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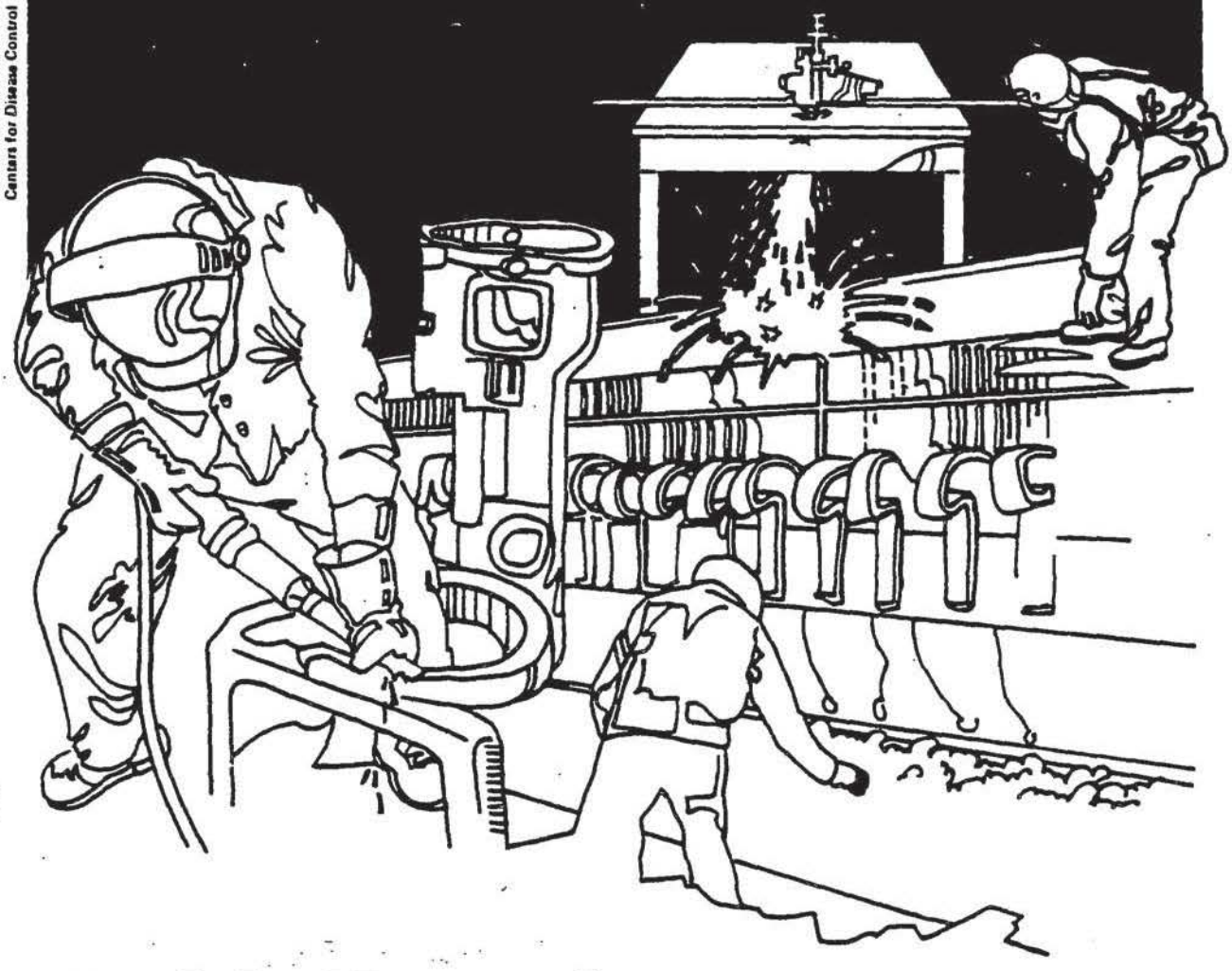

Health Hazard Evaluation Report

HETA 84-198-1560
DIVISION OF PUBLIC HEALTH
LABORATORIES, STATE OF OHIO
COLUMBUS, OHIO

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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DIVISION OF PUBLIC HEALTH LABORATORIES,
STATE OF OHIO
COLUMBUS, OHIO

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I. SUMMARY

On February 21, 1984, the National Institute for Occupational Safety and Health received a request for a health hazard evaluation from the State of Ohio, Department of Health, Division of Public Health Laboratories. The requestor was concerned about employees experiencing symptoms of mucous membrane and skin irritation while preparing petri dishes of gonorrhea culture media. In particular, they were concerned about exposure to ethylene oxide from the sterilized petri dishes.

