Ultrasonics reverberate through flowmeter market

Source: Instromet

Source: Daniel

By Jesse Yoder

Shooting its signals across technology's streams, this new challenger brings excitement.

Ultrasonic flowmeter technology, relatively new and once very misunderstood, now creates a deafening noise for competitors' differential pressure (dP), turbine, vortex, magnetic, and positive-displacement technologies.

This occurrence is relatively recent.

Who uses ultrasonic flowmeters?

These flowmeters measure process or influent and waste gases and liquids in the following areas:

- Natural-gas transmission companies
- Water and wastewater (particularly municipalities)
- Chemicals
- Pulp and paper
- Food and beverage

Today, industry better understands ultrasonics because of its wide use in a number of industries, so consequently many users are now more open to using these meters than they were 10 to 15 years ago.

That surge in ultrasonics use is significant.

In today's flowmeter market, a variety of technologies and products compete for end-user dollars. While users continue to be concerned with reliability, accuracy, repeatability, and price, they are not afraid to adopt new technologies—especially if there are advantages not offset elsewhere. Still, new technologies must overcome the built-in inertia that comes from users' natural tendency to "replace like with like."

A mid-twentieth-century development, ultrasonics go back almost 40 years to Japan, where in 1964 Tokimec (known then as Tokyo Keiki) introduced the first commercial ultrasonic flowmeter. In 1972, Controlotron introduced the first ultrasonic clamp-on

Advantages/Disadvantages of other flowmeter technologies

Technology	Operating principle	Advantages	Disadvantages
Coriolis	Fluid travels through a vibrating tube, causing it to twist. Mass flow proportional to the degree of twisting.	High accuracy No moving parts Low maintenance	High initial cost Hard to understand Not suited for large pipes
Differential pressure	Primary element causes obstruction in the flow path. dP proportional to flow rate.	Well understood Low initial cost No moving parts	Pressure drops Orifices wear down Pitot tubes clog
Magnetic	Electrically conductive fluid passes through magnetic field. Flow rate calculated by measuring voltage generated.	Nonintrusive Highly accurate Bidirectional flow	Conductive fluids only Must be kept filled
Open channel	Many use flumes or weirs and base flow rate on liquid level. Others calculate flow from depth, velocity, or diameter.	Low maintenance May be only solution for open channels and streams	Weirs become clogged Submerged pressure transducers hard to install in high-flow channels
Positive displacement	Area of known quantity catches fluid, which is drained. Flow rate determined by frequency of draining.	Highly accurate Good for low flows Durable	Bearing wear degrades accuracy Dirty liquids and corrosion degrade performance
Turbine	Rotor turns as fluid travels over it. Flow rate proportional to the speed of blades.	High accuracy High repeatability	Moving parts wear Leaks Sensor failure Electronic failure
Vortex	Shedder bar generates vortices. Flow rate calculated by counting vortices.	Moderate price Less pressure drop than dP with orifice	Vibration influences accuracy Swirl-free flow needed

Source: Flow Research

flowmeter in the U.S. Many companies have since offered these instruments.

Initially, users did not understand ultrasonics. Misapplications led to inaccuracies. These experiences in the late 1970s and early 1980s gave ultrasonic flowmeters a negative connotation among some end users.

However, things have definitely changed since then.

Noninvasive, no moving parts

A primary advantage of ultrasonic flowmeters is that for pipes carrying process and other liquids, they are nonintrusive.

Not so with other types of flowmeters. For example, to install a dP flowmeter, you must install a primary element, such as an orifice plate, in the pipe to interfere with the flow. That element causes a pressure drop, which in turn costs money due to the cost of pumping the fluid.

But ultrasonic flowmeters, whether clamp-

Recent developments in the ultrasonic flowmeter market

Besides FMC's MPU 1200, there have been several other developments in the past few years:

1997	Siemens introduced its Sitrans F ultrasonic transit-time flowmeter for process industries; the meter recently received Factory Mutual approval.
1997	Krohne brought out its Altosonic V, a five-path ultrasonic flowmeter for custody transfer of liquid applications, first in Europe and then in the U.S. in 1998.
1998	Endress+Hauser introduced the ProSonic Flow DMU93, a clamp-on ultrasonic transit-time flowmeter.
1/2000	EMCO introduced the Sono-Trak, a clamp-on ultrasonic transit-time flowmeter.
8/2000	Panametrics will introduce the PT878, an upgrade of its portable PT868 clamp-on liquid meter.

