

How will the new REACH diisocyanate regulations impact manufacturers using polyurethane adhesives?

Polyurethanes are polymers composed of organic units joined by urethane links. They are used to make rigid and flexible foams, and also used to make varnishes and coatings, adhesives, potting compounds, and fibres. Their most common application is in foams, which makes up around two thirds of all polyurethane use. Globally, 6% of polyurethane use is in adhesives, and a further 3% for sealants. Polyurethane (PU) adhesives are available in both one-part (1K) and two-part (2K) formulations, with both types demonstrating the same basic chemical reaction.

Benefits of PU adhesives

Polyurethane adhesives offer excellent adhesion to a wide range of materials – they bond well to plastics, metals and composites. Their surface energy is lower than that of epoxy adhesives, which can result in better wetting and adhesion on plastic substrates. A broad range of PU adhesives are available – they can be formulated with different pot lives, in viscosity grades from self-levelling to non-slump pastes, and in grades that cure from very soft to very hard.

Polyurethane adhesives offer good performance characteristics: they are extremely tough, have high peel strength, and are suitable for gap filling. They are popular in outdoor applications due to their resistance to impact, solvents, weather, and abrasion. Importantly, they are relatively low cost materials that are straightforward to apply and cure (typically, these adhesives cure at room temperature, although the process can be accelerated with heat). For best results, the manufacturer will need a good mix in the correct ratio.

Polyurethane chemistry

Polyurethanes are made from a reaction between an isocyanate (a highly reactive, low molecular weight family of chemicals) and a polyol (organic compounds containing multiple hydroxyl groups).

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Other components include pigments for colour, fillers for mechanical reinforcement and to reduce overall costs, plasticisers to increase flexibility, flame retardants and smoke suppressants to reduce flammability and smoke generation if burnt, and UV absorbers and antioxidants to minimise degradation.

Both polyols and isocyanates are hygroscopic and will react with moisture, and it is important that industrial users are aware of this. If isocyanate reacts with water, it forms an unstable carbamic acid, which decomposes to form urea and carbon dioxide gas. Therefore, entrapped humid air from mixing can lead to foaming or bubble formation, which may not be desirable aesthetically. The selection of an appropriate catalyst can either suppress or promote the reaction, should foaming be desired.

Isocyanates and safety

The most widely used isocyanates in polyurethane adhesives are diisocyanates, which have two isocyanate groups. There are two main types of diisocyanate used in polyurethane adhesives: toluene diisocyanate (TDI) and methylenediphenyl diisocyanate (MDI). In a polyurethanes adhesive, they are used up during the reaction, meaning virtually no diisocyanates are present in completed or cured materials.

Their reactive chemistry means there are some health risks associated with isocyanate exposure when handling PU adhesives prior to cure, including irritation of skin and mucous membranes, chest tightness, and difficulty breathing. The main potential effects of hazardous exposures are occupational asthma and other lung problems, as well as irritation of the eyes, nose, throat, and skin. In addition, isocyanates include compounds classified as potential human carcinogens that are known to cause cancer in animals.

New restrictions

Following a review by the European Parliament, the REACH Restriction (which continues to apply in the

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UK) on aliphatic and aromatic diisocyanates was published on August 4, 2020 and became effective on August 24, 2020. These restrictions mean that, as of **August 24, 2023**, training is required for all professional and industrial users of products with a total monomeric diisocyanate concentration of > 0.1%.

Like any chemical, diisocyanates are safe when they are handled according to the relevant risk management and health and safety measures. The aim of these restrictions is to ensure that this happens, with the aim of minimising the adverse effects induced by exposure to diisocyanates in the workplace, and along the entire supply chain.

The restriction requires adhesives and sealants manufacturers to provide end users with information about training on the safe use of diisocyanates and, from February 24, 2022, ensure all PU products for which safety training is required be labelled with the following statement: *As of 24 August 2023, adequate training is required before industrial or professional use of this product.*

Under the new requirements, employers are responsible for providing adequate training for all employees who come into contact with a substance containing diisocyanates. Format is not specified and many training courses are available online and are either free, or low cost. The Association of the European Adhesive & Sealant Industry (FEICA) is offering its members financial support for the training for member organisations and their clients, in the form of a [voucher code](#) that makes training material related to PU adhesives and sealants applications free of charge.

As well as providing the training, employers must collect evidence of the successful completion of training programmes, such as a log of certificates. Training certificates last five years, after which they need to be renewed.

Alternate approaches

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Another possibility for industrial users is to specify PU adhesives with a total monomeric diisocyanate concentration of $< 0.1\%$. There are new, leading edge polyurethane adhesive materials based on [micro emission technology](#) that mean training is not required if you specify those products, helping businesses avoid the cost, administrative, and time burden associated with the new mandated training, while ensuring a high standard of health and safety (H&S).



IRS3221-W-50 Point-One™

Structural Polyurethane Adhesive is based on micro emission chemistry, and doesn't require REACH

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training to use

Importantly, these new materials retain all the benefits of PUs, in that they have good adhesion, fast curing, and good environmental resistance. Micro-emission products may even bring additional H&S benefits – because they have very low emissions, there are likely fewer warning icons on labels.

With August 24 2023 looming, industrial users of PUs have a decision to make, train the team or adopt new, micro emission technology. Either approach enables manufacturers to maintain productivity, while prioritising the safety of their teams.

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