



## Monitoring ammonia

Ammonia is a harmful pollutant, which damages ecosystems, harms human health and contributes to global warming. The EU has set targets for its reduction and introduced Directives for its regulation, verifying compliance requires accurate ammonia sensors that do not interact with the gas they measure. Improved material test and calibration facilities with robust links to SI units are needed to support the development of sensors based on ammonia inert materials.

### 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

Intensive farming practices are producing growing ammonia emissions from animal waste and fertiliser use. Once in the air, ammonia reacts with other atmospheric chemicals to produce very small particles which are harmful when inhaled and gases that contribute to global warming. Under the 2012 UNECE Gothenburg protocol, EU member states must cut ammonia emissions by 6 % and particles by 22 % by 2020. Accurate monitoring schemes are required to track these reductions.

Whilst monitoring for other environmental pollutants has improved dramatically in recent years, ammonia monitoring has lagged behind. A major reason is that ammonia is very reactive making it hard to measure. When sucked into measurement sensors, ammonia has a habit of sticking to the sides, therefore the air measured does not contain the same concentration as that present in the atmosphere. A similar problem exists during ammonia sensor calibration with the ammonia gas cylinder standards appearing to reduce in concentration overtime as ammonia sticks to cylinder walls.

To increase the accuracy of ammonia monitoring, new techniques for testing materials and evaluating sensors, are needed to ensure all the sampled ammonia reaches the detector and none has been lost due to sticking to the gas sampling system.

# Solution

The EMRP Project, *Metrology for Ammonia in Ambient Air*, extended the capabilities of The Controlled Atmosphere Test Facility (CATFAC), an existing testing facility which evaluates how polluting gases interact with materials at the low concentrations encountered in the atmosphere. Gases simulating atmospheric pollution levels are pumped around a chamber containing the material under test. Gas absorption by the material undergoing testing is confirmed by accurately monitoring the gas concentration in the system.

As part of the project, the facility evaluated materials commonly used in ammonia sensors, and tested sensor performance under conditions similar to those found in environmental monitoring, providing valuable data to sensor manufacturers. The project also investigated the use of proprietary coating to reduce ammonia interactions with gas cylinder materials and discovered that a SilcoTek coating improved the long-term stability of precise ammonia gas calibration standards contained in cylinders.

# Impact

MIRICO, a manufacturer of high-performance gas sensing instruments was one of the first to employ project derived gas calibration standards to identify the most suitable materials for use in a prototype ammonia sensor. This sensor is being developed for standalone use and for inclusion into MIRICO's air quality monitoring platform.

The sensor sucks gas into a cell and shines a laser through the sample, calculating the ammonia concentration based on changes to the laser light's properties. As a result of this testing, MIRICO identified materials that have little interaction with ammonia, so increasing confidence in the sensors accurate measurement of low-level ammonia concentrations.

Ammonia sensors also have applications in the semi-conductor industry, where manufacturers need to confirm ammonia used in production has not leaked into cleanroom air and is

compromising product quality. Sensor advances made by MIRICO and others, through access to the upgraded gas standards and CATFAC facility, will help increase the accuracy of monitoring both global and local ammonia emissions. This in turn will help inform and enforce current emission reduction measures, reducing the harm to health and the environment that ammonia causes.

## Measuring ammonia in air

The EMRP project *Metrology for Ammonia in Ambient Air* developed ammonia reference gas standards for use in calibrations and in-the-field device performance assessments and upgraded the existing CATFAC facility for use with ammonia. This was then used to evaluate material/ammonia interactions to help inform user selection decisions. The facility has enabled the exposure of ammonia measuring devices to well characterised ammonia atmospheres similar to those encountered in the field and followed by a pioneering field study has enabled manufacturers to appreciate the importance of reliable characterisation data for sampler measurement accuracy. The CATFAC tests also included water vapour as a cross interferent at levels likely to be observed in the environment and assisted the introduction of laser-based spectroscopy technologies for real time ammonia monitoring. Greater measurement accuracy for ammonia emission reporting will assist member states demonstrate compliance with the EUs Industrial Emissions Directive.



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## EMRP

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