Taking a look at the two fastest-growing flowmeter markets

Coriolis and ultrasonic flowmeters: competitive or complementary?

Coriolis and ultrasonic flowmeters are widely used to measure liquids and gases, and both are just beginning to be used to measure steam. Because both flowmeters are very popular with end-users, it is worthwhile to discuss how they are alike and how they differ.

Certain key areas to compare include principle of operation, history, application, line size, and other key points of comparison. By looking at how the two flowmeter types compare in these critical parameters, it is possible to get a better sense of where these two flowmeter types are best suited in terms of application. Understanding this should go a long way towards finding out to what extent these two flowmeter types are competitive or competing.

Principle of operation

Coriolis and ultrasonic flowmeters have very different principles of operation. Coriolis flowmeters consist of one or two tubes that are caused to vibrate through electromagnetic force.

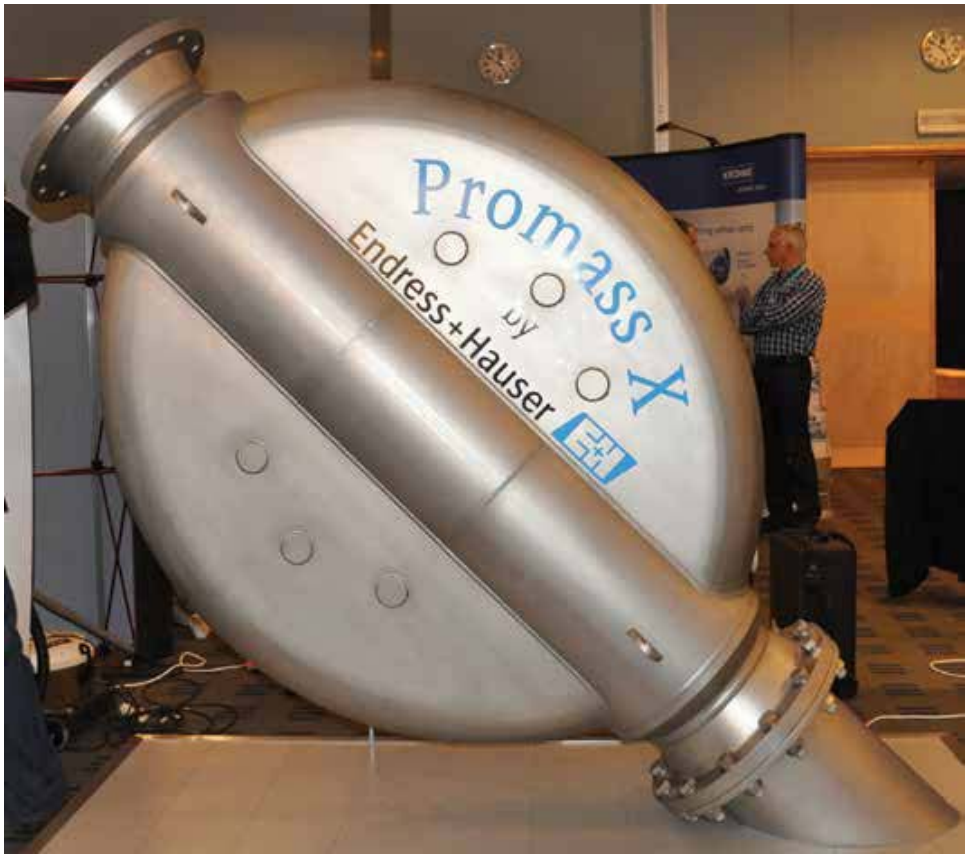
As fluid flows through the tube(s), the tube or tubes are deflected by the momentum of the fluid. The flowmeter detects the amount of deflection, and this is proportional to mass flowrate.

