



# Hardfacts

## Norwich Union Risk Services

Ref No 6013 (v3)

October 2005

### Isocyanates

Isocyanates, or di-isocyanates, are basic constituents in the production of polyurethane. Methods of use vary but the essential process is that they combine with polyester or polyether resins causing a reaction which creates durable polyurethane foams, elastomers, paints or adhesives. Whilst isocyanates are extremely useful, they are known to have a number of ill health effects which are serious and, in some cases, permanent.

A number of different forms of isocyanates are used in industry with MDI (diphenyl methane di-isocyanate or methylene bisphenyl di-isocyanate) and TDI (toluene di-isocyanate) being the most common. Other less common forms are:

HDI (hexamethylene di-isocyanate)  
IPDI (isophorone di-isocyanate)  
NDI (1,5-naphthalene di-isocyanate)  
TMDI (trimethyl-hexamethylene di-isocyanate).

TDI is used in the production of flexible foams but it is the most volatile of the common isocyanates, and gives off vapours at room temperatures which are likely to cause harm to health.

MDI, in various grades, is used to make foams, tough elastomers and flexible foams. It is considerably less volatile than TDI, so when used at room temperature, is regarded as less hazardous. However, significant exposure can cause asthma, particularly where it is sprayed or heated.

#### Common Uses

**Flexible foams** - used for furniture upholstery, mattresses, packing materials etc, are made by mixing TDI or MDI with a polyol and a foaming agent, using a foaming head which delivers the mixture to either a mould or to a paper lined conveyor.

The mixture expands to fill the space and then is left to cure. Whilst curing, isocyanate vapour is given off.

Solid mouldings are made using similar plant and the density and flexibility can be varied according to need. Other typical products include shoe soles and mouldings for the automotive industry.

**Rigid foams** - These are frequently used to insulate articles or structures and are usually MDI based. The foam mixture can be sprayed or injected and the equipment is often portable.

**Paint Spraying** - Two pack polyurethane paints (one containing an isocyanate and the other containing a polyol), are mixed together and applied before the mixture begins to cure. Often the paint is applied by spraying and heat curing may be used. These processes are probably responsible for the majority of cases of isocyanate induced asthma.

Other applications include use in adhesives, printing inks, foundry core binders and many other areas.

#### Health Effects

Isocyanates are irritants and highly potent sensitising agents affecting the skin and the upper respiratory tract.

Very high doses arising from inhalation can cause death due to acute pulmonary oedema. However, it is the allergic reactions which are the main cause of concern. Inhaling very low levels of vapour can cause asthma. Continued exposure can cause asthma attacks of varying severity, the worst being potentially fatal.

These conditions are quite common and isocyanates make a significant contribution to the toll of occupationally induced ill health in the UK.

## Occupational Exposure and Assessments

Isocyanates have been assigned a workplace exposure limit (WEL) as published in the HSE Guidance Note EH40. These figures refer to exposures and to concentrations of free isocyanates in air and are not necessarily a good indicator of what real exposures are likely to be (peak exposures are likely to be higher). Therefore the exposures need to be reduced to well below the WEL.

Isocyanates have no detectable odour, except at very high concentrations, and they are not visible as vapour. Measurements can be made using personal dose badges attached to individuals for the duration or part of a shift. These give reasonably accurate assessments of long term exposure and are useful for checking compliance with WELs, but they are not capable of assessing the peak exposures which are likely to be the critical cause of sensitisation.

### Health Surveillance

Where employees are likely to be exposed to free isocyanates, appropriate health surveillance should be provided by the employer. This should include pre-employment examination and on-going monitoring. The pre-employment examination should include a respiratory questionnaire plus a lung function test followed by further tests after two weeks, six weeks, six months and thereafter at six monthly intervals. For more detailed information refer to HSE Guidance Note EH16.

### Key Action Steps

- Where practicable replace TDI and HDI with MDI.
- All areas where isocyanates are poured, weighed, or dispensed must be well ventilated which in most cases will require local exhaust ventilation (LEV) to be installed.
- Where spraying or heating takes place, LEV plus suitable personal protective equipment (PPE) will be required.
- LEV must be correctly designed as poor designs may still permit unacceptable levels of exposure.
- LEV must be maintained in efficient working order and be tested and certified by a competent person every 14 months.
- Where assessment shows that exposures are within acceptable limits, then PPE

such as overalls, gloves, and eye protection should be used. Employees should be trained in their use.

- Where there is a risk of short term low level exposure to TDI then half face silicon rubber filter masks with carbon based filters are quite effective for short term respiratory protection.
- For MDI a combined carbon filter and particulate filter should give medium duration respiratory protection.
- Where high levels of exposure are possible, or where exposure will be of extended duration, air fed masks should be used, in order to minimise the risk of respiratory damage.
- All employees likely to be exposed to isocyanates should be trained in the hazards, COSHH assessments and control measures associated with the use of isocyanates.

### References

How to handle Isocyanates, Iain MacKenzie, The Safety and Health Practitioner - March 1997.

HSE Guidance Note EH40 Workplace Exposure Limits (Revised and republished annually) - HSE Books.

EH16 (2<sup>nd</sup> Rev) Isocyanates: Health hazards and precautionary measures, HSE Books 1999.

MDHS 25/3 – Organic Isocyanates in Air, HSE Books.

Control of substance Hazardous to Health (Fifth Edition) Approved Code of Practice and Guidance ISBN 0 7176 29813

*Ref No 6013 (v3)*

*October 2005*

Norwich Union Risk Services operates a Risk Helpline during normal business hours for the cost of a local telephone call. The telephone number is:

**0845 366 66 66**

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