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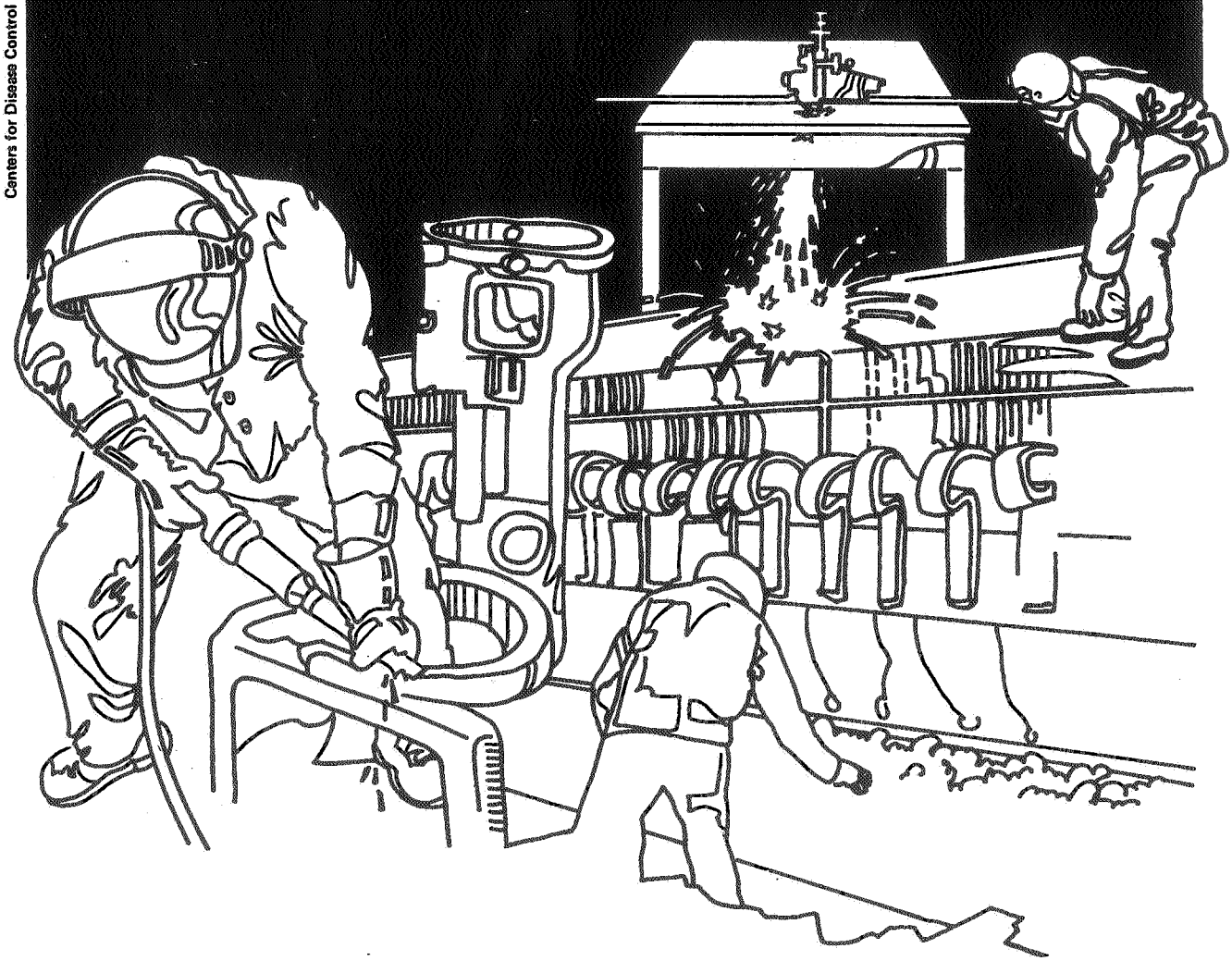
NIOSH



Health Hazard Evaluation Report

HETA 83-131-1412
MIDWEST FOUNDRY
COLDWATER, MICHIGAN

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 83-131-1412
JANUARY 1984
MIDWEST FOUNDRY
COLDWATER, MICHIGAN

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I. SUMMARY

In February, 1983, the National Institute for Occupational Safety and Health (NIOSH) received a request to assess chemical exposures for employees in The No-Bake Isocure Process in the Core room at Midwest Foundry, Coldwater, Michigan. On March 30, 1983 a NIOSH team conducted an initial environmental/medical evaluation; NIOSH conducted a follow-up environmental survey on June 9, 1983.

