

MDI Monitoring on American Polywater Foaming and Non-foaming Urethane Products

Exposure to isocyanates is a hot button topic for suppliers and users of foaming and non-foaming urethane products in our industry. This is driven by tight exposure limits listed for isocyanates, the possibility of worker sensitization from repeated contact with the material, and efforts by the OSHA to more closely regulate some isocyanates. Skin contact with these materials can be effectively avoided through the simple use of rubber gloves and safe application procedures. The wild card is exposure to isocyanates in the air during application. Some health and safety departments would like to ban the use of all urethanes without having a complete picture of the exposure risks involved. To help clarify some of the issues, all urethane products produced by American Polywater have been subjected to a sequence of isocyanate testing that measures the concentration of the chemical released into the workspace air during the product's intended use. Results show that the concentration of airborne isocyanate in the workspace is barely measureable, at a level below 1 part per billion (ppb).

Background

Isocyanates and Their Use

Isocyanates are very reactive chemicals that are used in polyurethane chemistry. Perhaps the most common applications are flexible and rigid foams for end uses such as cushioning and insulation. Isocyanates are also used in adhesives, coatings, sealants, and as additives for a variety of other chemistries. There are several isocyanates in commercial use, including methylene diphenyl diisocyanate (MDI) and toluene diisocyanate (TDI) which, together, make up over 95% of the commercially produced isocyanates worldwide. U.S. consumption of isocyanates in 2008 was about 2.6 billion lbs. and that number is growing. This paper is concerned only with sampling of MDI, as it is the only isocyanate used in products sold by American Polywater Corporation.

OSHA has taken an interest in these materials and their effects on workers, largely due to the significant population of workers (estimated at 280,000 in 1996), that could potentially be exposed to isocyanates on the job. Notable occupations that gained OSHA's attention: spray-on applicators of truck bed liners and home insulation. It should be noted that there is no OSHA movement to ban these materials. The interest is in the safe use of an extremely versatile raw material set.

Safety Concerns

The exposure concerns with MDI and other isocyanates are real. We are concerned with both skin and respiratory contact. Such contact can cause dermatitis, skin and respiratory tract irritation. Additionally, these materials are dermal (skin) and inhalation sensitizers. Workers that develop sensitivity to isocyanates can show a reaction to very small exposures. Symptoms may vary from mild to moderate to severe. Any worker that develops such sensitivity should no longer work with isocyanates. Such sensitization and asthma are the primary concerns.

Exposure Limits

OSHA regulates exposure through the use of a PEL, or Permissible Exposure Limit, for many substances. This is the legal limit in the US for exposure by a worker to a chemical. This PEL is normally a time-weighted average.

Substance	OSHA PEL
MDI	20 ppb
TDI	20 ppb

Therefore, if we perform air monitoring in the work space while our products are in use, the concentration of MDI measured should be less than 20 ppb.

Support for Monitoring Studies

American Polywater has always designed its urethane products to minimize isocyanate exposure through safe application procedures.

- We don't spray these products, so atomization is not a risk.
- We supply gloves in our kits to help prevent skin contact.

Exposure to MDI contained in Polywater® products is expected to be well below the stated PEL. With increased OSHA pressure and customer concern, we decided to monitor the amount of MDI released during the application of our products. This testing quantifies the MDI vapor concentration so that we are able to compare to the established PEL. Such testing has been encouraged by OSHA, and has been seen in other sectors of the urethane industry.

Results of one such study were published in an ASC Webinar from June 2012 entitled "MDI Monitoring for Spray Polyurethane Foam". Fomo Product monitored an actual field application of spray polyurethane foam insulation. Proper ventilation and personal protective equipment were used and the end result was a surprisingly low level of MDI measured in the workspace air. We determined to perform similar monitoring with our products, but under harsher conditions.

MDI Monitoring Conditions

We set up our MDI monitoring under simple conditions that somewhat exaggerated a confined workspace with no ventilation.

- *Confined Workspace 24 ft³:*

Our workspace was a sealed chamber with the dimensions of 2 feet by 4 feet by 3 feet. This is smaller than most workspaces, but we wanted to conduct our monitoring under the most stringent conditions. A smaller workspace means a higher MDI concentration in the air.