Terminology

AGA	**American Gas Association**
dP	**differential pressure**

on or fixed, do not require any such obstacle in the flow stream, giving them an advantage over dP as well as vortex, turbine, and positive-displacement flowmeters. The latter two also require periodic recalibration because components such as orifice plates deteriorate.

Ultrasonic flowmeters, however, have another important advantage: no moving parts that wear down. Of course, this does not mean the meters never wear down—they do. Their electronic transmitters experience the same type of failure as other electronic components.

Choose transit time or Doppler?

A most important distinction in the ultrasonic flowmeter market is the difference between transit time and Doppler applications. Both apply to closed-pipe applications and have a similar operating principle.

Transit-time flowmeters have two transducers, one located upstream of the other. Both transducers send acoustic signals from one side of the pipe to the other. When the ultrasonic signal travels with the flow, it travels more quickly—it has higher velocity through the liquid—across the pipe than when it travels against the flow. The flowmeter measures the difference in transit time to calculate flow rate.

Transit-time flowmeters, which are more accurate today, mainly work on clean liquids and gases (i.e., those having no dissolved gases or entrained bubbles).

However, improvements in electronic processing technology have enabled these flowmeters to measure flow of these liquids that are not completely clean.

Doppler flowmeters, which like transit-time flowmeters have two transducers that act as sender and receiver, find use with liquids containing bubbles or particles. However, instead of bouncing acoustic signals off the other side of the pipe, Doppler flowmeters bounce acoustic signals off the particles or bubbles in the flow stream. As the signals reflect off those particles or bubbles, there is a frequency shift in the signals. Because flow rate is proportional to frequency shift, the ultrasonic flowmeter calculates flow rate using the measured shift.

Multipaths meet custody transfer

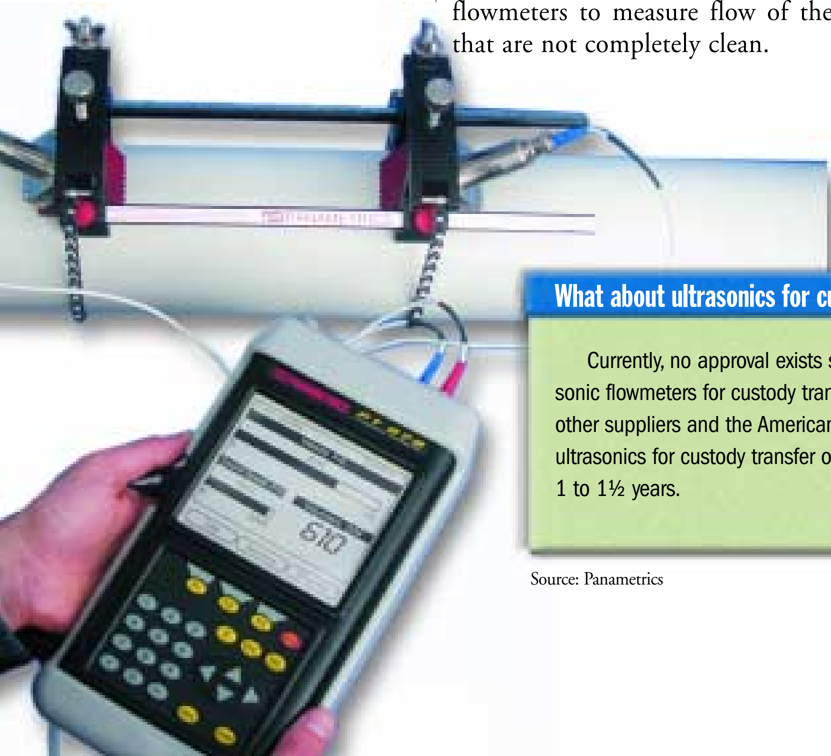
One most important recent development in the ultrasonic flowmeter market is the increased use of those devices to measure natural gas flow.

This move received a major boost in 1995 in Europe when Groupe Europeen de Recherches GaziŠres, commonly known as GERG, published Technical Monograph 8—*Present status and future research on multipath ultrasonic gas flowmeters*, which laid out criteria for using these instruments to measure natural gas flow for custody transfer.

