EnCal 3000 Biogas

Metrological approved
heating value measurement of biogas

Introduction

The generation of biogas as a renewable source of energy has soared in the past couple of years. Biogas generation plants are being built all over the world driven by the search for alternatives for fossil fuels and by CO_2 emission reduction programs.

Biogas as such is far from new. It is used for decades already but the scale of the generation plants is increasing in order to make the installations economically more attractive. With the growing scale of the installations it becomes more common to inject the generated biogas into the gas grid thus separating the location where the biogas is generated from the location of where it is consumed. Where biogas used to be locally consumed or converted into electrical energy it now contributes to the overall consumption of natural gas thus reducing the consumption of fossil fuels.

The feed of biogas into the pipeline network requires cleaning as well as changes to the gas composition to fit the properties of the pipeline gas. Upgrading of the biogas can be done by blending the gas with LPG. This introduces components which are normally not present in biogas, like ethane, propane and butanes. Since the biogas is fed into the pipeline network it also needs to be measured with metrological approved analysers to determine the gas properties like heating value and density.

Technical application

The EnCal 3000 gas chromatograph has been adapted to be able to measure all important components present in biogas. Components like O_2, and H_2S are normally not measured in natural gas heating value determination. These components are measured in the "EnCal 3000 biogas" version. The application has been approved by the PTB for use in metrological approved metering systems.

The EnCal 3000 biogas application uses different analytical columns then the standard heating value application. The oxygen present in the sample must be separated from the nitrogen which is done best with a mole sieve column. Mole sieve columns are particularly sensitive to water and CO_2 which are filtered out for that reason with special filter cartridges inside the gas chromatograph's housing.

The H_2S and COS concentration in the biogas are important to monitor since these components may have negative effects on the pipeline integrity and could damage instrumentation downstream, especially in the presence of water. These sulphur containing components in biogas can be measured with a detection limit of 2 ppm. As an important precaution to prevent damage in the gas chromatograph itself, it is recommended to install a moisture and liquid filter at the inlet of the EnCal 3000 system.

Analyser specifications

	Biogas		
Analytical hardware	2 parallel isothermal GC modules with narrow-bore capillary column technology in combination with MEMS based analytical components One of the channels uses a molsieve column which is protected against CO_2 and water by two filtercartridges that filter both the carriergas and the samplegas		
Analysis output	Full composition of biogas as specified below, heating value, density, Wobbe index		
Gascompositions	Allowed sample gas ranges: N2 : 0 – 15 % CH4: 60 – 100 % O_2 : 0 – 4 %* CO_2: 0 – 8 % C_2 : 0 – 12 % C_3 : 0 – 6 % i-C_4 : 0 – 3 % n-C_4: 0 – 3 % H_2S : 2ppm – 1 % COS: 2ppm – 1 % * PTB approved O_2 concentration is 0 – 3 %	Minimum detection limit: N_2 : 50 ppm CH_4 : 50 ppm O_2 : 50 ppm CO_2 : 5 ppm C_2 : 5 ppm C_3 : 10 ppm i-C_4 : 10 ppm n-C_4: 10 ppm H_2S : 2 ppm COS: 2 ppm	Advised calibration gas comp.: N_2 : 8.0% CH_4 : Balance O_2 : 2.0% CO_2: 2.0% C_2 : 4.0% C_3 : 3.0% i-C_4 : 0.5% n-C_4: 0.5% H_2S : * COS: * * depending on expected concentrations in the sample
Analysis cycle time	5 minutes		
Performance heating value measurement			
Uncertainty Repeatability	<0.20 % for all calculated properties (based on a single point calibration)) <2% for H_2S at 5 ppm mol/mol <0.5 % for O_2 at 0.5 % mol/mol <0.03 % for all calculated properties		
General specification			
Ambient conditions	Temperature: -20 °C to +55 °C (provided heated version is used)		
Dimensions	Base Ø 37 cm x height 37 cm (Ø 14" x height 14")		
Weight	<30 kg		
Approvals	ATEX II2G E Ex d IIB T4 IP 66, vibration and shock test in accordance with IEC 60068-2-31 and 64 EMC according to EN 61000-6-2 and EN 61000-6-4 PTB Metrological Certificate Reference No. PTB-3.31-4016861		
Power supply	24 V DC, 18 W nominal (50 W start-up peak) for non-heated version 24 V DC, 120 W nominal (170 W start-up peak) for heated version (ambient < 0 °C)		
Interfaces	Ethernet UTP 10 Base-T for ModBus TCP/IP and PC link Two RS 232/485 ports for ModBus RTU or ASCII 3 analogue Inputs for local sensors (4-20 mA or 0-10 VDC)		
Analyser	Complete stand-alone operation, including all calculations and generation of report formats, without need for operator intervention. Calculations in acc. with ISO 6976, GPA 2172 or GOST 22667		
PC requirements	Windows 2000 or Windows XP professional edition (Service Pack 1 or higher) 1000 MHz processor, 512 MB RAM, CD-rom player, free Ethernet port		
Data logging	History Log: local storage of last 35 days of all analytical data (analysis, events, alarms, averages, last chromatogram, calibration data) in accordance with API Report 21.1. All data available on remote workstation in XML format		
Sample conditioning (integrated)	Integral part of analyser. Consists of pressure regulators for each stream, particle filters and double block and bleed stream selection for up to 4 streams and 1 calibration gas. The internal sample conditioning system also contains a programmable sample bypass 0-20 Nl/hr.		
Sample conditioning (external)	Membrane filter required for sample gas. Since H_2S forms an aggressive acid in the presence of free water it is essential that the forming of free liquids is prevented. Therefore the sample gas should be dry at all times and kept above the water dew point.		
Carrier gas	Helium: Quality N5.0, supply pressure 5.5 barg, consumption ± 8 ml/min Pressure regulator should contain a safety relief set at 6.5 barg.		
Calibration gas	Supply pressure 2 barg nominal. Consumption ± 600 ml/day (@ atmospheric pressure)		