Industrial Hygiene Walk-Through Survey Report of Hoover Universal, Inc. Greenville, Ohio

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A walk through survey was conducted at Hoover Universal, Incorporated (SIC-3717), Greenwich, Ohio, on January 23, 1984. The facility manufactured car seats, and head and arm rests by hot and cold processes utilizing toluene-diisocyanate (26471625) (TDI). TDI foam operations were inspected. Personnel records were available as the facility had been selected for inclusion in a NIOSH retrospective cohort mortality survey of TDI exposed workers. Previous sampling by OSHA showed that personal exposures on the most labor intensive line ranged from 0.040 to 0.140 micrograms per cubic meter (microg/m3). The OSHA standard for TDI exposure is 0.140microg/m3. Personnel files contained records of approximately 1600 hourly and 200 salaried employees. Medical records consisted primarily of records of brief preemployment physical examinations. Pulmonary function tests were conducted routinely only on employees who had filed workmens' compensation claims for TDI related lung problems. The authors conclude that on the basis of past exposure data and personnel records, the facility should be included in the NIOSH survey.

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Mention of company or product name in this report does not constitute endorsement by NIOSH.

PURPOSE OF SURVEY:	To perform a walk-through survey of TDI foaming operations and to microfilm employee records as part of a retrospective cohort mortality study being conducted at this facility.
EMPLOYER REPRESENTATIVES CONTACTED:	Mr. James B. Black, Industrial Relations Manager (513) 981-2176 Mr. Bruce Jackson, Process Engineer (513) 981-2176
EMPLOYEE REPRESENTATIVE CONTACTED:	Mr. Rick Brunner, United Auto Workers
STANDARD INDUSTRIAL CLASSIFICATION (SIC):	3717 (Motor Vehicle Parts and Accessories)

ABSTRACT

A walk-through survey was performed at the Hoover Universal facility in Greenfield, Ohio on January 23, 1984. The facility was visited previously on December 15, 1983 and a decision was made by NIOSH to include this facility in a retrospective cohort mortality study of toluene diisocyanate (TDI) exposed workers. In addition to conducting a walk-through survey of the TDI-foam operations, microfilming of personnel records was also performed. A third visit will be made to conduct a limited industrial hygiene sampling study.

INTRODUCTION

The irritating effects of toluene diisocyanate (TDI) on the eyes, on the gastrointestinal tract, and on the respiratory system have long been known [1-5]. A small proportion of the individuals who are exposed to TDI also develop an allergic respiratory or dermal response[5-7]. Chronic diminution of ventilatory capacity has also been reported [8-11]. TDI is known to react with proteins in vitro[12] and has been shown to be mutagenic in a certain bacterial test assay[13]. Recently an experimental animal chronic feeding study conducted by the Department of Health and Human Services' National Toxicology Program concluded that TDI was carcinogenic in both sexes of both rats and in female mice [14]. Another study, involving chronic inhalation, using male and female rats and mice exposed to 0.05 to 0.15 ppm of TDI did not show any carcinogenic effects [15].

Due to the large numbers of workers regularly exposed to TDI, the Industrywide Studies Branch (IWSB), NIOSH, is initiating a cohort mortality study to determine if long term health risks exist for workers exposed to TDI. The Hoover Universal facility in Greenville has been included because of its singular use of TDI, the large numbers of potentially exposed workers, long history of TDI use, and excellent personnel record system.

HISTORY AND DESCRIPTION OF THE PLANT

This facility began production in 1965. Products made here include car seats and head and arm rests. These are made using toluene diisocyanate based flexible foam formed over rigid steel frames. During the period 1967-72 the seats and rests were vinyl clad on the outside, with the vinyl covering bonded to the foam during foaming. Early accounts of this operation indicate that a liquid polyvinyl chloride resin was used to form a vinyl encasement within the molds. The liquid polyurethane was then poured into the molds. All process equipment was reported to be locally exhausted. After 1972, pre-fitted seat coverings were used to finish the seats and rests.

The present production facility consists of a steel fabricated one floor structure with a twenty foot high ceiling. Currently there are four foam process lines in operation (see Figure 1). Prior to 1982 there were two hot foam process lines within the plant. Line number one was dismantled in 1982 and replaced with a cold foam process. The one remaining hot foam process line is line number two (the second old hot foam process line was located in the area now occupied by lines one and three). In addition to the foam process lines, there are an adjacent warehouse and a bulk storage room. Offices and a lunch room are located within the main production building but are separated by walls. No major changes have occurred in the design of the facility since 1965.

DESCRIPTION OF THE WORKFORCE

The number of workers employed at this site during 1967 through 1969 was slightly above 100. Employment grew to above 200 in 1970 and above 300 in 1972. Currently, there are 196 hourly and about 45 salaried employees. Hourly workers are represented by the United Auto Workers. Production is continuous over three shifts, typically six days per week.