Ultrasonic flowmeters operate on a different principle. While there are two main types, transit-time and Doppler, transit time is the dominant technology. Transit time ultrasonic flowmeters send an ultrasonic signal at an angle across the flowstream, using a transducer that is mounted in the pipe wall or is outside of the pipe. The signal is sent both across the flowstream and back, and is detected by a transducer that serves as a receiver. When the signal travels in the same direction as the flowing fluid, it travels more quickly than when it travels against the flowing stream. This different in 'transit time' is proportional to flowrate, and the flowmeter uses this value to compute flowrate.

Fluids measured

Both coriolis and ultrasonic flowmeters measure liquids and gases. However, coriolis flowmeters have an easier time with liquids. This is because liquids are denser than gases, and coriolis meters rely on momentum of the fluid to deflect the flowtube. Gases are lighter than liquids, and have a more difficult time deflecting the flowtube.

Ultrasonic flowmeters can measure the flow of both liquids and gases. They are widely used for the custody transfer of natural gas in pipeline applications. They are also used in upstream applications of water, gas, and oil in upstream applications in the context of exploration and production. Other flowmeters used in upstream applications include turbine and differential pressure



Endress+Hauser's Promass X coriolis flowmeter

flowmeters. Ultrasonic flowmeters are used to measure both natural gas and industrial gases.

Line sizes

Line sizes are an important difference between coriolis and ultrasonic flowmeters. Up until five years ago, the large majority of coriolis meters were for line sizes of 2" or less, although some were made for pipes up to 6" in diameter. One company, Rheonik (now owned by GE Measurement), made coriolis meters for line sizes above 6".

In the past five years, three new suppliers have entered the market for large line size coriolis meters: Micro Motion, Endress+Hauser, and Krohne. These companies are making coriolis meters for pipes with diameters of 6 to 16". This is a new development in the coriolis flowmeter market.

For ultrasonic flowmeters, line size is no barrier. In fact, ultrasonic flowmeters function best in pipes of 4" in diameter and up, although many are made for pipes with smaller diameters. The ultrasonic signal travels farther in both directions in large pipes, resulting in a greater difference in transit times. Ultrasonic flowmeters are widely used for custody transfer of natural gas in pipes with diameters of 20 to 42" and up. No coriolis meter made today could make these measurements.

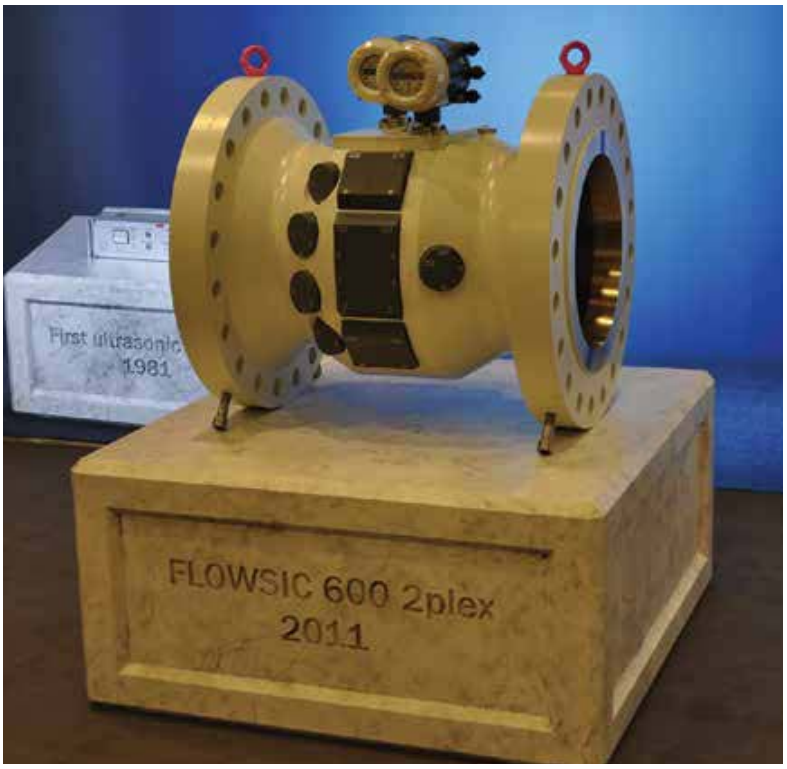
What is driving the development of large line size coriolis and ultrasonic flowmeters is the demand for more accurate and reliable measurement of oil and gas. Many of these flowmeters are made for custody transfer applications. With the price of crude oil in the $100 (€73) per barrel range, inaccurate measurements can be quite costly when the product is changing ownership. And even though the price of natural gas has remained relatively low, flow measurement of natural gas is increasing as it is viewed more widely as an alternative to petroleum liquids and as a long-term bridge to renewables.

