Measurements that matter

Panametrics
a Baker Hughes business

A wastewater operations e-book

This e-book contains a series of application stories based on monitoring and measuring wastewater operations.

1. Biogas measurement from wastewater to power plant

Benefits:

- Accurate and reliable measurement
- Ability to measure at very low pressure
- Absence of pressure drop

Summary

Stockholm water company produces biogas from their wastewater facility which feeds Scandinavian Biogas for energy production. As they need to accurately meter what they sell to the energy facility they used a project contractor firm to engineer and define the best solution for the project.

Application

Biogas comes from the digester. It is a mixture of methane and carbon dioxide and is handled at very low pressure and ambient temperature.

Biogas: CH4 58% to 70% + CO2: 42% to 30%, traces of N2 and H2S < 500ppm

Flowrate: 400 to 5,000 Nm3/h

Pressure: from 15 mbarg to 30 mbarg (0.22 psig to 0.44 psig)

Temperature: 0°C to 37°C (32°F to 99°F)

Pipe: DN300 (12") PN10 EN 1.4404 (SS316)

Challenge

Due to the technical challenges ultrasonic technology was selected. To get accurate readings they needed to find a compromise between meter velocity and pressure drop. Our partner's technical advices were taken into consideration and they went for a DN300 line (12").

Solution

We supplied our gas flow meter with our T5 transducers mounted on a flowcell with air calibration. That's a set up that has good records for low pressure application like what we see on flare lines. With this in place, Stockholm water company can now bill accurately Scandinavian Biogas Company and maximize the energy transfer thanks to the absence of pressure drop.

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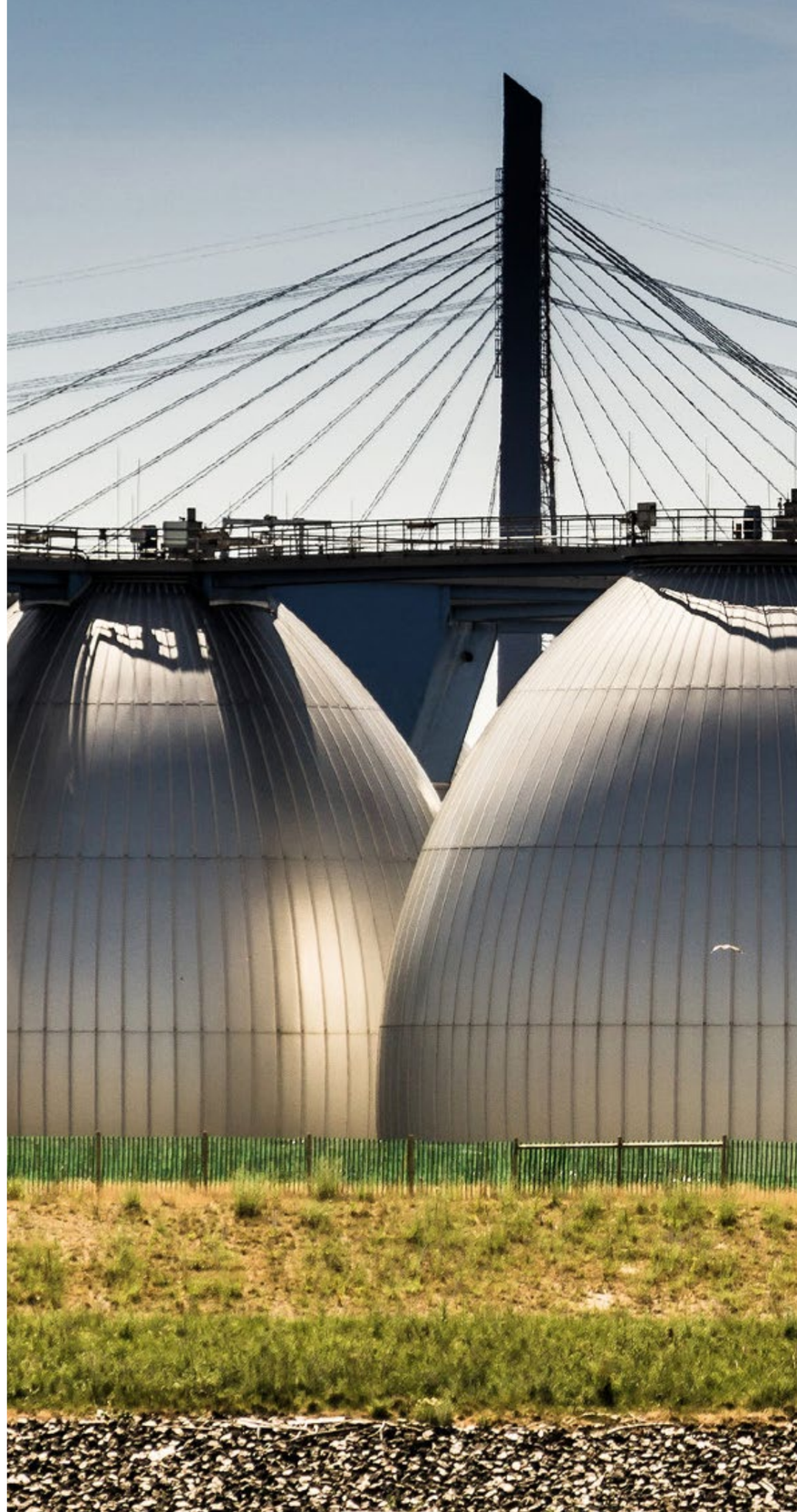
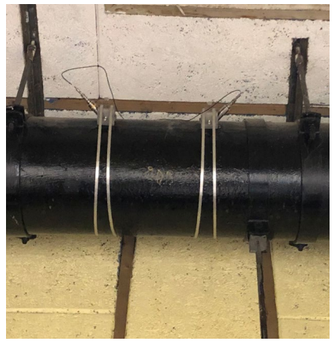