PROCESS DESCRIPTION

A. Hot Foam Process

In the hot foam process, metal molds move on a conveyor track through various operations. The manufacture of automobile seat and rest cushions begins with the manual spraying of the inside of the molds with a wax mold release agent. Metal reinforcing bars are then installed in the empty molds. Liquid TDI containing polyurethane resin is sprayed into the mold. The mold is then sent through a gas fired curing oven tunnel where the foam process is completed. Oven temperatures reach 450°F. The oven tunnel is exhaust ventilated. When the molds emerge from the curing oven tunnel, they are opened and the cushions taken out. The cushions are then placed on a moving conveyor for transfer to the finishing department. Here they are first repaired (as necessary) and trimmed. This involves removal of excess foam that has leaked between the mold lid seam by workers (called Trimmers) with mechanical shears.

The present hot foam process has four mold attendants per shift (Burlappers) who install the reinforcing bars and apply the mold release agent, one operator who monitors the automatic spray nozzles, and 5-6 workers who trim, remove cushions, and transfer finished product.

During the years 1967 to 1972 the company produced vinyl coated foam items via the hot foam process. A liquid polyvinyl chloride resin was introduced into the mold prior to the TDI containing resin. Details regarding the previous use of vinyl resin are not available. However, it is known that several phthalate plasticizers were used with this resin.

B. H.R. Process

The cold foam process operations are basically similar to the hot foam process operations. The foam and the wax release agent are sprayed as in the hot process. In the cold foam process, the molds are provided some supplemental heat (in addition to the heat created from the exotherm during reaction) through use of hot water jackets. Also, a greater concentration of catalyst is added than in the hot foam process. As in the hot foam process, upon removing the foam products from the molds they are transferred to the finishing department. Here they are repaired (as necessary), trimmed, and hung on a moving track to air cure before being packed.

C. Repair Operations

Imperfect foam items are patched by two operators who dispense small quantities of a methylene diphenyl isocyanate (MDI) containing foam resin from a paper cup. The MDI-foam resin has been used for about 13-14 years. After cold curing (only time is required to promote the cure) the repaired items are trimmed. A related operation involves repairing torn foam products by spraying on an adhesive glue. The glue vehicle consists of 1,1,1-trichloroethane. Four people per shift are involved with glue repairing. (These employees also affix cardboard bottoms to the underside of the seat units.) Two employees per shift are engaged in the patching operation.

D. Chemical Usage

All flexible foam produced at this facility has always been made using a 80/20 blend of 2,4 and 2,6 toluene diisocyanate. An aliphatic amine catalyst, primarily 1,4-diaza-bicyclo-(2,2,2 octane) (DABCO), in a dipropylene glycol vehicle is added at the spray nozzle to initiate foaming and rapid curing. A second catalyst, triethanolamine, has been used in making the arm rest units. The mold release agent used in this facility consists of 1 part wax and 3 parts methylene chloride.

EXPOSURE EVALUATION CRITERIA

The current legally allowable air concentration enforced by the Occupational Safety and Health Administration for 2,4-TDI is 0.02 ppm (0.14 mg/m^3), not to be exceeded at any time. NIOSH recommends that an 8-hour time weighted average exposure not exceed 0.005 ppm and that short term exposures to TDI not exceed 0.02 ppm for any 20 minute period. The American Conference of Governmental Industrial Hygienists concurs with the NIOSH recommendation in recommending a threshold limit value (TLV).

DESCRIPTION OF PAST EXPOSURES

Historically, employee exposures probably have been limited primarily to toluene diisocyanate, aliphatic amine catalysts, and solvents (including petroleum distillate, methylene chloride, and 1,1,1,trichloroethane). For six years, between 1967 and 1972, additional exposures to volatile components of a liquid polyvinyl chloride resin probably occurred. Details of the composition of this resin were not available.

The lacquer spray coat was applied to the finished armrests in the late 1960's. The lacquer was thinned with toluene. Silica exposure may have occurred until 1974 in an abrasive blasting mold cleaning operation. Since then, crushed walnut shells have been used as the abrasive in cleaning the molds. Six persons were assigned to this operation. Occasionally, higher exposures to TDI probably have occurred during leaks and spills. Both the union and company estimate that two to four accidental TDI releases occur per year. Some of these spills have required medical treatment.

Environmental monitoring of workplace exposures was performed by Hoover management on a regular basis between the years 1968 to 1973 during which time over 500 samples were taken for TDI. Presumably, most of the samples were personnel samples. All samples were collected over a 15 minute collection period in a Marcali solution using a Dupont Unico^{R} TDI reagent test kit. The test kit reports a minimum limit of detection of 0.01 part TDI per million parts of air (ppm). Unfortunately, only a memo prepared in 1973 on past exposures is known to contain any information on the results of those samples. These data consist of average yearly exposures and are likely to have a low bias since exposures below the limit of detection were included as zero quantities when calculating the average yearly exposure. These values are listed below.

