

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HEALTH HAZARD EVALUATION DETERMINATION
REPORT # 76-90-442

TAMARACK HOMES
WEISER, IDAHO

NOVEMBER 1977

I. TOXICITY DETERMINATION

It is determined that the unit assemblyman's exposure to methylene bisphenyl isocyanate (MDI) was potentially toxic at concentrations as used and found on August 2 and 3, 1977. This conclusion is based on the sample results that showed that he was exposed to at least 0.047 ppm and 0.036 ppm for two periods of at least 20 minutes each, which are in excess of the evaluation criteria of 0.02 ppm. MDI has a ceiling value which should not be exceeded for this length of time. During this exposure, he was not wearing respiratory protection. Under the current production rate, his 8-hour time weighted average exposure is less than 0.02 ppm.

II. DISTRIBUTION AND AVAILABILITY

Copies of this Determination Report are currently available upon request from NIOSH, Division of Technical Services, Information 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 through NTIS can be obtained from NIOSH, Publications Office at the Cincinnati address.

Copies of this report have been sent to:

- (1) Tamarack Homes, Weiser, Idaho.
- (2) Occupational Safety and Health Administration, Region X, Seattle, Washington.
- (3) NIOSH Region X

For the purpose of informing the approximately 5 "affected employees," the employer will promptly "post" the Determination Report in a prominent place(s) for a period of thirty (30) calendar days near the work area of the affected employees.

III. INTRODUCTION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6), authorizes the Secretary of Health, Education, and Welfare, following receipt of 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 concentration as used or found.

The National Institute for Occupational Safety and Health received such a request from the management at Tamarack Homes, Weiser, Idaho, to determine if the compound methylene bisphenyl isocyanate (MDI) present in Component A of the material used in urethane foam production is toxic as used or found.

IV. HEALTH HAZARD EVALUATION

A. Description of Process

Tamarack Homes produces mobile homes and solar furnaces. This request involves the use of MDI during the production of solar furnaces. The solar furnace is an enclosed A-Frame type structure, approximately

8 feet high by 20 or 24 feet long. The walls are constructed of outside surfaces of either plywood or metal with an inner core of urethane foam. The urethane foam is inserted by the use of a froth gun, with the wall section in the vertical position. The employee stands on top the wall section and inserts the gun down into the wall until the urethane foam has reached the top. The wall is then placed on a large table where additional parts are added. The walls are later put together to form the solar unit. When four of the five sides have been installed, the inside joints where the parts are connected are sprayed with urethane from a spray gun. The spray consists of a small stream that can be directed right at the point where the material is needed. The employee stands four to six feet away from where the spray terminates at the joint. The back wall is left out during the initial spraying. After the back wall has been installed, the remaining joints are sprayed. In order to do this, the employee puts his head and the upper portion of his body through a hole into the inside of the unit. During the time he sprays, he may get the spray within a foot of his breathing zone. His exposure here would consist of both a vapor and mist. Metal caps are then placed around the outside connecting joints and the air space is filled with urethane using the froth gun. There is no local exhaust ventilation being used and the employee does not wear a respirator during this spraying and frothing.

There are approximately fourteen employees working in the Solar Department. There are five employees who work directly with the urethane or in the area where the urethane is handled. Their job titles are: the wall builder, the wall assembly men, and the unit assembly men.

B. Study Progress and Design

1. General

The initial survey was conducted on July 18, 1976. Shortly after the initial survey, the operation was shut down and did not resume until late spring, 1977. The environmental study was conducted on August 1, 2, and 3, 1977.

2. Environmental Sampling

The sampling was designed to include the jobs where the employees are exposed to MDI and areas where MDI could be in the general atmosphere. Nine breathing zone samples were collected on the employees using the froth gun and the spray gun. Breathing zone samples are ones where the employee wears the sampling equipment and the air is sampled in the close proximity of the mouth. Thirteen general area samples were collected in the areas where MDI was suspected.

3. Medical

The medical evaluation consisted of a short questionnaire concerning smoking history, allergies, and pre and post shift responses to eye, nose, throat, and upper respiratory tract irritation.

