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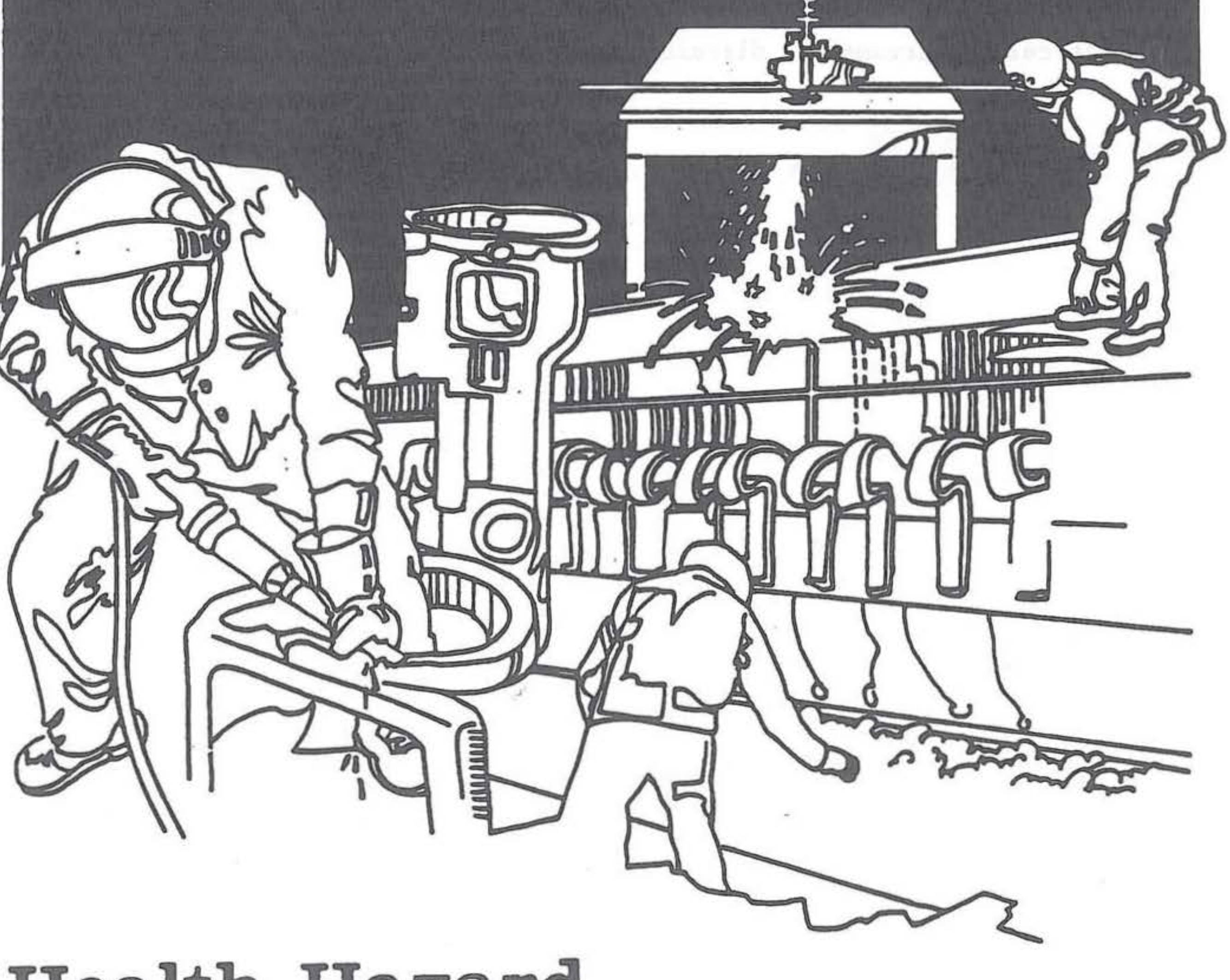

Health Hazard Evaluation Report

HETA 84-405-1717
NIOSH RIDGE BUILDING
CINCINNATI, 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.