2. Measuring wastewater flow in iron pipes

Benefits:

- No ingress or process interruption
- No contact with medium
- Easy to install and access
- Large rangeability and reliability



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Summary

The customer, based in Scandinavia, is a municipal association that supplies fresh drinking water, processes rainwater, purifies wastewater and responsibly disposes of household waste for half a million customers. Its activity is spread over several affiliated locations, with 15 sewage treatment plants, several hundred pumping stations, large-scale waterworks and several smaller local waterworks. These plants were built 50 years ago, however, the population has since doubled. Therefore, to drive network optimization, better flow monitoring is key.

Application

The client wanted to understand if wastewater was equally distributed across two pipes at one of its wastewater facilities.

As was common practice when these plants were constructed in the 1960s and 70s the pipes were made from cast iron, which is traditionally very hard to measure.

- Wastewater
- Cast Iron DN300 to DN400 (12" to 16")
- Temperature 15°C (59°F)
- Pressure 2-3 barg (29 – 43.5 psig)

Challenge

Due to the age of the iron pipes the wall thickness was unknown - the properties of cast iron pipes, plus wear over the years results in uneven pipe thickness. In addition, the cast iron material, debris and corrosion inside the pipe could cause scatter. The customer had trialed several other products, but they failed to provide the reliability and accuracy required.