Year	Number of Samples	Average Concentration (ppm)
1968	58	0.0517
1969	68	0.0155
1970	64	0.0098
1971	51	0.0109
1972	106	0.0089
1973	194	0.0100

In 1974 the Ohio Occupational Safety and Health Administration conducted some limited sampling for TDI. Several fifteen minute samples were taken near hot foam line number 1. The results of this sampling were:

Trimmer, outside line 1	0.02 mg/m^3
	0.02 mg/m^3
	0.02 mg/m^3
	0.01 mg/m^3
Line operator, Trimmer, line 1	0.02 mg/m^3
	0.01 mg/m^3
	0.01 mg/m^3
	0.01 mg/m^3
Sander, cold foam operation, repair	0.01 mg/m^3
	0.01 mg/m^3

In July of 1979 the federal Occupational Safety and Health Administration (OSHA) collected air samples for TDI. All samples indicated air concentrations below the permissible exposure limit (PEL) of 0.02 ppm or 0.14 mg/m^3. Sample collection was performed in a liquid bubbler containing "nitro" reagent. Short term samples were collected. The results were as follows:

Line 1 (hot foam)	
Burlapper	Not Detected
Burlapper	0.07 mg/m^3
Burlapper	Not Detected
Wax Sprayer	Not Detected
Line 2 (hot foam)	
Burlapper	0.0027 mg/m^3
Pull, clean & wax	Not Detected
Foam trimmer	Not Detected

Another survey by OSHA in 1983 was conducted using 1(2-pyridyl) piperazine coated onto glass fiber filters to collect TDI. Samples were collected over a 15 minute period. Personnel sampled on lines 1, 2, and 3 were exposed to TDI at concentrations of less than the limit of detection (0.00064 mg/m^3). Personnel exposures on line 5 were 0.079, 0.040, 0.140, and 0.120 mg/m^3. Line 5 is the most labor intensive. The operators are required to spray the TDI foam mixture into stationary molds which encircle the operators. Ventilation is not provided.

DESCRIPTION OF PERSONNEL AND MEDICAL RECORD SYSTEMS

Based on a previous inspection by IWSB investigators of the personnel records at this facility it was judged that they were adequate to use in a retrospective epidemiologic study. Microfilming of these records was performed during this second visit to the plant.

PERSONNEL RECORDS

Two sources of personnel data exist at the plant: an index card file of all employees since 1967; and personnel service cards for employees from 1973 forward.

Index Card File

The index cards are alphabetically filed separately for hourly and salaried workers. Each card contains:

Name	Date of birth
Last known address	Date of hire
Social security number	Date of termination
Clock number	Reason for termination

There are approximately 1600 hourly and 200 salaried employees in this file. Employees terminated prior to 1967 were purged from this file. Therefore the record of anyone who worked only between 1965 - 1967 would not be available.

The clock numbers were assigned sequentially for some unspecified time period. However numbers began to be reassigned to new employees at some point in the past. The company could not provide a date when this occurred.

Race and sex are not recorded on the index card or the service card record. However, the company stated that the number of black employees was small and that management could provide a list of black employees that have worked at Hoover. Given name and social security number, race, sex and date of birth can be obtained from SSA.

Service Cards

The payroll service cards for active employees are ordered alphabetically in a file drawer. Duplicate service cards ordered by job classifications are also kept in this drawer. These yellow, 2-sided cards contain the detailed work history of the individual. At the top of each card is the name, clock number, and date of hire.

Each change in job status, such as a lay off or transfer, is recorded on this card. Data recorded include: date of change, job classification, pay rate and remarks. This yellow card system was begun in 1973. No work history prior to this date is recorded on this yellow card. A system similar to the current one was in use before 1973. However, these cards were purged when the new system was devised.

When a person terminates employment, their yellow card is removed from the service card file and placed in his/her personnel folder. Personnel folders for all active and recently terminated (within 2 years) employees are kept in the 12 lateral file drawers located in the personnel office.

Personnel files of employees terminated between 1976 and 1979 are kept in the vault at the plant.

The warehouse in downtown Greenfield was visited to determine if there were additional, older files in storage. None were found.

MEDICAL RECORDS

Medical records consist primarily of records of brief pre-employment physicals. Most of these physicals were conducted by two physicians. Medical records contain initial job classification data and could serve as a check for personnel records. Pulmonary function tests are conducted routinely only on those persons who have filed workers' compensation claims for TDI related lung problems. Medical insurance is provided for employees by Hoover and records would be retrievable from the provider.

The location, type, and number of personnel records for this facility is summarized below.

