by Jesse Yoder, Ph.D.

A Hot Technology for Steam & Gas Flows

Industry Approvals & Innovation Drive Demand for Vortex Flowmeters

Vortex flowmeters make use of a principle called the von Kármán effect, named after Hungarian-American engineer Theodore von Kármán. According to this principle, flow will alternately generate vortices when passing by a bluff body. A bluff body has a broad, flat front. In a vortex flowmeter, the bluff body extends vertically into the flowstream. Flow velocity is proportional to the frequency of the vortices, and flowrate is calculated by multiplying the area of the pipe times the velocity of the flow.

In some cases, vortex meters require the use of straightening vanes or straight upstream piping to eliminate distorted flow patterns and swirl. Low flowrates present a problem for vortex meters, because such meters tend to generate vortices irregularly under low-flow conditions. The accuracy of vortex meters is from medium to high, depending on the model and manufacturer. In addition to liquid and gas flow measurement, vortex flowmeters are widely used to measure steam flow.

Technologies & Market Trends

Vortex flowmeters are well suited for measuring steam flow because they are capable of handling high-pressure, high-temperature applications with a wide range of variability. Different types of steam, such as wet steam, saturated steam and superheated steam, present different measurement characteristics, and vortex meters can effectively adapt to such changes.

Steam is often measured in process plants and for power generation. In these applications, vortex meters can accurately measure steam flow at varying velocities, such as when steam is measured coming out of a boiler.

Vortex flowmeters have some advantages over other types of new-technology flowmeters when it comes to measuring gas and steam flow in particular. Gas flow measurement is still a relatively new application for Coriolis meters, and the use of Coriolis meters to measure steam flow is just beginning. While ultrasonic meters are widely used to measure gas flow, steam flow is a new application for them. And magnetic flowmeters cannot be used to measure steam flow or nonconductive liquids, such as hydrocarbons. Multivariable DP flowmeters can be used to measure liquid, gas, and steam; however, multivariable DP flowmeters rely on the presence of a primary element, such as an orifice plate, for flow measurement, which means they have substantially greater pressure drop than vortex meters.

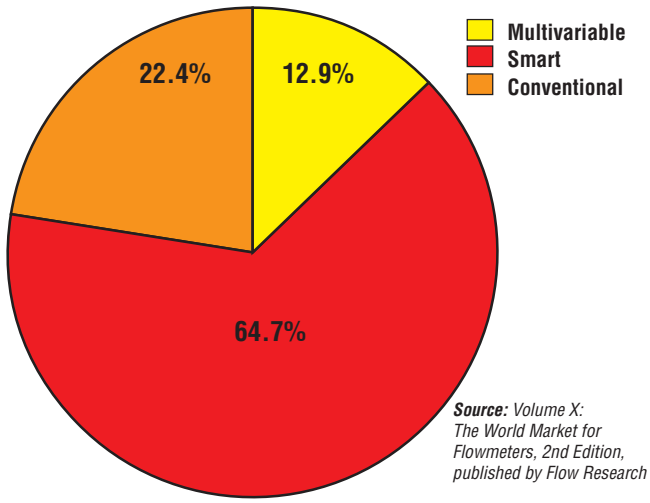
Vortex Flowmeters for Custody-Transfer Applications

Custody-transfer of natural gas is a fast-growing market, particularly with the increased popularity of natural gas as an energy source. Natural gas changes hands, or ownership, at a number of points between the producer and the end-user. This changing of hands occurs at custody-transfer points, and it is highly regulated by the American Gas Association (AGA, *www.aga.org*) and the American Petroleum Institute (API, *www.api.org*). Some other geographic regions have their own regulatory bodies. One such organization is the European Gas Research Group (GERG, *www.gerg.info*), which is largely composed of natural gas producers in Europe.

One important function of the AGA and the API is to lay down standards or criteria for sellers and buyers to follow when transferring ownership of natural gas from one party to another. In the past, these groups have published reports on the use of orifice-plate meters and turbine meters for use in the custody-transfer of natural gas. More recently, both Coriolis and ultrasonic flowmeters have been approved for custody-transfer applications, generating significant growth for both meter types.