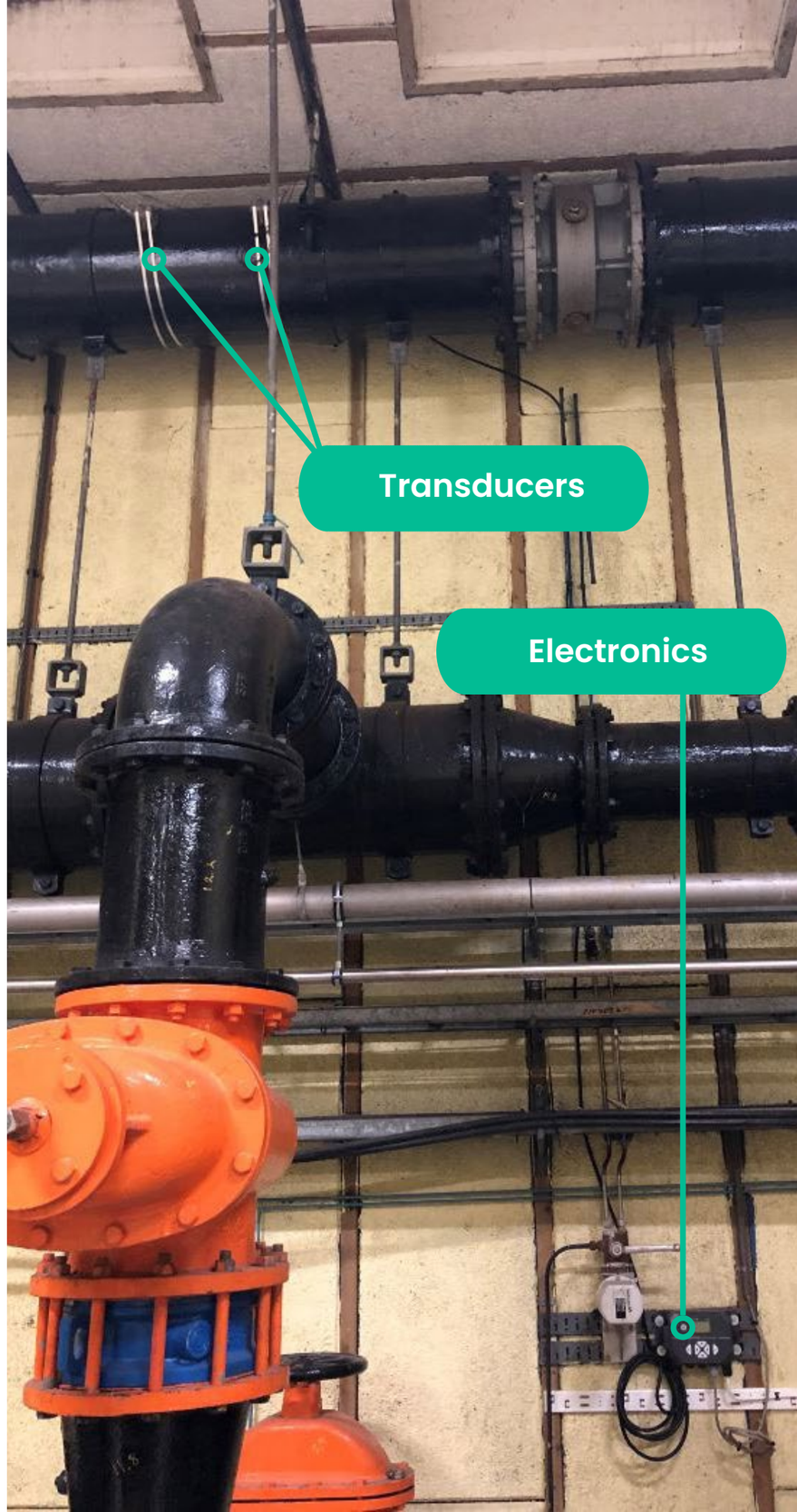
Solution

A strong coded signal and its processing method combined with firm alignment and proper parameter settings were required for a reliable measurement. Panametrics' Clamp-on ultrasonic measurement was ideal for non-intrusive flow measurement and had a strong track record of successfully monitoring flow through cast iron pipes.

Each measurement spot was first verified with the Panametrics TransPort PT900 ultrasonic clamp-on flow meter. Once diagnostic results were satisfactory, an AquaTrans AT600 was permanently installed to provide 24/7 monitoring. This was set up with a 401 transducer 500kHz and CPL-1 to ensure continued accuracy.

Results

The wastewater measurement was performed to check if the water was equally distributed over two pipes both of which were connected to the main meter. The sum of the two individual measurements matched the reading of the main meter, meaning the ultrasonic flow measurement was accurate. Not only did the customer achieve an accurate understanding of the flow volume distribution, it enabled the team to optimize its operations.



