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New-technology flowmeters offer performance breakthroughs

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The flowmeter market is undergoing some exciting changes. Technological advances have resulted in products that stretch the limits of performance. Multi variable flowmeters extract more information from the process, and produce a reading of mass as well as volumetric flow. At the same time, the newer flow technologies battle the tried-and-true traditional flowmeters for market share.

This article looks at three trends that are having an impact on today's flowmeter users:

1. Flowmeter manufacturers are releasing products that break through a host of barriers to enhanced performance and wider application;

2. Multivariable flowmeters are providing more information about the process, often at a reduced overall cost;

3. New-technology flowmeters are replacing traditional technologies as users look for improved accuracy, reliability, and nonintrusiveness. While these new products are based on a variety of flowmeter technologies, in the material that follows we will focus solely on ultrasonic and magnetic flowmeter developments.

Ultrasonic flowmeters

Suppliers of ultrasonic flowmeters are increasing the application flexibility of these devices in several ways. For one thing, transit-time ultrasonic flowmeters can now be used to measure dirty liquids. In addition, methods available to measure gas flow have increased, as have line-size options.

There are two basic types of ultrasonic flowmeters: transit time and Doppler. In closed pipe flow, transit-time flowmeters send two ultrasonic signals across the pipe. One signal travels with the flow and one travels against it. Ultrasonic meters measure the difference in transit time of the two signals and use this value to compute flowrate. Doppler flow meters, on the other hand, bounce an ultrasonic signal off particles in the flowstream and use a frequency shift measurement to compute flowrate.

As I indicated above, suppliers of ultrasonic flowmeters are finding ways to enable transit-time flowmeters to measure partially dirty liquids-mainly through enhanced software methods. Since transit-time flowmeters typically are more accurate than Doppler meters, this is an important step forward. Dual-mode flowmeters, which use both the transit time and the Doppler techniques, provide additional versatility.

FIG. 1: A Panametrics GC868 clamp-on ultrasonic flowmeter is shown installed on a 36-in. natural gas line.

While ultrasonic flowmeters have been used for more than 25 years to measure gas flow, this has mainly been done with inline flowmeters. These meters have a wetted transducer that makes contact with the gas. In October 2001, Panametrics introduced its GC868, a clamp-on ultrasonic flow meter designed for gas flow applications (Fig. 1). This represented an important step forward since clamp-on flowmeters are simpler to install than inline units and don't introduce any pressure drop.

Ultrasonic flowmeter manufacturers have also made a lot of progress in the area of line size. Traditionally, their instruments have performed best in larger line sizes (six inches and above) because larger pipes have more space for the signal to traverse. But new transit-time technology from D-Flow in Lulea, Sweden has resulted in an ultrasonic flowmeter designed for line sizes from / inch to 2 inches. D-Flow uses a sing-around algorithm in computing flowrate. D-Flow's transducers send out an ultrasonic pulse, just as do other transit-time transducers. How ever, the receipt of this pulse by a receiving transducer triggers another sending impulse, the receipt of which triggers a third, and so on. This use of multiple pulses results in improved timing accuracy.

A second enhancement by D-Flow in volves the use of high-frequency silicon ultrasonic transducers. By operating at a higher frequency, time resolution is improved and noise is reduced. D-Flow's new ultrasonic technology is intended to measure the flow of clean laboratory, industrial, or medical gases, and may have application to gas flow measurement in the semiconductor industry.

Magnetic flowmeters

Many early magnetic flowmeters used alternating current to excite the coils to produce a magnetic field. In order to compensate for noise that could affect the reading, these meters had to be calibrated at a no flow condition, while full of the process fluid being measured. To improve upon this design, suppliers developed magnetic flow meters that use direct current. With dc magnetic meters, the coil is excited with pulsed dc, then de-energized. In this state, the electrodes measure the voltage present, which represents noise in the system. By subtracting this value from the voltage present when the meter is turned on (which includes both the signal and noise components), the meter can compensate for the inherent system noise.

Because of this ap proach, dc magnetic flow meters do not require the zero calibration that is necessary with ac meters. However, dc meters can encounter problems in finding a dc pulse strong enough to operate the flowmeter, especially under difficult conditions. Suppliers have met this challenge by substantially increasing the dc signal power.

Magnetic flowmeters have also made important advances in the area of conductivity. These meters cannot measure nonconductive liquids, which has seriously hampered their usefulness in the refining and oil and gas industries. However, conductivity is a matter of de gree. Many mag netic flowmeters have a minimum conductivity level of 5 ìS/cm. However, by varying the frequency and the power of the pulse used to generate the magnetic field, some magnetic flowmeters have broken through the 5 ìS/cm barrier. These techniques also facilitate the use of magnetic flowmeters in hostile liquids.

Other barriers that have been broken

FIG. 2: Hoffer Flow Controls has released a line of Precision Turbine Flowmeters with ceramic bearings for increased life.