Air samples were collected in the core room to evaluate employee exposures to methylene bisphenyl isocyanate (MDI), 4,4'-methylene dianiline (MDA), dimethylethylamine (DMEA), and methylene chloride. Confidential medical questionnaires were administered to ten core room employees (9 males, 1 female) over three shits.

Airborne concentrations of MDI (two samples) were less than the limit of detection (0.0003 mg/sample). NIOSH recommends that time-weighted average (TWA) exposure to MDI not exceed 0.05 milligrams per cubic meter (mg/m^3) with ceiling 0.2 mg/m^3 for a 10-minute period. Airborne concentrations of MDA (4 samples) ranged from less than the limit of detection (10 nanograms per sample) to 0.08 micrograms per cubic meter (ug/m^3); the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) for MDA exposures is 800 ug/m^3. Airborne concentrations of dimethylethylamine (8 samples) ranged from 1.0 to 45.9 mg/m^3: there currently is no standard for exposure to this compound. Airborne concentrations of methylene chloride (4 samples) ranged from less than the detectable limit (0.01 mg/sample) to 2.5 mg/m^3; NIOSH recommends that exposure not exceed 261 mg/m^3.

The medical questionnaires revealed relatively few health complaints. With the exception of two individuals who reported occasionally experiencing shortness of breath when hurrying on level ground or when walking up a slight incline, pulmonary problems were not apparent. In the two persons who reported occasional shortness of breath, both associated cigarette smoking as the probable cause of this problem rather than exposures from their jobs.

Based on the results of environmental sample results obtained in this evaluation, employee interviews, and available toxicological information, NIOSH concludes that a health hazard did not exist at Midwest Foundry at the time of this investigation. Recommendations to aid in providing a safe and healthful working environment are presented in Section VIII of this report.

KEYWORDS: SIC 3321 (Gray Iron Foundries), methylene bisphenyl isocyanate (MDI), methylene dianiline (MDA), dimethylethylamine (DMEA), and methylene chloride.

II. INTRODUCTION

On February 2, 1983 the National Institute for Occupational Safety and Health (NIOSH) received a request from the International Molders and Allied Workers Union AFL-CIO Local 118 to evaluate employee exposure to various chemicals in the Core room at Midwest Foundry, Coldwater, Michigan. On March 30, 1983 an initial environmental/medical evaluation was conducted. A follow-up environmental survey was conducted on June 9, 1983.

III. BACKGROUND

Midwest Foundry is engaged in manufacturing gray iron and shell castings.

The area of concern was the No-bake Isocure Process located in the Core room. The No-bake process utilizes a two or three part binder system that when mixed causes the molding sand to harden completely at room temperature. The process does not require "baking" at an elevated temperature as required by some processes, hence the name no-bake.

The isocure core machine is a vertical press type consisting of a stationary sand hopper and attached match-plate, and a vertical piston with match-plate which opened and closed the core box. The coated sand from which the cores are made was prepared on an overhead mezzanine by automated mixing a measured amount of the two part resin with a predetermined amount of sand. The milled sand is then automatically dumped from the muller to the core hopper. An automated core lift-out rack was used to retrieve cores from the core box to the worker position. After they are finished, cores were removed from the conveyor and placed on storage racks.

IV. EVALUATION DESIGN AND METHODS

A. Environmental

On March 30 and June 9, 1983 NIOSH conducted an industrial hygiene survey to determine exposures to airborne contaminants. One personal and one area air sample for methylene bisphenyl isocyanate (MDI) were collected on 13-mm glass fiber filters impregnated with a nitro reagent at a flow rate of one liter per minute (LPM) and analyzed according to NIOSH Method P&CAM 347.[1] Two personal and two area air samples for 4-4'-methylene dianiline (MDA) were collected on 13-mm glass fiber filter at a rate of 1 LPM and analyzed for MDA according to the method of skarping, Sango, and Smith.[2] Four personal and four area air samples for

dimethylethylamine (DMEA) were collected via silica gel sorbent tube at a rate of 0.05 LPM and analyzed according to NIOSH Method P&CAM 221 (modified).[3]

Two personal and two area samples for methylene chloride were collected on 150 mg activated charcoal sorbent tubes at a rate of 0.10 LPM and analyzed according to NIOSH Method S-329 (modified).[4]

B. Medical

Confidential medical questionnaires were administered to ten employees who work in the Core room, including one supervisor. The questionnaire solicited information on the frequency of pulmonary problems experienced by employees in the Core room, as well as the frequency of several irritating and other kinds of symptoms. History of pre-existing medical conditions, use of medication and tobacco use were also determined.

V. EVALUATION CRITERIA

A. Environmental 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 hazardous 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, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

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.

The criteria used for this evaluation are listed in Appendix A.

