Biomethane Analysis Using Gas Chromatographs

Application Note

Process Overview

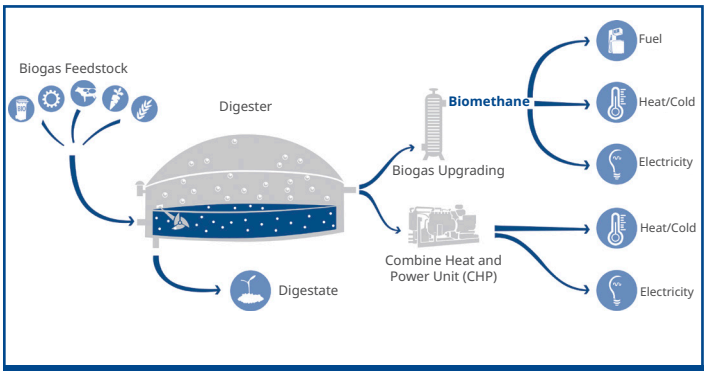
Biogas to Biomethane

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 used interchangeably with conventional natural gas. Typical uses include injection into existing natural gas grid and pipelines or use as a vehicle or turbine fuel.

The feedstock for biogas production can consist of food waste, landfill gas, livestock waste, wastewater treatment and crop residues. The type of feedstock and production technology affect the composition of the resulting biogas, with differences in concentrations of the desired components (methane) and the undesired components (e.g., hydrogen sulfide) between biogas from different sources. There are consequently differing technologies used for biogas cleaning and upgrading into biomethane; the aim of upgrading technologies is to achieve high methane purity, low methane losses and removal of undesired impurities with low energy consumption.

Figure 1 - Typical Production and Use of Biogas and Biomethane



Process Challenges

Biomethane Composition

To use the generated biomethane with natural gas or as a replacement for natural gas, it must meet performance standards and legal requirements. Before biomethane can be injected into the natural gas grid, it must be compatible with the gas already in the grid in measures of quality (composition), calorific value, and Wobbe index. To be used as vehicle or turbine fuel, it must comply with the requirements for fuel quality. A gas chromatograph (GC) is a reliable method for identifying the components of biomethane, measuring them, and determining the energy value of the gas.

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	-	-
CI	0.089 ppm	-	-
F	0.002 ppm	-	-
CH_2CHCI	0.032 ppm	-	-
NH_3	0.34 ppm	-	-

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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. 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™ 470XA 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 with 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.

Aside

Other regulations and guidelines that generally apply to biogas and biomethane include limits on hydrogen sulfide (H_2S) levels and the need for odorization. Most biogas sources introduce a high level H_2S to the biogas they generate. The biogas must therefore be subjected to a desulfurization process before further processing into biomethane, and the H_2S level in the biomethane is often verified by GC measurement. Because both natural gas and biomethane are odorless by nature many jurisdictions require that the gas be odorized by adding odor substances, (usually tetrahydrothiophene (THT), mercaptans or sulfur-free odorizing agents) to alert nearby personnel of risk during intentional or accidental releases.

For more information, visit
Emerson.com/RosemountGasAnalysis

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