A number of additional developments have recently occurred on the ultrasonic front, yielding more accurate, more reliable, lower cost technology. Here are a few additional examples. Suppliers of Coriolis flowmeters have broken through a price barrier by introducing units for under $3000. Vortex meter suppliers are using enhanced software techniques to reduce susceptibility of their devices to noise. And Hoffer Flow Controls has released a new turbine meter with much stronger bearings to reduce wear (Fig. 2).

Trend towards multivariable meters

Multivariable flowmeters measure more than one process variable, such as flow and pressure or flow and temperature. Many multivariable differential pressure (DP) transmitters measure differential pressure, static pressure, and process temperature, and use these variables to calculate mass flow. Some, however, simply make the pressure and temperature measurements and output the result to a flow computer, which calculates mass flow.

Multivariable flowmeters are one of the fastest growing segments in the flow market, and their increased use is having an impact on virtually all of the new-technology flowmeters. Cur rently there are multivariable vortex and multivariable magnetic flowmeters. In addition, Coriolis meters can be considered to be multivariable because they measure both density and flow. Since Bristol Babcock first introduced multivariable pressure transmitters in 1992, Rose mount, Honeywell, and ABB have followed with their multivariable pressure products.

Why are multivariable flowmeters a growing trend? To begin with, they make it possible to get more information out of the process, often with minimal added cost. This extra information may allow a user to compute, say, mass flow as well as volumetric flow. Also, there often is a cost savings in purchasing a multivariable flowmeter compared with the cost of purchasing the components individually. For example, a multivariable DP transmitter is typically less expensive than the combined cost of buying a DP transmitter, a pressure transmitter, and a temperature transmitter separately.

Trend towards new technology flowmeters

As we indicated in the beginning of this article, new-technology flowmeters, including Coriolis, magnetic, ultrasonic, vortex, and multivariable DP flowmeters, are gaining some ground among users as they compete against much more widely used traditional-technology flowmeters, such as positive displacement, turbine, open channel, thermal, and variable area meters. Some of these new-technology flow meters were first introduced in the 1950s, and later generations incorporate technological advances that avoid problems that showed up in earlier models. These newer devices are the focus of considerable product development, and typically perform at a higher level than traditional-technology flowmeters

One application area that is definitely taking greater advantage of this new technology is the measurement of natural gas for custody transfer. For years, DP and turbine flowmeters dominated this market. Then in 1995, the Groupe Europeen de Recherches GaziSres (GERG) published Techni cal Monograph 8-Present status and future research on multipath ultrasonic gas flowmeters. This document contained criteria for using ultrasonic flowmeters to measure natural gas flow for custody transfer, and its publication significantly boosted sales of multipath ultrasonic flowmeters for natural gas in Europe.

FIG. 3: The publication of AGA-9, specifying the criteria for the use of ultrasonic flowmeters in natural gas custody transfer applications, has opened up new opportunities for these flowmeters. Shown is a 20-in. Senior Sonic ultrasonic flowmeter by Daniel.

In June 1998, the American Gas Association (AGA) followed up with the publication of AGA-9. This document outlines criteria for buyers and sellers of natural gas to follow when using ultrasonic flowmeters to measure natural gas for custody transfer purposes (Fig. 3). The publication of AGA-9 resulted in a major growth in sales for ultrasonic flowmeters, especially in the United States, and this growth continues today.

As you can see, in the case of ultrasonic flowmeters, it has been the actions of regulatory bodies that have accelerated a shift to new-technology flowmeters. In other cases, though, the shift is being spurred simply by the preferences of users for features that new-technology flowmeters have. Users today are looking for the higher accuracy, increased reliability, and reduced maintenance that new-technology meters offer. For example, Coriolis flowmeters, which are well known for their high accuracy, are among the list of meters with the fastest growing market shares. New-technology flowmeters have few or no moving parts, reducing their susceptibility to wear and lessening their maintenance requirements. In addition, most new-technology flowmeters are less intrusive than traditional-technology meters, which reduces pressure drop and greatly decreases the possibility of clogging.

A look ahead

Look for more research on these technologies to result in further breakthroughs in price and performance. One area to watch in particular is that of flow sensors. During the late 1990s, there was a great deal of emphasis on developing fieldbus technology, and on dealing with all of the issues surrounding Y2K. With Y2K behind us, and the fieldbus issues at least partially resolved, suppliers may find more resources available to focus on sensors. D-Flow's sing-around transducer is one example of the kinds of significant developments that can result from a little extra focus.

You should expect the competition be tween new-technology and traditional-technology flowmeters to continue, and perhaps even heat up. Suppliers of traditional-technology meters aren't simply resting on their laurels. They are responding to the serious market challenges being posed by the newer technology by introducing enhancements to their own product lines. This competition is one that bears watching. End users will benefit, because the result is better technology flowmeters for all.

About the author

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