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

Selected Research Topic number: **SRT-g03**
Version: 1.0

Title: Metrology for biomethane

Abstract

In response to the EC's Mandate M/475 [1], traceable and robust measurement methods need to be developed before biomethane can be injected into the natural gas grid or before it can be used as a transport fuel. CEN TC408 is drawing up standard specifications for these methods in prEN 16723. Novel and traceable measurement standards and methods are required for the analysis of the key biomethane impurities which have not yet been addressed (hydrogen fluoride, compressor oil, amines content) and improved standards are need for other impurities (total silicon and siloxanes, halogenated VOCs, ammonia, HCl, particulate matter) in order to validate the corresponding field methods. There is also a requirement for validating methods for measuring the biogenic methane content and the contents of components that affect the odorants in natural gas.

Keywords

Gas, biomethane, impurities, siloxanes, VOCs, particulate matter, compressor oil, hydrogen fluoride, amines, sampling, conformity assessment, field use, natural gas, network, pipelines, odorants (terpenes)

Background to the Metrological Challenges

Declining European natural gas resources have led to an increased dependency on natural gas imports. The renewable energy directive 2009/28/EC and EC targets specify that by 2020, 20 % of energy consumption should come from renewable sources, and biofuels should constitute a minimum of 10 % of all transport petrol and diesel consumption. In order to meet these targets, there is an urgent need to significantly increase the amount of biomethane used within the existing natural gas infrastructure. By the end of 2014, Europe had a total of 17 240 biogas plants in operation, representing an increase of 18 % compared to the previous year. The number of biogas upgrading plants also increased by 23 % in this period. 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 this large market growth.

To provide necessary support for this growing market and to increase biomethane uptake, the EC issued mandate M/475 [1] to CEN to develop standard specifications for biomethane injection into natural gas networks and for use as a vehicle fuel. The development of these draft standards (prEN 16723-1 [2] for grid injection and prEN 16723-2 [3] for transport fuel) has been ongoing by CEN TC408 for several years. However, the specified test methods have been criticised for their lack of suitability and validation for biomethane. Therefore, to facilitate the implementation of these standards, there is an urgent need to specify and validate dedicated standardised test methods for biomethane in order to support reliable conformity assessment. These methods will require robust and accurate measurement standards for, e.g., disseminating metrological traceability to testing laboratories, the calibration of equipment and methods, the organisation of validation studies and proficiency testing. Methods are also needed for the representative sampling of the impurities within biomethane. In addition, measurement standards and methods are required for assessing biogenic methane content, as well as for assessing the content of terpenes and other components in biomethane.

In recent research, substantial parts of the specified infrastructure required for biomethane (EN 16723) have been implemented in EN 1776 [4], such as measurement standards and methods for biomethane composition, water content, calorific value, density, hydrogen, carbon monoxide, and oxygen content. However, the measurement standards for siloxanes and total silicon content still require improvement as their inadequate long-term stability currently leads to an unacceptably high measurement uncertainty and it increases the costs for their use in, e.g., calibrations. The measurement standards for halogenated VOCs and for particulate matter require similar improvements to their measurement uncertainties and agreed measurement standards and reference methods are needed for compressor oil, hydrogen fluoride, terpenes and amine content. Existing methods for measuring total silicon and siloxanes, fluorine and chlorine, ammonia, compressor oil, amines,

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and particulate matter have not been designed or validated for use with biomethane and draft specifications are required for their field measurement. For most of the parameters listed in the biomethane specification, the key performance indicators (KPIs) of the methods, such as repeatability, reproducibility, and the limit of detection have not been established despite being essential for the conformity assessment of biomethane. Based on established reference methods a standardised method for the measurement of particulate number, concentration and size distribution in gaseous media should be specified and validated. Mass flow controllers, permeation and diffusion techniques are generally used in the dynamic preparation of gas mixtures including biomethane. However, the influence of the flow measurement on the gas mixture prepared is as yet unknown. These devices ae also used in biomethane sampling.

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 improve the long-term stability of the measurement standards that are used in the measurement of impurities in biomethane (i.e. total silicon and siloxanes, halogenated VOCs, ammonia, HCl, HF, compressor oil, amines, particulate matter). The target expanded uncertainty is 2 % - 3 %.
2. To improve the performance of ISO 6145 methods for the dynamic preparation of gas mixtures of biomethane with various compositions of the aforementioned impurities. To eliminate biases in the instruments' readings that are caused by biomethane. The target expanded uncertainty is <1 %.
3. To develop and validate new methods, based on existing reference methods, for the regular conformity assessment of biomethane during which the content of the aforementioned impurities are measured. Biomethane sampling methods should be developed as appropriate.
4. To develop measurement standards and methods to measure the components in biomethane that affect the odorants used in natural gas (e.g. terpenes). The target expanded uncertainty is <4 %. To provide and validate a method, based on determining the $^{14}CH_4$ content, for the offsite assessment of the biogenic methane content in blends of biomethane and natural gas.
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 (CEN, ISO) and end users (energy sector, automotive 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.

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 ENG01, and ENG54 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 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.

Additional information

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

[1] European Commission, Directorate-general for energy, M/475 EN, Mandate to CEN for standards for biomethane for use in transport and injection in natural gas pipelines, Brussels, 8 November 2010

[2] prEN 16723-1 -- Natural gas and biomethane for use in transport and biomethane for injection in the natural gas network -- Part 1: Specifications for biomethane for injection in the natural gas network, Draft after CD ballot, 2015

[3] prEN 16723-2 -- Natural gas and biomethane for use in transport and biomethane for injection in the natural gas network -- Part 2: Automotive fuel specifications, Draft after CD ballot, 2015

[4] EN 1776 Gas supply systems - Natural gas measuring stations - Functional requirements, Brussels, Belgium, 1998