Approval in the U.S. of these meters for custody transfer came in June 1998.

Then, the American Gas Association (AGA) published document AGA-9, which lays out criteria for suppliers and buyers to follow in using ultrasonics to measure gas transferred. Since approval of AGA-9, there has been a strong upsurge in use of ultrasonics in this industry.

The market for ultrasonic flowmeters in natural gas custody transfer applications remains the fastest-growing segment. Widely used and less accurate single-path ultrasonics—measuring flare gas, check metering, pipeline monitoring, and underground storage—are not approved, however.



What about ultrasonics for custody transfer of liquids?

Currently, no approval exists such as the AGA's AGA-9 document for using ultrasonic flowmeters for custody transfer of liquids. However, Krohne is working with other suppliers and the American Petroleum Institute to formulate criteria for using ultrasonics for custody transfer of hydrocarbons. This project should take another 1 to 1½ years.

Source: Panametrics

Ultrasonic and Coriolis: Complementary or competing?

While orifice-plate and turbine meters have dominated custody transfer measurement of natural gas, ultrasonic and Coriolis flowmeters are becoming increasingly popular.

But do these two technologies compete?

Coriolis flowmeters are generally available for pipe diameters of 6–8 inches and smaller, unless parallel meters are used. Multipath ultrasonic flowmeters, however, are best suited in pipes that are 6–8 inches or larger in diameter.

Also, for lines under 6-inch diameters, due to physical limitations of the meter body itself and due to small pipe diameters, it is sometimes difficult to equip ultrasonic units with enough sensors/detectors to compensate sufficiently for profile and swirl effects.

Coriolis meters, though, generally don't "scale up" well, meaning they become large, relatively expensive, heavy, and unwieldy when their meter inside diameter is larger than 6 inches.

"Ultrasonic gas overlaps Coriolis at the 6-inch or 8-inch line size," said Tom O'Banion, director of business development for Boulder, Colo.-based Micro Motion Inc. "Other than this, they are most definitely complementary. Both technologies offer greatly improved usable turndown ratio and much-reduced straight-run requirements."

Source: Endress+Hauser

Only multipath ultrasonic flowmeters are approved because of the accuracy required for custody transfer measurement, The main suppliers of these flowmeters, which are substantially more expensive than single-path meters, are Instromet with its Q-Sonic and Daniel with its SeniorSonic. FMC Smith Meter, which has also recently introduced its MPU 1200 flowmeter in Europe for custody transfer, is now beginning to market its meter in North America.

Keeping tabs on district heating

Another area where ultrasonic flowmeters find use is district heating—widely used in Europe, where more than 60% of Danish homes use this method, and in Asia but not in the U.S.

This method, which replaces individual boilers in each building, is a form of centralized heating for entire villages and other densely populated areas. A centrally placed boiler heats water that is then piped to all buildings in the network. Like mass transit, district heating offers significant environmental savings, including reductions in emissions of air pollutants.

Ultrasonic flowmeters measure the amount of heat energy used by a particular home or apartment with several temperature sensors and a flow computer. Mechanical flowmeters are also used.

However, ultrasonic flowmeters in district heating applications are much different from ultrasonics used in process industries. Being in the consumer rather than industrial category, many of the former cost $150 to $600. The main suppliers of ultrasonic flowmeters for European district heating applications are Kamstrup (Multical), Siemens (Ultraheat), and Danfoss (Sonocal).

What's coming?

One common feature of fast-growing markets is that new companies get into the market, and existing products update regularly. This is very true in the ultrasonic flowmeter market, so look for new suppliers to enter.

Even so, while new companies will continue to enter the market, those that have established products and a good track record will continue to dominate. At present, these companies include Panametrics, Controlotron, Instromet, Daniel, Krohne, and Danfoss. They will all maintain market share by upgrading existing products and finding new markets.

The ultrasonic flowmeter market will continue to grow as more users become familiar with the technology and achieve success with its use. For natural gas applications, ultrasonics will continue to expand, especially in the U.S. and Asia.

But while ultrasonics will continue to take business away from dP flowmeters, improvements in dP technology, such as multivariable transmitters and changes in primary element technology, will keep some users in the dP camp.

The story of ultrasonic flowmeters will be fascinating to watch as it unfolds in the future. IT

Behind the byline

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