B. Toxic Effects

1. Diisocyanates

Occupational exposure to diisocyanates has well-recognized adverse health effects; the most common compound is toluene diisocyanate (TDI). The isocyanates have been described as irritants of the skin and conjunctiva (surface of the white part of the eye). The main effects are on the respiratory system. Acutely, in high concentrations, these materials are severe irritants of the upper and lower respiratory tract. Second, and of additional concern, is the potential development of sensitization to diisocyanates in which some individuals may have asthma-like reactions (immediate, delayed or both) at

concentrations much lower than those producing irritation. Chronic effects that have been reported include excess declines in the forced expiratory volume in 1 second (FEV_1) and the forced vital capacity (FVC), increased prevalence of bronchitis and dyspnea and possibly, hypersensitivity pneumonitis.(5)

2. 4-4'-Methylene Dianiline (MDA)

The toxicologic information concerning methylene dianiline is rather limited and is mostly provided by the Du Pont Company, one of the largest manufactures of this chemical. Both chronic exposures and acute high exposures to methylene dianiline have been found to cause liver and kidney damage in experimental animals. The mono isocyanate is a strong skin sensitizer and is known to cause severe irritation to skin, mucous membranes, and eyes. All contact with skin and eyes, and inhalation of vapors, should be avoided.(6)

MDA was reported to cause acute toxic hepatitis, in a community setting in the 1960s[7] ("Epping Jaundice") and in the workplace in the 1970s,[8] and has also been associated with contact dermatitis. Soon thereafter, the long-term effects were tested in an 8-month feeding study in which liver and kidney tumors in rats were induced as well as chronic liver changes.[9] It was noted that MDA acted like aminofluorene to which it is structurally related. Also of note, is the similarity of its structure to known human bladder carcinogens such as benzidine. The recently completed bioassay by the National Toxicology Program[10] found that under the conditions of the bioassay, methylene-dianiline was considered carcinogenic for F344/N rats and $B6C3F_1$/N mice of each sex, causing a significantly increased incidence of thyroid, liver and adrenal tumors. In addition, several rare tumors observed in the study (bile duct adenomas in male rats and ovarian granulosa-cell tumors and urinary bladder transitional-cell papillomas in female rats) may also have been related to administration of the compound.

3. Dimethylethylamine (DMEA)

As a member of the amine family, DMEA exerts its effects in man as a primary irritant. DMEA is very volatile and, therefore,

may produce irritation of the mucous membranes of the eyes, nose, throat, as well as the respiratory tract, producing cough, substernal distress and perhaps asthmatic-type symptoms. Direct contact with DMEA may produce primary skin irritation and dermatitis. Exposure to amine vapors may also produce headache, nausea, faintness, and anxiety symptoms. These systemic symptoms may be related to the pharmacologic action of amines. Animal experiments confirm the irritant properties of DMEA to the mucous membranes and lower respiratory tract.[11]

4. Methylene Chloride

Methylene chloride is a mild narcotic. Effects from intoxication include headache, giddiness, stupor, irritability, numbness, and tingling in the limbs. Irritation to the eyes and upper respiratory passages occurs at high dosages. Repeated contact with methylene chloride may cause a dry, scaly, and fissured dermatitis.[12]

VI. RESULTS

A. Environmental

Results of the environmental samples collected on March 30, and June 9, 1983 are presented in Table I. Airborne concentrations of MDI (two samples) were less than the limit of detection (0.0003 mg/sample). (NIOSH recommended TWA exposure to MDI 0.05 mg/m^3; ceiling of 0.2 mg/m^3 for a 10-minute period). Airborne concentrations of MDA (4 samples) were less than the limit of detection (10 nanograms per sample) to 0.08 ug/m^3. (The American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) is 800 ug/m^3). Airborne concentrations of DMEA (8 samples) ranged from 1.0 to 45.9 mg/m^3. (There currently is no standard for DMEA.) Airborne concentrations of methylene chloride (4 samples) ranged from less than detectable limit (0.01 mg/sample) to 2.5 mg/m^3. (The NIOSH criteron is 261 mg/m^3).

B. Medical

Confidential medical questionnaires were administered to ten employees (9 males, 1 female) who work in the Core room over three shifts. This number included 7 core machine operators, 2

maintenance personnel and 1 supervisor.

Generally, this group of employees had relatively few health complaints to report. With the exception of two individuals who reported occasionally experiencing shortness of breath when hurrying on level ground or walking up a slight incline, pulmonary abnormalities were not apparent. In the two persons who reported occasional shortness of breath, both associated cigarette smoking as the probable cause of this problem rather than exposures from their jobs. (Of the ten survey participants, nine were current "smokers".)