HETA 84-405-1717
JULY 1986
NIOSH RIDGE BUILDING
CINCINNATI, OHIO

NIOSH INVESTIGATORS:
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I. SUMMARY

In May 1984, the National Institute for Occupational Safety and Health (NIOSH) received a request for a Health Hazard Evaluation from the United Union of Roofers, Waterproofers and Allied Workers to evaluate the application of various roofing systems. Between June 20-26, 1984, NIOSH investigators had the opportunity to evaluate methylene bisphenyl isocyanate (MDI) and organic solvent exposures associated with the application of a polyurethane roofing system at the NIOSH, Ridge facility.

During the period of the evaluation personal and area air samples for MDI monomer, total reactive isocyanate groups (TRIG) and organic solvents were collected. Area samples for MDI monomer indicated concentrations ranging from non-detected (N.D.) up to 74 ug/m^3. Total reactive isocyanate group concentrations ranged from N.D. to 338 ug/m^3. Of the 8 personal samples collected for MDI monomer, 4 showed positive results. Concentrations on these four samples ranged from 2 ug/m^3 to 3.9 ug/m^3. A comparison study of different sampling and analytical methods used in the evaluation, however, suggests the method used to collect the personal samples may have underestimated MDI monomer exposure by a factor between 25 and 50. The NIOSH recommended exposure level (REL) for monomeric MDI is 50 ug/m^3. There is no OSHA standard or NIOSH recommended standard for TRIG. Since exposures to isocyanates were measured in this study, it is prudent to utilize positive-pressure supplied-air respirators as recommended by NIOSH when conducting roofing applications of this type.

Analysis of the personal and area samples for organics indicated no overexposures. Toluene concentrations ranged from N.D. to 35 mg/m^3 (REL-375 mg/m^3), xylene from N.D. to 128 mg/m^3 (REL-434 mg/m^3), methylcyclohexane from N.D. to 4.3 mg/m^3 (REL-1600 mg/m^3), hexachloroethane from N.D. to 1 mg/m^3 (REL-100 mg/m^3), 2-ethoxyethanol from N.D. to 16 mg/m^3 (REL-19 mg/m^3) and N,N-dimethcyclohexylamine from N.D. to 0.52 mg/m^3.

Although no direct measurements were made of isocyanate levels above the recommended criteria, the data collected strongly suggest overexposures to monomeric MDI and total isocyanate group occurred during roofing application procedures. No overexposures to solvents were measured. Recommendations to reduce exposures are presented in Section VIII of this report.

KEYWORDS: SIC 1761 (Roofing and Sheet Metal Work); methylene bisphenyl isocyanates (MDI), TRIG

II. INTRODUCTION

In May 1984, NIOSH received a health hazard evaluation request from the United Union of Roofers, Waterproofers, and Allied Workers to evaluate the application of various roofing systems. Between June 20-26, 1984, NIOSH investigators had the opportunity to evaluate methylene bisphenyl isocyanate and organic solvent exposures associated with the application of a polyurethane roofing system at the NIOSH, Ridge Avenue facility.

III. BACKGROUND

Polyurethane roofing systems are a relatively recent development in the roofing industry. These, as well as single-ply roofing systems, are successfully competing with traditional coal tar pitch or asphalt for the new and replacement roofing market for commercial buildings.

The workforce for this particular polyurethane roofing application consisted of 6-8 individuals. Using a spray on technique, two workers applied an organic solvent primer to help the polyurethane foam adhere to the existing roof (asphalt material). During an eight-hour workshift, the application of primer took about two hours to complete. Next, two workers using a compressed air system applied the polyurethane foam to the old roof. The foaming operation lasted for approximately four hours of the eight-hour workshift. Finally, to help seal the foam, silicone material was sprayed on top of the foam after it had dried. This sealing operation lasted the remaining two hours of the eight-hour workshift. One employee during the shift worked in a truck which housed the compressor, hoses and storage drums for the liquid primer, isocyanates (polyurethane foam) and silicone.