3. Oxygen content in wastewater digester gas

Specifications:

Range	0-100% O2 in N2/CO2
Temperature	Ambient
Pressure	Atmospheric
Enclosure	Weatherproof (Stainless Steel optional)

Benefits:

- Years of reliable service
- No moving parts
- Non-Depleting sensor
- Turnkey analyzer + sampling system

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Summary

In wastewater treatment, aerobic digestion enables plants to increase their capacity by injecting oxygen into the wastewater head space. This results in up to a five time increase in the treatment capacity.

Application

Oxygen concentration is critical to the treatment process. If the oxygen concentration is too high, it is an indication that the active population of microorganisms have died off and need to be replenished. If the oxygen concentration is too low, the oxygen flow rate must be increased.

The process involves a four-stage reaction chamber. Pure oxygen is injected in the head above the liquid wastewater. Microorganisms in the water digest the waste, while consuming oxygen and producing CO2 (carbon dioxide). The oxygen level in the fourth stage is measured by the XMO2. The transmitter is used control the flow of oxygen and wastewater on demand to enable optimal digestion.

Solution

The process requires monitoring of the oxygen content, to insure proper wastewater treatment and the survival of microorganisms that decompose the waste. Oxygen concentration indicates process efficiency. Panametrics XMO2 thermoparamagnetic oxygen transmitter is ideal for this application. The transmitter is installed in a turnkey sample conditioning system and provides an output to the plants data acquisition and control system. The XMO2 is reliable and time proven. It has no moving parts and its cost effectiveness make it the oxygen transmitter of choice.

4. Panametrics technology helps track potable water leaks

Benefits:

- Easy to set up and programt
- No process interruption
- Strong reputation and local support in water measurement
- Reliability and accuracy

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Summary

Ronneby is a small Swedish city with 12,000 people. Its Local Authority was concerned about the volume of potable water losses through its pipeline network due to leakages. This is a problem not unique to Ronneby but applies to many cities in Sweden and around the world.

1 m3 of potable water is currently priced €1.50 in Sweden, meaning that that the cost of any significant leaks can be huge (it is not uncommon to see millions of m3 worth of leakage across a water network not equipped with leak detection technology). Quite apart from the cost and efficiency, water is becoming scarce in many parts of the world, and in Sweden, greater attention is being taken to identify, track and remedy leakages.

Identifying leakages, in Ronneby, the Local Authority focuses on night flows, when people are generally sleeping, as the flow is expected to be very low. If the flow is unusually high, then it raises the likelihood of leakage.

The introduction of Panametrics flowmeters to map the municipal water network will help the Local Authority to rapidly identify leakages enabling quicker fixes.

Application

Medium:	Potable Water
Pipe size and material:	PVC 160x17.7 mm (6.3”x0.3”)
Flow Rate:	Bi-directional -90 to 90 l/s (1426 GPM)
Temperature:	2-25°C (35-77°F)
Requested accuracy:	<±2% of reading

Challenges

Understanding how the water grid is mapped is key to identifying the optimum measurement locations are selected. These can include water towers, pump stations, boosting stations, etc. In this instance, as the city had already installed electromagnetic meters and Panametrics’ Aquatrans meters at various points, it was decided to trial the installation of Panametrics’ clamp-on ultrasonic flow measurement technology in a manhole.

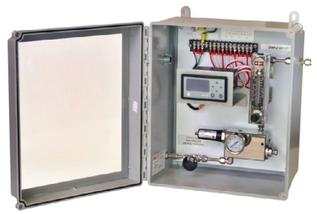
The Panametrics Team had to find a way to install the meter in a very confined space. It was clear to the customer that installing any electromagnetic meter was not an option because of the burden associated with flow interruption that would have resulted in increased cost to consumers and the mechanical work required to install flanges on the PVC pipe. A clamp-on ultrasonic option was much more realistic and would prove to be effective.

Solution

Working in partnership with the customer, Panametrics’ Aquatrans AT600 Clamp- on Ultrasonic Flow Meter with CRS 402 and submersible cable was selected. The AT600 electronics sits in the cabinet at street level as shown in the picture opposite.

