Publishable Summary for 16ENG05 Biomethane
Metrology for Biomethane

Overview

The overall objective of this project is to develop standardised test methods for the parameters (mainly impurities) to be monitored when injecting biomethane into the natural gas grid and when using it as a vehicle fuel. A further objective is to develop or improve the measurement standards for these parameters, in order to enable SI traceable calibration and measurement results. This project will closely liaise with the biogas producing and upgrading industry, regulators and biomethane testing laboratories to ensure that the developed test methods are robust and efficient and can readily be implemented.

Need

As European natural gas resources decline the EU is depending increasingly on imported natural gas. Consequently, diversification of the European natural gas supply has become necessary and this is being implemented as required by the Renewable Energy Directive 2009/28/EC. EC targets also specify that 20 % of EC energy consumption should come from renewable sources by 2020 and that biofuels should provide at least 10 % of transport petrol and diesel consumption by 2020. Under mandate M/475, CEN/PC 408 developed specifications for biomethane (i.e. EN 16723-1 for injection into natural gas grids and prEN 16723-2 for transport fuel). In order to assess conformity with these specifications this project aims to develop new and novel standardised test methods, for e.g. the content of total silicon and siloxanes, halogenated volatile organic compounds (VOCs), hydrogen chloride (HCl), hydrogen fluoride (HF), ammonia, terpenes, compressor oil and amines in biomethane, as well as the supporting measurement standards. In addition, the project will address the short term stability of measurement standards for these groups of components, as this needs to be improved in particular for siloxanes and halogenated VOCs.

Currently, the test methods cited in EN 16723 are neither harmonised nor validated, lack aspects of metrological traceability, and are usually not dedicated to biomethane. Thus they are hampering the energy transition from natural gas to biomethane and are causing the realisation of the EC's H2020 goals to be too slow. Regulators, grid and refuelling station owners, and testing laboratories urgently require harmonised and validated test methods to enable the transportation of biomethane using existing infrastructure as well as clear financial transactions without disputes. By making these harmonised test methods for biomethane available, this project will enable end users to meet contractual and consumer protection obligations and safety requirements. This project will also enable laboratories to implement these dedicated testing methods and to obtain the necessary laboratory accreditation to underpin their competence in novel measurement services.

For legal purposes, a standardised test method is also needed for determining the fraction of biogenic methane in blends of biomethane and natural gas.

Objectives

The specific objectives of the project are:

1. To improve the long term stability (2-3 years for static standards) of the measurement standards and the performance of related calibration methods that are used in the measurement of the contents of VOC impurities in biomethane (i.e. the target relative expanded uncertainties are 3 % for total silicon and siloxanes, 3 % for halogenated VOCs, < 4 % for terpenes, and 5 % for amines).
2. To improve the long term stability (2-3 years for static standards) and the performance (i.e., by eliminating biases in the instruments' readings caused by biomethane, for dynamic standards based on ISO 6145 methods) of the measurement standards and the related calibration methods that are used in the measurement of the contents of corrosive impurities and compressor oil in biomethane (i.e. the target relative expanded uncertainties are 3 % for ammonia, 3 % for HCl, 10 % for HF, 10 % for compressor oil).

3. To develop and validate novel test methods, based on existing calibration methods, for the regular conformity assessment of biomethane during which the content of total silicon and siloxanes, total fluorine and chlorine, ammonia, terpenes, compressor oil, amines, and biogenic methane (based on determining the $^{14}CH_4$ content in biomethane and blends of biogas and natural gas) are measured.
4. 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).

Measurement standards and methods for assessing the particulate content in biomethane and upgraded biogas have already been developed in EMRP JRP ENG54.

Progress beyond the state of the art

Measurement standards and related novel high-accuracy reference methods for the contents of HF, amines, compressor oil and terpenes currently do not exist for biomethane. In addition, some of the measurement standards for the contents of impurities in biomethane developed in in EMRP JRP ENG54 need further work to be fit for purpose: siloxanes and silicon, halogenated VOCs, ammonia, and HCl. The measurement uncertainty of these standards has been reduced and their long-term stability has been improved and for HCl, the impact of spectroscopic interference on its detection has been reduced, however all still need to be further improved.

The preparation of dynamic gas mixtures currently results in a large uncertainty in the development of the measurement standards for ammonia and HCl. The improvements in dynamic gas mixture preparation will improve the state-of-the-art in two ways: a lower expanded uncertainty for the dilution of gas mixtures (down to 1 % - 3 %) and an extension to matrices relevant for the trade in renewable gas (e.g. biomethane).

This project will deliver dedicated standardised test methods for the parameters in EN 16723, as well as for terpenes and biogenic methane content, and will disseminate these in the form of a NWIP (New Work Item Proposal) to the working group of ISO/TC 193. These methods replace the currently cited methods in EN 16723, which are not dedicated to biomethane, lack metrological traceability, and have not been demonstrated to be fit-for-purpose. The NWIPs will be accompanied by a summary of the results of the validation and performance evaluation completed by this project, to enable the standardisation committee to assess the suitability of the methods. The method development will use the high-accuracy analytical methods developed in EMRP JRP ENG54 and in this project as their basis and the specificity of the methods will be improved, so that the standardised test methods will generate SI-traceable results with known uncertainty.