IV. EVALUATION DESIGN AND METHODS

Because of prior difficulties encountered with measuring isocyanate concentrations, a comparison of isocyanate sampling and analytical methods was attempted during the evaluation of the application of the isocyanate-based urethane roof. Four sampling methods were originally chosen for the comparison study.

1. 37-mm glass-fiber filters coated with 1-(2-pyridyl) piperazine. The sampling flow rate was 1.0 ℓ/min. This is a method developed by OSHA for the determination of monomeric isocyanate concentrations.

2. 25-mm glass-fiber filter coated with 1-(2-methoxyphenyl)-piperazine and diphenylmethane. The sampling flow rate was 150 cc/min. This was an experimental method developed at the NIOSH laboratory for determination of both monomeric and total reactive isocyanate group exposures.

3. Impingers containing toluene solutions of methoxyphenyl-piperazine at a concentration of 43 ug/ml. The sampling flow rate was 1.0 ℓ/min. This is NIOSH Method 5505 used for determination of both monomeric and total isocyanate concentrations.

4. Impingers containing toluene solutions of methoxyphenylpiperazine at a concentration of 4.3 ug/ml. The sampling flow rate was 1.0 ℓ/min. This was a modification of Method 5505. The purpose of using this concentration was to see if any improvement in the total isocyanate (polymeric and monomeric) measurement could be obtained.

A 12 part sampling cone was used to obtain replicate area samples. Three samples for each method were taken in each set of samples. A set of samples was collected on four different days of the roofing operation. A fifth sampling method, nitro reagent in impingers, was added on the second day of sampling, because of the wide disparity of the results of area samples taken side-by-side with the OSHA filter method and the methoxyphenyl-piperazine/impinger method.

In addition to 11 other area samples, a total of 8 personal breathing zone samples for isocyanates were collected using Method 1 for approximately 3-4 hour sample durations.

Organic solvent exposures were also evaluated as part of the study. Seven bulk samples were analyzed by gas chromatography/mass spectroscopy (GC/MS) to identify the major organics present. A total of 14 personal and 11 area air samples for organics was collected on charcoal tubes at a flowrate of 200 cc/minute for approximately 2-3 hours. Samples were analyzed for toluene, xylene, methylcyclohexane, hexachloroethane, 2-ethoxyethanol and N,N-dimethylcyclohexylamine, compounds identified by the GC/MS analysis.

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 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 not usually 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 becomes 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, Occupational Safety and Health Administration (OSHA) Occupational Health Standards. In addition, a British isocyanate standard was included for this study to compare measured total reactive isocyanate groups (TRIG) with a referenced criteria. Further discussion regarding TRIG follows in the next section (Isocyanates).

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 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.

Isocyanates

All isocyanates contain the -N=C=O group, which reacts readily with compounds containing reactive hydrogen atoms to form urethanes. The di- and poly-isocyanates contain, respectively, two and three or more of these groups. The chemical reactivity of the isocyanates makes them ideal for polymer formation. Hence, they are widely used in the manufacture of polyurethane foams, paints, adhesives, fibers, resins, and sealants.

In general, the potential respiratory hazards encountered during the use of diisocyanates in the workplace are related to their vapor pressures. The lower-molecular-weight diisocyanates tend to be more readily volatilized into the work place atmosphere than the higher-molecular-weight diisocyanates. Although the vapor pressures of the higher-molecular-weight diisocyanates are relatively low, they may generate vapor concentrations sufficient to cause respiratory and mucous membrane irritation if they are handled in poorly ventilated areas. Also, the potential for skin irritation is generally higher for the lower-molecular-weight diisocyanates, and the severity of these irritant responses is reduced with increasing molecular weight.

