Journal of Occupational and Environmental Hygiene, 3: D24–D27
ISSN: 1545-9624 print / 1545-9632 online
DOI: 10.1080/15459620500506935

OSHA Compliance Issues
Isocyanate Exposure in an Autobody Repair and Collision Center

Column Editor
Richard Fairfax

Reported by
Eric Brooks

Eric Brooks is an industrial hygienist with the U.S. Department of Labor, Occupational Safety and Health Administration, Bismarck, North Dakota. For more information, he can be contacted at 701-250-4521.

INTRODUCTION

This inspection by the Occupational Safety and Health Administration (OSHA) reports on an overexposure to methylene bisphenyl isocyanate (MDI) during the spray application of a protective coating for truck beds. The inspection was conducted at an autobody repair shop and collision center that also operated a spray-on truck bed coating operation. The investigation was initiated as a complaint inspection and was limited to the complaint allegation. The employee complaint alleged that workers were exposed to harmful vapors during application of the truck bed liner.

BACKGROUND

Occupational exposure to MDI can occur in a variety of industries, including painting, mining, manufacturing of plastics and automotive parts, roofing, packaging, glues, and insulating structures.[1] A relatively new industry, primarily composed of smaller employers, has recently developed that uses an MDI-based spray-on urethane to provide a protective coating on truck beds. The isocyanate portion of the urethane is contained in a two-part system that uses an MDI mixture composed of both MDI monomer and isomers of MDI, trimeric species, and oligomers of MDI.[1] Recent articles in the literature have discussed the overexposure of workers to MDI during this type of operation and to the work-relatedness of occupational asthma in the spray-on truck bed lining industry.[1,2] Workers' compensation claims, from January 1993 through December 2002, in the state of Washington, reported that eight workers in the truck bed lining industry filed claims for asthma, for an incident rate of 200 per 10,000 full-time equivalent. Unfortunately, in these cases none of the truck bed lining cases received medical testing to objectively link their asthma to exposure in the workplace.[2]

Workplace exposure to MDI is further compounded by the fact that MDI has no odor warning properties. A serious health effect is respiratory sensitization resulting in asthma. Additional health effects include irritation or serious burns to the eyes and marked irritation of the nose and throat.[1,2] The health effects of MDI exposure can be both short and long term. OSHA sampling data between February 2004 and March 2005, found approximately 46% of samples collected for MDI under 132 OSHA inspections in this industry to have exceeded OSHA's ceiling permissible exposure limit (PEL) of 0.2 mg/m^3.

The industry reports a steady increase in the number of franchises for this operation and, nationwide, the number currently exceeds 2000. The estimated number of workers involved in this work is estimated at 10,000, and most businesses employ an average of six workers or fewer.[1] Based on these literature reports and complaints from workers, OSHA has focused outreach and enforcement in this industry through the implementation of local emphasis programs (LEPs) in 8 of its 10 regions. The LEPs

were developed in response to the potential for occupational asthma and the reports of worker overexposures to MDI in the literature.[1]

OSHA Inspection

The inspection was initiated as a result of an employee complaint alleging exposure to harmful vapors during the spray application of truck bed liners. On arrival at the worksite, OSHA found that no trucks were scheduled that day for application of the liner. Consequently, OSHA interviewed workers and management and reviewed the health-related programs. All programs were found to be deficient in meeting minimal OSHA requirements.

Hazard Communication (29 CFR 1910.1200)

Although the employer was in possession of the material safety data sheets for the products and the workers knew of their existence, there was no program for training and educating the employees. Workers were not aware of the hazards associated with their use of chemicals and were not adequately trained in the signs and symptoms of exposure and how to adequately protect themselves.

Respiratory Protection (29 CFR 1910.134)

From worker and employer interviews, OSHA found that employees used half-mask respirators fitted with organic vapor cartridges. According to the interviews, OSHA found that the employer had originally borrowed an airline-supplied air respiratory protection system for the employees during the truck bed liner spraying work. Further interviews documented that the employer had actually borrowed several airline respirator systems and in a piecemeal fashion, built an airline respiratory protection system. The workers had declined to use the system and persisted with the organic vapor half-mask respirators. The company did not have a written respiratory protection program; had not conducted respirator fit testing; had not assured that workers were medically able to wear a respirator; trained workers on donning, doffing, and safe use of the respirators; and had not assured proper storage and cleaning of respirators. Respirators were found stored next to contaminated protective clothing in the work area. The employer had also not developed a change-out schedule for respirator cartridges used for protection against air contaminants with poor warning properties.