C. Evaluation Methods

The employees exposure to MDI was determined using two types of sampling instruments. The breathing zone samples were collected with a Series 400 MCM Personal Monitor. This monitor is a continuous tape sampler. The sampling tape was analyzed on a Series 4100 MCM Integrating Reader Recorder. The remainder of the samples were collected with midget impingers at a flow rate of 1.0 liters per minute. The absorbing reagent consisted of 15 milliliters of a mixture of hydrochloric acid, glacial acetic acid, and distilled water. The chemical analysis was performed according to NIOSH Method No. P&CAM 142 for MDI in air. (HEW Publication No. NIOSH 75-121)

D. Evaluation Criteria

1. Environmental Criteria

The Occupational Health Standards as promulgated by the U.S. Department of Labor, Code of Federal Regulations, dated July 1975, Part 1910, Title 29, Chapter XVII, Subpart Z, Table Z-1, and the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV) for Chemical Substances and Physical Agents in the Workroom Environment for 1976 both have an exposure limit of 0.02 parts of MDI per million parts of air with a ceiling value attached. The ceiling value is for materials that are fast acting or that can, when the value is exceeded for short periods, cause a response in the individual.

2. Toxic Substances Medical Data

The adverse effects from exposure to MDI as listed in the Documentation of the Threshold Limit Values is as follows: Isocyanates, in general, are irritating to skin, eyes and respiratory tract, causing damage to mucous membranes and are a common cause of allergic sensitization of the respiratory tract. Careful handling is demanded.

Early industrial experience in handling MDI revealed no cases of skin irritation. MDI adheres firmly to skin, however, the irritation may be increased or produced by attempts at removal.

MDI has a low but significant vapor pressure. This physical characteristic presents both a vapor and particulate (droplet) exposure in one of the current applications of MDI namely, in foam or film coating of surfaces by spray gun techniques.

Because there is no present information that would lead one to attribute a different type of toxicologic response, particularly sensitization of the respiratory tract, from that produced by TDI and, in view of the physical characteristics and industrial applications resulting in appreciable vapor and particulate concentration, a ceiling value of 0.02 ppm, like that of TDI, is recommended. Bruckner, et al, stated that a study of clinical and immunologic factors tended to support the TLV of 0.02 ppm for MDI and TDI."

E. Results and Discussion

1. Environmental Results

The environmental results are shown in Tables 1 and 2. The MDI concentrations ranged from less than 0.001 ppm to 0.047 ppm.

Both froth and spray urethane foaming operations were being used. The exposure to MDI varies greatly between these two operations. During the frothing of the wall building operation, the operator's exposure to MDI was 0.006 ppm. Directly above the wall during another frothing job the level was 0.003 ppm. This operation takes approximately 10 minutes per wall or 40 minutes per unit (the two ends are done together). The remainder of the time his exposure is less than 0.001 ppm. These levels are less than the evaluation criteria of 0.02 ppm. The operator did not wear a respirator during this evaluation.

The unit assembly man's exposure to MDI while frothing the edges of the assembled unit was 0.0045 and 0.002 ppm. The time to complete this job was not determined, since on the days of the survey they were experiencing difficulties with the froth gun and therefore was not done continuously. He does not wear a respirator during this operation. This exposure is less than the evaluation criteria of 0.02 ppm.

The unit assembly man also performs two spraying operations. The first is done when the unit is partially assembled (the back wall is not yet in place). At this time he sprays all the inside wall joints with a fine stream of urethane. He will stand about four to six feet from the parts to be sprayed. On occasion he will be closer than four feet from the termination of the spray. On both days that the operation was done, they began spray painting a flat black paint about 15 to 20 feet away. The paint drifted to the unit assembly man and discolored the sampling tape, thus voiding the sample. An impinger sample collected behind the employee during one of these times showed the MDI level was less than 0.001 ppm. This, however, was not near his breathing zone, as his breathing zone was between the spray and the sampler. The time required to complete this operation is approximately 10 minutes. When the back wall of the unit is in place, he sprays the remaining joints. In order to do this, he puts his head and upper body through a hole and sprays inside the unit. This is a very confined space. At times he is spraying

within 12 inches of his breathing zone. At this point he is exposed to both MDI vapor and mist. This job takes about 10 minutes to complete. Breathing zone samples collected on two days during this operation showed that his peak exposures for two 20 minute periods were 0.047 and 0.036 ppm. This exceeds the ceiling value of 0.02 ppm, which is the evaluation criterion for MDI. In addition, the operator did not wear respiratory protection. A supplied-air full face or hooded respirator needs to be worn during this operation.

