Air Monitoring for MDI during Simulated Customer Use of PUR Products

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Introduction

3M™ Scotch-Weld™ PUR Adhesives are a family of one-component, moisture curing, urethane adhesives. These adhesives are applied warm and bond a wide variety of substrates such as wood, fiber reinforced plastic (FRP) and many other plastics to themselves, to metal and to glass. The products contain urethane polymers, but have a residual amount of p,p'-diphenylmethane diisocyanate (MDI, CAS 101-68-8). MDI is present at <3% for all products in the family, typical amount is 1.5%.

Isocyanates including MDI are known skin and respiratory sensitizers. It is possible to become sensitized to isocyanates after a single exposure; therefore it is important to limit exposure during the use of these products.

3M has conducted simulated use studies on representative products to determine the concentration of MDI probably present during use of this family of products.

Overall Study Results

The current airborne exposure limit for MDI is an ACGIH® (American Conference of Governmental Industrial Hygienists) TLV® (Threshold Limit Values) of 0.005 ppm as an 8 hour time weighed average. This TLV was set to protect previously unsensitized individuals. Previously sensitized individuals may not be protected by keeping the exposure within the TLV.

There are several 3M studies that measured MDI concentrations in close proximity of the operator: attached to the operator (Test 3, 6, 7, 8); 12-18 inches above the applied adhesive or within the breathing zone (Tests 1, 2, 3); and 6 inches or half way between the applied adhesive and the breathing zone (Tests 4, 5). Measurements were taken in a small room with general room ventilation with a wide variety of operating conditions: bulk or cartridge dispensing; typical operating temperatures (222ºF - 275ºF); various sample durations (4 – 45 min.); and various product dispense rates. In all cases the airborne MDI concentrations were found to be below the TLV value of 0.005 ppm.

Pail changeover during bulk application is another potential exposure point during customer use. During the changeover, the top of the product pail must be removed and the pail loaded into the bulk applicator unit. This is typically a 20 minute process. MDI measurements were taken during this process with a typical PUR product (Test 1) and the MDI concentration was found to be below the TLV value of 0.005 ppm.

The heating mechanism of the hand-held applicators can be much closer to the operator. MDI measurements were taken in different areas around the applicator gun: by the nozzle (Test 6, 7, 8); by the dump valve (Test 6, 8); by the trigger (Test 7); and 3 inches above the applied adhesive (Test 4, 5, 7). Measurements were taken in a small room with general room ventilation with a wide variety of operating conditions: typical operating temperatures (222ºF - 275ºF); various sample times (4 - 45 min.); and various flow rates. In all cases except for one sample, the airborne MDI concentrations were found to be below the TLV value of 0.005 ppm. The one sample slightly greater than the TLV (0.0052 in Test 7) was taken a short distance above applied adhesive, not a likely exposure zone.

Test #	Product	Operating Temperature	Room Ventilation	Location	Dispense Rate	Duration (min)	Concentration
1	TE030	250°F	General room ventilation	Breathing Zone – 12 in above applied adhesive	Bulk dispensing at a rate of 126 g/min	30	0.0021 ppm
				Top of drum during pail changeover		20	LOD
2	TS230	245°F	No room ventilation	Breathing Zone – 12 in above applied adhesive	Bulk dispensing at a rate of 1.5 lb/hr	20	LOD
				Breathing Zone – 12 in above applied adhesive	Bulk dispensing at a rate of 4.4 lb/hr	20	0.0012 ppm
				Breathing Zone – 12 in above applied adhesive	Bulk dispensing at a rate of 1.5 lb/hr	20	0.0008 ppm
3	TE015	250°F	General room ventilation	Operator sample	5 cartridges (300 gr) at a rate of 114 gr/min	30	LOD
				18 in above the applied adhesive		30	LOD
4	TE031LV	250°F	General room ventilation	Halfway between breathing zone and applied adhesive	600 gr dispensed continuously	8	LOD
				Between breathing zone and applied adhesive		6	LOD
				3 in above applied adhesive		4	0.001 ppm
5	TE031	250°F	No room ventilation	Halfway between breathing zone and applied adhesive	300 gr dispensed continuously	4	0.001 ppm
				Halfway between breathing zone and applied adhesive		6	0.001 ppm
				Halfway between breathing zone and applied adhesive		5	0.001 ppm
				3 in above applied adhesive		4	0.001 ppm
6	TE100	222°F	Non-operating lab hood	Operator sample	320 gr dispensed continuously	45	LOD
				By applicator nozzle		45	0.0007 ppm
				By dump valve on applicator		45	LOD
7	TE200	250°F	General room ventilation	Operator sample	528 gr dispensed continuously	45	LOD
				By trigger on applicator		45	LOD
				By applicator nozzle		45	LOD
				3 in above applied adhesive		45	0.0052 ppm
8	TS230	275°F	Operating Lab Hood	Operator sample	320 gr dispensed continuously	29	LOD
				By applicator nozzle		29	0.001 ppm
				By dump valve on applicator		29	LOD

LOD = 0.0004 - 0.001 ppm

Conclusion
All results within the breathing zone of the operator were less that the exposure limit. However, the limit is not set to protect sensitized individuals and they can experience adverse health effects at lower exposure levels. It is recommended the adhesive is applied 18" away (an arm's length) from the breathing zone in an open area with good general room ventilation. Gloves and safety glasses are also recommended. These results do not replace the need for a site specific IH assessment.

WARNING: Do not use 3M™ Scotch-Weld™ PUR Adhesives above 275°F (135°C). 3M™ Scotch-Weld™ PUR Adhesives should not be applied to substrates that exceed 275°F (135°C).

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