

Focus on IFA's work

Issue: 12/2024

New reference material for higher-molecular-weight PAHs at workplaces

Problem

Polycyclic aromatic hydrocarbons (PAHs) are a large group of compounds occurring in different occupational settings. Some of them are known to be capable of modifying the genome and causing cancer. For this reason, measurement of this group of substances is important and has been established practice in environmental protection and occupational safety and health for decades. The PAHs usually analysed mainly comprise lower-molecular-weight substances with two to five benzene rings. By contrast, some PAHs of higher molecular weight with five to seven benzene rings, are suspected to exhibit even greater carcinogenic potential and have not yet been considered individually in routine analysis. This is partly due to the large number of isomers, which complicates the analysis of samples containing these PAHs. In addition, analytical standards for higher-molecular-weight PAHs have only become commercially available in recent years.

To gain additional insights into the hazard potential, for example at workplaces in coking plants or in the steel industry, these higher-molecular-weight PAHs could be included as an addition to already established air monitoring methods. This requires analytical methods to be adapted and revalidated, which in turn requires a reference material for higher-molecular-weight PAHs for use as a quality assurance measure during validation of the methods.

Activities

The IFA has developed a reference material for higher-molecular-weight PAHs in order to allow interlaboratory method comparisons for laboratories interested in an expansion of existing methods towards these compounds.



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Hot coke from the coke oven, ready for transport and further use.

The reference material comprises a Polytetrafluoroethylene (PTFE) filter, loaded with higher-molecular-weight PAHs such as five different dibenzopyrene isomers, and benzo[a]pyrene serving as a lead substance for PAHs. Following numerous tests and internal checks, a production process for the filters was established with which variances of less than 1% can be achieved. Several test series of the filters were supplied to national and international laboratories to check the reproducibility and correctness of the PAH content on the filters.

In the course of internal checks of the filters, the IFA developed two analytical methods: one gas chromatographic, the other liquid chromatographic. Both methods enable the measurement of established PAHs used in contract analysis as well as other PAHs that may be of importance for occupational safety and health. Besides the PAHs for which the reference material was developed, the extended selection

also includes alkylated PAHs. The two methods were presented and compared in the journal *Gefahrstoffe – Reinhaltung der Luft* (in German).

Results and use

During development of the reference material, the extraction efficiency was found to depend on the filter/filter material. It could be shown that the recovery of higher-molecular-weight PAHs on quartz fibre filters is insufficient. However, differences were also noted between PTFE filters from different manufacturers. These findings must be taken into account when choosing filter materials for air monitoring methods that should be extended towards higher-molecular-weight PAHs.

With the quartz fibre filters initially used for the reference material, variance between the measurement results obtained by the external laboratories ranged from 4.6 to 23.7 %. Use of the PTFE filters reduced the variance to a maximum of 20.4 %. In January 2024, a proficiency testing scheme was carried out with 15 participating laboratories. Between 5 and 13 results were evaluated for each analyte. Relative standard deviations of between 5.1 and 13.5 % were determined across all laboratories. This is comparable with other, already established IFA proficiency tests.

User group

Laboratories of the accident insurance institutions in the MGU, analytical laboratories within companies, international occupational safety and health institutes.

Technical enquiries

- IFA, Department Chemical and Biological Hazards – Proficiency Testing

Literature enquiries

- IFA, Department “Interdisciplinary Services”

Further information

- Linke, J.; Breuer, D.: Validierung und Vergleich einer gas- und flüssigchromatographischen Methode zur Messung schwerflüchtiger PAK. *Gefahrstoffe – Reinhalt. Luft* 83 (2023) Nos 9-10, pp. 218-228

Published by:

Deutsche Gesetzliche Unfallversicherung e. V. (DGUV)
Glinkastrasse 40 · 10117 Berlin
ISSN (Internet): 2190-006X

Subscription:

www.dguv.de/publikationen Webcode: p022708

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