Consistent abnormalities among these employees could not be identified. Occasional episodes of eye irritation and headaches were equally reported by four individuals, while three persons reported dizziness and lightheadedness. Two persons reported experiencing occasional stomach pains and one person reported experiencing frequent episodes of dermatitis on the hands and forearms, but controllable by using a prescribed ointment. Four individuals reported no symptoms at all.

The symptoms that were reported were commonly associated with vapors, resulting from occasional leaks and spills occurring in the area around the "Isocure Machine". However, most of the employees have not been troubled by symptoms since the leaks in the pipelines were repaired and a local exhaust fan was installed in February 1983. Several persons described experiencing a momentary "breathless or choking-like" feeling from breathing vapors that occur when the Isocure is drawn out of the storage drum, that is housed in a small shed outside the plant. To avoid this problem, most individuals stated that they "hold their breath" while they draw the isocure from the drum. (Isocure is typically drawn off only once during each shift for a short period of time this procedure is performed outdoors, and always by two people.)

VII. CONCLUSION

Based on the environmental sample results, employees interviews, and available toxicological information, NIOSH concludes that health hazards did not exist at the time of these surveys on March 30, and June 9, 1983.

VIII. RECOMMENDATIONS

1. Continue the practice of cleaning up spills and repairing leaks in the lines around the "Isocure" lines.

2. An educational program should be instituted so that employees are made aware of the potential hazards associated with the chemical used in Core room.

3. All containers of methylene bisphenyl isocyanate, dimethylethylamine, and methylene chloride should be properly labeled.

4. Good personal hygiene and good work practices should be observed by all employees; washing of hands before smoking, eating, and drinking will help reduce contamination.

IX. REFERENCES

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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. Midwest Foundry, Coldwater, Michigan
2. Authorized Representative of Employees, International Molders and Allied Workers Union AFL-CIO Local 118
3. NIOSH, Region V
4. 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 I

Midwest Foundry
Coldwater, Michigan

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Date	Job and/or Location	Sample Period	Sample Volume (Liters)	Type	Methylene Bisphenyl Isocyanate (MDI) mg/m³*	Methylene Dianiline (MDA) ug/m³**	Dimethylethylamine (DMEA) mg/m³	Methylene Chloride mg/m³
3-30-83	isocure operator	0714-1440	446	PBZ***	LD****	LD	-	-
3-30-83	isocure area	0720-1500	460	GA*****	LD	LD	-	-
3-30-83	isocure operator	0714-1116	11.1	PBZ	-	-	2.7	-
3-30-83	isocure operator	1117-1433	9.0	PBZ	-	-	1.7	-
3-30-83	isocure area	0720-1118	11.8	GA	-	-	3.3	-
3-30-83	isocure area	1119-1500	10.1	GA	-	-	1.0	-
6-9-83	isocure operator	0700-1427	447	PBZ	-	.08	-	-
6-9-83	isocure area	0705-1432	447	GA	-	LD	-	-
6-9-83	isocure operator	0700-1115	13.4	PBZ	-	-	28.4	-
6-9-83	isocure operator	1150-1425	7.4	PBZ	-	-	45.9	-
6-9-83	isocure area	0705-1125	13.1	GA	-	-	9.1	-
6-9-83	isocure area	1126-1430	8.9	GA	-	-	6.7	-
6-9-83	isocure operator	0700-1115	24.2	PBZ	-	-	-	2.5
6-9-83	isocure operator	1150-1426	14.3	PBZ	-	-	-	LD
6-9-83	isocure area	0705-1129	25.4	GA	-	-	-	1.6
6-9-83	isocure area	1130-1431	17.1	GA	-	-	-	1.8
Environmental Criteria					.05 mg/m³	800 ug/m³	no standard	261 mg/m³
Limit of Detection					0.3 ug/sample	10 ng/sample	0.01 mg/sample	0.01 mg/sample

* mg/m³ = milligrams of substance per cubic meter of air sampled
** ug/m³ = micrograms of substance per cubic meter of air sampled
*** PBZ = Personal Breathing Zone
**** LD = Less than Limit of Detection, such concentration equals the analyte's lower limit of detection (mass per sample) divided by the air volume (cubic meter) sampled
***** GA = General Area

APPENDIX A

Evaluation Criteria

Midwest Foundry
Coldwater, Michigan

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	NIOSH Recommended Criteria TWA (mg/m^3)	OSHA Standards TWA (mg/m^3)	ACGIH TLV mg/m^3
Methylene Bisphenyl Isocyanate (MDI)	0.05 0.2 ceiling	0.2	0.2
4,4'-Methylene Dianiline (MDA)	-	-	0.8
Dimethylethylamine (DMEA)	no standard	no standard	no standard
Methylene Chloride	261 1740 ceiling	1740	360