Biomethane Analysis Using Gas Chromatographs

Process Overview

Biogas to Biomethane

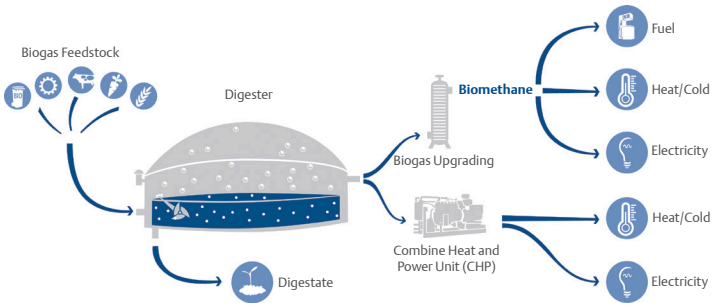
Biomethane or Renewable Natural Gas (RNG) is biogas that has been processed through two major steps:

1. A cleaning process to remove trace components, such as hydrogen sulfide, carbon dioxide, water vapor, siloxanes, ammonia, oxygen, carbon monoxide, and nitrogen.

2. A upgrading process to enrich its methane content and adjust its calorific value. Upgrading is performed so biomethane can be injected into the existing natural gas grid (including pipelines) and used interchangeably with conventional natural gas. Biomethane can also be used as vehicle fuel.

There are different technologies used for biogas cleaning and upgrading into biomethane. The aim of upgrading technologies is to achieve high methane purity and low methane losses with low energy consumption. The production technology and biogas feedstock affect the composition of biomethane. Biogas feedstock can consist of food waste, landfill gas, livestock waste, wastewater treatment and crop residues.

Figure 1 - Typical Production and Use of Biogas and Biomethane



Process Challenges

Biomethane Composition

In order for biomethane to be injected into the gas grid, it must be compatible with the properties of natural gas. To be used as vehicle fuel, it must comply with the requirements for fuel quality. Several countries have defined standards for grid injection of biomethane or for utilization as vehicle fuel. For instance, a hydrogen sulfide content of max. 5 mg/m³ is permitted in biomethane or natural gas in some countries. Consequently, biogas must be subjected to a desulfurization process before further processing, feed-in and used as biomethane.

When biomethane is fed into the grid, the gas quality and energy quantity introduced must be determined and the accuracy of these values must be verified. A gas chromatograph (GC) is a reliable method for identifying the compositional analysis of biomethane and monitoring its quality, calorific value and Wobbe index.

Table 1 - Typical Gas Composition and Standards

Parameters	Biogas	Biomethane	Natural Gas
	Measurements		
CH_4	60.15 %	97.20 %	95.41 %
C_2H_6	-	0 %	1.93 %
C_3H_8	-	0 %	0.15 %
C_4H_{10}	-	0 %	0.02 %
CO_2	35.50 %	1.80 %	0.65 %
H_2S	2,876 ppm	1 ppm	4 ppm
Total Sulfur	2,730 ppm	-	-
O_2	0.95 ppm	0.20 ppm	0 ppm
H_2	0.005 ppm	0 ppm	0 ppm
H_2O	saturated	5.40 ppm	21.50 ppm
	Derived Values		
N_2, O_2, CO_2	39.85 %	2.80 %	2.47 %
Calorific Value	22.68 MJ/Nm³	36.64 MJ/Nm³	37.89 MJ/Nm³
Wobbe Index	23.70 MJ/Nm³	48.30 MJ/Nm³	50.38 MJ/Nm³
	Trace Components		
COV	8,016 ppm	-	-
Cu	9,500 ppm	-	-
Hg	0.1 ppm	-	-
Siloxanes	0.150 ppm	-	-
Cl	0.089 ppm	-	-
F	0.002 ppm	-	-
CH_2CHCl	0.032 ppm	-	-
NH_3	0.34 ppm	-	-

Biomethane injection into gas grids and biomethane feed-in plants must comply with the legal requirements for energy quantity and gas quality. Since natural gas and biomethane are odorless by nature, this can present a considerable safety risk if leakages occur. In many countries, the gas must therefore be odorized by adding odor substances, which are usually tetrahydrothiophene (THT) mercaptans or sulphur-free odorizing agents. This typical warning smell is intended to indicate when gas installations are leaking or gas escapes unburnt.

The Emerson Solution

There is a need for a robust analyzer capable of measuring sulfur compounds as well as heating value/BTU content in one single-analyzer solution. Using traditional hydrogen sulfide (H_2S) analyzers that rely on lead acetate tape with mechanical systems and short lifespan sensors require a great deal of maintenance, operating cost, and proper handling of lead. Emerson offers two gas chromatograph solutions to address biomethane analysis needs. These GCs are certified to industry and national metrology standards.

Option 1: Rosemount 700XA Gas Chromatograph

- Offers the unique capability of measuring both energy content (BTU analysis) and sulfur compounds in one single-analyzer solution, eliminating the need for two separate analyzers. This results in reduction of cost and footprint.
- Ideal for trace contaminant monitoring and determining the concentration of impurities.
- Class 1, Division 1, explosion-proof, ATEX/IECEX safety-rated field-mountable analyzer reduces the need for instrument air required for purging, ensuring safety and significantly reducing total cost of ownership.

Option 2: Rosemount 370XA Gas Chromatograph

- Ideal for determining the gas composition for quality monitoring and energy content of biomethane that has been cleaned and upgraded.
- Can be paired with a hydrogen sulfide (H_2S) analyzer when measurement of hydrogen sulfide is critical.
- Economical, compact, and easy to use. Field-mountable and offers low installation and operational costs
- A unique Maintainable Module enables inexperienced technicians to easily replace the analytical hardware as a single module in the field and with very low downtime.

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