HOW TO DO IT

doi:10.1093/occmed/kqz109

Biological monitoring for isocyanates

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Biological monitoring (BM) is the assessment of exposure by the measurement of the substance itself or a breakdown product in biological fluids, most commonly urine, but blood, hair, saliva, etc. may also be used in some cases. In Great Britain, the only mandatory BM required in workplaces is for blood lead where there is a likelihood of 'significant exposure'. Further details of the requirements can be found in the Control of Lead at Work Regulations [1]. All other BM is voluntary but can be very useful in assessing the efficacy of exposure control and, as such, the Health and Safety Executive (HSE) has guidance on setting up a BM programme [2], including the requirements for informed consent. The HSE has also produced Biological Monitoring Guidance Values (BMGVs) for 17 chemicals; these are listed in EH40 [3]. One of these BMGVs is for isocyanates. It is based on a urine sample taken at the end of exposure and is measured for the corresponding diamine. The BMGV is based on 'good occupational hygiene practice' and was set at the 90th percentile of results (1 µmol/mol creatinine) from a dataset where exposure controls were deemed to be adequate. It was used in a national intervention study in motor vehicle repair (MVR) paint sprayers [4] to assess compliance with control measures and it was observed that after training, workers showed lower levels of exposure. As a result, the HSE issued guidance [5–7], which recommended that all paint sprayers using isocyanate-containing paints should have a urine test at least once per year. However, the test is able to check exposures for at least the four main isocyanates in use so the test can be helpful in a wide range of industries using isocyanates (polyurethane moulding, foam blowing, use of adhesives etc.).

What should you use it for?

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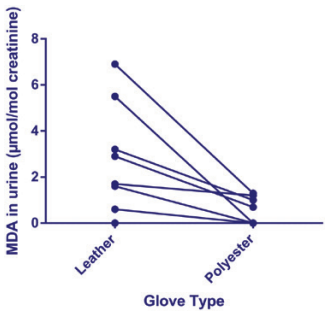
Isocyanates are still one of the leading causes of occupational asthma in Great Britain [8], although some progress was made among MVR paint sprayers as a result of the national intervention programme some 15 years ago [4,9]. Control of exposure, and therefore prevention of ill-health, often relies on closed ventilation systems (spray booths, enclosed moulding machines), air-fed respiratory protection and personal protective clothing/gloves. BM for isocyanates can inform as to whether these control measures are sufficient and/or are being used correctly. Because BM aggregates all routes of exposure, inhalation, ingestion and skin absorption, a positive result does not identify the source of exposure but does point to the need for corrective action.

As well as MVR paints isocyanates are used in many situations such as foam blowing, hard polyurethane manufacture, glues and adhesives, and floor screeding [10].

Relevance to occupational health practitioners



BM helps to assess exposure of workers to isocyanates and provide some information as to whether control measures are sufficient. It does not inform on the presence or likelihood of developing occupational asthma. Ideally, BM is a preventative

indicator, helping to keep exposure below levels that might induce health effects. However, if workers are presenting with symptoms, the test may be useful in determining whether there is occupational exposure that may be relevant to their symptoms.

Isocyanates are also skin sensitizers. Although the test does not reflect sensitization, it can indicate skin uptake of isocyanates and therefore provides information on the extent of dermal contamination, particularly where control relies on glove use (see figure [11]).

Ease of use

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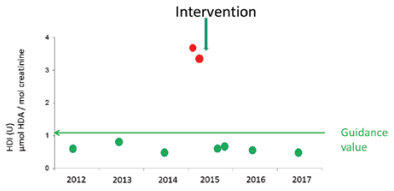
The test is easy to perform, requiring only a post-exposure urine sample. However, it is important that the sample is, ideally, taken within an hour of the end of exposure especially for those tasks involving HDI (hexamethylene diisocyanate, used in two-pack spray paints), IPDI (isophorone diisocyanate, used in two-pack spray paints) and TDI (toluene diisocyanate, used in adhesives and foam blowing) as these are rapidly excreted. MDI (methyl phenylene diisocyanate) exposures should be sampled at the end of the shift and, if significant skin exposure is a possibility, pre-shift next day samples should also be considered (due to the delayed absorption through the skin). Because of the short half-life of excretion, the sample mostly reflects that day's exposure and so does not inform on long-term exposures. It is therefore recommended that several samples are taken initially to ensure that 'normal practice' is captured. Samples should be sent same day or next day to a suitable laboratory for analysis (they will usually provide packaging, etc.). If shipping is delayed, samples should ideally be stored frozen prior to despatch.

Time to master

Setting up of a BM programme is straightforward, but the ethical and data handling aspects should be given sufficient consideration. The sample collection is easy to master and can be performed by any competent person (including health and safety professionals, floor supervisor, etc.). Interpretation of results requires an appreciation of the work practices, tasks and controls used by an individual worker on the day of sampling.



There are usually three broad categories of interpretation: 'none detected'—no evidence of exposure to the requested isocyanates (no further action required and repeat testing in 1 year); 'low-level exposure'—this is exposure detected but within the BMGV (control measures and their use should be checked but repeat testing is not required immediately; the result may be due to intermittent behaviours, such a visor-flipping, if investigation shows no systematic concerns); and 'exposure exceeds the BMGV'—action is required to check the control measures and their use and to resample workers once any issues have been resolved (if results remain elevated, further investigation is required but workers do not need to be removed from tasks). Where work practices or exposure controls are significantly altered then retesting should be considered to ensure that exposure levels have not increased as a result.

Pros and cons

The test is easy to perform and gives results about exposure of an individual worker. The personal nature of the sample can help to reinforce behavioural change and correct ways of working. There is a BMGV to aid interpretation and the requirement for any further action. Individual results should be treated as sensitive personal data, but anonymized results (or simple statistics such as the average or range of results) can be shared to help give an idea of what is achievable within a workplace. Results from a BM programme will inform the initial completion and regular review of a risk assessment required under the Control of Substances Hazardous to Health (COSHH) Regulations [12].

The test does not provide information on health or likelihood of sensitization. The result only reflects that individual's exposure on the day of sampling. The test can be confounded by co-exposure to the corresponding diamine so uses of such substances need to be noted. There is no legal requirement and therefore no compunction for workers to participate in monitoring (although generally they are willing to do so with proper informed consent).

Cost and where it can be obtained

Several laboratories within the UK offer this analysis. One way to find such providers is through the UKAS website (www.ukas.com). Price of analysis is less than £100 per sample. Sampling kit, packaging and return postage are often included in the price.

Acknowledgement

The author would like to thank Sam Lord and Craig Sams, both from the Health and Safety Executive (HSE), for comments and review.

Competing interests

K.J. is employed by the Health and Safety Executive (HSE), which provided support for this manuscript. Its contents, including any opinions and/or conclusions expressed, are those of the author alone and do not necessarily reflect HSE policy in Great Britain.

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