



Measuring roadside air pollution

Air pollution, such as that generated by road vehicles, is known to harm public health, damage biodiversity and contribute to climate change. In response, Europe has made air pollution one of its main concerns and developed an extensive body of legislation, establishing limit values for major air pollutants such as NO₂ and particulate matter, to improve human health and environmental quality.

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

Congested areas such as city centres still suffer from elevated levels of certain pollutants - in particular NO₂, which is associated with adverse effects on health including reduced life expectancy. To tackle the problem, Switzerland, a leading player striving towards cleaner air, is introducing improved automotive exhaust emissions monitoring. Authorities in major Swiss cities are striving to monitor emissions at the challenging concentration levels (parts per billion) permitted by European regulation and need improved measurement capabilities.

Instruments used to monitor NO₂ pollution ideally require calibration in-situ to ensure they provide reliable measurements at such low concentrations. But certified low concentration gas mixtures of NO₂ in pressurised cylinders drift over time, meaning that the most reliable way of calibrating monitoring instruments requires accurate levels of NO₂ to be generated on-site. This involves transporting the equipment needed to generate NO₂ out into the field; however, previously, this was a bulky and costly process and unsuitable for some monitor locations.

Solution

As part of the EMRP project *Metrology for chemical pollutants in air (MACPoll)*, METAS (the Federal Metrology Institute of Switzerland) developed a new traceable mobile NO₂ permeation generator, which can be used to accurately produce NO₂-mixtures at the parts-per-billion level into installed monitoring instruments. This simpler approach enables instruments to be easily and reliably calibrated on-site, improving the reliability of their measurements through traceability to national standards.

Impact

The METAS NO₂ generator has already been used by the City of Zürich Health and Environment Department and in other Swiss cities to calibrate installed instrumentation and perform national comparison exercises on behalf of the Swiss Federal Office for the Environment, FOEN. More accurate measurements of NO₂ pollution will support the evaluation of pollution reduction strategies and continue the successful reduction of NO₂ pollution in Zürich city centre and throughout Switzerland.

The Swiss government recently awarded funding to METAS and LNI Swissgas, a leading manufacturer of environmental gas calibration systems and gas generators, to commercialise a novel compact NO₂ permeation generator, which incorporates features of the METAS prototype into LNI Swissgas's existing product, resulting in a fully traceable and user-friendly transfer standard.

The resulting generator could have a significant impact in the pollution monitoring market, which is expected to expand as new micro-sensor technology gains popularity. These small and relatively cheap sensors have the potential to significantly increase the capability of current air monitoring networks and supply real-time data to support public health advice and pollution warnings – warning, for example, against cycling on congested roads at particular times. Ahead of deployment, a portable and compact field calibration instrument is needed to confirm the performance of each NO₂ micro-sensor installed within a network.

The new portable calibration method provides crucial support to this expansion of Europe's air monitoring networks, which is an important step towards more comprehensive pollution monitoring and the effective protection of Europe's citizens.

METAS traceable mobile NO₂ permeation generator

The transportable NO₂ generation system developed by METAS within the EMRP project drives a controlled and stable gas flow through a chamber containing a permeation tube maintained at a constant temperature to produce an accurately-defined NO₂ reference gas mixture. NO₂ concentrations of between 10 and 500 parts-per-billion can be generated, enabling instrument certification at operating conditions for the first time. The new generator has reduced measurement complexity by removing the need for individual gas standards of NO₂ and synthetic air or ozone, which then need to be diluted to the parts-per-billion levels measured in the environment, while reducing measurement uncertainties.

Metrology for chemical pollutants in air

Reliable indoor and outdoor measurements of chemical pollutants in air are required to underpin and implement European air quality legislation designed to protect human health and the environment. The EMRP project *Metrology for chemical pollutants in air* made a significant contribution to fulfilling the air quality objectives of European legislation by establishing the metrological infrastructure needed to produce accurate measurements for robust short- and long-term assessment of a range of indoor and outdoor pollutants.



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