Methods for Air Monitoring of Aliphatic Isocyanates

In general, isocyanates are highly reactive compounds. In order to allow for reliable workplace measurements, methods used for monitoring airborne isocyanate concentrations must be capable of trapping and derivatizing the isocyanates to stable derivatives in-situ.

Various authorities have set limits on exposure to isocyanates. The majority of these limits are concentration thresholds applicable to individual isocyanates. In Germany, exposure to polyisocyanates (oligomers and (pre-)polymers) is assessed by the so-called **E**xpositions**B**eurteilungs**W**ert (EBW; Exposition assessment value) per TRGS430 (http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/TRGS/TRGS.html, German only), an approach, which considers the significant differences in toxicological behavior of high molecular weight polyisocyanates compared to monomeric diisocyanates. However, some countries like Finland, Ireland, Switzerland and the United Kingdom have adopted a standard based on total isocyanate groups. For information about occupational exposure limits (OEL), please refer to the documents published in the section 'Regulatory Information' in the ALIPA Library.

In derivatization methods, a suitable reagent is used to convert the isocyanate into a stable derivative. Common sampling methods for quantitative analysis operate with a glass fiber (GF) filter impregnated with a trapping reagent and/or an impinger containing an absorption solution in solvent. Derivatization of the collected isocyanate species on the one hand stabilizes the isocyanate, which would otherwise be lost to reaction with polyols or water and on the other hand improves detection of the isocyanate by increasing sensitivity and selectivity. The stable derivatives are then separated by chromatography followed by identification and quantification. This principle is used in a variety of methods which differ for instance with regard to quenching agent or sampling technique.

To assess workplace exposures, a combination of personal and area samples are usually applied. In personal sampling, personnel from different disciplines and carrying out different tasks may be assessed for workplace exposure to aliphatic isocyanates.

Area samples are collected at key locations along production lines to evaluate the risk of exposure to personnel who may be required to work in specific locations. In addition, area sampling is used to identify any potential peak load areas that may require special attention, for example, to assess the efficiency or the need to introduce additional local exhaust ventilation, use of personal protective equipment, etc.

An overview about analytical methods for chemical agents at workplaces is given at the website of the Institute for Occupational Safety and Health (IFA) of the German Social Accident Insurance (DGUV) at Germany. IFA is an institute for research and testing. http://www.dguv.de/ifa/GESTIS/GESTIS-Analysenverfahren-f%C3%BCr-chemische-Stoffe/index-2.jsp. The database GESTIS - Analytical Methods (GESTIS - Analysenverfahren) contains validated lists of methods from various EU member states described as suitable for the analysis of chemical agents at workplaces and was elaborated in co-operation with experts of ten European institutes. This website is also available in English.

Air monitoring of isocyanates requires sound analytical knowledge. In order to obtain reliable results only laboratories with experience in that specific area should be engaged with such

measurements.

In Germany, a list of independent measuring institutes and testing laboratories that are approved to perform workplace air monitoring and analyses is published by DGUV/IFA at http://www.dguv.de/ifa/Fachinfos/Arbeitsplatzgrenzwerte/Messstellen-f%C3%BCr-Gefahrstoffe/index.jsp. (German only).

Various portable or stationary instruments are available for the continuous measurement of isocyanates in the air. A typical representative is a paper tape instrument. They function on the principle of colorimetric evaluation of an indicator paper strip. They are operating continuously and unattended. Paper tape systems are easy to use and do not require skilled analysts to operate them. They give rapid results and are therefore suitable for leak detection and in emergency situations. However, they may read incorrect at very high or very low humidity, are unsuitable for aerosols and may not be accepted for purposes of regulatory compliance.

General information:

ISO/TR 17737:2012 Guidelines for selecting analytical methods for sampling and analysing isocyanates in air
http://dx.doi.org/10.4172/2161-0525.1000293 Monsé et al., J Environ Anal Toxicol 2015, 5:4; Validation of a New Paper-Tape Monitor for the Quasi-Continuous Determination of Airborne Diisocyanate Concentrations

Examples of methods:

DGUV/IFA, D: http://publikationen.ifa.dguv.de/Publ_such.aspx?Sprache=Englisch
DFG, D:
http://www.dfg.de/en/dfg_profile/statutory_bodies/senate/health_hazards/structure/working_groups/air_analyses/index.html
HSE, UK http://www.hse.gov.uk/pubns/mdhs/index.htm
INRS, F: http://www.inrs.fr/publications/bdd/metropol/
INSHT, ES: http://www.insht.es/portal/site/Insht/
NIOSH, USA: http://www.cdc.gov/niosh/topics/isocyanates/
OSHA, USA: https://www.osha.gov/dts/sltc/methods/index.html
ISO: http://www.iso.org/iso/home/store/catalogue_tc/catalogue_tc_browse.htm?commid=52736