Asthmatic attacks may occur immediately after exposure or at an interval of hours after cessation of exposure, presenting as nocturnal cough and breathlessness. Exposure to isocyanates may also result in chronic impairment of pulmonary function. Isocyanate exposure during accidental spills is a major cause of sensitization, and there is evidence that massive exposures may produce effects on the central nervous system. One recently completed animal study found dose-related statistically significant cancer excesses in mice and rats administered TDI by gavage (not the usual route of human exposure) in very high concentrations. The tumors were distant from the site of administration.

In the United States, Federal OSHA exposure standards for diisocyanates have been established only for toluene diisocyanate and methylene bisphenyl isocyanate. The current Federal OSHA standard and ACGIH TLV for MDI is a ceiling limit of 0.02 parts of MDI per million parts of air (ppm); (200 micrograms per cubic meter of air [ug/m^3]).

The current NIOSH recommended exposure limit (REL) for MDI is 50 ug/m^3, for up to a 10-hour workshift, 40-hour workweek and 200 ug/m^3 as a ceiling concentration for any 10-minute sampling period. The NIOSH recommended standard for diisocyanates was based on three types of effects of exposure: direct irritation, sensitization, and chronic decrease in pulmonary function. This standard applies to diisocyanate monomers only, and not to higher polymers of these compounds. Little is known about the toxicological effects of polymeric isocyanates. No long-term studies have been conducted on polymeric isocyanates, and furthermore, their potential for inducing pulmonary hypersensitivity, as shown for monomeric isocyanates, has not been investigated. However, results of a recent NIOSH study revealed that work in an industrial setting where polymeric isocyanate exposures were documented was associated with small mean decreases in FEV_1 and FVC which were not observed in an unexposed group. Also, the change in FEV_1 over the shift correlated with personal airborne exposure to polymeric but not monomeric MDI.

In February 1983, the United Kingdom Health and Safety Commission set a "common control limit" for workplace exposure to all isocyanates. This new control limit is an 8-hour TWA of 20 ug of isocyanate group (NCO) per cubic meter of air, and a 10-minute TWA of 70 ug of isocyanate group per cubic meter of air. This new control limit, in units of ug (NCO)/m^3, requires that the analytical methods be applicable to "total isocyanate", i.e., the sum of all isocyanate species, including monomers and prepolymers.

VI. RESULTS AND DISCUSSION

The average air concentrations (ug/m^3) of monomeric MDI obtained during the comparison study using the five methods previously outlined are presented in Table I. A review of the data indicates the highest MDI concentrations were obtained using the methoxyphenylpiperazine impinger method (concentration 43 ug/ml). The methoxyphenylpiperazine impinger method (concentration 4.3 ug/ml) and the Nitro reagent method both measured lower MDI concentration and the two filter methods (OSHA method and methoxyphenylpiperazine method) measured no detectable MDI.

These data suggest several things. The results of both filter sampling methods lend support to the idea that the physical nature of the field atmosphere affects the collection efficiency of the method used. In this case, the filter methods lacked sufficient solvent to rapidly dissolve the aerosol thus preventing the isocyanate from physically reaching the reagent. This allows the isocyanate time to react with other compounds also present from the industrial process. The data from the impinger samples imply that the concentration of methoxyphenylpiperazine in toluene has an effect on the rate of reaction. The results from the nitro reagent samples imply that the reaction rate of this reagent with isocyanates may be slower than the reaction rate of the methoxyphenylpiperazine at the same reagent concentration. The results of the comparison study therefore suggest that the methoxyphenylpiperazine impinger method (concentration 43 ug/ml) would be the appropriate sampling method to use under the conditions of this evaluation.

Table II shows the results of the MDI monomer and total isocyanate group obtained from the methoxyphenylpiperazine impinger method during the comparison study. A review of the data shows that although all concentrations of MDI monomer are below the REL of 50 ug/m^3, the total isocyanate group concentration are well above the British 20 ug $(NCO)/m^3$ recommendation. No results for total isocyanate group were reported on the filter samples because the data were thought to be unreliable.

