

Aquaflex and Isocyanates: The Truth

Not all isocyanate chemistry is the same... know the whole story

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What are isocyanates?

- A polyurethane polymer is the result of the 2 part chemical reaction between a polyol resin and a hardener agent called polyisocyanate.
- The polyisocyanate hardener is composed of a reacted mixture of diisocyanate with other organic materials.
- Unreacted diisocyanate from the creation of the hardener is the material that is of concern as related to potential harmful health effects.
- Over 99.5% of the diisocyanate material is fully reacted in producing the hardener.

What is Aquaflex?

- Aquaflex is a patented 1 pack (or 1 part) formulated urethane mixture.
- Aquaflex can be considered a “partially formed” urethane polymer or “pre-polymer”.
- Aquaflex reacts with available substrate and atmospheric moisture to reach final reactive cure.
- Aquaflex does not “dry” like a paint.
- The residual diisocyanate or “free” isocyanate (MDI in the case for Aquaflex) is so low that it is virtually immeasurable. In other words, it is a trace component at levels less than 1ppm (parts per million).
- In addition, the application of the viscous Aquaflex adhesive by hand trowel eliminates possible airborne exposures referenced by the environmental community as potentially harmful.

It is important to note that the risks associated with the diisocyanate monomer should be balanced with risks in using alternative curing agents, and with the application of any solvent-borne coating. If the user always followed their respective State Regulations (Qld, NSW, ACT, Vic, Tas, SA, WA & NT) wearing well-fitted clothes and solvent-resistant gloves, then potential exposures are eliminated.

Where are isocyanates used?

Isocyanates are used in the production of paints and coatings to create weather-resistant surfaces. They are also used to make building materials (for example, Styrofoam, flexible foams, adhesives, elastomers, and binders) and in the production of manufactured goods (for example, bedding, furniture, clothing, appliances, electronics, tires, and packaging). The popular adhesive Gorilla Glue available at Home Depot is an example of an adhesive composed of polyurethane prepolymer.

What are the potential hazards?

All chemicals have the potential to harm, if used incorrectly. (Even nutritional supplements can cause severe toxic effects if misused!) However, if a polyurethane adhesive is handled in accordance with relevant Safety Data Sheets, product specifications, and State regulations no adverse health effects are expected. Symptoms or effects that may arise if there is uncontrolled exposure to the product or if it is mishandled are described on the Safety Data Sheet as follows:

- Ingestion: Swallowing can result in nausea, vomiting and central nervous system depression. If the affected person is showing signs of central system depression (like those of drunkenness) there is greater likelihood of that person breathing in vomit and causing damage to the lungs.
- Eye contact: May be an eye irritant.
- Skin contact: Contact with skin may result in irritation. A skin sensitizer. Repeated or prolonged skin contact may lead to allergic contact Dermatitis.
- Inhalation: Although highly unlikely due to the physical nature and application of Aquaflex, the material may be an irritant to the mucous membranes of the respiratory tract (airways) if the adhesive were burned. Breathing in vapor can result in headaches, dizziness, drowsiness, and possible nausea. Inhaling high concentrations can produce central nervous system depression, which can lead to loss of co-ordination, impaired judgement and if exposure is prolonged, unconsciousness. Respiratory sensitizer. Can cause possible allergic reactions, producing asthma-like symptoms.

Brush and roller application

Neither polyisocyanate curing agent nor diisocyanate monomer evaporate to any great extent from polyurethane paints and therefore do not present an inhalation hazard under normal brush and roller application conditions. Comparing the vapor pressure of the polyisocyanate curing agents and the diisocyanate monomer with solvents (including water) puts the relative risk of inhalation of each into perspective.

It should be mentioned first that all isocyanate products used in coatings applications evaporate slowly, at rates from hundreds to thousands times slower than other liquids, such as water or organic solvents. Among isocyanates, HDI and TDI evaporate faster than the other isocyanates listed below. Products classified as very slow to evaporate are “free”-isocyanate MDI and even slower polymeric isocyanates such as trimer and biuret. Aquaflex polymer is even slower still, at over a million times slower than water. To illustrate the great difference in speed of evaporation, one can compare the room temperature vapor pressures of various materials. On a relative scale, if water is assigned the value of 1, the ease of evaporation (vapor pressure) numbers would be:

Polyisocyanate (Aquaflex)	< 0.0000001
Polyisocyanate (Isocyanate biuret)	0.0000005
Polyisocyanate (Isocyanurate trimer)	0.000001
“free” diisocyanate (MDI)	0.0014
Water	1
Solvent (Methyl ethyl ketone)	5.6

The above table reference MEK solvent as 5.6 times faster evaporating than water and polyisocyanate biuret 50 million times slower!

In the case of the Aquaflex “pre-polymer” formulation, the possible exposure becomes ZERO due to the partially reacted state and immeasurable diisocyanate content. Application of polyurethane by brush or roller exposes the applicator to risk of splash and spillage of wet paint onto unprotected areas of the body only, and not to any airborne material. Therefore, the major risks of brush and roller application include contact with skin and eyes exclusively.

Is there cyanide in isocyanates or is cyanide given off during the normal use of isocyanate products?

Although the two chemical names are similar, **NO** cyanide is used to make or is present in isocyanate products. In addition, no cyanide will be released during the normal use of isocyanate products. However, cyanide can be produced from isocyanates by heating to decomposition and/or burning. In fact, burning ANY nitrogen-containing material, even those that were not made from isocyanates, can produce some hydrogen cyanide. This includes chemical like ammonium fertilizers, some household cleaners and aerosols. Some examples of these nitrogen-rich materials not made from isocyanates are: epoxy/polyamide coatings, melamine coatings, alkyd urea coatings, and even some natural materials such as wool! All of these will generate some measurable amount of hydrogen cyanide upon combustion or when burned.

Do isocyanates cause cancer?

There is no evidence that diisocyanates cause cancer in humans. Animal testing has shown that near lifetime inhalation exposures given to rats of “free” diisocyanate vapor did not cause cancer.¹

Environmental Information

Spilled polyisocyanate polymer products represent a very low environmental impact to soil, waterways, and/or groundwater. Polyisocyanate polymer products are insoluble in water. Upon contact with water or moist air, these products will react to form stable, insoluble polyurea (urethane) solids. This reactivity dramatically limits the mobility of these products in the event of a spill (spills are localized and have only transient impact), and the products will tend to remain in, and react within, the environment to which they are released. The polyurethane solids that are formed by the reactions of polyisocyanate pre-polymer with water have been shown to resist biodegradation and hydrolysis, which means they are stable and unreactive. Polyisocyanate polymer materials and their polyurethane reaction products are not likely to accumulate in the food chain (their bio-concentration potential is extremely low) due to their insolubility and high molecular weight, and are practically non-toxic to aquatic organisms. As a result of these findings the Organization for Economic Cooperation and Development (OECD) concluded, “free” diisocyanate (immeasurable in formulated products like Aquaflex) and even “free” diisocyanate emitted directly to water or soil pose a low priority risk to the environment. Furthermore, Environment Canada has concluded that diisocyanate and polyisocyanate do not meet its criteria for classification as persistent, bio-accumulative, or inherently toxic to aquatic organisms; therefore the substance was not identified as a priority for further assessment under its Categorization and Screening of Domestic Substances List (CSDSL) program.

1. U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES - Public Health Service - Agency for Toxic Substances and Disease Registry, Aug 1998, TOXICOLOGICAL PROFILE FOR HEXAMETHYLENE DIISOCYANATE