EMPIR Call 2019 – Energy, Environment, Normative and Research Potential

Selected Research Topic number: **SRT-g16**
Version: 1.0

Title: Metrology for biomethane II

Abstract

EN16723 standards have provided a sound basis for the conformity assessment of biomethane before it is injected into the natural gas grid, and primary standards have been developed for the key reactive components. However, it is currently challenging to perform accurate conformity assessments in the laboratory due to difficulties in sampling and transporting biomethane. Therefore, gas analysers, which can currently only be calibrated in the laboratory, need to be further developed for the online real-time monitoring of reactive impurities in biomethane. This will require suitable calibration gas mixtures (transfer standards) and accurate traceable methods to be developed before the performance of the gas analysers is evaluated and metrologically characterised. Contributions to the standards development work of technical committees, including ISO/TC158 “Analysis of gases” and ISO/TC193 “Natural gas”, are also expected.

Keywords

Biogas, biomethane, conformity assessment, EN16723, impurities, methane, reactive gases, transfer standard

Background to the Metrological Challenges

Declining European natural gas resources have led to an increased dependency on natural gas imports. To meet the goals of the Paris Climate Accord 2016, the natural gas grid needs to be decarbonised to reduce greenhouse gas emissions. The second renewable energy directive 2018/2001 specifies that by 2030, 32 % of energy consumption should come from renewable sources. In order to meet this target, there is an urgent need to significantly increase the amount of biomethane used within the existing natural gas infrastructure. By the end of 2017, Europe had a total of 17 783 biogas plants in operation, representing an increase of 2 % compared to the previous year. The number of biomethane plants increased by 8 % in 2017 to 540. The ability to blend biomethane with natural gas, has provided a direct route into the established and robust European infrastructure, which has helped to facilitate market growth.

To provide necessary support for this growing market and to increase biomethane uptake, EN16723 standards have provided a sound basis for the conformity assessment of biomethane. Research into metrology for biomethane has been focussed on providing a first suite of measurement standards and methods, related to the content of trace-level reactive impurities, to support this assessment. Novel spectroscopic methods and dynamic reference gas mixtures have been developed for the analysis of trace levels of, e.g., ammonia, hydrogen chloride and hydrogen fluoride. These developments enable the calibration of biogas analysers, but only in a laboratory setting. There is a need to improve the efficiency of biogas and upgrading plants by enabling the online monitoring of hazardous and toxic by-products such as hydrogen fluoride, hydrogen chloride and ammonia. Therefore, measurement methods for onsite monitoring need to be further developed, including methods for the preparation of transfer standards, and gas analysers (e.g. infrared spectroscopy) need to be metrologically characterised. The use of these techniques to monitor critical process variables will ultimately lower the costs of producing biogas and biomethane.

It is challenging to sample and transport biomethane to the lab to carry out biomethane conformity assessments. Therefore, transfer standards are needed. Static reference gas mixtures have been developed for ammonia with improved long-term stability and measurement uncertainty. However, static reference methods for the content of e.g. hydrogen chloride, hydrogen fluoride and hydrogen cyanide in a biogas or biomethane matrix are not yet available. Methods, including new gas cylinder passivation techniques, are currently being developed for the static preparation of hydrogen chloride in hydrogen or nitrogen. Therefore, this knowledge needs to be extended to the static preparation of hydrogen chloride in a biogas and biomethane matrix, as well as to the preparation hydrogen fluoride and hydrogen cyanide.

Laser-based spectrometers combine highly sensitive detection of small molecules with good accuracy and long-term stability. Therefore, they are good candidates for use in the online real-time quality control of biogas

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and biomethane. Although, many laser-based spectrometers cannot be used with matrices such as biogas and biomethane, which absorb in the infrared part of the spectrum; development work is ongoing. The most promising technologies for use in the online trace-level analysis of reactive impurities in biogas and biomethane include optical feedback cavity enhanced absorption spectroscopy and off-axis integrated cavity output spectroscopy, but they are currently limited to trace measurements of a small subset of potential impurities. Therefore, prototype spectroscopic online gas analysers need to be developed for measuring the concentration of the key reactive impurities that occur in methane, biomethane and biogas. In addition, traceable and validated methods need to be improved and developed for metrologically characterising and optimising the performance of the prototype spectroscopic online gas analysers. The methods developed will need to be traceably tested to ensure that they consider gas matrix- and cross-interferences with the impurities specified in EN16723. This will prevent interruptions to the supply of biomethane into the European gas infrastructure caused by over-reporting, and damage to the infrastructure caused by under-reporting.

There is also a need to contribute to the standards development work of technical committees, including ISO/TC158 "Analysis of gases" and ISO/TC193 "Natural gas". Activities either need to be aligned with the needs of EN16723 or new standards need to be proposed.

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 biomethane.

The specific objectives are

1. To develop accurate methods for the preparation of calibration gas mixtures (transfer standards) using static gravimetry for the key reactive impurities (e.g. siloxanes, hydrogen fluoride, hydrogen chloride, ammonia) that occur in methane, biomethane and biogas.
2. To develop prototype spectroscopic online gas analysers for measuring the concentration of the key reactive impurities (e.g. siloxanes, hydrogen fluoride, hydrogen chloride, ammonia) that occur in methane, biomethane and biogas.
3. To improve and develop traceable and validated methods for metrologically characterising and optimising the performance of the prototype spectroscopic online gas analyser. The methods developed should also be traceably tested to ensure that they take into account gas matrix- and cross-interferences with the impurities specified in EN16723. This should enable real-time measurement.
4. To contribute to the standards development work of technical committees, including ISO/TC158 "Analysis of gases" and ISO/TC193 "Natural gas", to ensure that the outputs of the project are aligned with the needs of EN16723, or propose new standards depending of the outcomes of the project.
5. To facilitate the take up of the technology and measurement infrastructure developed in the project by the measurement supply chain (e.g. accredited laboratories, verification laboratories, instrumentation manufacturers), standards developing organisations (CEN, ISO) and end users (e.g. energy sector, automotive industry, EMN on Energy gases and other running EMPIR projects).

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.

Proposers should establish the current state of the art, and explain how their proposed project goes beyond this. In particular, proposers should outline the achievements of the EMRP projects ENG01 GAS and ENG54 Biogas and the EMPIR project 16ENG05 Biomethane 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 across all selected projects in this TP.

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 biomethane 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.