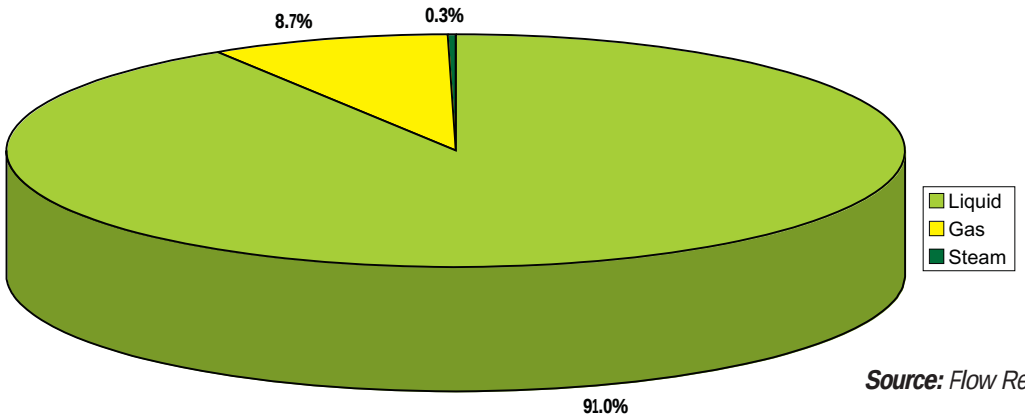
by Jesse Yoder, Ph.D.

The Changing Face of Coriolis

Technology Evolves to Meet More Measurement Needs

Shipments of Coriolis Flowmeters Worldwide in 2007 by Fluid Type



Source: *Flow Research Inc.*

Today's flowmeter market is influenced by a number of forces. End-users are looking for increased accuracy and reliability in the flowmeters they purchase, while growth in the energy markets, especially the oil & gas industry, has led to increasing demand for instruments to measure both oil and natural gas. The run-up in the per-barrel price of crude oil means that end-users are willing to pay more to measure it. It also increases the importance of accuracy in measurement.

Coriolis flowmeters are well-positioned to take advantage of the current trends in the flowmeter market. Coriolis flowmeters are the most accurate type of flowmeter. Accuracy levels for many Coriolis meters are in the +/-0.1 percent range. This makes them ideal for custody-transfer applications, and other applications requiring high accuracy. With no moving parts other than a vibrating flowtube, Coriolis meters are highly reliable and require a minimal amount of maintenance. While many Coriolis meters have a relatively high purchase price, their total cost of ownership is competitively low.

The roots of today's Coriolis meters are traceable back to the 1950s. However, the first commercially viable Coriolis flowmeter was not introduced until 1977. This meter was introduced by Micro Motion (*www.micromotion.com*), which remains a leading supplier to this market today. Since that time, a number of other suppliers have entered the market. Some of these suppliers include Endress+Hauser (*www.endress.com*), KROHNE (*www.krohne.com*), Yokogawa (*www.yokogawa.com*), and Siemens (*www.siemens.com*).

How They Work

The body of a Coriolis meter consists of one or more vibrating tubes. Typically, these tubes are bent, although some manufacturers make straight-tube meters. The fluid to be measured, usually liquid or gas, passes through the vibrating tubes. As the fluid flows towards the maximum vibration point, it accelerates; then it decelerates as it leaves the maximum vibration point. This causes a twisting motion in the tubes. Tube positions are detected by position sensors. Mass flow is directly proportional to the amount of twisting in the tubes.

The Price Factor

While Coriolis flowmeters are highly accurate and reliable, they are also one of the most expensive flowmeters in terms of purchase price. Suppliers such as Micro Motion and Endress+Hauser have responded by making available some lower cost Coriolis flowmeters, in the $3,000 range. These meters are competitive with magnetic, vortex, ultrasonic, and positive-displacement systems. However, the accuracy levels of these lower-cost meters are not as high as higher-end Coriolis devices. Even so, the emergence of low-cost Coriolis flowmeters makes Coriolis technology available to companies that are unable or unwilling to buy above a certain price point.

When looking at the cost of Coriolis flowmeters, many end-users distinguish between high purchase price and total cost of ownership. Some flowmeters, such as turbine and differential pressure (DP), have a relatively low purchase price. However, total cost of ownership may be high due to the need for periodic maintenance. Turbine flowmeters have a moving impeller, and the orifice plates often used with DP flowmeters are subject to wear. Coriolis flowmeters, by contrast, have no moving parts, apart from their vibrating tubes, and typically require little maintenance. This reduces their total cost of ownership, even though their initial purchase price may be relatively high.

