EMPIR Call 2016 – Energy, Environment, Normative and Research Potential

Selected Research Topic number: **SRT-v13**
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Title: Metrology for VOC indicators in air pollution and climate change 2

Abstract

Volatile Organic Compounds (VOCs) are a very large category of organic compounds in vapour or gaseous form that are present in the air. They are of particular interest in air quality and climate change due to their toxicity levels for human health and the environment and their influence on ozone and aerosol formation. Traceable and accurate standards are essential for the reliability and harmonisation of the measurement data across European and is needed in order to support a joint reduction of VOC emissions. Therefore, the metrology needs to be developed to support the traceable and accurate measurement of VOC indicators for air pollution and climate change applications, including gas standards and novel sampling and analytical techniques.

Keywords

VOCs, air pollution, climate change, air quality, sampling, gas standards, reference materials, Quality Assurance/Quality Control (QA/QC)

Background to the Metrological Challenges

Long-term, accurate data is essential for the evaluation of climate change and global trends in air quality However, for many VOC indicators (such as short-lived or fluorinated gases) there is currently a lack of Certified Reference Materials and Quality Assurance/Quality Control (QA/QC) solutions and traceable reference gas mixtures and stability tests are urgently needed. Because VOC levels in the atmosphere are ultra-low (parts-per-billion to parts-per-trillion) and some VOC species are very reactive, the sampling and analysis of VOCs and their traceability and accuracy are extremely problematic.

The previous EMRP project ENV56 KEY-VOCs made progress on the preparation of gas standards and reference materials for polar and semi-VOCs, but further research is needed for glycols, aldehydes and chlorinated VOCs. ENV56 KEY-VOCs also performed qualitative and quantitative studies on the interaction of selected VOCs with various material surfaces, as understanding the chemical interaction of VOCs on material surfaces is fundamental for the development of improved surface passivation treatments of vessels for VOCs storage and transport. However, because each VOC species has its own specific physical and chemical properties, further research is needed to extend the applicability of the findings to a larger number of key VOCs and to include the influence of moisture and ozone.

The use of passive (diffusive) and active sampling techniques with different VOC materials is widely used in ambient air (it is the indicative method in the Air Quality Directive 2008/50/EC) and indoor air measurements (as described in ISO 16000-6). However, metrological validation of these sampling techniques, especially novel VOC sampling techniques, with respect to their accuracy, uncertainty and stability of the stored gases is urgently needed. In addition to this, some standards developed by CEN TC 351 and part 9 of ISO 16000 specify test chambers for the determination of VOC emissions from construction products and furnishings. However, QA/QC, validation and equivalence of the specified exposure test chambers is currently lacking.

Proton Transfer Reaction Mass Spectrometry (PTR-MS) and Selected Ion Flow Tube Mass Spectrometry (SIFT-MS) analytical techniques have the potential for measuring VOCs in real air at background locations. These new generation techniques have the advantages of being able to measure in real time and at low concentration levels without sample enrichment (pre-concentration). However, before such techniques can be used the accuracy and uncertainty of their measurement results needs further investigations as well as the comparability with more classical techniques e.g. VOC automatic analysers.

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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 protocol.

The JRP shall focus on the traceable measurement and characterisation of VOC indicators for air pollution and climate change applications.

The specific objectives are

1. To develop long-term and stable gas standards (i.e. reference materials having years of lifetime) for the following VOC species:
    - Acetaldehyde, methacrolein and acetonitrile – at nmol/mol concentration levels to comply with World Meteorological Organization Global Atmosphere Watch (WMO-GAW) data quality objectives. In addition, to assess the influence of matrix gas, on the accuracy and stability of the gas standards and the performance of the analytical system.
    - Short-lived fluorinated gases – at pmol/mol concentration levels using dynamic methods.
    - Glycols, aldehydes and chlorinated VOCs – at concentrations compliant with the Construction Products Regulation (CPR) (EU) No.305/2011.
2. To validate the uncertainty and stability of the use of novel VOC sampling techniques using coated canisters, sampling bags and (diffusion) sorbent samplers. In addition, to expand the sampling range of VOCs to meet the list of ozone precursors listed in the Air Quality Directive 2008/50/EC.
3. To validate analytical methods based on PTR-MS or SIFT-MS in terms of accuracy, range of measured components and limit of detection and compare such analytical methods against VOC automatic analysers. In addition, for indoor air monitoring, to validate the use of exposure chambers for the measurement of VOC emissions from construction products.
4. To evaluate, using surface analysis and Computational Fluid Dynamics (CFD) modelling, the interaction of VOCs with surfaces such as tubing, mixed contact materials, cylinder walls and particle backgrounds. The evaluation should take into account the influence of moisture and ozone and the effect of scrubbing techniques on VOC composition.
5. To facilitate the take up of the technology and measurement infrastructure developed in the project by the measurement supply chain (accredited laboratories, instrument manufacturers), standards developing organisations (e.g. CEN TC 351 and those linked to the Air Quality Directive 2008/50/EC) and end users (environmental monitoring and regulation bodies (e.g. the WMO-GAW) to support the development of new low VOC emitting products, thereby enhancing the competitiveness of EU industry.

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 research, the involvement of the appropriate user community such as industry, standardisation and regulatory bodies is strongly recommended, both prior to and during methodology development.

EURAMET expects Europe to lead the international metrology efforts in this area and any proposal against this SRT should outline how the project would contribute to that expectation.

Proposers should establish the current state of the art, and explain how their proposed research goes beyond this. In particular, proposers should outline the achievements of the EMRP projects ENV01 MACPoll and ENV56 KEY-VOCs and how their proposal will build on those.

EURAMET expects the average EU Contribution for the selected JRPs in this TP to be 2.0 M€, and has defined an upper limit of 2.3 M€ for this project.

EURAMET also expects the EU Contribution to the external funded partners to not exceed 35 % of the total EU Contribution to the project.

Any industrial partners that will receive significant benefit from the results of the proposed project are expected to be unfunded partners.

Potential Impact

Proposals must demonstrate adequate and appropriate participation/links to the “end user” community, describing how the project partners will engage with relevant communities during the project to facilitate knowledge transfer and accelerate the uptake of project outputs. Evidence of support from the “end user” community (e.g. letters of support) is also encouraged.

You should detail how your JRP results are going to:

- Address the SRT objectives and deliver solutions to the documented needs,
- Feed into the development of urgent documentary standards through appropriate standards bodies,
- Transfer knowledge to the Environment sector.

You should detail other impacts of your proposed JRP as specified in the document “Guide 4: Writing Joint Research Projects (JRPs)”

You should also detail how your approach to realising the objectives will further the aim of EMPIR to develop a coherent approach at the European level in the field of metrology and include 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 EURAMET Member States whose metrology programmes are at an early stage of development to be increased
- organisations other than NMIs and DIs to be involved in the work

Time-scale

The project should be of up to 3 years duration.