By Jesse Yoder, Ph.D.

# Trends In New-Technology Flowmeters

## *Features & Reliability Drive Demand for Flow Measurement Systems*

In 2009, most flowmeter markets worldwide declined from 5 percent to 20 percent. The hardest hit were traditional technology meters, especially positive-displacement and turbine. While some new-technology flowmeter markets also declined in 2009, they fared better on the whole than did the traditional meters.

### Defining New-Technology Flowmeters

New-technology flowmeters, as defined by Flow Research Inc. (*www.flowresearch.com*), are characterized by the following traits:

1. The core technology was introduced after the end of World War II.
2. They incorporate technological advances that eliminate some of the common problems found in traditional flowmeters.
3. They receive more focus in terms of new product development than older technologies.
4. Their performance, including criteria such as accuracy, is at a higher level than that of traditional technology flowmeters.

Generally speaking, flowmeters that fit in the "new technology" category include Coriolis, magnetic, ultrasonic, vortex, and thermal.

### Coriolis Flowmeters

Coriolis flowmeters, which were introduced in the early 1970s, are still the most accurate type of flowmeter made. They are widely used in the chemical, food & beverage, pharmaceutical, oil & gas, and refining industries. They are produced in hygienic versions, often using stainless steel. Their high accuracy makes them a good fit for custody-transfer applications.

One limitation of Coriolis flowmeters is their line size. Coriolis flowmeters become unwieldy and expensive in line sizes above two inches, and the large majority of Coriolis meters sold are for line sizes of two inches and less. Despite this, there is a growing market for Coriolis meters in line sizes of six inches and above. This large line size market used to be dominated by Rheonik (now owned by GE Sensing, *www.gesensinginspection.com*). However, in the past several years, other companies have entered this market. These companies include Endress+Hauser (*www.us.endress.com*), Micro Motion (*www.micromotion.com*), and KROHNE (*www.krohne.com*). Look for continued product development in this large line size market.

Coriolis flowmeters are more widely used for liquid than for gas applications. Liquids are more dense than gases, and Coriolis meters depend on the ability of the fluid to deflect the flow tube. However, the market for custody transfer of natural gas is a growing market for Coriolis meters. Coriolis meters are also seeing more use for measuring liquefied natural gas (LNG).

Another important development for Coriolis meters has been the introduction of low-cost Coriolis meters. While these are typically not as accurate as their more expensive counterparts, low-cost Coriolis meters have opened up a market for end-users who want the advantages of Coriolis flowmeters, but may not require the same high accuracy that Coriolis meters typically have. Companies that have introduced low-cost Coriolis meters include Micro Motion and Endress+Hauser.

### Magnetic Flowmeters

Magnetic flowmeters were first introduced in industrial markets in the early 1950s. They are most widely used in the water & wastewater industry. Other industries for magmeters, as they are often called, include food & beverage, chemical, and pulp & paper.

Magnetic flowmeters can only be used to measure liquid flows; they cannot measure the flow of gas or steam. However, they are the meter of choice for many liquid applications. Magmeters can easily handle slurries and other wastewater and dirty water applications, as many have liners that tolerate these types of liquids. Magnetic flowmeters are also used for filling machines that dispense soda and other consumer-oriented beverages.

One recent development in the magmeter market has been the introduction of a wider variety of liners to accommodate sanitary and other applications. The most popular liners are PFA, PTFE, and hard rubber. Hard rubber is widely used for water applications, while PFA and PTFE are used for liquids containing chemicals.

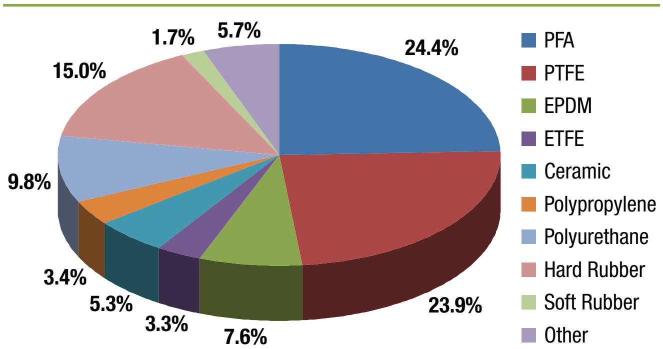


***Figure 1.*** *Shipments of Wafer and Flanged Magnetic flowmeters by Liner Type in Europe in 2008 (Percent of Dollars)*

One main advantage of magnetic flowmeters is that they can be used in almost any line size from less than ½" to over 120 inches. They are among the most adaptable flowmeters for any line size. Large line-size magmeters are used for large pipes in the water & wastewater industry, while small ones are used in food and pharmaceutical applications. In addition to the inline meters, magmeters also come in the form of insertion meters for large line sizes. While insertion magmeters are not as accurate as the inline versions, they are considerably less expensive.

### Ultrasonic Flowmeters

Tokyo Keiki first introduced ultrasonic flowmeters for industrial applications in Japan in 1963. There are two main types: transit-time and Doppler. Transit-time meters are the more accurate of the two types, and are better suited for clean fluids. Doppler meters can measure the flow of dirty liquids, and compete with magmeters for some applications. Suppliers have made many improvements in transit-time meters, and now they can handle fluids containing some impurities.