The municipality is very pleased with the results. Better able to identify leaks, the customer is already improving efficiency and saving water. It now plans to purchase 10 additional meters to be used for the same application.

5. Monitoring moisture on the inlet to an ozone generator



Summary

Ozone is a common disinfectant in water and wastewater treatment plants. Ozone generators are used to produce the ozone on-site. Moisture measurement is a key measurement in the oxygen fed into the ozone generator.

Application

Ozone generators convert oxygen from either an air source or a pure oxygen source into ozone. This is done by applying a large amount of power to the system. The presence of moisture can cause arcing or sparking in the ozone generator, which is detrimental to the operation and health of the generator.

The source gas is expected to be dry going into the generator; but, leaks in the system can allow ambient moisture to enter. Monitoring for moisture is the proper preventative maintenance.

Solution

The choice of moisture analyzer technology is based on the customer need. A simple aluminum oxide moisture analyzer is ideal, as it can monitor the moisture content from ambient down to the low ppm values of moisture typically found in these applications. These systems can be provided cleaned for oxygen service with little difficulty and at little expense to the customer. An annual calibration at the vendor's nearest calibration facility ensures that the sensor is providing accurate measurements. Having a spare sensor on hand is inexpensive and allows for verification when readings appear higher than expected.

The moisture measurement system is comprised of an aluminum oxide sensor mounted in a sample system that draws a small amount of the oxygen past the sensor. The display package drives the measurement and can be equipped with alarm contacts to help indicate an alarm condition. The analog output can provide a constant reading back to the control room.

Tunable diode laser hygrometers may be used, but at a higher base expense. Providing these cleaned for oxygen service will also increase the total up-front purchase price. Savings can be realized over the life of the analyzer, as no regular maintenance of calibration is required.

It is critical to quality to choose a manufacturer who has decades' experience with recommending and providing the appropriate technology and with sample system design. Choosing the appropriate materials and providing a complete package ensures analyzer performance and minimizes uncertainty in the measurement integrity.

6. Benefits of measuring oxygen content in wastewater digester gas using thermoparamagnetic oxygen analyzers

Summary

In wastewater treatment, aerobic digestion enables plants to increase their capacity. This process includes using oxygen-enriched air in the wastewater head space. This results in up to a five time increase in the treatment capacity.

Application

Oxygen is added to the air in the head above the wastewater. Microorganisms in the water digest the waste, while consuming oxygen and producing carbon dioxide. The oxygen level is measured at the outlet vent. The measurement is used control the flow of oxygen on demand to enable optimal digestion.

The oxygen concentration is critical to the treatment process. If the oxygen concentration is too high, it is an indication that the active population of microorganisms may have died off. If the oxygen concentration is too low, the added oxygen must be increased.

