Safety Considerations for Application of Spray-On Truck Bed Liners

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ABSTRACT

Most polyurethane or polyurea spray-on truck bed lining (TBL) products contain MDI, a diisocyanate which can cause irritation and allergic reactions in exposed workers. Occupational asthma can be caused or made worse by overexposure to MDI. Authorities in Michigan recently investigated the case of a worker who died from an asthmatic attack after applying a TBL. To protect TBL applicators and nearby workers, a comprehensive approach including medical considerations, engineering controls, work practices and proper use of personal protective equipment is recommended.

INTRODUCTION

Polyurethane, polyurea and polyurea hybrid spray-on truck bed lining (TBL) products have been in use for more than fifteen years. These tough, elastomeric, plural-component products protect pickup truck/cargo van beds and other surfaces by creating a slip-resistant coating. However, the application process presents some potential health hazards to the applicator because most TBLs contain diphenyl methane diisocyanate (MDI). MDI, like diisocyanates in general, can cause irritation to the eyes, nose, throat, lungs and skin. In addition, skin sensitization (allergic dermatitis) and respiratory sensitization (asthma) can be caused or made worse by overexposure to MDI. The reader is urged to read the Material Safety Data Sheet specific to the product in use for a more complete discussion of potential health effects.

HISTORY

Recently, several publications have re-emphasized the need to protect TBL applicators. In October 2003, Lofgren et. al. [1] reported on data from visits to 13 shops where TBLs were being applied. In 7 of the 13 worksites, airborne MDI concentrations were found to be in excess of the OSHA ceiling Permissible Exposure Limit (PEL-C) of 0.2 mg/m^3. Five of the 15 sprayers employed at these 13 shops were identified with MDI-related health effects. Two of these were new-onset asthma cases.

In May 2005, Bonauto et. al. [2] published a study of work-related asthma workers compensation claims in Washington State. They concluded that "The rate of work-related asthma in the truck bed lining industry is excessive and suggests a need for significant intervention, including improvements in the clinical assessment provided to MDI-exposed workers."

As with any asthmatic condition, exposure to the asthmagen, once identified, should be avoided. This is especially important since it is well known that any severe asthmatic attack can be life-threatening. A case-in-point was reported in the Michigan OSHA News in the fall of 2003 [3]. A worker who ". . . had become sensitized . . ." to MDI died of a severe asthmatic attack minutes after completing a TBL application to the interior of a van. The author concluded that "This unfortunate fatality may have been prevented if any of the following would have been in place:

- Adequate training of employees on the hazards of isocyanate exposure;
- Sufficient ventilation inside a spray room or booth;
- Respiratory protection that was properly selected, used, and maintained;
- Medical surveillance program for employees exposed to isocyanates."

This tragic case reminds us of the need to take proper precautions when working with MDI-containing TBL products.

APPLICATION CHARACTERISTICS

In addition to the necessity for a good basic worker health and safety program as outlined above [3], the TBL application presents some specific industrial hygiene challenges. First of all, the worker is spraying a formulation that may contain up to 25% free monomeric MDI while standing in a box (pickup truck bed) or a partially enclosed space (interior of a van). In addition, since most TBL formulations are 100% solids (i.e., solvent-free/non-flammable) and are unaffected by small

specks of dust that can ruin the appearance of an automotive refinish application, there is no apparent need for a commercial spray paint booth. Fortunately though, this very ability to tolerate a less than pristine spray environment, makes possible the use of a negative pressure ventilated enclosure. It thus is easier to contain spray mist without the use of a tightly sealed booth which typically would be operated at slightly positive pressure to prevent entry of dusty air. Furthermore, most TBL formulations are designed to cure rapidly because of the need to apply a relatively thick-section coating. This characteristic makes it possible for unprotected workers to safely re-enter the enclosure relatively soon after the cessation of spraying. Finally, the very low vapor pressure of MDI minimizes the generation of airborne MDI vapors from surfaces on which the TBL has been deposited.

Taken together, the above characteristics of MDI-based TBL products result in an operation where it is relatively easy to use engineering controls to protect everyone but the actual spray applicator. To prevent MDI overexposure to the sprayer, a comprehensive approach, including medical considerations, training, ventilation, work practices and personal protective equipment, must be employed.