Results

1. *To improve the long term stability (2-3 years for static standards) of the measurement standards and the performance of related calibration methods that are used in the measurement of the contents of VOC impurities in biomethane (i.e. the target relative expanded uncertainties are 3 % for total silicon and siloxanes, 3 % for halogenated VOCs, < 4 % for terpenes, and 5 % for amines).*

This project will deliver novel measurement standards and related novel high accuracy reference methods for the content of amines and terpenes in biomethane (currently, such standards do not exist). The lifetime of the measurement standards for measuring siloxanes and halogenated VOCs will also be improved from 6 months to 2 – 3 years.

2. *To improve the long term stability (2-3 years for static standards) and the performance (i.e., by eliminating biases in the instruments' readings caused by biomethane, for dynamic standards based on ISO 6145 methods) of the measurement standards and the related calibration methods that are used in the measurement of the contents of corrosive impurities and compressor oil in biomethane (i.e. the target relative expanded uncertainties are 3 % for ammonia, 3 % for HCl, 10 % for HF, 10 % for compressor oil).*

This project will deliver measurement standards and calibration methods for the content of HF and compressor oil in biomethane. Novel facilities for dynamic gas mixture preparation, for ammonia and HCl, will be set up so that they provide SI-traceable gas compositions with a relative expanded uncertainty of 1 % - 3 %. The spectroscopic detection of HCl and long term stability will also be improved.

3. *To develop and validate novel test methods, based on existing calibration methods, for the regular conformity assessment of biomethane during which the content of total silicon and siloxanes, total fluorine and chlorine, ammonia, terpenes, compressor oil, amines, and biogenic methane (based on determining*

the $^{14}CH_4$ content in biomethane and blends of biogas and natural gas) are measured.

This project will deliver fit-for-purpose services to laboratories, and industries will be able to undertake e.g. SI traceable calibrations of equipment and the calibration of gas mixtures, and they will be able to use certified reference materials that are related to the trace components in biomethane.

It will also be possible to assess the biogenic methane content offsite.

4. *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).*

This project will deliver dedicated standardised test methods for the parameters described in EN 16723. These will be disseminated, in the form of a NWIP, to the working group of a suitable standardisation committee. Therefore, SI traceable results with known uncertainty will be generated.

Impact

This project will generate impact for all of the parties involved in the renewable gas supply chain, e.g., biogas producers, upgraders, natural gas grid operators and refuelling station owners, as well as laboratories, equipment manufacturers and regulators. It will do this by improving sampling and testing methods for the key parameters mentioned in the specification for biomethane and upgraded biogas EN 16723.

Impact on industrial and other user communities

This project will foster the implementation of the specifications for biomethane for injection into the natural gas grid (EN 16723-1) and for use as transport fuel (prEN 16723-2). The proposed standardised test methods for the conformity assessment of biomethane will enable laboratories to implement these specifications in their organisations and to obtain a laboratory accreditation by meeting the requirements of ISO/IEC 17025. By implication, laboratories will be able to provide metrologically traceable measurement results, with a known uncertainty, for the trade in biomethane - thus facilitating the conformity assessment of biomethane.

This project will enable NMIs, DIs, and industrial parties to deliver calibrations, certified reference materials and proficiency testing thereby ensuring that equipment can be calibrated with SI traceability and with appropriate quality control. In this way, a complete measurement infrastructure will be put in place facilitating the comparability of results.

By facilitating the implementation of EN 16723, the project's outputs will enable the owners of gas grids and refuelling stations to guarantee the quality of the gas they sell to industrial customers and consumer markets.

Impact on the metrology and scientific communities

This project will create impact on the metrology and scientific communities by completing the suite of measurement standards for impurities (siloxanes, hydrogenated VOCs, ammonia, HCl, HF, amines, compressor oil) in biomethane and components affecting odorants (terpenes). It will also create impact through the development of related high accuracy methods that are necessary to deliver calibrations, through the development of certified reference materials and through related measurement services that make biomethane measurement results comparable and SI traceable. These novel services will be provided with state of the art calibration and measurement capabilities to stimulate innovation in the production and upgrading of biogas to biomethane that meets the specifications.

Impact on relevant standards

This project will create the seven NWIPs necessary for extending the portfolio of international standards, which describe test methods for natural gas properties, to the supplementary parameters relevant for biomethane: during which the contents of, (i) total silicon and siloxanes, (ii) total fluorine, chlorine and halogenated VOCs, (iii) ammonia, (iv) terpenes, (v) compressor oil, (vi) amines, in biomethane are measured; and (vii) a test method is used for the determination of the biogenic fraction in biomethane and blends of biogas-natural gas mixtures. These NWIPs will, once processed by ISO, lead to new international standards. Once in place, these documentary standards will enable CEN, under its mandate M/475, to update EN 16723 by replacing the currently referenced methods by methods that are dedicated to biomethane. The project's outputs will also enable ISO/TC 158 to further develop its documentary standards, for example the ISO 6145 series for use with energy gases.

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Coordinator: Jianrong Li, Dr., VSL	Tel: +31 15 2691573	E-mail: jli@vsl.nl
Project website address: tbc		
Internal Funded Partners: 1 VSL, Netherlands 2 IMBiH, Bosnia and Herzegovina 3 NPL, United Kingdom 4 PTB, Germany 5 RISE, Sweden 6 VTT, Finland	External Funded Partners: 7 ENGIE, France 8 INERIS, France 9 ISSI, Italy 10 NEN, Netherlands 11 RUG, Netherlands 12 WAL, United Kingdom	Unfunded Partners: