Technical Publication

How A Biogas Processing System Manufacturer Identified the Best Flow Meter for Gas Measurement

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FCI FLUID COMPONENTS INTERNATIONAL LLC

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Klargastechnik Deutschland GmbH is a leading bio-engineering, designer, manufacturer and installer of biogas and disgester gas processing equipment and systems that is headquartered in Germany. The company's products include all-welded gas storage tanks, flare systems, dry and biological desulphurization systems, explosion proof (ATEX) certified blowers, gas drying units, filters and accessories.

The firm's equipment and processes help customers address organic biomass fermentation and recovery while supporting electric power co-generation. The result is clean, green electric power that also reduces both solid waste and hazardous toxic gases such as carbon dioxide (CO2) and methane (CH4), which pollute the environment and contribute to global warming.

In order to provide these benefits, the company's equipment and systems rely on highly precise and reliable flow measurement of process waste gases. Organic biomass fermentation and recovery is a dirty process environment with variable operating conditions and product throughput that cause wide swings in gas content, volume, pressure and temperature. These factors represent a tough challenge in selecting instrumentation to support the process—especially flow meters.

The Process

Organic industrial waste from food processing and slaughter-house, food waste from restaurants, homes, manure collected from livestock, as well as energy crops can be digested under anaerobic conditions in reactor tanks, which are also called fermentation towers. One of the outputs from this biomass digestion process is biogas, a mixture of methane (CH_4), carbon dioxide (CO_2), water and trace hydrogen sulfide (H_2S).

The entire process involves gas creation, cleansing, storage (tank or bag-type accumulator) and ultimately the use of biogas as a fuel source for heating or generating electricity. A ground flare is an integral part of the safety system for the process (Figure 1).

The Problem

Measuring biogas flow at several points in the system provides operators with critical information for optimal gas production, control, safety and reporting. Biogas applications present several challenges in selecting the proper flow meter:

- Low flow sensitivity during start-up and for seasonal changes which produce lower flow rates
- Temperature compensation for correct readings in varying temperatures
- Calibration for mixed gas composition of CH_4 + CO_2 + trace gases
- Wet, dirty gas with corrosive H_2S content
- Potentially flammable or explosive gas installation environment
- Easy, low cost installation and low maintenance

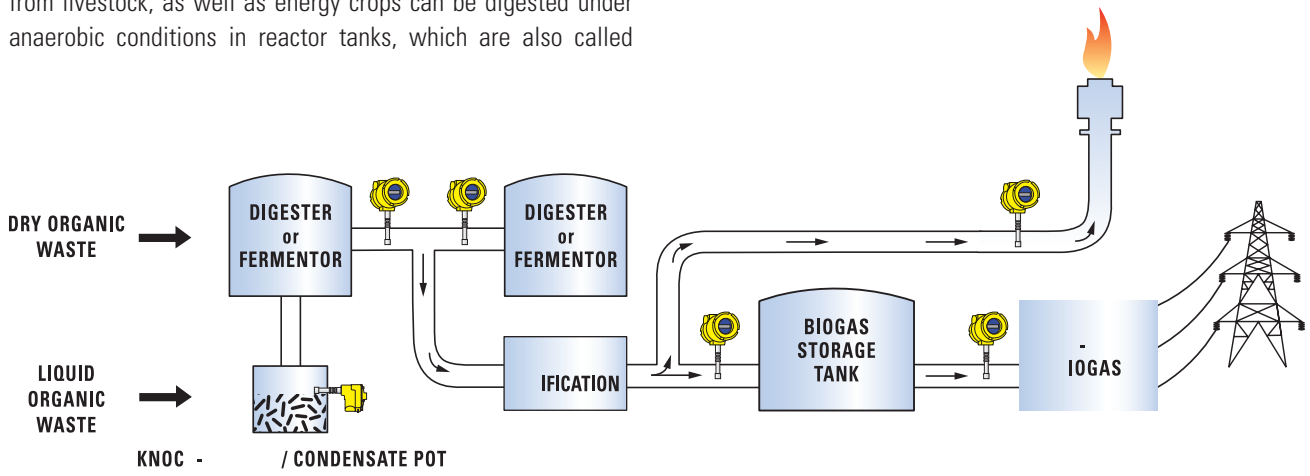

Figure 1. Biogas Recovery Process Flow

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The engineering team at Klargastechnik tried various types of flow meters with its equipment and systems. These meter types included Venturi and Vortex Shedding flow meters. All flow measurement technologies have their advantages and limitations—there is no universal type appropriate for all applications. In the case of Venturi meters, which utilize a differential pressure technology, they create a non-recoverable pressure loss and accuracy is dependent on the pressure gauge. Vortex Shedding meters can be sensitive to pipeline noise and require flow rates high enough to generate vortices and also create a pressure loss.

The Solution

The engineering team at Klargastechnik contacted Fluid Components International (FCI) to discuss the possible application of Thermal Dispersion flow measurement technology in its biogas flow measurement applications. Thermal mass flow meters provide a gas flow measuring solution that is accurate, repeatable, easy to install and requires virtually no maintenance (Figure 2).

Thermal dispersion mass flow measurement technology places two thermowell protected platinum RTD temperature sensors in the process stream. One RTD is heated while the other senses the actual process temperature. The temperature differential between these two sensors is measured and is directly proportional to the mass flow rate of the fluid (Figure 3).

FCI's thermal mass flow sensor design utilizes a constant power measuring technique, which because of a light heating effect actually dries condensate moisture off the sensor. This technology provides better accuracy and repeatability in moist biogas measurement applications.

FCI recommended to Klargastechnik its ST98 Flow Meter (Figure 4), which is ideal for biogas measurement and features high accuracy to ±1% of reading, 0.5% of full scale. Exceptionally consistent, the ST98 offers repeatability to ±0.5% of reading and is temperature-compensated for accurate measurement under variable environments.