Table III contains the results of the personnel samples collected for MDI. Concentrations of MDI ranged from N.D. to 3.9 ug/m^3. All personal samples were collected by the OSHA filter method. Table IV contains the results of the area samples collected for MDI. Side-by-side area samples were collected using the OSHA filter method and the methoxyphenylpiperazine impinger method (43 ug/mℓ concentration). Results are consistent with the comparison study data. The samples collected by the OSHA filter method showed no detectable MDI. The average MDI concentration for the area samples determined by the methoxyphenylpiperazine method was 12 ug/m^3. The comparison study and the area samples therefore suggest that MDI concentrations measured by the methoxyphenylpiperazine method are 25-50 times greater than those measured by the OSHA filter method. As a result, the MDI concentrations on the personnel samples measured by the OSHA method are highly suspect and probably greatly underestimate true MDI exposure.

Analyses of the bulk samples by GC/MS indicated the presence of 2-ethoxyethanol, toluene, xylene, hexachloroethane, methylcyclohexane and N,N-dimethylcyclohexylamine. Results of the analyses for the personal and area samples for these substances are presented in Table V. Toluene concentrations ranged from N.D. to 35 mg/m^3 (Recommended Exposure Level [REL] - 375 mg/m^3), xylene from N.D. to 128 mg/m^3 (REL - 434 mg/m^3), hexachloroethane from N.D. to 1 mg/m^3 (REL - 100 mg/m^3), methylcyclohexane from N.D. to 4.3 mg/m^3 (REL - 1600 mg/m^3), 2-ethoxyethanol from N.D. to 16 mg/m^3 (REL - 19 mg/m^3) and N,N-dimethylcyclohexylamine from N.D. to 0.52 mg/m^3. All concentrations measured are below the respective exposure limits.

VII. CONCLUSIONS

Although no direct measurements were made of isocyanate levels above the recommended criteria, the data collected strongly suggests overexposure to monomeric MDI and total isocyanate group occurred. For example, if a concentration of 3.9 ug/m^3 of MDI was measured by the OSHA method and the results obtained by this method underestimate exposure by 25-50 times, actual exposure levels would be 100-200 ug/m^3. This is well above the REL of 50 ug/m^3 for MDI. Exposure to organic solvents was not a problem. Based on the information collected during the evaluation the following recommendations are being made.

VIII. RECOMMENDATIONS

1. Respiratory Protection

The official NIOSH position on controlling respiratory exposures to isocyanates was presented in a July 12, 1985, letter to Mr. Edward J. Baier, Director of Technical Support, U.S. Department of Labor, OSHA, Washington, D.C., from Mr. John B. Moran, Director of the Division of Safety Research, NIOSH, Morgantown, West Virginia. This letter states:

> The NIOSH position on isocyanate containing paints remains unchanged. The lack of warning properties of isocyanates eliminates NIOSH approval for air-purifying respirators. In addition, the problem of sensitization of persons exposed to very low concentrations of isocyanates dictates use of the best available respiratory protection. Therefore, we recommend positive pressure supplied-air respirators be used for respiratory protection against isocyanate containing paints.[14]

The NIOSH criteria document for occupational exposure to diisocyanates[5] (DHEW, NIOSH, Publication No. 78-215) recommends that a worker exposed to diisocyanates should be provided with, as a minimum, a Type C supplied-air respirator with full facepiece operated in pressure-demand or other positive pressure mode, or with full facepiece, helmet, or hood operated in continuous-flow mode. However, it must be realized that providing respiratory protection for individuals wearing corrective glasses is a problem. A proper seal cannot be established if the temple bars of eye glasses extend through the sealing edge of the full facepiece. Systems have been developed for mounting corrective lenses inside full facepieces.

When a worker must wear corrective lenses as part of the facepiece, the facepiece and lenses should be fitted by qualified individuals to provide good vision, comfort, and a good tight seal.

2. Protective Gloves

For protection of the hands against MDI and organic solvents, gloves impervious to MDI and solvents should be used.

IX. REFERENCES

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13. National Institute for Occupational Safety and Health. Current intelligence bulletin 39 - glycol ethers. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1983. (DHHS (NIOSH) Publication No. 83-112).