Industry approvals benefit both meter types

When crude oil, petroleum liquids, and natural gas change hands at custody transfer points, these exchanges are influenced by regulatory bodies.

The American Gas Association (AGA) and the American Petroleum Institute (API) have published criteria or standards that lay out guidelines for how these measurements are to be properly made. These guidelines were initially published for differential pressure (DP) flowmeters using orifice plates by the AGA in 1930. This report was called AGA-1, and it was followed up in 1935 with AGA-2, as a result of additional tests. The AGA first published AGA-3 in 1955, which is the report still associated with orifice plate meters for custody transfer. However, it has been substantially revised and updated since that time.

Approvals for ultrasonic flowmeters came much later. In the mid-1990s, the Groupe Europeen de Recherche GaziSres (GERG), a European association of natural gas producers, issued a report laying out criteria to govern the use of ultrasonic flowmeters in the custody transfer of natural gas. This resulted in a substantial increase in the sales of ultrasonic flowmeters for this purpose in Europe. In June 1998, the AGA issued AGA-9, a report that also gave criteria for using ultrasonic flowmeters in natural gas custody transfer situations. This caused a substantial boost in the sales of ultrasonic flowmeters for custody transfer, especially in the US. The market for measuring natural gas for custody transfer with ultrasonic flowmeters is one of the fastest growing segments of the flowmeter market.



SICK's FLOWSIC 600 ultrasonic flowmeter

In 2003, the AGA approved a report called AGA-11 on the use of coriolis flowmeters for custody transfer of natural gas. This report partially explains the overall positive growth rate of coriolis flowmeters, as users begin to use them for natural gas custody transfer applications. Even though end-users often take time to adopt a new technology, this report has boosted the use of Coriolis flowmeters for natural gas flow measurement.

The API has issued a draft standard entitled Measurement of Single-Phase, Intermediate, and Finished Hydrocarbon Fluids by Coriolis Meters. In July 2012, this document was added to the API Library. The API has also approved a second draft standard called Measurement of Crude Oil by Coriolis Meters. Coriolis flowmeters are used for downstream applications of petroleum liquids for custody transfer, where they compete with positive displacement flowmeters.

Frontiers of research

One main frontier of research for coriolis flowmeters is continuing to work on building larger line size meters. While there does not appear to be a theoretical limit to how large a line size coriolis flowmeters can accommodate, there is the practical problem that the meters get extremely large and heavy in these large line sizes. As long as coriolis flowmeters cannot measure flow in line sizes over 16", they are unable to participate in many of the pipeline applications for custody transfer of natural gas. Many of these line sizes are over 20".

For ultrasonic flowmeters, much of the R&D is centered on getting more value from the multiple paths in multipath ultrasonic meters. Multipath flowmeters do provide enhanced accuracy, but they also can provide greater diagnostic information about the meter and about the fluid measurement. Currently multipath ultrasonic flowmeters have from three to 18 paths. While having more paths does not automatically mean greater accuracy, multipath ultrasonic meters are more accurate than single and dual path meters.

One reason why the ultrasonic and coriolis flowmeter markets are the fastest growing is the amount of R&D put into them by the suppliers. Expect this to continue as coriolis and ultrasonic flowmeter suppliers work to meet the challenges of measurement that result from increased energy demands.

For more information:
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