Publishable JRP Summary Report for ENG54 Biogas Metrology for biogas

Background

To support the use of green gas, the European Commission has issued mandate M/475 to CEN, the European Organisation for Standardisation, concerning the specifications for biogas and biomethane for injection into natural gas grids and for use as transport fuel. This mandate was issued to facilitate the market penetration of biomethane through the development of a European Standard for a quality specification for biomethane. CEN has been given the mandate to develop, as a first step:

a) A European Standard for a quality specification for biomethane to be used as a fuel for vehicle engines,

b) Technical Specifications or EN standards for quality specification for biomethane to be injected into natural gas pipelines transporting either High calorific-gas or Low calorific-gas. The specifications and standards shall include a method (such as gas chromatography-mass spectrometry, ^{14}C-isotope analysis or equivalent) to determine the volume fraction biogenic methane in the pipeline.

For the implementation of such specifications, metrologically traceable methods and reference materials are required to ensure that measurements of the relevant properties of biogas are robust and reliable. For a substantial number of parameters, such methods and reference materials are lacking. Reliable measurement results with stated measurement uncertainties are a prerequisite for assessing conformity with the aforementioned specifications for biogas. This conformity assessment is a prerequisite for the trade and use of biogas and biomethane.

Need for the project

As natural gas resources are declining and the EU depends increasingly on imported natural gas, diversification of the European natural gas supply is underway as required by the Renewable Energy Directive 2009/28/EC and EC targets, which 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 the same year. There is now an urgent need to significantly increase the amount of biogas which is injected into natural gas networks.

To promote the use of biomethane as required by the EC Directive concerning common rules for the internal market in natural gas (2003/55/EC), specifications have been developed for the injection of biomethane into the natural gas transport and distribution grids and for use as transport fuels. Access to the natural gas grids and fuelling stations is essential for the promotion of biomethane. This project aims to develop new and novel methods for measuring these specifications. Without the results of the work in this JRP, the growth in the use of biogas is effectively stopped as it will be uneconomic to transport, and the objectives concerning the diversification of gas resources and the increased use of renewable fuels cannot be met.

Scientific and technical objectives

This JRP aims to develop and validate methods for determining key impurities, moisture, particulates, calorific value, and density:

- novel traceable methods for the measurement of the contents of key trace-level impurities in biogas and biomethane namely: total silicon and siloxanes, sulphur-containing compounds, aromatic hydrocarbons, halogenated hydrocarbons, ammonia, hydrogen cyanide, hydrogen chloride and carbon monoxide.

EMRP European Metrology Research Programme Programme of EURAMET
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- robust analytical capabilities for the measurement of the particulate content and water content / dew point of biogas and biomethane.
- methods for the measurement of the calorific value, heat capacity, and density of biogas and biomethane.
- a traceable method for determining the concentration of biomethane in samples of blended biomethane and natural gas.
- robust methods for sampling biogas and biomethane in the field, and to enable the biogas industry to perform robust and traceable quality assessment measurements.

The results of this JRP will enable the National Metrology Institutes (NMIs) to provide services that enable the gas industry to reliably measure key properties of biogas and biomethane. The work undertaken will be discussed with CEN TC408 on biogas and it will support the efforts of this TC and other committees in setting up specifications for biogas and biomethane as well as in developing test methods for key parameters.

Expected results and potential impact

Traceable methods for key impurities

The preparation of reference gas mixtures of siloxanes, ammonia, monocyclic aromatic hydrocarbons (BTEX), and sulphur-containing components has started. These gas mixtures play a key role in the further development of methods for the determination of these impurities in upgraded biogas and biomethane. The work on a method for the total silicon content using Microwave plasma-atomic emission spectroscopy is well underway and progress has been made in finding suitable media for trapping the silicon. For the assessment of sulphur-containing species in the presence of water, the necessary mixtures have been prepared and the stability study is underway. For the chlorinated and fluorinated hydrocarbons, a selection has been made of the most relevant components for biogas and biomethane. A proposal for the compositions to be used in the JRP is being discussed.

Capabilities for particulate and water content

The work on water content has started well. Some of the improvements and modifications necessary for measuring the dew point of water in biogas are well underway, whereas some others are still at the design stage. Commercially available dewpoint sensors have been selected for testing.

Capabilities for calorific value, heat capacity and density

The preparatory work for the experiments on the calorific value determination has started. A suite of gas mixtures for comparing direct calorimetry with the indirect method has been prepared. Sampling of real biogas has begun with the first Swedish biomethane sample being sent to LNE and PTB. One of the field calorimeters has been replaced and the new one has been optimised. The comparison between calorimetry and calculated calorific values will be done on the basis of the forthcoming ISO 6976 standard. For the density and heat capacity measurements, a set of reference gas mixtures is being prepared. The experimental work revealed some issues in measuring the density of moist biogas, which is being investigated further.

Traceable method for biogenic methane content

The first steps towards the development of a traceable method for biogenic methane content have been taken.

Sampling methods

An overview of sampling methods has been prepared and offered to a scientific journal for publication. Most experience exists with sampling biogas for the determination of the volatile organic compounds (VOCs) content, and there is little to no existing experience for components like ammonia, hydrogen chloride and hydrogen cyanide. A biogas sampler has been built and successfully used for sampling biogas for the work on calorimetry.

Specifically, this JRP generates impact by contributing to the knowledge and expertise of:

- Laboratories to
  - Measure the contents of key impurities (siloxanes, sulphur-containing components, aromatic hydrocarbons, halogenated hydrocarbons, ammonia, hydrogen cyanide, carbon monoxide and hydrogen chloride) in biogas at relevant content levels with established metrological traceability and known uncertainty. This means that laboratories can purchase reference materials and transfer standards for the measurement of the contents of these impurities;
  - Measure the particulate content in biogas. Laboratories will be able to purchase reference materials and transfer standards to determine the particle content and particle size distribution in biogas;
- Standardization bodies to
  - Further develop existing standards (e.g., ISO 6145 series) on the preparation of calibration gas mixtures for low-level impurities in energy gases;
  - To address issues in the calculation of natural gas, biomethane and biogas properties as a result of the outcome of the research in the project;
- Biogas producers and grid owners to
  - Use field calorimeters with known performance as an alternative to gas chromatography. This creates impact, especially for small biogas producers, as the costs of ownership of gas chromatographs is deemed to be too high;
  - Have access to dedicated models and methods for water dew point measurements in biomethane and biogas, so that these measurements have similar accuracy to those in conventional natural gas. The water content will be measured more reliably and accurately. This in turn will have an impact in that the gas treatment can be optimised so that the water dew point specification can be reliably met, without drying the raw biogas any more than is needed;
  - Have reliable methods for sampling for use in the offsite measurement of the contents of key impurities and particulates. The content of the impurities will be able to be more reliably measured, and conformity assessments will be more conclusive;
- Authorities and inspection agencies to
  - Assess the content of biogenic methane in natural gas networks and stores for fiscal purposes and the fight against fraud. Taxation schemes supporting the use of biogas will be enforceable and claims of biogas content in networks can be verified;
- Producers, transmission companies, and traders to
  - Have density data and calculation models for volume conversion in biogas and biomethane flow measurement with similar accuracy to those for conventional natural gas. Therefore, revenues for biogas producers will increase.

JRP start date and duration:	1 June 2014 (36 months)
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