On March 26-27, 1984 the NIOSH investigators conducted an environmental evaluation at the State of Ohio, Public Health Laboratories, Columbus, Ohio. Air samples for ethylene oxide were collected and analyzed by portable gas chromatography on site and from sorbent tubes. Also sorbent tube samples were collected and analyzed for a wide range of organic compounds. All of the ethylene oxide analyses showed no detectable concentrations and insignificant levels of organic compounds were measured.

Although on at least two occasions within the past two years, employees experienced somewhat severe, acute respiratory and skin irritations while pouring culture media, no problems occurred on the days of this investigation. Due to the absence of notable symptoms and no unusual monitoring results, general recommendations are given to help in avoiding further health problems.

On the basis of data obtained in this investigation, the substance(s) which may have caused acute health problems among employees working in the gonorrhea media culture laboratory could not be determined. On the day of the survey air sampling results showed no unusual levels of contaminants and no notable symptoms among the employees were reported.

KEYWORDS: SIC 9431, ethylene oxide, biological laboratories

II. INTRODUCTION

On March 26-27, 1984, the National Institute for Occupational Safety and Health (NIOSH) evaluated the exposures of employees to ethylene oxide, a sterilant, while the employees poured gonorrhea culture media into sterilized petri dishes at a State of Ohio, public health laboratory.

Exposures to ethylene oxide were monitored by collecting breathing zone samples on sorbent tubes and area samples for analysis on a direct reading, portable gas chromatograph. Area and personal samples for identifiable organic compounds were also obtained.

III. BACKGROUND

Two employees at the Division of Public Health Laboratories produce from 10,000 to 15,000 dishes of gonorrhea culture media each week. These media dishes are sent to local and municipal laboratories. The production of this culture media takes three days. First the agar (GIBCO Laboratories GC Agar and Agar) and hemoglobin (GIBCO Laboratories Hemoglobin Bovine) are mixed separately in large jars and flasks. The agar is incubated at a warm temperature to avoid solidification while the hemoglobin is incubated at a cool temperature. After incubation the two are mixed by adding enrichment and antibiotic and filtering through gauze. The mixed media is then sterilized in an autoclave.

The day the media is poured into petri dishes, the employees wash the table with a diluted solution of a disinfectant (National Laboratories, Roccal II). Boxes of petri dishes (Scientific Products and Lab Tech, a division of Miles Laboratories) are brought from the storage room. The polystyrene petri dishes are packaged and sterilized in polyethylene plastic bags and these bags are opened before the media pouring begins. If the dishes are not stuck together they can be loaded directly on the petrimat machines otherwise they have to be popped apart by hand while in the plastic bags.

The jars of media are connected by hoses to the two petrimat machines. This machine lifts the lids of the dishes, pours the correct amount of media, and replaces the lids. The filled dishes slide onto metal trays and are gathered by hand into stacks of ten. These stacks are set at the other end of the long laboratory table for cooling and solidifying. The next day the prepared dishes are packaged in plastic bags and boxed for shipping to other laboratories.

One day early in 1982 both employees experienced dryness of the nose and throat and swelling, reddening and dryness of the skin on the hands while opening and manipulating bags of petri dishes that were particularly stuck together. In addition, one employee reported burning eyes and the other headache and a "plastic" taste in the mouth. Symptoms abated after this one incident except that the skin problems continued when dishes had to be separated by hand. A couple of months before this survey the full range of symptoms reoccurred. Both employees noted that in the previous 7-9 months petri dishes were more often than not found stuck together.