During the past five years, the Committee of Petroleum Measurement of the API has developed a standard relating to the use of vortex flowmeters for custody-transfer of liquids and gases. This committee was comprised of representatives from flowmeter manufacturers, major oil and gas companies and independent consultants. The standard they developed was approved and published as a draft standard in January 2007. The publication of this standard is likely to boost the use of vortex flowmeters for liquid and gas applications. Meanwhile, the AGA figures to get involved in considering the gas portion of the standard with the specification to be reviewed again in 2010.

Shipments of Vortex Flowmeters by Type in 2008
Percent of Dollars



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Reducer Vortex Flowmeters Enhance Accuracy

The introduction of reducer vortex flowmeters represents an important technology enhancement in recent years. Reducer vortex meters have a smaller diameter in the center of the pipe where the bluff body generates vortices. This reduced diameter speeds up the flow where the pipe narrows. This design has simplified vortex installation and improved the accuracy of the vortex measurement. Emerson Process Management (*www.emersonprocess.com*) released its line of reducer vortex flowmeters in July 2003.

Multivariable Vortex Flowmeters for Steam & Gas Flows

Sierra Instruments (*www.sierrainstruments.com*) introduced the first multivariable vortex flowmeter in 1997. This meter included an RTD temperature sensor and a pressure transducer with a vortex-shedding flowmeter. By using the information from these sensors, the flowmeter can determine volumetric flow, temperature, pressure, fluid density, and mass flow. This multivariable flowmeter is one of a growing number of new multivariable flowmeters, including multivariable magnetic flowmeters and multivariable DP flowmeters, as well as multivariable ultrasonic flowmeters, which are popular in district heating applications.

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In the past several years, a number of new suppliers have introduced multivariable vortex flowmeters. These include ABB (*www.abb.com*), Yokogawa (*www.yokogawa.com*), KROHNE (*www.krohne.com*), EMCO Flow Systems (*www.emcoflow.com*), and Endress+Hauser (*www.us.endress.com*). While multivariable flowmeters are somewhat more expensive than their single-variable counterparts, they enable end-users to obtain significantly more information about the process than a single-variable volumetric meter. This additional information can result in increased efficiencies that more than make up for the additional cost of the multivariable flowmeter. Multivariable vortex flowmeters also have the capability of measuring mass flow, which makes them particularly attractive for steam and gas flow measurement.

Insertion Flowmeters Reduce Costs for Larger Line Sizes

Vortex flowmeters come in three mounting types – wafer, flanged and insertion. Wafer and flanged vortex meters top out at 16 inches, but insertion vortex meters can be used for larger line sizes. Though they represent a relatively small portion of the total market, insertion vortex meters are important because they are cost-effective in large line sizes. Like insertion magmeters, insertion vortex meters are used when a wafer or flanged meter is not practical, or when cost is a major consideration.

Industry News & Notes

Over the past five years, a number of companies that previously had only single-variable vortex flowmeters have entered the multivariable vortex flowmeter market. In addition to this, some new companies have entered the vortex flowmeter market in general. These companies include Aalborg (*www.aalborg.com*), Yamatake (*www.yamatake.com*), and Nice Instrumentation (*www.niceinstrumentation.com*). Aalborg entered the market in February 2005 when it acquired Venture Measurement's (*www.venturemeas.com*) vortex flowmeter line.

In addition, Racine Federated (*www.racinefed.com*) purchased the industrial vortex flowmeter product line from J-TEC Associates (*www.j-tecassociates.com*) in April 2005, and it acquired Asahi America's (*www.asahi-america.com*) vortex flowmeter product line in March 2007. Spirax Sarco (*www.spiraxsarco.com*), a UK-based firm focused on steam-related products, purchased the vortex flowmeter line from EMCO Flow Systems in June 2005. Meanwhile, Universal Flow Monitors (*www.flowmeters.com*) brought out a new line of plastic vortex flowmeters called Cool Point in 2002. The presence of these new suppliers and product lines is injecting new life into the vortex flowmeter market and helping to spread this technology to still more customers. FC

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For more information on Flow Research's new study "The World Market for Vortex Flowmeters 4th Edition," please visit ***www.flowvortex.com***