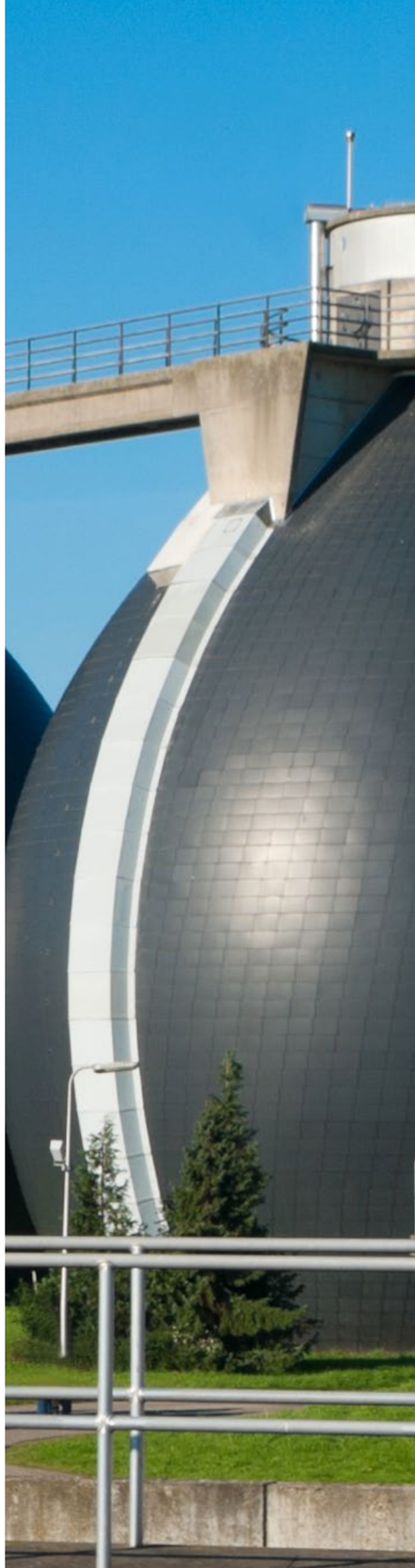
Solution

The process requires monitoring the oxygen content to ensure proper wastewater treatment and the survival of microorganisms that decompose the waste. Oxygen concentration indicates how efficient the process is functioning. Choosing a robust and reliable technology instills confidence in the measurement.

Thermoparamagnetic oxygen transmitters are ideal for this application when designed into a sample conditioning system that removes entrained mists or liquids. Since this technology involves no moving parts, should there be a small upset, the sensor is not typically damaged and can recover quickly. The transmitter provides an analog output signal proportionate to the oxygen content to the plant's data acquisition and control system.

When paired with the appropriate display/controller, you can increase the intelligence of the system and the accuracy by adding solenoid valves to sample system to choose between sample gas and calibration gases. The system can initiate an auto-calibration or auto-verification on a regular basis, ensuring maximum accuracy in these critical monitoring and/or control systems. The controller can track the change in calibration over time, allowing the operator to see if there have been changes that tie back to upset conditions in the application.

It is critical to quality to choose a manufacturer who has decades' experience with this technology and with sample system design. Putting together a sample panel without this experience may result in poor analyzer performance and/or uncertainty in the measurement integrity.



7. Reliable biogas percent methane content and flow rate with ultrasonic flow meters

Watch our webinar to learn more about our **Ultrasonic Flow Meters**

PanaFlow Ultrasonic Advantages for Process Flow Measurement Video

Innovation in flow measurement

Biogas flow measurements have always been difficult due to wet gas conditions and changing compositions of methane and carbon dioxide. Traditional technologies have struggled to achieve a consistent and reliable measurements without field optimization or repair. Today, because of advanced electronics and transducer designs, ultrasonic flow meters are now being installed more and more in biogas applications as they have broken the stigma of only being suitable for clean applications.

Ultrasonic flow meters are an excellent fit for biogas flow measurements since they are well suited for low pressure gas, low to medium velocities, changing stream compositions, and tolerance to wet gas installations. However, not until recently have ultrasonic flow meters utilized their naturally measured sound speed and more readily accessible diagnostics.

With a transit time ultrasonic flow meter, two transducers are mounted on opposite sides at an angle so that one transducer is upstream of the flow and the other transducer is downstream of the flow. The transducers act as a pair and both transmit and receive ultrasonic signals. With flow, the signal from the downstream transducer will slow down as it is going against the process fluid to the upstream transducer and while the signal speeds up going from the upstream transducer to the downstream transducer. With the difference in transit time and knowing the spacing between transducers, the fluid velocity is calculated.

Innovation in flow measurement

The exact transit time it takes an ultrasonic soundwave to acquire from one transducer to the other transducers is based on sound speed. Sound speed is property of a specific fluid (gas, liquid, or solid) but also changes with temperature. With sound speed, temperature, and pressure, a Panametrics ultrasonic flowmeter can now also provide a constant percent methane concentration in a biogas fluid eliminating a need and the maintenance associate with a separate gas analyzer.

With both a dependable percent methane content and flow measurement in a single pipe penetration, wastewater treatment plants are now able to better optimize operations and improve efficiency.