On April 6, 1982 the Division of Occupational Health, State of Ohio surveyed these employees for exposure to ethylene oxide, styrene and other compounds. They found 0.65 ppm (parts of compound per million parts of air) ethylene oxide and less than 1 ppm each of styrene, toluene and ethyl benzene in three bags of petri dishes. NIOSH was then asked to survey this media laboratory after the second major occurrence of symptoms during media pouring procedures in early 1984.

IV. EVALUATION DESIGN AND METHODS

The afternoon of March 26, 1984 the two NIOSH investigators toured the media laboratory and storage room areas. On this day the two laboratory technicians were boxing finished media dishes and preparing for media pouring procedures to be carried out the next day. A bulk charcoal tube area sample was placed at each end of the long laboratory table while the employees were packing boxes. A portable gas chromatograph was set up in the laboratory also and background readings for ethylene oxide were taken near boxes of unopened bags of petri dishes. The portable gas chromatograph had a photoionization detector operating at room temperature with air as a carrier gas. For this gas chromatograph the limit of detection for ethylene oxide is 0.5 ppm.

On March 27, 1984 the media pouring procedures took place in the morning. The two laboratory technicians each wore two personal sampling pumps. One pump operated at a flow rate of 0.5 liters per minute and was connected to a 150 milligram charcoal tube. The other pump operated at a flow rate of 20 cubic centimeters per minute and was connected to two charcoal tubes used for collecting ethylene oxide.[1] Area bulk charcoal tube samples were also placed near the petrimat machine and in the storage room. The major activities occurred in the morning and those in the afternoon were limited.

Syringe air samples were taken throughout the morning near the media pouring operations. These samples were read through the portable gas chromatograph for ethylene oxide. Previously, some boxes with dishes that were stuck together had been put aside at the laboratory for later evaluation. Without opening these bags, they were sampled by syringe. Most of the bags of petri dishes opened on the day of the NIOSH survey were stuck together and the dishes had to be popped apart while still in the bags by hand.

V. EVALUATION CRITERIA

Environmental Criteria and Toxicological Effects

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).

The primary sources of environmental evaluation criteria for the workplace are: 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) occupational health standards. Often, the NIOSH recommendations and ACGIH TLV's are lower than the corresponding OSHA standards. Both NIOSH recommendations and ACGIH TLV's usually are based on more recent information than are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended standards, 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 found in this report, it should be noted that industry is legally required to meet only those levels specified by an OSHA standard.

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

Ethylene Oxide

A. Toxicological

Exposure of humans to airborne concentrations of ethylene oxide greater than 50 ppm may cause irritation of the eye and respiratory tract and central nervous system depression.[2]

Epidemiological studies indicate an association between worker exposure to ethylene oxide and a significant increase in the risk of death from cancer. Hogstedt et.al.[3], found an increased risk of death from leukemia among workers exposed to ethylene oxide when used as a sterilant. In a second study[4], these investigators confirmed an increased leukemia risk and also observed a significant excess of stomach cancer deaths and total cancer deaths among production workers. Morgan et.al.[5], found an increased risk of mortality from Hodgkin's disease and pancreatic cancer among ethylene oxide production workers.

Studies using experimental animals have shown that ethylene oxide is carcinogenic in multiple species and by several routes of administration.[6,7] Exposure to ethylene oxide by inhalation induced leukemia, brain cancer, and mesothelioma in rats.[6] In addition, numerous reports of short-term tests have demonstrated DNA damage, mutations and chromosomal changes in non-mammalian cells, mammalian cells, intact experimental animals and occupationally exposed workers.

In animal studies, adverse reproductive effects of ethylene oxide have been observed.[8-10] Exposure of the female parent during critical periods of gestational development or the male parent prior to conception has resulted in embryonic or fetal loss. Among humans, an epidemiologic study of hospital workers exposed to ethylene oxide reported a significant increase in spontaneous abortions.[11]

B. Environmental

As of June, 1984 OSHA established a permissible exposure limit for occupational exposure to ethylene oxide of 1 ppm determined as an 8 hour TWA concentration. The ACGIH TLV for ethylene oxide is 10 ppm as an 8 hour TWA with a recommended change to 1 ppm. Neither OSHA nor ACGIH have published a short-term exposure limit. NIOSH recommends that ethylene oxide be regarded as a potential occupational carcinogen.[12] NIOSH recommends an 8 hour TWA of 0.1 ppm and an exposure-time ceiling limit of 50 ppm-minutes, (e.g., 5 ppm for 10 minutes or 1 ppm for 50 minutes).

