European Metrology Research Programme

Delivering Impact

Traceability for mercury measurements

Mercury, a highly toxic metal, can be released into the environment from human sources. European and international treaties are in force to limit its emission, introducing the need for reliable mercury monitoring. Cheap and easy to use sensors that can be deployed anywhere in the world and capable of operating without power supplies are needed for monitoring atmospheric mercury levels.

Europe's National Measurement Institutes working together

The European Metrology Research Programme (EMRP) brings together National Measurement Institutes in 23 countries to address key measurement challenges at a European level. It supports collaborative research to ensure that measurement science meets the future needs of industry and wider society.

Challenge

Mercury is a ubiquitous and naturally occurring metal which can be released into the environment through natural processes, but a major source is from human activities such as mining or the use of fossil fuels. Highly toxic in all its forms, mercury compounds can be spread through the air and accumulate in both terrestrial and aquatic bio-systems. This has led the World Health Organisation (WHO) to label this metal as a priority hazardous substance and one of the top ten groups of chemicals of major public health concern. In 2013 the Minamata Convention was held with the aim of minimising the man-made releases of mercury into the environment and from this an international treaty came into force in 2017. In support of this European directives aim to progressively reduce its discharges, emissions and losses to zero within the next 20 years.

Monitoring networks are now being set up throughout the world to track mercury emissions and the success of reduction strategies. However, determining ambient mercury levels in the atmosphere is difficult as mercury easily volatilises or adsorbs onto surrounding surfaces. This, along with a lack of validated measurement methods with robust SI links for assessing low mercury concentrations, means it is currently not possible to defensibly assess mercury levels at internationally agreed limits. Simple, cost effective mercury sensors are needed to increase network measurement capability, especially those which can operate without the need for external power supplies on technical intervention.

Solution

The EMRP project *Traceability for Mercury Measurements* developed a new prototype "passive sensor" for determining mercury in ambient air. Researchers at the National Research Council of Italy's Institute of Atmospheric Pollution Research (CNR-IIA) used novel materials based on an adsorbent layer of titanium nanoparticles finely decorated with gold to form a regular structure able to trap mercury. As well as being low cost, these sensors are re-usable and designed to give information about average mercury pollution levels down to ultra-trace amounts, with robust links to the international system of units (SI).

Comparable in performance to traditional sensors they can be deployed in the field for times ranging from few hours to weeks/months and have the added advantage in that they do not require an external power supplies or technical expertise for use.

Impact

The United Nations Environment Programme and the World Health Organization through a cooperation with the CNR-IIA have used the project's passive sensors at 10 sites worldwide in a pilot study for the development of a global monitoring system to meet the requirements of the Minamata Convention. In addition, these new sensors are being used in a comparative study currently organised by CNR-IIA in the EU funded project Integrated Observing Systems for Persistent Pollutants. This project is developing measurement instruments for mercury and other persistent pollutants supporting the new Group on Earth Observation's Flagship, "GOS4M" (Global Observing System for Mercury) that aims to develop a global observation system for mercury.

Increasing mercury measurement coverage around the world will lead to an increased knowledge of the scale of this global problem and help identify were efforts are most needed to reduce mercury release to the environment so reducing its potential for damage in the future.

Monitoring mercury in the environment

The EMRP project *Traceability for Mercury Measurements* developed a calibration system for airborne mercury and used it to calibrate environmental monitoring sensors based on accurately determining mercury vaporisation weight loss, to provide a potential replacement for currently used empirical equations. This calibration system was used to characterise an SI traceable transfer instrument that circulated between the project partners enabling the generation of international equivalence for the first time. It also confirmed the performance of project developed innovative, low-cost, mercury-in-air monitoring sensors demonstrating their suitability for use in monitoring for atmospheric traces of mercury. These have subsequently been trialled by an international monitoring network. Working with multiple biota samples, the project optimised and validated preparation procedures for determining mercury content in fish and used these to establish inter-species differences resulting from variation in fat content or habitat. This is important for analysing samples drawn from rivers and oceans to determine mercury uptake in the food chain.

© B&M Noskowski

EMRP
European Metrology Research Programme
Programme of EURAMET

The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union

www.euramet.org/project-ENV61

Paola Fisicaro
LNE, France
+33 1 40433759 | Paola.fisicaro@lne.fr

11326/0519 - ENV61 19022