Mass Flow Measurement

One of the most important features of Coriolis flowmeters is that they measure mass flow. While measuring volumetric flow is generally sufficient, sometimes it is necessary to measure mass flow. Many products are sold by weight rather than by volume, and mass flow measurement is often desirable in these cases. Chemical reactions are often based on mass rather than volume,

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so mass flow measurement is often required in the chemical industry. Mass flow is especially appropriate for gas flow measurement. This is because gas is affected more significantly by changes in temperature and pressure than liquids.

Key Differentiators

Tube Style

Coriolis suppliers differentiate themselves in a variety of ways. One is in the proprietary design of the bent tubes that make up the Coriolis meter body. Some companies offer single bent tubes, while others offer dual bent tubes. Other companies offer straight tube Coriolis flowmeters. In 1994, KROHNE became the first company to introduce straight-tube Coriolis meters. Straight-tube Coriolis meters cause less pressure drop than bent-tube meters and are also easier to clean. Both single bent tube and dual bent tube Coriolis meters are available.

Line Size

Line size is an important issue for Coriolis flowmeters. The large majority of Coriolis meters are sold for line sizes of two inches and less. Unlike ultrasonic flowmeters, which excel in line sizes above four inches, Coriolis meters become unwieldy and expensive in line sizes of four inches and above. However, suppliers are currently working to expand the line size support offered by Coriolis flowmeters.

For many years, Rheonik (www.rheonik.com) was the only company offering Coriolis flowmeters for line sizes above six inches. In the past several years, however, other suppliers have begun offering Coriolis meters in larger line sizes. These suppliers include Endress+Hauser, Micro Motion, KROHNE, and Yokogawa. It remains to be seen how end-users will respond to the availability of Coriolis flowmeters in the larger line sizes, but it does offer them a wider range of choices. Rheonik itself, which is based in Germany, was acquired by GE Sensing & Inspection Technologies (*www.gesensinginspection.com*) in January 2008.

Support for Steam Flow

Nearly all Coriolis flowmeters are used for both liquid and gas flow measurement. However, a very limited number of Coriolis meters are beginning to be used to measure steam flow. Today, steam flow measurement is dominated by DP and vortex flowmeters. However, concerns with efficiency and the need for higher accuracy are causing users to look at both Coriolis and ultrasonic flowmeters for measuring steam flow. One difficulty in using Coriolis meters for steam flow is in handling condensation in the steam flow lines. Coriolis flowmeters today are an emerging technology for steam flow measurement. Watch for further developments in this application.

Industry Approvals

Industry approvals have also played an important role in the growing use of Coriolis flowmeters. The American Gas Association (AGA, www.aga.org) has approved a report on the use of Coriolis flowmeters for custody transfer of natural gas. And the American Petroleum Institute (API, *www.api.org*) has issued several draft standards on the use of Coriolis flowmeters for measuring crude oil and liquid hydrocarbons. Industry approvals have previously played a major role in growth in the DP, turbine, and ultrasonic flowmeter markets, and they are also helping Coriolis flowmeters gain wider acceptance, particularly for custody-transfer application environments.

The Road Ahead

Look for suppliers to continue to make technological improvements to Coriolis flowmeters. Coriolis meters are now much better able to measure gas flow than previous iterations of the technology. Straight-tube Coriolis meters have become more accurate and reliable. Expect to see more Coriolis flowmeters designed for specific applications, including food and beverage, as well as compressed natural gas (CNG) and liquefied natural gas (LNG). Coriolis meters are, and will continue to be, widely used in the food & beverage and pharmaceutical industries, as they are well-suited for hygienic applications.

Expect also to see products at the high and low ends of the Coriolis flowmeter spectrum. End-users will continue to demand Coriolis flowmeter technology at a competitively low price. On the high end, more companies are bringing out Coriolis flowmeters for large line sizes. End-users will continue to demand higher performance, including enhanced diagnostics. The higher price of fuel will put more emphasis on accuracy in measuring fuel flow and will increase the importance of custody-transfer measurement. Coriolis flowmeters will offer a solution for those measurements. FC

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