EMRP Call 2013 – Energy and Environment

Selected Research Topic number: **SRT-v02**
Version: 1.0

Title: Metrology for ammonia in ambient air

Abstract

Ammonia emissions from agriculture, industry, traffic and cooling plants are responsible for newly discovered environmental problems like eutrophication (e.g. the “bloom” in a water or soil body in response to increased levels of nutrients) resulting from a change in nitrogen balance and causing a significant degradation in biodiversity. As a precursor for particulate matter, ammonia emissions contribute to Europe wide air pollution. As NO_x emissions decrease, NH_3 will increasingly dominate future reactive nitrogen emissions so NH_3 reductions are key in improving nitrogen use efficiency and reducing N_2O emissions.

In order to achieve a reduction of more than 220 thousand tons of ammonia by 2020 (as documented in the 2012 amendment of the Gothenburg Protocol), a fundamental metrological base for monitoring the efficiency of reduction measures must be developed. Accurate data traceable to realised primary standards and uncertainty estimation needs to be developed, allowing confirmation of declared emissions (as is done for O_3 and SO_2) thereby providing more reliable air quality modelling in Europe.

Conformity with the Work Programme

This Call for JRPs conforms to the EMRP Outline 2008, section on “Grand Challenges” related to Energy and Environment on page 24.

Keywords

Ammonia, agricultural emissions, traceability, calibration standards, biodiversity measures, instrumentation, environmental control, air quality measurements

Background to the Metrological Challenges

The fundamental metrological base for monitoring the ammonia decrease needs to be developed. This will allow underpinning of the declared emissions by independent measurements as is done for other pollutants (such as NO_x, O_3, SO_2 and BTEX) throughout Europe.

In current measurement, traceability for sampling techniques is usually not addressed and discrepancies of up to 50 % in inter-comparisons have been experienced. Existing measurement techniques may consist of relatively low cost passive or active samplers with variable sampling time (sometimes into months), followed by lab photometry or ion chromatography analysis and gravimetric primary mixtures are currently deemed as unreliable at low µmol/mol concentrations.

Highly sensitive and selective spectroscopic instruments (such as cavity ring down spectroscopy) are now replacing traditional systems like denuders. Furthermore, dynamic methods based on permeation of gases through semi-permeable membranes are now available, being widely used for low accuracy work and at higher concentrations. To date, however, these are not well established for traceable calibration work for ammonia.

There is a need for low uncertainty calibration to be developed at ambient levels. Existing discrepancies of key comparisons must be resolved, characterising various realisations and comparing these by means of permeation generators / analysers. Transferring the traceability down to the field level measurements may be achieved by calibration of samples of active or passive sampling devices exposed to controlled atmospheres.

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Scientific and Technological Objectives

Proposers should address the objectives stated below, which are based on the PRT submissions. Proposers may identify amendments to the objectives or choose to address a subset of them in order to maximise the overall impact, or address budgetary or scientific / technical constraints, but the reasons for this should be clearly stated in the JRP-Protocol.

The JRP shall focus on the traceable measurement and characterisation of ammonia in ambient air.

The specific objectives are:

1. Evaluation of existing measuring instruments for traceable measurement of ammonia at ambient concentrations (0.5 to 500 nmol/mol) including development and validation of novel measurement methods such as cavity ring down spectroscopy (CRDS), photo acoustic spectroscopy (PAS) or tuneable diode laser spectroscopy (TDLAS).
2. Development of open path optical techniques for absolute measurement of ammonia.
3. Development of traceable preparative calibration standards (including portable) at ambient levels based on existing methods. This will include the reduction of existing discrepancies between gas standards (e.g. CCQM-K46) and the production/purification of a high purity matrix gas with validated levels of ammonia for use in static and dynamic reference standards.
4. Development of a transportable optical transfer standard calibration device and validation of a proficiency test installation to perform comparisons at ambient concentrations.
5. Evaluation and comparison of results produced with field measuring methods, promoting long-term efficiency monitoring of ammonia reduction measures, and the development of sampling methods.

These objectives will require large-scale approaches that are beyond the capabilities of single National Metrology Institutes and Designated Institutes. To enhance the impact of the R&D work, the involvement of the user community such as industry, and standardisation and regulatory bodies, as appropriate, is strongly recommended.

Proposers should establish the current state of the art, and explain how their proposed project goes beyond this and EMRP JRP ENV01 (MACPoll) ‘Metrology for Chemical Pollutants in Air’.

EURAMET expects the average size of JRPs in this call to be between 3.0 to 3.5 M€, and has defined an upper limit of 5 M€ for any project. Any proposal received for this SRT is expected to be significantly below 3.0 M €. The available budget for integral Research Excellence Grants is 30 months of effort.

Potential Impact

Proposals must demonstrate adequate and appropriate participation/links to the “end user” community. This may be through the inclusion of unfunded JRP partners or collaborators, or by including links to industrial/policy advisory committees, standards committees or other bodies. Evidence of support from the “end user” community (eg letters of support) is encouraged.

You should detail how your JRP results are going to:

- feed into the development of urgent documentary standards through appropriate standards bodies
- transfer knowledge to the environmental and health sectors.

You should detail other impacts of your proposed JRP as detailed in the document “Guide 4: Writing a Joint Research Project”

You should also detail how your approach to realising the objectives will further the aim of the EMRP to develop a coherent approach at the European level in the field of metrology and includes the best available contributions from across the metrology community. Specifically the opportunities for:

- improvement of the efficiency of use of available resources to better meet metrological needs and to assure the traceability of national standards
- the metrology capacity of Member States and countries associated with the Seventh Framework Programme whose metrology programmes are at an early stage of development to be increased
- outside researchers & research organisations other than NMIs and DIs to be involved in the work

Time-scale

The project should be of up to 3 years duration.

Additional information

The references were provided by PRT submitters; proposers should therefore establish the relevance of any references.

[1] Convention on Long-range Transboundary Air Pollution (CLRTAP), Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg Protocol) incl. Amendment 2012 http://www.unece.org/env/lrtap/lrtap_h1.html

[2] DIRECTIVE 2001/81/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 October 2001 on national emission ceilings for certain atmospheric pollutants http://ec.europa.eu/environment/air/pollutants/ceilings.htm