ISOCYANATES AND BIOLOGICAL MONITORING

Isocyanates are used in materials commonly found in the construction (and motor) industry – they are often found in paints, coatings, glues, foam, insulation, fibres, etc. Not all isocyanates are the same. Nigel Roper of Concrete Repairs Ltd reports.

FIGURE 1 ABOVE: Resin injection to column base.

FIGURE 2 BELOW: Isocyanate and semi-conductor gas monitor.

In recent years the EU, UK Government and industry have taken a 'precautionary principle' approach to isocyanates assuming them to be terribly dangerous until proven otherwise.

Isocyanates have gained a bad reputation for causing acute and chronic skin and respiratory disease. However, not all isocyanates are the same or pose the same level of risk. The level of risk depends on numerous factors such as the type and amount used, the frequency of use, the techniques employed and the conditions in which they are used. There are also numerous varieties of isocyanates, including:

- MDI – methylenebis (phenyl isocyanate) (MDI)
- TDI – toluene diisocyanate (TDI)
- HDI – hexamethylene diisocyanate (HDI)
- NDI –naphthalene diisocyanate (NDI).

Some products are inherently safer as they are prepolymerised during production, making them less harmful at the point of use.

CRL often uses waterproofing materials that contain isocyanates. The material is injected under pressure into concrete structures using single- or twin-piston pumps. Rather than taking a theoretical, worst-case scenario approach and resorting to the inevitable over-reliance on PPE, CRL decided to investigate actual exposures to isocyanates.

In 2007, the company conducted atmospheric grab sampling (during resin injection for waterproofing) using a next step isocyanate and semiconductor gas monitor (see Figure 2). The results showed likely exposures to be extremely low, and in any case well below the workplace exposure limit published in the Health and Safety Executive's *EH40 Workplace Exposure Limits*[1] and the material safety data sheet.

FIGURE 3 TOP:
Resin injection to column base.

FIGURE 4 ABOVE:
Resin injection to floor.

BIOLOGICAL MONITORING

Since that 2007 study, occupational hygiene techniques have developed and the most effective means of measuring exposure to isocyanates is using biological monitoring techniques, which include urine sampling. On inhalation, isocyanates become metabolised to form diamines. Urine sampling looks for the presence and levels of diamines in an operative's urine.

RISK ASSESSMENT

While assessing the risk posed by isocyanates, CRL applied the requirements of the Control of Substances Hazardous to Health (COSHH) Regulations, which explain that the risk assessment must consider:

- the hazardous properties of the substance
- information on health effects provided by the supplier, usually found in the material safety data sheet
- the level, type and duration of exposure
- the circumstances of the work, including the amount of the substance involved
- activities, such as maintenance, where there is the potential for a high level of exposure
- any relevant occupational exposure Standard, maximum exposure limit or similar occupational exposure limit
- the effect of preventive and control measures that have been or will be taken
- the results of relevant health surveillance
- the results of occupational hygiene monitoring

The output from these considerations helped CRL review its risk assessment, biological monitoring and occupational health surveillance regimes.

LIMITS AND VALUES

To quantify exposures we needed to investigate workplace exposure limits (WELs) and biological monitoring values.

Material safety data sheets, COSHH assessments and the HSE publication *EH40 Workplace Exposure Limits* give the following WELs and biological monitoring values for isocyanates:

- 0.02mg/m^3 (long-term exposure limit)
- 0.07mg/m^3 (short-term exposure limit)
- Biological guidance monitoring values of 1µmol isocyanate-derived diamine/mol creatinine in urine.

These figures are of absolutely no use unless you can compare them with real-world data, so we decided to carry out biological monitoring on a project on the A1(M) in West Yorkshire. The six-week contract involved two employees injecting resin into cracks on the soffit of a road bridge.

EMPLOYEE ENGAGEMENT

The employees were actively involved in the process to ensure their engagement and to ensure that they were confident that their health was being protected.

THE RESULTS

Laboratory analysis of the urine samples showed no detectable signs of exposure; in fact, exposure was below traceable limits. This backed up the results of the 2007 grab sampling study.

The advantage of this simple, cost-effective process is that CRL has real-time, real-life, task-specific exposures that will inform the review and revision of isocyanate control and inform managers, clients, enforcing agencies and – most importantly – operatives to put their minds at rest.

THE FUTURE

This study is part of CRL's long-term objective to quantify chemical and physical agent exposures. In the past, the company has conducted similar studies on: noise; vibration; electromagnetic fields; methyl methacrylate; xylene; and dusts (including silica). The results will assist CRL and its occupational health provider in tailoring its health surveillance regime to focus on likely, rather than unlikely, health risks. C

Reference:

1. HEALTH AND SAFETY EXECUTIVE. *EH40/2005 Workplace exposure limits. Containing the list of workplace exposure limits for use with the Control of Substances Hazardous to Health Regulations 2002 (as amended).* HSE, Bootle, January 2020.

FIGURES 5 AND 6 BELOW:
Resin injecting wind turbine bases at Aikengall windfarm.