Project Outcomes

MetroPOEM will enable and harmonise measurement methods for the detection and characterisation, of both radioactive isotopes and stable polluting elements, in support of the EU Green Deal's aim toward a zero pollution, toxic-free environment. The new reference materials (RMs) developed in this project will address the ongoing need to produce suitable and relevant RMs that can validate measurement capabilities.

The scientific outcome of the proposed research will deliver validated and traceable analytical approaches for the analysis of the concentration of pollutants, as well as determining the source and monitoring any contamination of pollutants through isotope ratio measurements. This will close existing metrological gaps and will lead to a harmonisation of methods.

MetroPOEM will deliver an improved system of metrology and will establish an infrastructure that directly supports the application of EU regulations or EU directives. By implementing new traceability chains, different methods will be combined in the field of pollution monitoring, which will then lower the detection limits. This will result in better protection of the environment, provide new tools for complex studies in climate observation, support validated data collection. Additionally, accurate waste classification engenders public confidence and ensures inventories are correct for future infrastructure planning, such as the scale and design of pollutant remediation programmes.

The outputs from the project may be employed in several diverse fields including routine real-time monitoring, emergency response, geological dating, and climate change studies, and in other activities, such as nuclear forensics, decommissioning non-nuclear industries. The collaboration between European laboratories established in this project is expected to continue beyond the end of the project.

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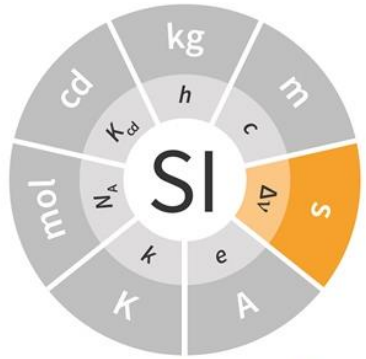
Website: www.npl.co.uk/euramet/metropoem

Email: metropoem@nmbu.no

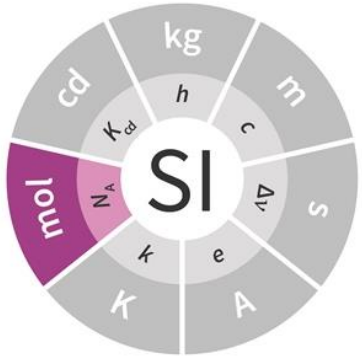
MetroPOEM



Activity (Bq = s^{-1})

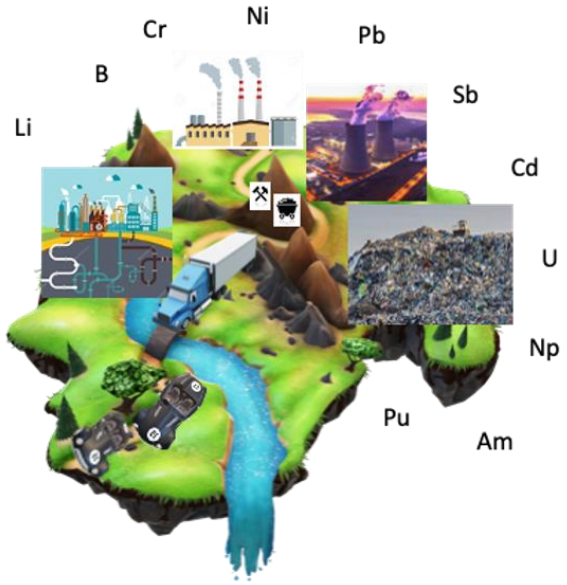
$$n = \frac{A \cdot T_{1/2}}{N_A \cdot \ln 2}$$

Amount of substance (mol)



21GRD09 MetroPOEM

Metrology for the harmonisation of measurements of environmental pollutants in Europe



Summary

MetroPOEM, coordinated by the **Physikalisch-Technische Bundesanstalt of Germany**, will be delivered by a consortium of 22 partners from 13 countries throughout Europe.

The European Green Deal's ambition for zero pollution requires the development of highly sensitive techniques to detect ultra-low amounts of pollutants. This requirement will be delivered via strategies described by the two European Metrology Network (EMN) on Pollution Monitoring (PolMo) and the EMN on Radiation Protection, supporting the Basic Safety Standards directive. Implicit in these strategies is a strong need to improve data quality for monitoring and reporting pollution in the air, water, and soil. In addition, the lack of suitable traceability chains and appropriate quality control compromises the comparability and robustness of measurements.

To detect radioactive isotopes and stable polluting elements in the environment, fast, sensitive, and inexpensive analytical procedures are needed. Mass spectrometry is a key method for determination of non-radioactive polluting elements and is of increasing importance for long-lived radionuclides. Despite the increasing application of single collector ICP-MS, this potential cannot be fully realised unless techniques can be validated with traceable multi-element reference materials. However, multi-element certified reference materials are usually not available and single-element certified reference materials are limited to very few elements. Nevertheless, these reference materials are urgently needed to calibrate mass spectrometric measurements, due to mass bias effects occurring during the measurements in mass spectrometers.

Objectives

The overall aim of MetroPOEM is to bridge the gap between radiometric techniques and mass spectrometry for the characterisation and detection of polluting long lived radionuclides and stable elements and element tracers by comparing and linking both techniques, thus significantly improving measurement uncertainties and detection limits. The aims and objectives of MetroPOEM will be delivered through 4 technical work packages, supported by project and impact management activities:

- Establish and compare (inter-laboratory) the selectivity and detection limits of diverse types of mass spectrometers for selected radioactive pollutants (e.g., U, Np, Pu, Am) using isotope reference materials and/or activity standards. This includes assessing relative instrument performance with respect to current measurement challenges and establishing detection limits in relation to regulatory waste criteria levels or environmental regulations.
- Develop measurement methods for isotope ratios that are traceable to the SI by using multi-collector ICP-MS and apply these methods on more commonly available techniques (ICP-MS/MS, ICP-QMS) by providing suitable operating procedures focussing on stable polluting elements (e.g., Li, B, Cr, Cd, Ni, Sb, Pb, U). To produce recommendations for sample processing, treatment, uncertainty budgets, and if feasible, the quantification of the so-called mass bias.
- Develop two radioactive reference materials with the sample matrix containing radioactive pollutants (e.g., U, Np, Pu, Am) for use in an inter-laboratory comparison employing techniques used WP1, which will demonstrate the variations in parameters including detection limits, sample preparation, sample introduction methods, total procedural time, and uncertainty budgets.
- Implement and validate the methods for isotope ratio measurements established in objective 2 by the development of one aqueous certified reference material that is certified for the same stable polluting elements with lowest possible uncertainties using multi-collector instruments, to facilitate the calibration of single collector ICP-MS, instrument validation, as well as quality control.
- Facilitate the acceptance of the technology and measurement infrastructure developed in the project by the measurement supply chain (e.g., accredited laboratories), standards developing organisations and international organisations and end users (e.g., environmental monitoring agencies).