Optimize Biogas Production With Accurate, Real-Time Monitoring

Many utilities and industries today face increasing pressure to lower costs and improve sustainability. Reducing electrical usage — or even selling electricity back to the grid — helps to accomplish both of these goals, and anaerobic digesters may play a part in doing so.

Water Online spoke with Alan Vance, Industry Manager- Environmental, of Endress+Hauser about anaerobic digestion and ways WWTPs optimize their facility.

Endress+Hauser is a global leader in measurement instrumentation, services, and solutions for industrial process engineering. They understand the importance of timely and accurate monitoring to obtain the best performance of sometimes problematic digesters.

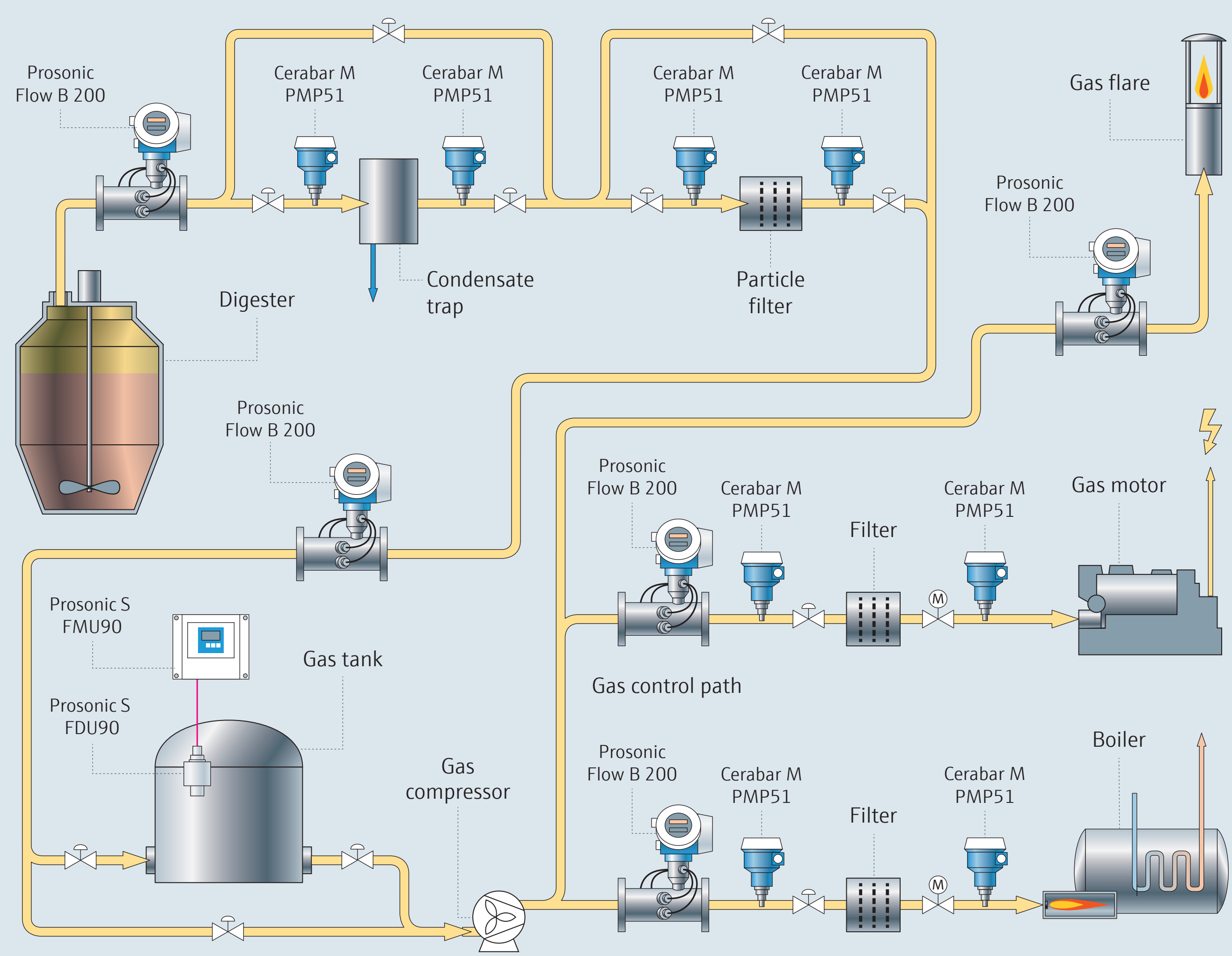
The use of anaerobic digesters for both municipal and industrial wastewater facilities has increased in recent years. What are the primary reasons for the use of anaerobic versus aerobic digestion?