14. Letter of July 12, 1985, from John B. Moran, Director of the Division of Safety Research, NIOSH, Morgantown, West Virginia to Edward J. Baier, Director Directorate of Technical Support, U.S. Dept. of Labor, OSHA, Washington, D.C.

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XI. DISTRIBUTION AND AVAILABILITY OF REPORT

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1. Professional Urethanes, LaCrosse, Wisconsin
2. Foam Enterprises, Inc., Minneapolis, Minnesota
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

Average Air Concentration (ug/M^3) Monomeric MDI
Ridge Building
Cincinnati, Ohio

HETA 84-405

Sampling Method	Sampling Day 1	2	3	4
Methoxyphenylpiperazine Impinger (43 ug/ml concentration)	5	15.5	22.1	25.5
Methoxylphenylpiperazine Impinger (4.3 ug/ml concentration)	<2	11.2	15.0	12.9
OSHA Filter Method	<0.7	<0.5	<0.3	<0.5
Methoxyphenylpiperazine Filter Method	<0.5	<0.4	<0.2	<0.4
Nitro Impinger Method	-	12.6	13.0	13.6

Table II

Monomer MDI and Total Reactive Isocyanate Concentration
Using Methoxyphenylpiperazine Impinger Method

Ridge Building
Cincinnati, Ohio

HETA 84-405

Sample	Monomeric MDI (ug/M^3)	Total Isocyanate Group (ug/M^3)
Day 1		
A1	5.4	311
A2	N.D.	338
A3	7.9	314
Day 2		
A4	17	141
A5	16	219
A6	14	218
Day 3		
A7	23	69
A8	25	52
A9	14	61
Day 4		
A10	23	124
A11	25	159
A12	25	135

Table III

Monomeric MDI Concentrations
Using OSHA Filter Method

Ridge Building
Cincinnati, Ohio

HETA 84-405

Job	Sampling Date	Sampling Time	MDI Concentration (ug/M^3)
Foam Sprayer 1	6/20/84	13:34-16:52	3.0
Foam Sprayer 2	6/20/84	13:34-16:52	3.9
Foam Sprayer 1	6/21/84	13:25-17:50	2.0
Foam Sprayer 2	6/21/84	13:25-17:50	3.4
Foam Sprayer 1	6/22/84	13:03-17:04	N.D.
Foam Sprayer 2	6/22/84	13:03-17:04	N.D.
Foam Sprayer 1	6/25/84	15:12-20:13	N.D.
Foam Sprayer 2	6/25/84	15:12-20:13	N.D.

Table IV

Monomeric MDI Concentrations
Using OSHA Filter Method and Methoxyphenylpiperazine Impinger Method

Ridge Building
Cincinnati, Ohio

HETA 84-405

Sample	Sampling Time	OSHA Filter Method (ug/M^3)	Methoxyphenylpiperazine Impinger Method (ug/M^3)
		June 22, 1984	
1	13:07-16:43	N.D.	12.0
2	13:07-16:43	N.D.	12.5
3	13:07-16:43	N.D.	13.4
		June 25, 1984	
1	14:35-19:50	N.D.	17.5
2	14:35-19:50	N.D.	6.7
3	14:35-19:50	N.D.	14.9
		June 26, 1984	
1	11:55-16:15	N.D.	12.4
2	11:55-16:15	N.D.	15.5
3	11.55-16:15	N.D.	13.0

