Emerson explains how advanced automation technology can help operators to overcome biomethane injection challenges

Maximising biomethane production efficiency using advanced automation technology

Biomethane presents a great new opportunity for Europe as a low-cost, eco-friendly form of energy and the market for this product is growing rapidly. New regulations within many European countries not only enable biomethane to be added to the natural gas networks, but incentives are also available to increase the amount of biomethane added to the grid.

However, there are several challenges facing operators wanting to inject biomethane into the grid. They must comply with very stringent regulations and standards, deliver continued, reliable, efficient and safe operations, and ensure there is lifecycle support for all plant assets. Advanced automation technology is enabling operators to win these challenges and take advantage of a thriving new market.

Pressure reducing and metering station

Biomethane

Biomethane is a mix of gases produced from both biological (upgrading of biogas) and thermochemical processes. Biomethane is gaining considerable attention in Europe, due to the increasing focus and desire for renewable energy. Critically, as a renewable gas it can make a significant contribution towards meeting the European Union's renewable energy targets. As a result, biomethane production is showing the highest level of growth of any gas market in the world.

Biogas has a restricted range of uses, due to its low thermal efficiency and a chemical composition that is not compliant with the fuel gases used by transmission and distribution infrastructures. The upgrading process used to convert biogas into biomethane produces a fuel with compatible characteristics and the same benefits as natural gas. The new regulatory framework permits biomethane to be added to the natural gas network and, additionally, most European countries have created incentives to increase the amount of biomethane injected into the grid. Before the injection, the necessary stages of compression, odourisation and often propane injection must be performed. Here, advanced automation becomes a critical part of the process.

Gas analysis

Firstly, the gas quality must be tested to ensure compliance with pipeline and safety standards. Only if the gas quality meets these standards can it be injected into the grid. Gas chromatographs are used to perform this task and can be considered the heart of the analytical testing section. Together with the ancillary systems, the gas chromatograph analyses the gas and ensures its suitability in accordance with the end users' requirements. It is essential, therefore, that the gas chromatograph has the necessary metrology approvals required to support consumer billing.

Gas Chromatograph model 700XA

The analytical module of a biomethane plant and, specifically, the gas chromatograph can present some challenges for the operator. Most injection stations are pre-fabricated modules to make transport to the site easier, which means there is a restriction on size.

Furthermore, because of the need to ensure very accurate and consistent analysis of the gas quality delivered to the customer, this can create a complex system that may increase operational and lifecycle costs.

Automation solutions address these challenges with compact gas chromatographs to overcome the space limitation. Low utility and sample flow rates keep operational costs to a minimum and enhance the reliability of the system. Technical support can be provided remotely, eliminating the need for costly site visits by engineers. Moreover, intuitive software and a unique 'maintainable module' can simplify operations while maintaining

Gas analysis section

highly accurate compositional data reporting with low measurement uncertainty.

Once the quality of the gas has been analysed, its value is converted into a signal that controls a three-way valve installed downstream. Depending on the value, the gas will either be directed back for additional processing or forwarded to a pressure reduction and metering station. This is very similar to a standard natural gas station, with gas filtered and then measured using a custody transfer flowmeter and flow computer. Pressure regulators are used to reduce and stabilise the injection pressure to the required value of the destination pipeline. It is very important to select the correct regulator type and necessary overpressure protections to ensure safe operations.

Odourisation

Another important part of the process is odourant injection. As with natural gas, biomethane cannot be added to the distribution grid without the necessary odourisation. Odourant injection systems vary in type, from very simple, manually operated units (i.e. absorption type), to more complex, fully automated units. The fully automated systems control the concentration ratio using a microprocessor-based device that will monitor the liquid injected, and automatically adjusts the rate to maintain a constant odourant ratio.

One of the challenges associated with odourant injection is ensuring compliance with both the local regulations and industry standards; another is trying to reduce operating costs. National energy authorities take odourisation into consideration when performing quality-of-service evaluations and conclude that poor odourisation can have a significant impact on operational costs. Traditional technologies, such as absorption or pump systems, produce several issues, including uneven odourant distribution, unplanned downtime and a subsequent increase in the time that maintenance engineers must spend visiting units that are often located remotely.

The systems that use solenoid injection valves provide a great solution in terms of ease of use, reduced maintenance and the possibility of both remote access and control. The accuracy granted by solenoid injectors can be maintained over the entire flow range of the system, approaching infinite turn-down. Automatic calibration during normal operation adjusts for any changes in mechanical components and also detects failures that can be flagged up by alarms. The system can also be configured to use redundant injectors and/or an emergency backup or bypass absorption system. The control system stores both real-time and historical data. This can be viewed locally or remotely on a laptop using configuration software, or remotely using a supervisory control and data acquisition system.

Custody transfer

Measuring the exact flow rate of biomethane is essential, as the gas company must know how much biomethane is going to be injected into the grid. There are several technologies available for gas custody transfer measurement, some of which have been around for a long time, for example, turbine, rotary or diaphragm meters. All these technologies are well-known and accepted by operators.

It is worth mentioning a couple of the latest technologies that are growing in popularity, which can provide some additional benefits compared to the traditional meters: these are ultrasonic (volume measurement) and Coriolis (mass measurement) flowmeters. One of the main advantages of both technologies is that they don't have moving parts, reducing many issues and maintenance activities and ultimately ownership costs.

Another great feature is the possibility to associate meter verification software that not only provides information on the health of the meter itself, but also a deeper insight into other important operating conditions (e.g., gas characteristics like presence of liquid, pipe conditions, presence of a blockage, and so on). This will ensure operators remain aware of possible issues that can affect the high level of accuracy mandatory in custody transfer applications.

Integrated systems

It is critical that the gas chromatograph, flowmeter, pressure regulators, odourant injection system and control system work together seamlessly to guarantee the quality of the gas and ensure that the plant meets the other operating challenges discussed.

Due to the breadth of components and technology required to monitor and control a plant of this type, this can present a challenge when designing and implementing a solution. Measurement accuracy and subsequent gas quality can be impacted should

Biomethane injection skid – building

the complete solution not be installed, calibrated and connected correctly. It can also be difficult to assign responsibility should a malfunction occur.

A vendor able to provide support for all the main devices can help maximise operational performance of the plant and provide lifecycle care to ensure continued efficient production. The customer can also be supported on the necessary requirements to meet the latest standards and regulations.

Smart solutions

The biomethane injected into the grid must be privileged compared to traditional gas; the injection station will be set at a higher value than the traditional grid, which will remain inactive until the biomethane flow rate becomes insufficient to meet the real need. The management of the biomethane injection points and the whole grid requires, therefore, automatic implementation systems, controlled locally or remotely, whose logic will be customised for each network depending on its specificity. The implementation of automatic management of traditional grid and new biomethane stations will allow operators to take maximum advantage of this new source.

Biomethane injection skid – inside

Automation technologies can be applied to the main sections of a biomethane injection station: gas analysis, pressure control, odourant injection, custody transfer measurement and the entire control and management of the single station up to the gas grid. Their understanding and use help operators solve their many daily challenges, maximising biomethane production and guaranteeing the best performance of their plant. ●

For more information:
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