accessible to those employees, for a period of 30 calendar days.

TABLE I
Environmental Air Monitoring Data
Cornell University
Ithaca, New York
August 30, 1989

PARAFFIN WAX FUME

(Book Binding Room)

	Sample No.	Time (min.)	Volume (Liters)	Results (mg/M^3)
Area	1787	338	676	0.2
Area	1786	340	680	0.2
Area	1795	340	680	0.5
Personal	1796	340	612	1.3

Criterion (OSHA, ACGIH) 2.0

HYDROCARBONS (as Petroleum Distillates)

(Book Binding Room)

	Sample No.	Time (min)	Volume (Liters)	Results (mg/M^3)
Area	18	334	37.4	ND

(Printing Room)

	Sample No.	Time (min)	Volume (Liters)	Results (mg/M^3)
Personal	7	270	12.9	186
Area	4	263	13.8	210

Criterion (NIOSH) 350