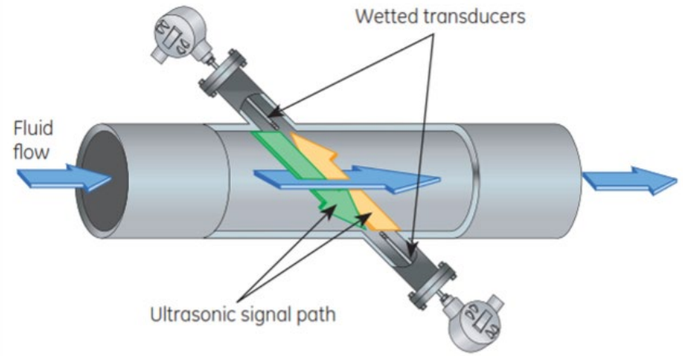


Figure #1: Ultrasonic Flow Meter Transit Time

Figure #2: Ultrasonic Flow Meter Transducers & Signals

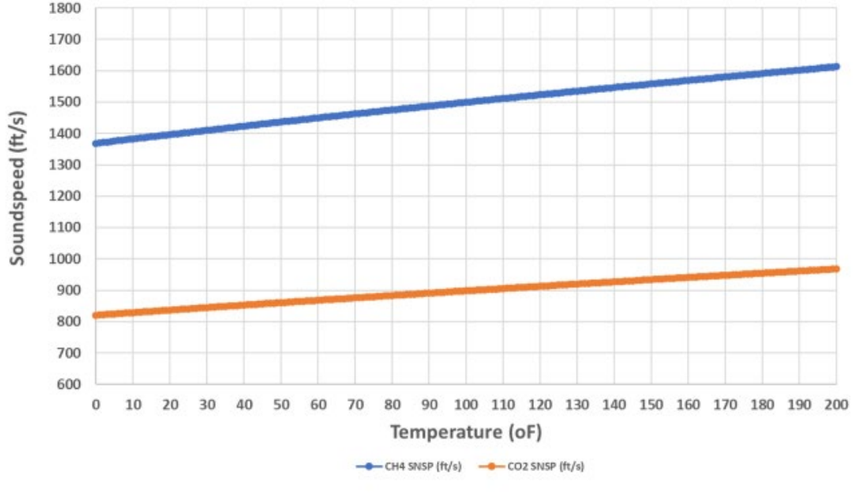


Figure #3: Speed of Sound (Methane and Carbon Dioxide)

8. Biogas flow measurement for power generation

Benefits:

- Actual flow rate
- Real time calculations of normal gas flow rate
- Help for accurate reporting

Summary

A small city in Scandinavia was using flowmeters to report how much gas they were using and venting, to the environmental authorities.

The city was using mechanical meters with a local totalizer and no output. Every morning they had to send an employee to look at the totalizer from the two meters and calculate the actual difference from inlet gas and the burned gas to assess their plant performance and amount of gas flared.

Application

Medium:	Biogas
Pipe size:	2″ (DN50)
Temperature:	Ambient
Requested accuracy:	±2% of reading

Challenge

This biogas was somewhat ‘dirty’ and ‘wet’ and the municipality was questioning the meters’ totalizers. They were looking for a more reliable solution with outputs showing actual flow as well. When the company erected another biogas plant, they were keen to find the best suitable solution.

Solution

Across both plants the customer opted for the PanaFlow Z1G DN50. The package we supplied included Pressure and Temperature sensors to read normal flow. After several months of operation, the customer confirmed the meters were working per expectations and to their satisfaction.

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Contact us

A Panametrics expert is ready to listen to your case, or visit panametrics.com.

Panametrics, a Baker Hughes business, provides solutions in the toughest applications and environments for moisture, oxygen, liquid and gas flow measurement.

Experts in flare management, Panametrics technology also reduces flare emissions and optimizes performance.

With a reach that extends across the globe, Panametrics' critical measurement solutions and flare emissions management are enabling customers to drive efficiency and achieve carbon reduction targets across critical industries including: Oil & Gas; Energy; Healthcare; Water and Wastewater; Chemical Processing; Food & Beverage and many others.

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