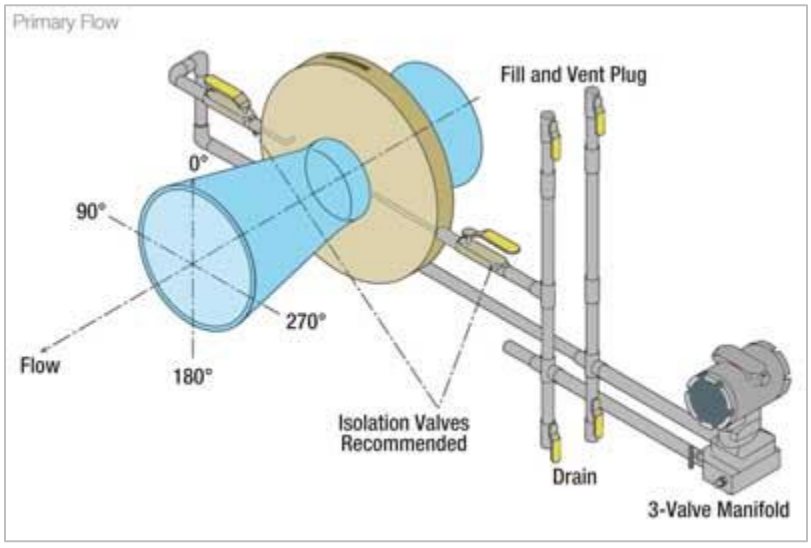
Down and Dirty: Tips for Accurate Metering of Digester Gases in Municipal Wastewater Facilities

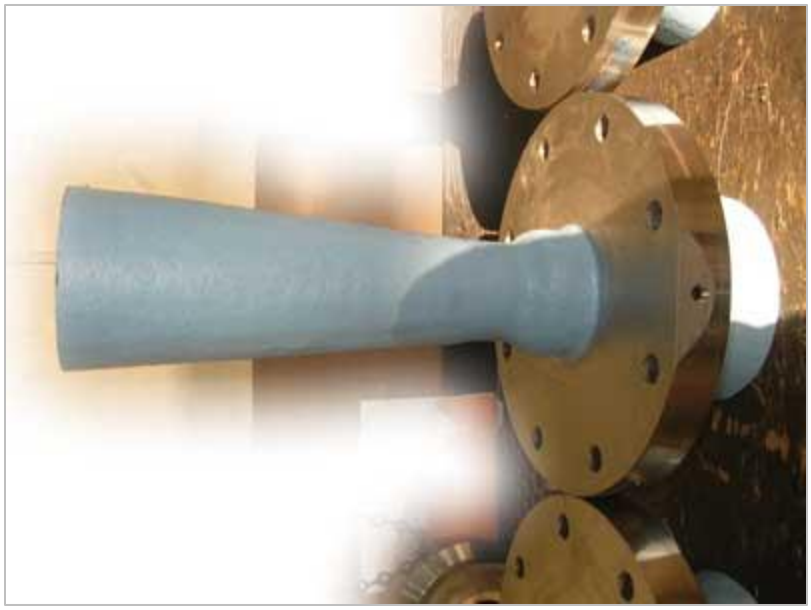
By Jeff Smith
Source: Primary Flow Signal, Inc.

In the municipal wastewater treatment process, the goal is to remove all biological and chemical contaminants. Municipal facilities utilize several processes, including chemical addition, coagulation, flocculation, sedimentation, filtration, and disinfection in order to decontaminate the water. During this process, biogases, or digester gases, are created as byproduct of the decomposition of organic matter by anaerobic bacteria. Digester gas is typically composed of 60 percent methane and 40 percent carbon dioxide (CO_2) and is similar to natural gas, which is composed of 99 percent methane.

However, these gases pose safety and environmental concerns and must be handled appropriately for several reasons: they emit unpleasant odors, they're combustible and they're considered greenhouse gases. According to the EPA, methane can stay in the atmosphere for roughly 12 years; pound for pound, the impact of methane on climate change is over 20 times greater than CO_2 over a 100-year period. Although wastewater management facilities account for only 2 percent of U.S. methane production, a significant amount is released into the atmosphere, and increasing regulations are demanding that the emission of greenhouse gases be properly monitored.



Meter Installed with PFS Nameplate on Top at 0 Deg High and Low Taps on Horizontal Centerline at 90, 270 Deg.



Primary Flow Signal's HVT-DG is designed to deliver reliable service despite very low line pressure and dirty, wet gas environments.

Handling methane and other digester gases appropriately can be difficult because they retain gas properties at normal conditions and temperatures. To dispose of the constant buildup of digester gas, it is common practice for many facilities to flare them at high temperatures with the intention of leaving very little residual effects. However, many wastewater facilities are coming to realize that digester gas can serve as a fuel substitute for natural gas in certain applications, such as boilers, hot water heaters, reciprocating engines, turbines, and fuel cells.