The MDI concentration at or just inside the opening during the spraying was 0.01 ppm. The levels inside the unit decrease rapidly after the spraying is completed. A twenty minute sample collected in the unit right after the spraying was completed was 0.001 ppm.

General air samples collected near the wall building area and the unit assembly area were all less than 0.001 ppm. The MDI concentration in the store room during a hot afternoon was 0.018 ppm. The unit assembly man had one 90 minute breathing zone sample that was 0.005 ppm, with a high twenty minute average of 0.012 ppm, which was collected while he spent some time in the storeroom. There was an accumulation of Component A (which contains the MDI) on the floor and on top of the barrel as the pump was leaking. During the two days of sampling, the froth pump was not working properly and several employees spent considerable time in the storeroom trying to repair it. Based on the sample results, their exposure would be below the evaluation criterion of 0.02 ppm. Clean-up of the spilled MDI, repair of the pump, and improved housekeeping should reduce the concentration in the storeroom considerably.

The employees were not wearing rubber gloves when handling the equipment that was contaminated with the Component A and Component B.

2. Medical Evaluation

A pre and post shift questionnaire was administered to the wall builder, the wall assembly man, the unit assembly man, and the lead man. During the days of the survey, none of these employees experienced any cough, burning or itching of the eyes, wheezing, or tightness in the chest. One employee has an allergy to penicillin. This individual should be informed that he may be at increased risk of adverse health effects from industrial exposure to isocyanates.

F. Conclusions

It is determined that the unit assembly man's exposure to MDI was potentially toxic at concentrations as used and found on August 2 and 3, 1977. This conclusion is based on the sample results that showed that he was exposed to at

least 0.047 ppm and 0.036 ppm for two periods of at least twenty minutes each, which exceed the evaluation criterion ceiling value of 0.02 ppm. A ceiling value should not be exceeded for this length of time. During this exposure, he was not wearing respiratory protection. Under the current production rate, his 8-hour time weighted exposure is less than 0.02 ppm.

G. Recommendations

1. Supplied-air hoods or full face supplied-air respirators should be used when spraying inside of the totally assembled unit. It is also advisable to wear the supplied-air respirator during the spraying of the partially assembled unit. When utilizing respiratory protection, a respiratory protection program is mandatory. This would involve the proper air supply, which includes filtration of the air to remove water vapor, oil mist, oil vapors, and other contaminants that could be present in the supplied air. It also involves a respirator cleaning program. Respirators are not to be used by two individuals, unless they have been properly cleaned and disinfected between uses. The OSHA standard spells out in detail the components of a respirator program in Section 1910.134 of title 29, Code of Federal Regulations.

2. The storeroom should be cleaned up of all spills of Component A. The liquids are on the floor, and, in one area, on the wall. It is also on top of the barrel from which it is being pumped.

3. The pump used to pump Component A from the barrel is leaking and needs to be repaired.

4. Rubber gloves should be worn when handling the liquids or equipment contaminated with the liquids. They should also be worn when washing the gun with the cleaning solvents.

5. If the clothing becomes wetted with Component A, it should be changed and laundered before wearing again.

6. Local exhaust ventilation could be provided to exhaust air from the solar unit during the spraying operation. With the way the operator has to conduct his work, it is doubtful that this would keep the MDI concentrations below acceptable levels. He would still have to wear the supplied-air hood to be properly protected.

7. Local exhaust ventilation should be provided on the barrels where the froth guns are blown out with methylene chloride. Although the usage rate is low at this time, if the production rate increases, there is a potential exposure with this operation as it is now being conducted.

8. Any employee who has allergies (penicillin, hay fever, etc.) should be advised that he is subjected to an increased risk of adverse health effects from his exposure to the isocyanates.

9. Medical examinations - Preplacement. A comprehensive physical examination for the employees handling the spraying and frothing operations should be made available, to include as a minimum: medical history, a 14 inch by 17 inch chest roentgenogram, total white blood cell count with differential, baseline forced vital capacity (FVC) and forced expiratory volume at one second (FEV 1.0). An absolute eosinophil count on capillary blood is recommended as an additional useful baseline measurement. The history should pay particular attention to the presence and degree of any respiratory symptoms, i.e., breathlessness, cough, sputum production, wheezing, and tightness in the chest. Smoking history should also be elicited.