CASE STUDY DATA

From February 2004 through April 2005 airborne MDI concentrations were measured during sixteen spray application events. Thirteen applications were pickup truck beds; three were cargo van floors. Free monomer MDI content in the mixed, ready-to-spray TBL formulations ranged from 16% to 25%. Ventilated temporary enclosures were used in all cases. They were not tightly-sealed but were operated at negative pressure during the spray application. Enclosure dimensions and ventilation rates are shown in Table 1. Air changes per minute ranged from just under 1 to almost 3, resulting in 60 to 180 air changes per hour. Air flow velocities in the spray zone ranged from 100 to 200 linear feet per minute.

Twenty-nine airborne MDI concentrations were measured in the breathing zones of spray applicators during active spraying. The arithmetic mean concentration was 3.7 mg/m^3 with a range of 1.2-6.1 mg/m^3. Thus, the mean concentration exceeded the PEL ceiling of 0.2 mg/m^3 by a factor of 18.5. Seven (24%) of the samples exceeded 25X the PEL. Only one (3.4%) sample was less than 10X the PEL. Fortunately, these samples were taken on the lapel of the spray applicators outside of their respiratory protection, which in every case, was an air-supplied respirator. Thus, the measured airborne MDI concentrations do not represent actual worker exposures. However, when one considers these data in light of the reasonably good ventilation flow rates, it is clear that achieving compliance with the PEL in the sprayers' breathing zones by engineering controls alone may be something of a challenge.

Twenty-two area samples also were taken inside the enclosures during active spraying. MDI concentrations ranged from <0.002 to 3.7 mg/m^3 with a mean of 1.2 mg/m^3. Clearly, these data show once again that one cannot rely on area samples to accurately predict the breathing zone concentrations of the sprayers.

Seventeen MDI samples were taken outside the enclosures during spray applications. All but one resulted in no detectable airborne MDI. The range was from <0.0016 to 0.01 mg/m^3. It is encouraging to see that even though the enclosures were not completely sealed, especially under the trucks, enough negative pressure was maintained to consistently prevent MDI from escaping into surrounding work areas.

Lastly, fourteen samples were collected inside the enclosures after spraying had been stopped. Once each application was complete, the truck/van was left in the enclosure and the exhaust fan was left on. Five minutes after spraying had stopped, samplers were started and run

Table 1. Enclosures

Dimensions (feet)	Volume (cubic feet)	Volumetric Flowrate (cubic feet/minute)	Air Changes Per Minute
18D x 16W x 11H	3168	3000	0.95
18D x 16W x 11H	3168	4500	1.42
18D x 16W x 11H	3168	4700	1.48
18D x 14W x 11H	2772	8100	2.92

for 10 minutes. The enclosure exhaust fans were left on through the sampling period. Twelve of the 14 samples showed no detectable MDI. In the two in which MDI was detected, the concentrations were 0.04 and 0.08 mg/m^3, only 20% and 40% of the PEL ceiling. The mean concentration was ≤0.016 mg/m^3. Based on these data, it seems clear that 5 minutes post-application, workers without respirators could safely re-enter the booth, open it up, and drive the truck out without danger of MDI overexposure to themselves or others.

CONCLUSIONS

Both the literature reports and the case study data make clear that application of MDI-containing spray-on truck bed liners involves the potential for overexposure to airborne MDI. In addition, continuing to work with these products, once one is sensitized, can be life-threatening.

To prevent adverse health effects, owners and employees of TBL operations are urged to:

1. Read Material Safety Data Sheets and labels of the specific product being used.
2. Read the Alliance for the Polyurethanes Industry (API) brochure entitled Truck Bed Liners: Worker Protection [4].
3. Implement a comprehensive hazard control program including training, medical monitoring, ventilated enclosures, good respiratory protection and protective clothing to prevent skin and eye contact.

Work is continuing under the auspices of an Alliance for the Polyurethanes Industry (API)/OSHA Region 5 Alliance to determine best practices and to conduct outreach to educate users in the safe use of TBL products. It is hoped that improved ventilation design will lower the MDI concentrations in the applicator's breathing zones. In the meantime, however, the data presented here would support the need for applicators to continue to use air-supplied respirators, with a protection factor ≥50, during spray application.

REFERENCES

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BIOGRAPHIES

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Mr. Myer holds a Master of Science Degree in Industrial Hygiene from the University of Pittsburgh and has been certified in the comprehensive practice of industrial hygiene by the American Board of Industrial Hygiene since 1983. With 27 years of experience, he manages a product safety program for the coatings, adhesives and sealants business unit of Bayer MaterialScience LLC in Pittsburgh, PA. He chairs the Spray-On Truck Bed Lining Task Group of the Alliance for the Polyurethanes Industry as well as the Aliphatic Diisocyanate Panel of the American Chemistry Council.

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