The insertion style ST98 Flow Meter operates over a wide flow range from 0.75 SFPS to 600 SFPS (0.21 NMPS to 172 NMPS). It features a turndown ratio that is factory preset from 10:1 up to 100:1 within the calibrated flow range and operates at pressures up to 250 psig [17 bar(g)].

The ST98's transmitter features robust, microprocessor-based electronics. The transmitter can be located integral with the sensor or remote mounted up to 1000 feet [350 meters].

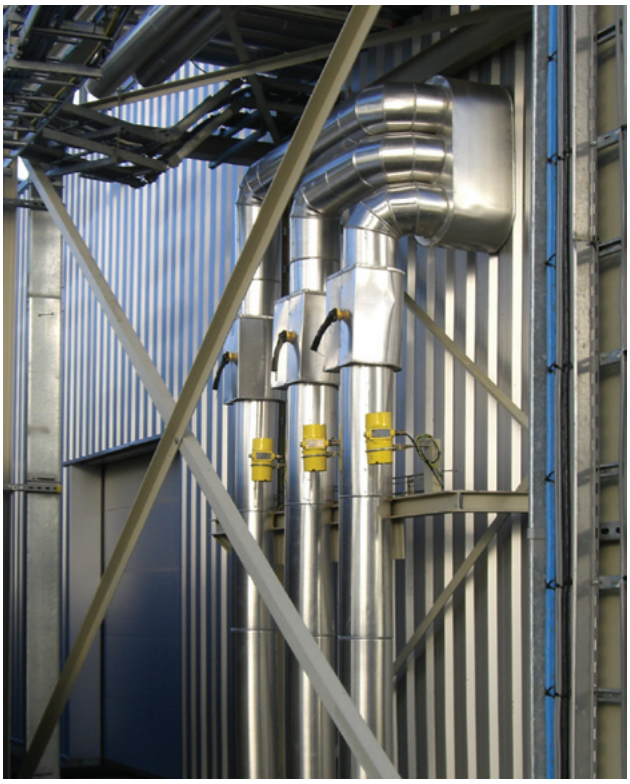

Figure 2. Klargastechnik Equipment With FCI Flow Meters

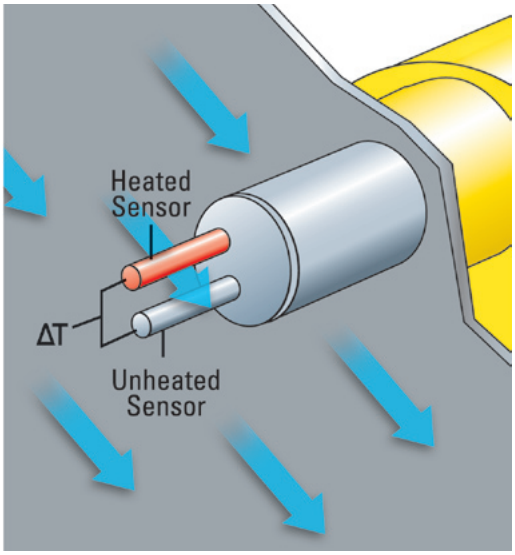

Figure 3. Thermal Dispersion Mass Flow Measurement Theory of Operation

A NEMA/CSA Type 4X (IP66) rated enclosure and explosion-proof, Division 1 [Zone1] rated enclosures are available for the toughest environments.

The Result

After extensive testing and evaluation of various flow metering technologies, Klargastechnik selected and standardized on FCI's thermal dispersion type ST98 and ST51 Mass Flow Meters. Since initially installing its first ST98 Flow Meters, the company is now also utilizing the ST51 Flow Meter because of its lower cost for some applications.

Klargastechnik selected FCI's flow meters because they are versatile instruments that can be programmed and adjusted in the field to fit individual applications. A ball valve configuration was chosen because it allows the meter to be removed from the process under pressure. Ease-of-use was important too because the meters will be installed at plants where the operators have no basic experience with flow meters.

Other important consideration in selecting the FCI flow meter included their low cost of installation, no required or scheduled maintenance, long life and overall low operating costs. FCI's ability to carry out local calibration verifications at our plant on short notice and ability to deliver spare parts were also critical in the decision-making process.

In selecting a flow meter for biogas recovery, engineering teams need to review a number of selection criteria. These criteria include:

- Mass flow measurement of both the rate and totalized flow
- No moving parts or small holes to plug or foul in dirty, wet environments
- Biogas-specific calibration
- Low flow sensitivity to at least 0.6 feet per FPS
- Pressure drop over flow element limited to 0.01 PSI
- All wetted parts resistant to H2S corrosion (minimum 316L stainless steel)
- Easy and safe removal under line pressure with simple ball valve
- System agency safety approvals in Div 2 (Zone 2) or Div 1 (Zone 1)

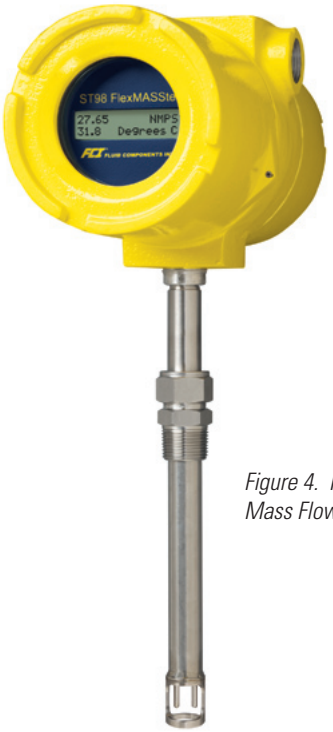

Figure 4. FCI ST98 Mass Flow Meter