EMPIR Call 2015 – Health, SI, Normative and Research Potential

Selected Research Topic number: **SRT-n08**
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Title: Metrology for sampling and conditioning SO_2 emissions from stacks

Abstract

With an economic cost of EU air pollution of €102 - €169 billion [1] and the Aphekom project [2] establishing a linear relationship between SO_2 air pollution and mortality, the need for the increasingly stringent emission limits set out in the Industrial Emissions Directive [3] is clear. However, to enforce these lower limits a new standard reference method, based on a filtered and dried gas stream, needs to be developed. Due to the complex nature of stack gas matrices this presents risks of sampling losses due to physical changes / chemical reactions, which must be resolved to allow standardisation and ultimately to enable the enforcement of lower SO_2 emission limits.

Keywords

SO_2 emissions, standard reference method, industrial emissions directive, UNECE convention on long-range transboundary air pollution (CLRTAP), CEN/TC 264 air quality

Background to the Metrological Challenges

CEN is committed to support EU policies in relation to air quality and climate as described in the CEN/CENELEC Work Programme 2015 [4]. Also, CEN/TC 264 / N2204 [5] have identified the following future work items: “identify new monitoring requirements of the IED”, “assessment of current SRM to meet stricter limit values” and “automated methods for measuring emissions”. At the 2014 Plenary meeting of CEN / TC264 member state experts agreed on Decision 894 [6] which formally tasks CEN / TC264 Task Force Emissions to consider the issues behind these work items. The request for work submitted to the 2015 Pre-Co-Normative Orientation stage by CEN/TC 264 Air Quality, stated that the barrier to the standardisation of many instrumental techniques for the emissions monitoring of SO_2 related to the lack of pre-normative work on sampling and conditioning.

The EU’s Industrial Emissions Directive (IED) is bringing in increasingly stringent limits for SO_2 emissions. These requirements will have an impact on many European industries, which will need to install new abatement technologies to reduce emissions. The mandatory Standard Reference Method (SRM) produced by CEN/TC 264 for SO_2 requires the measurement uncertainty to be given as a fraction of the emission limit value. Therefore, enforcement is only possible if the SRM can measure to the associated uncertainty. However, for some processes the SRM for SO_2 has too high an uncertainty for enforcement and Automated Measuring Systems (AMSs), for the continuous monitoring of emissions to air, cannot be calibrated to the required uncertainty. Ultimately this compromises the accuracy of member state emission inventories, which are reported in the European Pollutant Release and Transfer Register [7].

The SRM for SO_2 [8], produced and validated under mandate from the EC, involves extracted stack gas being passed through a series of glass impingers filled with $H_2O_{2(aq)}$, which is subsequently analysed off-line for the sulphate content, and which can be related back to the in-stack SO_2 concentration. When originally validated the SRM’s associated uncertainty was ±1.7 $mg.m^{-3}$ (95 % confidence), whereas for LNG combustion processes, the IED now requires ±1.0 $mg.m^{-3}$ (95 % confidence). Also, AMS manufacturers are required to put their systems through type approval and certification under EN 15267-3 [8]. This requires the overall uncertainty to be 75 % of the directive required uncertainty; consequently, for LNG the required uncertainty would decrease to ±0.75 $mg.m^{-3}$, hence, for some processes this SRM may be even less suitable for AMS calibration than it is for compliance measurement. For both existing and likely future requirements, alternative techniques must be developed.

As an alternative to the SRM, existing portable instrumental techniques, which provide real-time data, could be used to achieve the required uncertainty. Using such real-time data would thus enable process plant operators to take prompt action to correct AMS emission data reporting errors. Such state-of-the-art instrumental techniques include non-dispersive infrared (NDIR), gas filter gas correlation (GFGC) and others,

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which only measure dry gas samples. However, stack gas is generally hot (e.g. 400 °C), wet (up to 40 % H_2O) and contains dust of a wide variety of compositions. Therefore, sampling using heated probes, and filters with either chiller or permeation based drying units, are commonly used. However, further work is needed on the sampling side of the measurement, which given the challenging conditions is a significant proportion of the measurement problem. Pre-normative work is required to meet the IED uncertainty requirements through the development of a new SRM with appropriate process-specific sampling configurations.

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 metrology research which is necessary to support standardisation in the sampling and conditioning of SO_2 emissions from stacks.

The specific objectives are

1. To determine the performance of possible sampling system configurations, which are already employed in some member states, for use with alternative instrumental techniques that require a conditioned gas stream. This should include an investigation of the physical changes and the chemistry that leads to sample losses. The following is required:

    - the determination of a baseline sampling performance for a range of industrial processes that use the existing Standard Reference Method for SO_2 (EN 14791). This should include a critique of the impact of the findings on the capability for enforcing decreased emission limits under the Industrial Emissions Directive.

    - the investigation of appropriate materials (e.g. stainless steel, borosilicate glass, ceramic) for use with different stack gas matrices i.e. in order to avoid sample alteration e.g. due to catalysing surface reactions. The stability of sampled gaseous components should be investigated in order to determine the consequences of short term affects.

    - the performance of chiller versus permeation based drying technologies should be investigated to see which processes are at risk of sample bias. The mechanism of sample bias should also be determined.

2. To contribute to a revision of EN 14791 by providing the data, methods and recommendations, which are necessary for the standardisation of SO_2 sampling and conditioning, to CEN TC264. Outputs should be communicated through a variety of media to the standards community and to end users.

The proposed research shall be justified by clear reference to the measurement needs within strategic documents published by the relevant Standards Developing Organisation or by a letter signed by the convenor of the respective TC/WG. EURAMET encourages proposals that include representatives from industry, regulators and standardisation bodies actively participating in the projects.

Proposers should establish the current state of the art, and explain how their proposed project goes beyond this.

EURAMET expects the average EU Contribution for the selected JRPs in this TP to be 0.4 M€, and has defined an upper limit of 0.5 M€ for this project.

EURAMET also expects the EU Contribution to the external funded partners to not exceed 30 % of the total EU Contribution to the project. Any deviation from this must be justified.

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 environmental 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.

Additional information

This topic is in response to needs identified by CEN/CENELEC published at http://msu.euramet.org/pre_norm_2015/index.html#stage1-orientation (priority 5: Measuring emissions of SO_2 from stacks and flues).

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

[1] http://www.eea.europa.eu/media/newsreleases/industrial-air-pollution-cost-europe/

[2] http://ec.europa.eu/environment/integration/research/newsalert/pdf/375na4_en.pdf

[3] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control). OJ EU L334: 17-119.

[4] Work Programme 2015: European Standardisation and Related Activities. CEN and CENELEC, July, 2014.

[5] Future Work Items / Activities of CEN/TC 264. CEN/TC 264 N2204, 30th March 2014.

[6] Decisions 24th Meeting of CEN/TC 264, Verneuil-en-Halatte, France. CEN/TC 264 N2213, 22nd May 2014.

[7] Regulation (EC) No 166/2006 of the European Parliament and of the Council of 18th January 2006 Concerning the Establishment of a European Pollutant Release and Transfer Register and Amending Council Directives 91/689/EEC and 96/61/EC. O.J.E.U., 2006, L33:1-17.

[8] Air Quality – Certification of Automated Measuring Systems. Comité Européen de Normalisation, EN 15267-3: 2007.