VI. RESULTS AND DISCUSSION

Table 1 presents the results of personal air sampling using charcoal tubes for ethylene oxide. During the morning media pouring operations no detectable levels of ethylene oxide were found. No ethylene oxide was detected also by the portable gas chromatographic analysis of air samples from both the laboratory room air and within the petri dish bags.

Table 2 shows the levels of organic compounds found in the media laboratory and storage room areas by bulk charcoal tube analysis. Most of the compounds were found in trace amounts. For two samples very low concentrations of n-hexane, toluene, and methylene chloride were found. One of these samples was from the storage room. The two compounds detected in the storage room were not also detected in the laboratory. Although the petri dishes are made of polystyrene, no styrene was detected by these bulk samples.

On the days of this survey neither of the employees experienced notable symptoms. Because of the absence of symptoms on the days of the survey, it is unlikely that the substance(s) causing the reported health problems was present in sufficient concentrations to be measured. Without taking measurements on the exact day when conspicuous symptoms occur it is difficult to discern the environmental cause of the problems. Therefore, recommendations given below are generally applicable to substances found in the air or contacting the skin.

VII. RECOMMENDATIONS

The following recommendations are offered to assist in reducing exposure to substances which may be causing symptoms among employees during media pouring procedures:

1. If acute symptoms, other than minor skin irritation, recurs employees should leave the laboratory and move to an area of fresh air until the symptoms have abated and the general ventilation has removed any contaminants.

2. The general air ventilation to the media laboratory should be checked to assure that any contaminants released in the room will be removed within a reasonable period of time.

3. Employees are encouraged to wear gloves which will shield their hands and wrists from contact with the plastic bags and petri dishes. Gloves would provide daily protection of the skin which is the area most frequently affected.

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X. DISTRIBUTION AND AVAILABILITY OF REPORT

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1. Division of Public Health Laboratories, State of Ohio
2. NIOSH, Region V
3. OSHA, Region V

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 1

Personal Air Sampling for Ethylene Oxide

Division of Public Health Laboratories, State of Ohio
Columbus, Ohio
HETA 84-198
March 27, 1984

Job Title	Sampling Time	Sample Volume	Ethylene Oxide Concentration
Laboratory Technician	8:05am-11:15am	4.5 liters	N.D.* N.D.
Laboratory Technician	8:05am-11:15am	3.9 liters	N.D. N.D.

* N.D. = None Detected, less than 0.1 micrograms per sample or less than approximately 0.01 ppm.

Table 2

Charcoal Tube Sampling and Analysis for Identifiable Organic Compounds

Division of Public Health Laboratories, State of Ohio
Columbus, Ohio
HETA 84-198
March 26-27, 1984

Location or Job Title	Type of Sample	Date Collected	Sampling Time	n-Hexane (ppm)	Toluene (ppm)	Xylenes (ppm)	Methylene Chloride (ppm)
On petri mat machine	Area	3/26	2:04p-4:25p	trace*	0.007	trace	N.D.**
End of laboratory table	Area	3/26	2:17p-4:25p	trace	trace	trace	N.D.
Laboratory Technician	Personal	3/27	8:01a-11:15a	trace	trace	trace	N.D.
Laboratory Technician	Personal	3/27	8:01a-11:15a	trace	trace	trace	N.D.
End of Laboratory, Table Near Petri Mat Machine	Area	3/27	8:25a-11:17a	trace	trace	trace	N.D.
Storage Room Next to Boxes of Petri Dishes	Area	3/27	8:42a-11:20a	0.07	trace	trace	0.7

* Trace = Between the LOD (limit of detection) and the LOQ (limit of quantification)
** N.D. = None Detected, less than 10 micrograms per sample or less than approximately 0.02 ppm
TLV for n-hexane = 50 ppm
TLV for xylenes = 100 ppm
TLV for methylene chloride = 100 ppm

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