Personal Protective Equipment (29 CFR 1910.132)

The employer had not evaluated the need and level of personal protective equipment for the workers. Interviews with workers found that they used cloth work gloves, rubber boots, goggles, and a Tyvek suit. OSHA found that the employer had not chosen the personal protective equipment on the basis of the hazard, but rather had used the extra equipment that was available from the employer's related painting and finishing operations. In addition, the employer had not developed an effective training program that addressed the need for and proper use of personal protective equipment. The employer also had not provided a shower and eyewash station available for immediate flushing of workers' eyes and skin in the event of direct contact.

Engineering Controls

At the beginning of the inspection activity, OSHA found that the employer had developed minimal engineering controls for the spray area. The area was located in the corner of the automotive bay and was corner-framed with standard 2×4 construction timbers. The area was covered in a plastic tarp that was held down by various pieces of wood.

Ventilation consisted of a single, wall-mounted exhaust fan with a housing diameter of approximately 1 foot with a $1/2$ horsepower motor. The condition of the fan was such that the make and model could not be determined, and air velocity measurements at the point of spray operation were found to be nonexistent.

Shortly after the initial visit, the employer contracted a heating and ventilation contractor to install a more effective ventilation system. The planned system consisted of a dual intake (upper and lower) draw with eight $16 \times 20 \times 2$-inch and two $16 \times 20 \times 2$-inch replaceable filter banks. The exhaust component consisted of a 3 horsepower fan powering a 2-foot diameter exhaust fan (rated for 1910 rpm).This system was designed to draw the isocyanate vapors away from the spray area with the upper intake focusing on the back of the truck area and the lower intake focusing on the outer area. The outer area is most frequently used to spray the tailgate and other smaller items.

OSHA Sampling

Following the initial workplace observations, OSHA returned to conduct sampling from the breathing zone of the operator who was spraying on the truck bed liner.

Note that when OSHA returned to begin sampling of the truck bed spraying operation, it was noted that the workers were wearing new Tyvek coveralls, gloves, foot protection, a hood, and a new supplied air respiratory protection system. While the new respiratory protection and new personal protective equipment were being used by the workers, the program elements including training, fit testing, medical, and evaluation still had not been implemented.

Two samples were initially collected: one from the breathing zone of the operator and an area sample collected from a nearby workstation involved with autobody repair work. All sampling and analytical procedures conformed to OSHA requirements outlined in the *OSHA Technical Manual*.[3] The spray operator was found *not* to be exposed to MDI in excess of the OSHA ceiling limit (Table I). However, the operator on leaving the spray booth was noted as having the sampling hose from the sampling pump to the air filter wrapped around the Tyvek collar indicating that the airflow may have been impaired, thus resampling was necessary.

On returning to resample the operator, a breathing zone sample was collected from the spray operator. The spray operator was found to be exposed to MDI in excess of the OSHA ceiling limit (Table I). The spraying operation involved a standard

TABLE I. OSHA Sampling Results

Sampling	Activity	Results	Duration	Overexposure Factor
Day 1	Area sample	Nondetected	27 min	0
Day 2	Spraying truck bed liner	0.34 mg/m^3	34 min	1.69
Day 3	Spraying truck bed liner	0.35 mg/m^3	31 min	1.76

(also known as a "short-box") truck bed. From interviews with employees and management officials it was determined that standard truck beds typically take approximately 20 to 30 min to spray. The larger, "long-box" truck beds require more time and take approximately 30 to 45 min to complete. In order for OSHA to determine the type of engineering controls needed to assure compliance with the OSHA PEL and minimize employee exposure, a sampling operation involving a long-box style was required.

OSHA returned to the facility a third time to sample a spray operation involving a long-box truck bed. A personal sample was collected from the spray operator. The spray operator was found to be exposed to MDI in excess of the OSHA ceiling limit (Table I).