In the case of electricity generation, some facilities are using this process to produce power for internal operations, such as on-site fuel boilers for use in the digesting process. Certain facilities are affiliated with feed-in programs and sell surplus electricity back to the local utility. While the wastewater facility benefits from the energy and heat it can generate, the facility is reusing its digester gases to lower its greenhouse gas emissions and keep within the regulatory requirements - and better contribute to local communities.

Wastewater treatment facilities have an added incentive to reuse digester gas. In California, for example, the California Public Utilities Commission has a program called the Self-Generation Incentive Program (SGIP), which provides financial consideration when facilities utilize these waste gases for waste-to-heat power, gas turbines and emerging technologies, such as fuel cells. The SGIP program provides payments of $0.50 to $2.25 per watt generated by these systems. These facilities also realize significant operational savings when they calculate the lower electricity usage that would be needed for power, heating, cooling, etc.

In addition, the EPA created 40 CFR Part 98 or the Greenhouse Gas Reporting Program, a rule for the mandatory reporting of greenhouse gases from large emissions sources in the U.S. This program applies to direct greenhouse gas emitters, fossil fuel suppliers, industrial gas suppliers, and facilities that inject CO_2 underground. In general, facilities that emit 25,000 metric tons or more of CO_2 equivalent per year must report it. Facilities that fall below the 25,000 metric ton limit are not required to report their emissions to the EPA.

With all of these factors in mind, it's becoming more important than ever for facilities to be able to monitor, measure and properly utilize the gases created in the wastewater treatment process. However, there are several issues that make measurement difficult. Digester gases are typically wet and dirty and flow at low or irregular pressures, and maintaining an accurate reading in fluctuating, dirty environments can be challenging.

Solutions

Implementing an accurate measurement solution requires a meter that is rugged, accurately calibrated and able to handle the wet, dirty debris that results from the digester environment. There are several options to choose from, and when selecting a measurement technology, it's important to keep in mind that it must deliver reliable, long-term measurement capabilities. In addition, engineers looking to utilize these meters must also understand their role when implementing a device.

Thermal Dispersion Type Mass Flow Meters

A common solution for digester gas calculations are thermal dispersion type mass flow meters. These meters are inserted into the pipeline, are easy to install and have no moving parts. When installed correctly, these meters claim to provide flow accuracy of ± 0.75%. The overall benefit of using a thermal dispersion flow meter is that it offers a packaged solution for a mass flow rate. In essence, it provides engineers with the necessary numbers without requiring calculations, therefore delivering a one-stop reading for digester gas measurement.

However, there are some downfalls to this solution. As a thermal dispersion meter is electronic and relies on sensors inserted into the pipe, it can be contaminated and become inaccurate due to the constant exposure of the dirty, wet digester gas. If these meters begin to fail, it may be difficult for municipalities to repair them on their own or with little support from the manufacturer. In addition, these meters must be regularly cleaned and calibrated, and it can be argued that the correct method for calibration should be done by a knowledgeable field engineer trained to produce verifiable results.

Differential Type Meters

The best option for monitoring digester gas in wastewater facilities is a proven, accurate solution that has been implemented by wastewater treatment facilities around the world for generations. Differential-type meters, such as the Venturi, can be field-calibrated and are traceable and verifiable. Although these meters are subject to blockages due to debris and the viscous digester gas material, they are physically equipped with clean-out ports to make this easy for facility technicians to conduct on a regular basis. For example, the HVT-DG from Primary Flow Signal is designed specifically to deliver reliable service despite very low line pressure and dirty, wet gas environments.

Although any typical Venturi meter can monitor digester gas, the HVT-DG features a tap cleanout rod for both the high and low pressure sensing points that allows for the removal of particles from the meter, offering a simple solution to ensure debris does not impact flow measurement. This specialized, insertable Venturi meter is customizable and is available in a standard configuration, as well as special configurations designed for any line size, and for the specific conditions of each application.

The HVT-DG maintains an accuracy of ± 0.50% of actual reading or better and can handle temperatures up to 350°F with the appropriate selection of materials. Although measurements require calculations and are not automatically displayed like thermal dispersion type mass flow meters, the HVT-DG delivers accurate measurements without the requirements for recalibration. In addition, when paired with secondary metering elements, the readout will compensate for line conditions, greatly improving overall accuracy. In the end, the HVT-DG provides a long-term, reliable solution that can be independently verified and calibrated.

Conclusion

The growing environmental requirements for accurately monitoring and repurposing digester gases are spurring the demand for effective and reliable digester gas measurement. Municipal facilities can produce a quantifiable return on their investment in more accurate meters, particularly when paired with technologies to repurpose the gases for power or heat generation.

About the Author: Jeff Smith is the National Sales Manager at Primary Flow Signal. He has worked in the instrumentation and process controls market for over 30 years. In 1995, Smith founded Alpha Valve & Controls, a manufacturer's representative firm specializing in flow measurement instrumentation, representing PFS Venturi Flowmeters, as well as magnetic, ultrasonic, open-channel, and Area X Velocity flow meter manufacturers. He joined Primary Flow Signal following the sale of Alpha Valve & Controls in 2007.