If a positive personal history of respiratory allergy, previous sensitization to isocyanates, or chronic obstructive pulmonary disease is elicited, the applicant should be counseled on the increased risk from exposure to the isocyanates. If a history of allergy other than respiratory or of other chronic respiratory disease is elicited, he should also be counseled that he may be exposed to increased risk from adverse health effects from exposure to the isocyanates.

Periodic - The above examinations with the exception of the chest roentgenogram, should be provided annually, or as otherwise indicated by professional medical judgment, so long as the occupational exposure to the isocyanates continues.

V. AUTHORSHIP AND ACKNOWLEDGEMENTS

Report Prepared By:

Arvin G. Apol
Industrial Hygienist
Region X

Originating Office:

Jerome P. Flesch, Chief
Hazard Evaluation Services Branch
Cincinnati, Ohio

T A B L E 1

METHYLENE BISPHENYL ISOCYANATES (MDI)
AIR CONCENTRATIONS
USING TAPE SAMPLER

TAMARACK HOMES
WEISER, IDAHO
HHE #76-90

<u>JOB BEING PERFORMED</u>	<u>SAMPLE NUMBER</u>	<u>DATE</u>	<u>SAMPLE TIME MINS.</u>	<u>SAMPLING PERIOD TWA* PPM**</u>
BZ Unit Assembly Man spraying in completely assembled Solar Unit & frothing edges of same unit	1	8-1-77	85	0.017
BZ Unit Assembly Man during spraying portion of sample #1 (employee's head inside unit)	1A	8-1-77	20	0.047
BZ Unit Assembly Man during frothing portion of sample #1	1B	8-1-77	20	0.002
BZ Unit Assembly Man assembling unit. Some frothing of walls being done 30-40 ft. away	2	8-2-77	120	< 0.001
BZ Unit Assembly Man during spraying of assembled unit (employee's head inside unit)	3	8-2-77	20	0.036
BZ Unit Assembly Man during frothing edges of assembled unit	4	8-2-77	20	0.0045
GA Storeroom (8:30 am - room cool)	5	8-3-77	20	0.002
BZ Wall Builder during frothing of wall	6	8-3-77	20	0.006
GA On top of wall being frothed	7	8-3-77	20	0.003
GA Inside of assembled unit right after spraying was completed	8	8-3-77	20	0.001
BZ Unit Assembly Man; froth pump was broken, man in and out of storeroom and doing other odd jobs	9	8-3-77	90	0.005
BZ High 20 minute average of sample #9	9A	8-3-77	20	0.012

*TWA - Time Weighted Average

**ppm - Parts of vapor or gas per million parts of air

BZ - Breathing zone (sample)

GA - General area (sample)

T A B L E 2

METHYLENE BISPHENYL ISOCYANATES (MDI)
AIR CONCENTRATIONS
USING IMPINGER SAMPLING

TAMARACK HOMES
WEISER, IDAHO
HHE #76-90

<u>LOCATION</u>		<u>SAMPLE NUMBER</u>	<u>DATE</u>	<u>SAMPLE TIME MINS.</u>	<u>SAMPLING PERIOD TWA* PPM**</u>
GA	On platform 3 ft. from where walls are frothed	1	8-2-77	210	0.0003
		4	8-2-77	210	0.0003
GA	≈ 5 ft. from table where walls are sub-assembled	2	8-2-77	210	0.0011
		5	8-2-77	210	0.0007
GA	Against wall alongside assembled units where spraying & frothing of units is done	3	8-2-77	210	0.0007
		6	8-2-77	210	0.0007
GA	On top of wall form during frothing of wall	7	8-2-77	20	< 0.001
GA	About 1 to 2 ft. behind unit assembly man while spraying seams on partially completed unit	8	8-2-77	15	< 0.001
GA	Near employee when spraying inside completely assembled units, usually 1 ft. from breathing zone at opening or just inside opening	9	8-2-77	20	0.01
GA	Storeroom where urethane components are stored and pumped (afternoon-outside temperature 98°F)	10	8-2-77	60	0.01

* TWA - Time Weighted Average

** PPM - Parts of vapor or gas per million parts of air

GA - General Area (sample)