Generally speaking, while anaerobic digesters require a significant capital expenditure from the customer, they offer a relatively small footprint, high efficiency and significant reduction in sludge volume, and lower operational costs compared to aerobic systems. Becoming energy independent is critical for most customers, in that the biogas generated from the anaerobic digestion process contains methane (CH4) gas which can be captured and used as a fuel source to create renewable electricity to power the facility.

How do anaerobic digesters work to produce energy?

Municipal wastewater, industrial wastewater, food waste and livestock manure all contain biodegradable material which is broken down by microorganisms in the absence of oxygen. The microorganisms break down the biomass and produce biogas, which primarily consists of methane (CH4) and carbon dioxide (CO2), along with trace amounts of other gases. Typical biogas from wastewater treatment plant sludge is 60-75 percent CH4 by volume.

Biogas control



What conditions must be maintained to keep anaerobic digesters operating properly?

The process begins with a consistent supply of organic matter. Also, an oxygen-free environment, constant temperature (95°F), proper mixing, and a relatively neutral pH (6.6-7.6) all play an important role in this application.

What problems occur when an anaerobic digester gets "out of sorts?"

There is an old adage in process control which says, "what cannot be measured cannot be controlled." Most plants want to know the quantity but more importantly the quality of the biogas. If the bacterial health declines without indication and with no corrective action, the process loses efficiency, and the volume of waste that can be treated is reduced dramatically. While other parameters like temperature and pH are important to the overall health of the digester, they can be slow to react. A significant loss of biogas production and methane concentration in the biogas is a rather fast indicator.

Which are the most important parameters to monitor to ensure optimum biogas production?

A consistent supply of organic matter. Other basic parameters are an oxygenfree environment, constant temperature, tank level, proper mixing, pH, and actual biogas flow/percent methane content.

Which methods are typically used to analyze and record these parameters?

Typically, in process plants we see two types of control, i.e., programmable logic controller (PLC) or distributed control system (DCS). These supervisory control and data acquisition (SCADA) systems monitor and control all the signals generated from various field devices, such as instrumentation, pumps, motors, and drives. A human machine interface (HMI) displays all the parameters and acts as a window to the process for the plant operators.

What are common challenges for using instrumentation to monitor anaerobic digester performance?

A major challenge is finding accurate and repeatable instrumentation that performs over time and measures the percent methane (CH_4) content of the biogas.

Are thermal mass or thermal dispersion flowmeters a good solution for measuring biogas flow from anaerobic digesters?

No. Historically, customers will use either a thermal dispersion (thermal mass) type flowmeter or an orifice plate/differential pressure to monitor flow. Biogas presents many severe application challenges, such as low flow, varying temperatures, and wet/dirty gas. Also, how do you calibrate the unit accurately for mixed and changing gas compositions (CH_4 + CO_2 + trace gases)? However, once the gas has been dried and cleaned, thermal mass technology can be used effectively.

What type of instrumentation can accurately provide real-time monitoring of biogas flow, temperature, and methane content for anaerobic digestion systems?

Ultrasonic "transit time" technology with an integral temperature sensor uses sound velocity to calculate the methane fraction of the biogas. In addition, pressure can be assumed as constant or, if variable, the transit time flowmeter can take an external input from a pressure transmitter. This calculation uses a proven relationship between sound velocity, temperature, and a methane/carbon dioxide gas mixture. All trace gas components are ignored except water vapor, which is compensated for as well.

Is there a risk of explosion when using instrumentation to measure biogas?

Biogas contains methane (CH_4), which is a highly combustible gas. Thus, the overall anaerobic system design, including the instrumentation, is required to meet the proper hazardous area classifications. In addition, the digester vessel is considered a confined space (oxygen-free), so extreme caution and following OSHA regulations is critical when performing maintenance in and around the vessel.

Published on Water Online

Endress+Hauser, Inc.
2350 Endress Place
Greenwood, IN 46143
Tel: 317-535-7138
Sales: 888-ENDRESS (888-363-7377)
Fax: 317-535-8498
info@us.endress.com
www.us.endress.com

Endress+Hauser
People for Process Automation

WP01048C/24/EN/01.17
(03.17)