

Focus on IFA's work

Issue: 12/2024

MUST software application: calculation of the measurement uncertainty of methods for determining workplace exposure

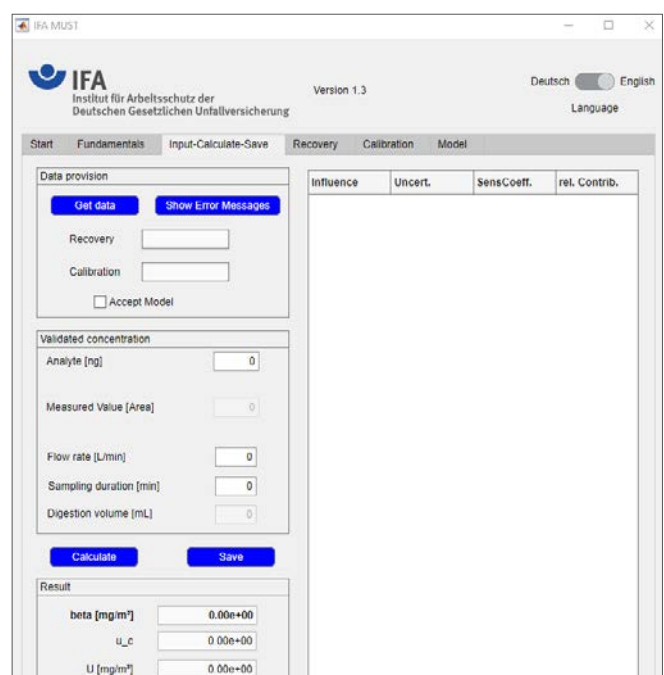
Problem

Determining the concentration of hazardous substances in the workplace atmosphere requires validated measurement methods that include both sampling and laboratory analysis. Method validation concludes with calculation of the method's expanded measurement uncertainty. This determines its suitability in accordance with the German TRGS 402 Technical Rules for Hazardous Substances.

In the past, measurement method-specific Microsoft Excel data sheets were used for this purpose. These contained uncertainties and deviations set out in standards, by means of which simplified calculation of the expanded measurement uncertainty was possible in the laboratory. To permit more comprehensive calculation of the expanded measurement uncertainty, taking into account all uncertainty variables influencing the measured value, the IFA has developed the "MUST" software application (the acronym stands for "measurement uncertainty service tool"). MUST provides a user-friendly interface with which the expanded measurement uncertainty can be determined for standard measurement methods (three at present). The calculations are based on the requirements of the "Guide to the expression of Uncertainty in Measurement" (GUM).

Activities

In the first step, the IFA's Departments 1 (Exposure and Risk Assessment) and 2 (Chemical and Biological Hazards) identified the standard methods most commonly used in the IFA's laboratories for determining the concentration of hazardous chemical substances:



MUST application – tab sheet 3

- Measurement of analytes following extraction, by means of chromatographic methods (high performance liquid chromatography or gas chromatography)
- Gas chromatographic quantitation of volatile analytes by means of thermodesorption
- Determination of metallic hazardous substances by means of inductively coupled plasma mass spectrometry (ICP-MS).

A list of factors influencing the measured value was then drawn up and divided into random and systematic deviations. From the influencing factors, measurement method-specific mathematical models were developed containing sensitivity coefficients in addition to the deviations and distribution assumptions of the factors. Based on the mathematical models, an application with a graphical interface was programmed by means of the MATLAB software. In the final step, data sheets were created in which the validation parameters are entered. These data sheets can be read in with MUST, enabling further uncertainty variables to be determined from the validation. The result of the measurement uncertainty calculation can be saved.

Results and use

Approximately three years of development resulted in an application that can be used to calculate the expanded measurement uncertainty for standard measurement methods (three at present) for determining the concentration of hazardous substances at workplaces. The application is available free of charge in English and German on the IFA's website. In the coming years, it will be extended successively with the inclusion of further measurement methods.

The mathematical models on which the calculations are based were reviewed and validated. MUST is already in use in the IFA's laboratories. The application is available for download from the IFA's website in the form of a ZIP archive. The unzipped file (.exe) can be launched on Windows 10. The methods modelled in MUST can be adapted if necessary to the conditions in users' own laboratories. The MUST project group can provide custom support if required.

User group

The MUST measurement uncertainty service tool can be used in any laboratory involved in determining the concentration of hazardous chemical substances in the air at workplaces.

Technical enquiries

- IFA, MUST project group: must@dguv.de
- IFA, Department "Exposure and Risk Assessment"
- IFA, Department "Chemical and Biological Hazards"

Literature enquiries

- IFA, Department "Interdisciplinary Services"

Further information

- [TRGS 402](#) Identification and assessment of the risks from activities involving hazardous substances: inhalation exposure. (GMBI 2011 p. 175 [No. 9], March 2011, not up-to-date and unofficial version; mandatory is the current German version: GMBI 2023, pp. 898-920 [No 42], 11 September 2023)
- IFA website: Practical solutions –Hazardous substances: Software: Measurement Uncertainty Service Tool <https://www.dguv.de/ifa/praxishilfen/hazardous-substances/software-must/index.jsp>
- Rissler J.; Wippich C.; Dospil J.: [Measurement Uncertainty for Measurement Methods of Air Monitoring](#). Workshop presentation at Airmon 10 Bristol/UK (2022)

Published by:

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

Subscription:

www.dguv.de/publikationen Webcode: p022712

Edited by:

Dr Cornelia Wippich
Institute for Occupational Safety and Health
of the German Social Accident Insurance (IFA)
Alte Heerstrasse 111, 53757 Sankt Augustin, Germany
Tel. +49 30 13001-0 · Fax: -38001
Email: ifa@dguv.de
Internet: www.dguv.de/ifa