Isocyanates, Urethane Monomer, Urethane Prepolymers, Urethane Sensitivity, Hazards and Explanation.

An isocyanate is an organic group, which when reacted with other chemical compounds, vary in toxicity and properties much like other organic groups like ketones, ethers, alcohol, etc. For example, we can drink ethanol safely, but methanol is highly toxic. Modern moisture-cure urethane coatings are produced by the reaction of diisocyanate monomers such as HDI, IPDI, MDI and TDI with other larger molecules called polyols to produce polymeric isocyanates. Polymeric isocyanates, as used by Wasser, are not volatile and are much lower in toxicity than raw isocyanate.

A number of situations have brought isocyanates and urethanes to the public eye. Over 20 years ago, urethane foams were introduced to the public as an industrial insulation. The early urethane foams had an excess of isocyanate monomer, and the Installers of these particular foams and workers or others exposed to these foams had reactions to isocyanate's slightly volatile, reactive substances, which was predominantly toluene diisocyanate (TDI).

These urethane products were not like those used for coatings. The urethanes used by the coatings Industry are resins that use the reaction of attached isocyanate groups to form fully reacted, chemically resistant polymers. They are made up of a backbone of polyether, polyester, and other polyols reacted with an isocyanate monomer like TDI, MDI, HDI or IPDI. The resultant resin is a longer, essentially non-volatile molecule with very little or no remaining monomer (isocyanate).

A justified outcry developed much like that which developed with formaldehyde fumes.

The urethane manufacturers rapidly solved the problem with resins that had extremely low, essentially non-volatile levels of TDI. The products were made safe and homes and offices are now full of urethane foams and plastics manufactured to new safe standards. However, the concern over TDI damage remained, and many industries completely banned any urethane, even though the hazards had been minimized and safe handling protocol had been developed.

The second part of the urethane isocyanate story came with the discovery that two-component urethane automotive paints contained isocyanates. The manufacturers of two-component urethanes had always suggested the mandatory use of respirators; however, early on, the automotive and industrial painters sprayed without respiratory protection.

The third part of the isocyanate story began with the Bopal incident, where large volumes of the volatile gas methyl isocyanate, a strong and deadly poison, escaped from an industrial manufacturing plant and killed scores of local people. Because of the severity of the damage caused by this accident, America scrutinized the automotive industry's isocyanate situation, which lead to increases in lawsuits against coating and resin manufacturers.

In nearly every case, the coating and resin manufacturers have been found harmless by having provided adequate warnings and safety precautions with their products. In a few cases, the negligent party had been employers who did not adequately train or equip their painters. The determination was made that painters must be adequately protected with all coatings that are used and not just with the urethanes.

Some important facts should be made clear.

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1. All coatings contain hazardous ingredients, including water base coatings.

2. The Federal Right to Know Act and OSHA regulations clearly state that employees must be protected from the hazardous ingredient alone or combined with other hazardous ingredients with the lowest TLV. The TLV is the level of exposure that is considered hazardous or potentially harmful to the "average" person.

3. None of the modern solvent based urethane coatings show detectable levels of isocyanate before the TLV of the solvent is reached. This is also the case with most reactive ingredients in solvent-based epoxy coatings. Therefore, with any solvent based coating you will have to wear respiratory protection to prevent exposure to the organic solvents inherent in the coatings. If a respirator is not worn when using alkyds, vinyls, phenolics, epoxies, and epoxy esters it is in violation of the OSHA standards.

4. Water based coatings also contain hazardous volatile ingredients and require the employment of respirators when using these coatings.

5. Urethane paint and resin manufacturers have recommended full fresh air respirators when using urethane coatings because urethane polymers and isocyanate monomers have no odor. However, canister respirators with activated charcoal cartridges are able to remove about 100 times more active isocyanate particles than particles of organic solvents. With no warning odor in isocyanate, it is safer to use fresh air hoods, since the canister respirator may leak or go beyond its service life when the cartridges are exhausted. However, if an employee replaces a canister at first sign of solvent odor they may remain protected from isocyanates. Using a fresh air hood also has the advantage of protecting an employee's eyes and facial skin from potential exposure to hazardous ingredients in any coating.

6. It is important to mention that Wasser's specific moisture cure urethanes are far lower in isocyanate monomer than other typical two component urethanes. In fact, Canadian testing showed Wasser's pigmented urethanes to be totally free of measurable isocyanate monomer, Monomer Free.

   Isocyanate monomer is essentially non-volatile but some measurable monomer can get into the vapor phase during heavy paint applications and spraying. Typical two component urethanes can show some vapor phase measurable monomer. Wasser coatings do not. However, the primary make-up of any urethane is the 10,000 times less volatile urethane reactive polymer. The only avenue of exposure to this polymer is from airborne spray dust particles.

   An employee wearing a properly fitting, canister respirator may be completely protected from the isocyanate hazard if there are no leaks and no exposure to eyes or skin. Again, a fresh air hood offers the best protection.

7. With industrial painting, over spray can quickly cover faceplates and painters must be able to see what they are spraying. In this case removable plastic sheets are helpful.

   The most practical approach is using a fresh air hood with the eye plate removed. Sufficient positive pressure can help control over spray or fumes that may enter the mask and the painter may more easily see the surface the paint is applied to. However, OSHA and Health Officers may not recommend this approach even though it may be a practical solution for the painter or application process.

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8. Most urethanes and certainly moisture cure urethanes react rapidly with water. This reaction renders them inert and insoluble, preventing reactive isocyanate from being absorbed through the skin and carried into the blood stream in a reactive state. However, skin exposure does carry the potential for skin surface irritation in individuals sensitized to isocyanates.

Conclusion:

All organic coatings are hazardous both medically and from a legal liability standpoint, and using any volatile hazardous substance, like organic solvents, requires respiratory protection. This protection also prevents exposure to reactive urethane or epoxy chemicals.

With specific moisture cure urethanes, like Wasser's, the major hazard of urethane monomer is removed in the manufacturing process. However, good respiratory protection eliminates any hazard of not only reactive substances like urethane silicone, epoxy or polyester resins, but also exposure to volatile organic compounds like organic solvents, amines, and additives.

Improvements in manufacturing and resins have lowered the level of potential hazards inherent in the use of urethane coatings, and today, millions of gallons of urethane coatings are being used worldwide

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