Transit-time meters measure flow by measuring the time it takes an ultrasonic pulse to travel back and forth across a pipe, usually at an angle. The traveling of the ultrasonic pulse back and forth across the pipe is considered a "path." Some ultrasonic flowmeters use more than one path to increase the accuracy of the flowmeters. Any ultrasonic flowmeter that has three or more paths is considered a multi-path meter.

The development of multi-path ultrasonic flowmeters for custody transfer of natural gas has been one of the most important developments in the flowmeter market in the past 10 years. In 1998, the American Gas Association (AGA, *www.aga.org*) approved the use of ultrasonic flowmeters for custody transfer of natural gas. The AGA had previously approved the use of differential pressure (DP) and turbine meters for this purpose. Since the AGA approval, the ultrasonic flowmeter market for custody transfer of natural gas has been steadily expanding, although ultrasonic meters still compete with turbine and DP meters for this application. Suppliers of custody-transfer meters to this market include Elster-Instromet (*www.elster-instromet.com*), Emerson Daniel (*www.daniel.com*), Sick Maihak (*www.sicknorthamerica.com*), and FMC Technologies (*www.fmctechnologies.com*).

## Vortex Flowmeters

Vortex flowmeters first came onto the market in 1969. Since that time, the market has grown somewhat slowly, despite certain advantages that vortex meters have. Vortex meters are among the most versatile of meters, in that they can measure liquid, gas, and steam flows with relative ease. They are especially suited for steam flows because they can handle the high pressures and temperatures that typically accompany steam flow measurement. They are more intrusive than ultrasonic and magnetic flowmeters, since they rely on the presence of a bluff body in the flowstream to generate vortices. Even so, they are significantly less intrusive than DP or turbine meters and also cause less pressure drop.

One important development in recent years has been the introduction of reducer vortex meters. Reducer meters have a smaller line size than the pipe they are placed in. The reduced line size enables the meter to measure lower flows. Most incorporate a single line size reduction, though some incorporate two line size reductions. Some companies offering reduced-bore vortex flowmeters include Emerson Rosemount (*www.rosemount.com*), Endress+Hauser, and Yokogawa (*www.yokogawa.com*).

Another important development was the approval by the American Petroleum Institute (API, *www.api.org*) for the use of vortex meters for custody-transfer applications. This approval was the work of API's Committee on Petroleum Measurement (COPM), which is made up of representatives from supplier and end-user communities. The approval, which occurred in January 2007, applies to the use of vortex flowmeters for liquid, gas and steam.

## Thermal Flowmeters

Thermal flowmeters were developed in the early 1970s as an offshoot of research into turbulence and air velocity profiles. This air-flow research used hot-wire anemometers, which were too fragile for industrial applications. John Olin, Ph.D., and Jerry Kurz, Ph.D., collaborated to develop a thermal flowmeter that was more rugged than the hot-wire anemometers. In 1973, they together formed Sierra Instruments (*www.sierrainstruments.com*). In 1977, Dr. Kurz formed Kurz Instruments (*www.kurzinstruments.com*), while Dr. Olin stayed with Sierra.

During the same period of time, Fluid Components International (FCI, *www.fluidcomponents.com*) was formed and developed thermal switches. While FCI was formed before Sierra (1964), it did not actually develop thermal flowmeters until 1981.

Thermal flowmeters were popular in the 1990s, during the advent of continuous emissions monitoring (CEM). In response to the need for CEM, thermal suppliers developed multi-point thermal flowmeters. Single-point thermal meters measure flow at a point, making it difficult to accurately compute flow for a large pipe. Multi-point meters measure flow at as many as 16 points, and use these values to compute flow for the entire pipe, duct or stack.

The 21st century has brought a new age of environmental awareness, giving new life to thermal flowmeters. Today they are used for a multitude of environmental applications, including ethanol distillation, biomass gasification, monitoring of flue gas, monitoring flare gas flows, and measuring emissions from steam generators, boilers, and process heaters.

## A "Magic Bullet" Technology?

Sometimes people ask if any new flow technology will come along all of a sudden and render the existing technologies obsolete. The odds against this are high. There are several newer technologies, classified as emerging technologies, which have begun to take some hold on the market. These emerging technologies are sonar and optical. Yet, like other flow technologies, they each have their advantages and disadvantages.

While there is no doubt that more flow technologies will emerge in the future, each will have to go through a 5-10 year period of acceptance and adoption, just like all the other flow technologies already have. Likewise, each is likely to be better suited for some applications than for others. The flowmeter market is complex, and cannot easily be reduced to a single formula or technology. For this reason, expect the new-technology flowmeter markets discussed in this article to be around and to continue to grow for as long as there is a need to measure flow.

***Jesse Yoder, Ph.D.****, is president of Flow Research Inc. in Wakefield, Mass., a company he founded in 1998. He has 22 years of experience as an analyst and writer in process control. Yoder specializes in flowmeters and other field devices, including pressure and temperature products. He has written over 110 journal articles on instrumentation topics. Flow Research has recently published a study that includes all flowmeter types, called "Volume X: The World Market for Flowmeters, 3rd Edition" (www.floweverything.com). Dr. Yoder can be reached at jesse@flowresearch.com.*

***www.flowresearch.com***