LOCATION	TYPE OF RECORD	NO. OF RECORDS
Personnel office	1) Index card file	1800
	2) Active service card file	200
	3) Personnel folders	12 lateral file drawers

Vault	1) Personnel folders of 1976-1979 terminated workers	4 storage boxes

DESCRIPTION OF MEDICAL, SAFETY, AND INDUSTRIAL HYGIENE PROGRAM

The company does not employ anyone on location who is specifically trained in health, safety, or industrial hygiene. Industrial hygiene sampling is no longer performed although samples were taken in the past. Mist/dust combination respirators are available, but no indication was obtained that fit testing or a respirator maintenance program is in effect. Various types of protective gloves are also available. Showers and locker facilities are not available.

A basic pre-employment physical examination was required of all new employees until 1978 when this practice was discontinued. Periodic physical exams were not provided by the company. Presently, the company is reinstituting an initial employment physical exam using nearby clinics and physicians. In addition, a respiratory function screening program and periodic follow-up of sensitized or suceptible employees is being developed in cooperation with the University of Cincinnati, Kettering Laboratory.

CONCLUSIONS

Past exposure data and the number of personnel records at this facility suggest that it should be included in the NIOSH cohort mortality study of TDI exposed workers. Because polyvinyl chloride resin had once been used in this plant, and it is probable that some residual vinyl chloride monomer may have been present in the resin, confounding exposures to vinyl chloride in the air may have occurred. However, correspondence from the Industrial Commission of Ohio during inspections of the plant in 1968 described the process as essentially a closed system. Unfortunately no air measurements were taken. Air samples collected by NIOSH at other extrusion operations in the early 1970's frequently found no airborne vinyl chloride monomer. Attempts to reconstruct past environmental exposures, in support of the retrospective epidemiologic study, will continue. However, the extent of that reconstruction will depend directly on the completeness of the process records, personnel interviews, and personnel records.

REFERENCES

1. NIOSH, Criteria for a Recommended Standard. Occupational Exposure to Diisocyanates, DHEW (NIOSH) Publication No. 78-215, 1978.

2. Fuchs S, Valade P: [Clinical and experimental study of several cases of intoxication by Desmodur T (toluene diisocyanate) 1-2-4 and 1-2-6.] Arch Mal Prof 12: 191-96, 1951 (Fr).

3. Reinl W: [Diseases in the manufacture of polyurethane-based plastics.] Zentralbl Arbeitsmed 3: 103-07 1953 (Ger).

4. Swensson A, Holmquist CE, Lundgren KD: Injury to the respiratory tract by isocyanates used in making lacquers. Br J Ind Med 12: 50-53, 1955.

5. Upjohn Chemical Division, Precautions for the proper usage of Polyurethanes, Polyisocyanates, and Related Materials, Technical Bulletin 107, second edition, 1980.

6. Dodson VN: Isocyanate inhalation. J Occup Med 13: 238-42, 1971.

7. Munn A: Experiences with diisocyanates. Trans Assoc Ind Med Off 9: 134-38, 1960.

8. Peters JM, Murphy RLH, Pagnotto LD: Respiratory impairment in workers exposed to "safe" levels of toluene diisocyanate (TDI). Arch Environ Health 20: 364-57, 1970.

9. Adams WGF: Long-term effects on the health of men engaged in the manufacture of tolylene di-isocyanate. Br J Ind Med 32: 72-78, 1975.

10. Wegman DH, Peters JM, Pagnotto L, Fine LJ: Chronic pulmonary function loss from exposure to toluene diisocyanate. Br J Ind Med 34: 196-200, 1977.

11. Butcher BT, Jones, RN, O'Neil CE: Longitudinal study of workers employed in the manufacture of toluene-diiocyanate. Am Rev Respir Dis 116: 411-21, 1977.

12. Scheel LD, Killens, R, Josephson A: Immunochemical aspects of toluene diisocyanate toxicity. Am Ind Hyg Assoc J 25: 179-84, 1964.

13. Anderson M, Binderup ML, Kiel P, Larsen H, Mazild J: Mutagenic action of isocyanates used in the production of polyurethanes. Scand J Work Environ Health 6: 221-26, 1980.

14. Dieter MP: NTP Technical Report on the carcinogenesis bioassay of toluene diisocyanate. NIH Publication number 82-2507, National Toxicology Program, Research Triangle Park, N.C. August 1982.

12. Loeser E: Long-term toxicity and carcinogenicity studies with 2,4/2,6-toluene-diisocyanate (80/20) in rats and mice. Tox Let 15: 71-81, 1983.

16. Letter, from Albert E. Scheible, Industrial Commission of Ohio to the Hoover Ball & Bearing Company, Greenfield, Ohio dated April 1, 1968.

Figure 1 - Plant Layout, Hoover Universal, Greenfield, Ohio 1984