Table V

Organic Vapor Concentration for Personal and Area Samples

Ridge Building
Cincinnati, Ohio

HETA 84-405

June 20-26, 1984

Sample Type	Sample Date	Sample Time	Organic Vapor Concentrations					
			Toluene (mg/M3)	Xylene (mg/M3)	Hexachlorethane (mg/M3)	Methycyclohexane (mg/M3)	2-ethoxyethanol (mg/M3)	N,N-dimethylcyclohexylamine (mg/M3)
Inside Bldg (#1)	6/20/84	14:20-17:05	N.D.	N.D.	N.D.	N.D.	N.D.	-
Inside Bldg (#2)	6/20/84	14:30-17:05	1.3	0.64	N.D.	N.D.	N.D.	-
Inside Bldg (#3)	6/20/84	14:35-17:05	1.7	0.67	N.D.	N.D.	N.D.	-
Outside Bldg (#1)	6/20/84	14:35-16:52	29	N.D.	N.D.	N.D.	N.D.	-
Foam Sprayer & Sealer (#1)	6/20/84	13:37-16:52	N.D.	N.D.	N.D.	N.D.	5.8	0.15
Foam Sprayer & Sealer (#2)	6/20/84	13:34-16:52	N.D.	N.D.	N.D.	N.D.	17	0.13
Primer (#1)	6/20/84	15:19-15:42	35	128	N.D.	4.3	N.D.	N.D.
Primer (#2)	6/20/84	15:19-15:42	32	122	N.D.	3.6	7.0	N.D.
Inside Bldg (#1)	6/21/84	14:08-16:15	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Inside Bldg (#2)	6/21/84	14:12-16:18	1.2	0.64	N.D.	N.D.	N.D.	N.D.
Inside Bldg (#3)	6/21/84	14:20-16:20	1.7	0.67	N.D.	N.D.	N.D.	N.D.
Foam Sprayer & Sealer (#2)	6/21/84	13:25-16:50	0.44	N.D.	N.D.	N.D.	N.D.	0.16
Foam Sprayer & Sealer (#2)	6/21/84	13:25-16:50	2.0	N.D.	N.D.	N.D.	N.D.	0.19

(Continued)

Table V

(Continued)

Sample Type	Sample Date	Sample Time	Organic Vapor Concentrations					
			Toluene (mg/M3)	Xylene (mg/M3)	Hexachlorethane (mg/M3)	Methycyclohexane (mg/M3)	2-ethoxyethanol (mg/M3)	N,N-dimethylcyclohexylamine (mg/M3)
Inside Bldg (#1)	6/22/84	10:17-15:48	0.27	N.D.	N.D.	N.D.	N.D.	N.D.
Inside Bldg (#2)	6/22/84	10:23-15:53	2.1	0.77	N.D.	N.D.	N.D.	N.D.
Foam Sprayer (#1)	6/22/84	13:12-17:04	0.33	N.D.	N.D.	N.D.	N.D.	0.52
Foam Sprayer (#2)	6/22/84	13:03-17:04	0.30	N.D.	N.D.	N.D.	0.94	0.31
Silicone Sealer (#1)	6/22/84	13:14-15:01	1.5	N.D.	N.D.	N.D.	N.D.	N.D.
Silicone Sealer (#2)	6/22/84	13:14-15:03	1.3	N.D.	N.D.	N.D.	N.D.	N.D.
Inside Bldg (#1)	6/25/84	12:55-16:28	1.4	1.0	N.D.	N.D.	N.D.	N.D.
Inside Bldg (#2)	6/25/84	13:00-16:25	1.4	0.17	N.D.	N.D.	N.D.	N.D.
Foam Sprayer (#1)	6/25/84	15:12-20:13	0.81	1.9	1.08	N.D.	0.73	.05
Foam Sprayer (#2)	6/25/84	15:12-20:13	0.40	1.1	N.D.	N.D.	0.65	.25
Primer (#1)	6/25/84	14:22-14:57	17	51	N.D.	2.0	N.D.	N.D.
Primer (#2)	6/25/84	14:22-14:57	16	58	N.D.	2.0	2.2	N.D.
Silicone Sealer (#1)	6/26/84	12:50-16:45	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Silicone Sealer (#2)	6/26/84	12:50-16:45	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Silicone Ass't (#1)	6/26/84	12:55-16:45	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Silicone Ass't (#2)	6/26/84	12:55-16:45	0.17	N.D.	N.D.	N.D.	N.D.	N.D.

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