RESULTS

As previously noted, significant deficiencies were found in the company hazard communication program (29 CFR 1910.1200), their respiratory protection program (29 CFR 1910.134), personal protective equipment programs (29 CFR 1910.132), the company lacked adequate quick drenching facilities (29 CFR 1910.151), and finally, there were overexposures to MDI requiring the company to implement additional engineering controls (29 CFR 1910.1000). Citations were issued for all program deficiencies.

To protect the workers against skin and airborne exposure to MDI, OSHA recommended the following control measures to the employer:

1. All spray operations should be conducted inside a ventilated paint spray booth.
2. Air velocities through the paint spray booth should be maintained at a minimum of 100 ft/min.
3. Should use local exhaust ventilation when spraying inside the truck panels and in dead air spaces.
4. Operators should remain outside of the bed of the truck during spraying of the liner to avoid areas such as the front to the truck bed adjacent to the truck cab where there is generally dead air space.
5. Operators should use a spray extension handle to keep the spray nozzle as far away form the operator breathing zone as possible.
6. Adjust the spay air pressure and temperature to the minimum level needed to complete the work to reduce overspray and vaporization.
7. If a half-mask respirator is used, operators should wear a face shield or goggles to prevent eye contact.
8. Operators should wear gloves and protective coveralls when prepping, spraying, and during cleanup work.
9. Use tools such as spatulas when mixing to keep hands and skin away form the materials.

Follow-Up

As a result of the sampling operations, the employer implemented changes to the operation to reduce the levels of exposure. First, the employer made changes to the ventilation system in order to increase air movement across the back of the truck bed. To do this, a supply of air was drawn off the facility's existing HVAC system and directed through duct work to the truck bed spray area to increase the air movement across the back of the cab and toward the exhaust filters. To accomplish this, the employer drew air off the air supply vent to the spray booth of the existing HVAC system already present in the paint spray area of the shop. This provided a positive air supply across the back of the cab of the truck (as the supply was drawn from an overhead HVAC duct) that allowed for increased air movement across the back of the truck bed and directed toward the exhaust filters. This was designed to further reduce the amount of MDI reaching the breathing zone of the spray operator. The additional air supply brought into the spray area also necessitated additional balancing of the spray area HVAC system to keep the overspray moving toward the exhaust filters.

Second, the employer developed a policy regarding the location of vehicles in the spray area. Previously the vehicles were positioned in a manner where the cab of the truck inhibited air movement toward the ventilation exhaust filter box. The new policy required that the truck beds were positioned alongside the filter box, which allowed for increased air (provided by the new air supply) to cross the back of the bed and be drawn off by the exhaust ventilation system.

OSHA returned to the facility to perform a follow-up inspection. A personal sample was collected from the spray operator using the previous methodology. The spray operator was found to be exposed to MDI below the OSHA ceiling limit (Table II).

The results of the monitoring inspection found the work to be typical and representative of a normal spray operation and demonstrated a decrease in employee respiratory exposure to MDI of approximately 45%. This was a significant reduction given the minimal changes to the employer's engineering controls.

TABLE II. OSHA Follow-Up Sampling Results

Sampling	Activity	Results	Duration	Overexposure Factor
Monitoring	Spraying truck bed liner	0.16 mg/m^3	0 min	0.8

The incorporation of effective engineering controls and personal protective equipment improved operating procedures, and the development and implementation of comprehensive safety and health programs resulted in a marked improvement toward protecting employee safety and health. The employer took an active part in the design and development of engineering controls and operating procedures, resulting in a safety and health culture change that carried on throughout the entire facility. The ability of OSHA and the employer to work together toward the common goal of improved worker safety and health was essential toward completion of the inspection.

REFERENCES

1. **Lofgren, D.J., T.L. Walley, P.M. Peters, and M.L. Weis:** MDI exposure for spray-on truck bed lining. *Appl. Occup. Environ. Hyg. J. 18*:772–779 (2003).
2. **Bonauto, D.K., A.D. Sumner, C.C. Curwick, S.G. Whittaker, and D.J. Lofgren:** Work-related asthma in the spray-on truck bed lining industry. *J. Occup. Environ. Med. 47*:514–517 (2005).
3. **U.S. Department of Labor (DOL), Occupational Safety and Health Administration (OSHA):** OSHA Instruction CPL 2-2.20B CH-1. In *OSHA Technical Manual*. Washington, D.C.: USDOL OSHA, 1993.