- *OSHA Sampling Method OSHA 47 MOD:*

A filter sampling method provided by ALS Environmental, an accredited laboratory was used to collect test specimens. This is a common method of collecting aerosol (particulate) and/or vapor phase contaminants. Filter sampling uses a calibrated personal sampling pump to pull a known volume of air through a filter cassette. The filter cassette contains media chemically treated such that the MDI in the air chemically reacts with the media to form a stable derivative. The stable derivative is quantified at the ALS lab. Using the known volume of air sampled, the concentration of MDI in the air during the sampling interval is determined. This test procedure follows OSHA 47 MOD for MDI.



Sampling pump with hose intake near reacting foam

- *Sampling Interval Based on Cure Rate:*

The sampling interval was defined as the time for each product to reach 95% of full cure. The final cure can take hours or longer, so that by using this sampling interval we will find the highest concentration of MDI in the air for each product.

- *Intake Hose Inlet Close to Reaction:*

In addition to running the sampling in a chamber of limited volume, we selectively placed the inlet to the sampling pump in close proximity (3 inches) to the reacting material. Once again, although this is closer proximity to the product than a worker is likely to be, the point of the exercise was to illustrate the worst possible case, and maximize the MDI levels sampled.

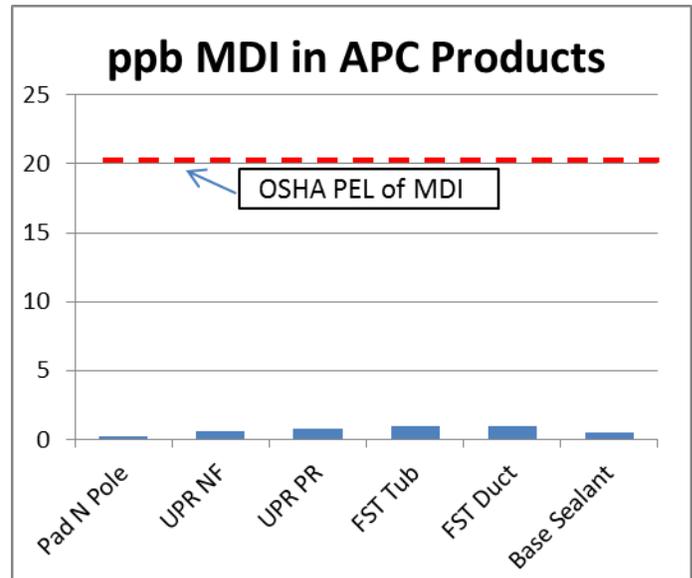
Results

The following table shows the results of the MDI sampling for American Polywater products.

Polywater® Product	Amount and Condition	Sampling Interval (minutes)	ppb MDI
Pad N Pole	Contents of one 50 ml cartridge spread on 1 ft ² fiberglass cloth	130	<0.15
UPR NF	Contents of one 250 ml cartridge, free rise in a 6" tub	35	<0.56
UPR PR	Contents of one 250 ml cartridge, free rise in a 6" tub	27	<0.72
FST	Contents of one 250 ml cartridge, free rise in a 6" tub	20	<0.98
FST	Contents of one 250 ml cartridge, 3" seal in a 4" PVC duct	20	<0.98
InstaGrout PMT	Contents of one PMT-3 spread over 4 sq. ft.	40	<0.49

Conclusions

Analysis for each of the samples shows a concentration well under the 0.02 ppm or 20 ppb PEL set forth by OSHA. **No sample exceeds 1 ppb MDI.**



Keeping in mind that the sampling was performed under the most extreme conditions of no ventilation and very small workspace, it is clear that the American Polywater products are very unlikely to expose workers to airborne MDI in concentrations high enough to cause issues. As always, we recommend the use of gloves and safety eyewear when using these products. While care should be taken with the use of these and all chemical products, workers can be confident that, with proper use, American Polywater products can be used safely.



ADHESIVES | CLEANERS | LUBRICANTS | SEALANTS WWW.POLYWATER.COM

phone: 1-800-328-9384
1-651-430-2270
fax: 1-651-430-3634

email: support@polywater.com
Stillwater, MN 55082, U.S.A

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