Recent flowmeter advances reflect energy market priorities

Bigger Coriolis meters, diagnostic-minded ultrasonics and more reliable thermal flowmeters among advances

By Jesse Yoder

The past few years saw numerous innovations in flowmeter technology. While most examples involve new-technology flowmeters, i.e., those introduced since 1950, some innovation also has occurred in traditional flowmeters. One significant driver of innovation has been issues related to petroleum extraction from oil and gas reserves. Also important have been needs for better diagnostics, higher accuracy and greater reliability.

One major development has occurred in Coriolis flowmeters. It used to be that Rheonik — now owned by GE Measurement & Control Solutions, Billerica, Mass. — was the only flowmeter supplier offering Coriolis flowmeters above 6 inches in diameter. Today, suppliers that include Emerson Process Management's Micro Motion, Boulder, Colo.; Endress+Hauser, Greenwood, Ind., and Reinach, Switzerland; and KROHNE Group, Duisburg, Germany, all offer Coriolis flowmeters in these larger line sizes. The two largest Coriolis meters currently available, from Endress+Hauser and Micro Motion, fit a 16-inch line.

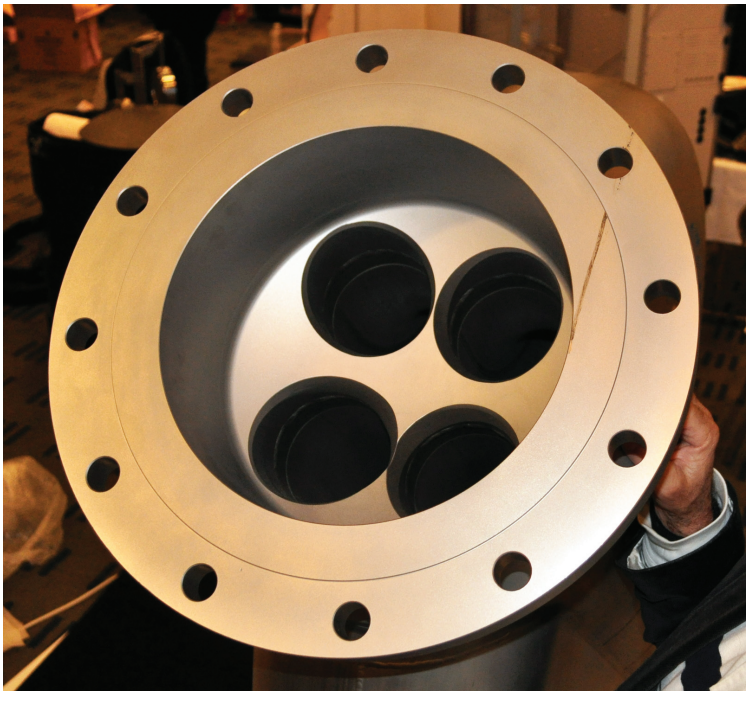
These new 8-inch and 16-inch Coriolis flowmeters are suitable for custody-transfer applications in oil and gas markets. In today's oil and gas fields, ownership of the wells' productive output is typically governed by complex arrangements. Variations in output, phase separation, line losses or other factors can mean that reconciling the measured output at the wells with measured input at terminals or refineries can be challenging. Oil companies are therefore willing to invest in the very best technology at the well site to measure that output. While these meters can cost as much as the $75,000 range, they offer high accuracy with stable and reliable measurement.

GE Rheonik, Micro Motion and Endress+Hauser all use a bent-tube design. KROHNE, by contrast, uses a straight-tube design. This can have decided space advantages, since bent-tube meters are large and heavy.

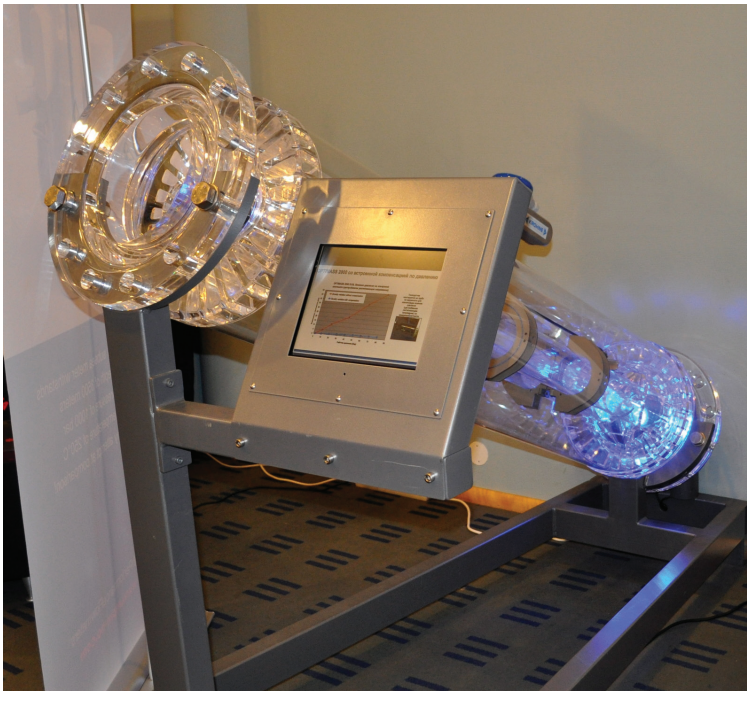
These large line size meters are changing the Coriolis meter market profile. In the past, 85% to 90% of Coriolis flowmeters shipped were for line sizes of 2 inches and less. Moreover, suppliers may soon make use of materials that allow reducing the overall size of large Coriolis meters. And it is safe to say that suppliers will not stop at 16 inches in terms of line sizes.

Ultrasonic paths and chords

Custody-transfer applications also figure large in research and development efforts aimed at ultrasonic flowmeters. Elster Instromet, Essen, Belgium, and SICK



Entrance to Endress+Hauser's Proline Promass 83X/84X Coriolis flowmeter



KROHNE's OPTIMASS 2000

Maihak GmbH, Dresden, Germany, have made contributions here. In addition, improvements have been seen in the performance of clamp-on and insertion ultrasonic flowmeters. Other suppliers of ultrasonic flowmeters include KROHNE, Flexim and Cameron.

Elster-Instromet's latest ultrasonic flowmeter offering is the Q.Sonic-plus, with six paths and 16 chords, and meant for application to natural gas custody transfer. In addition, the Q.Sonic-plus is for fiscal metering in natural gas transmission, distribution, storage and production. Elster introduced the Q.Sonic-plus to the North American market in May 2011 at the American Gas Association (AGA) Conference in Nashville, Tenn. Its diagnostic capability reduces needs for upstream piping.

These advanced diagnostics take into account flow profile, swirl and turbulence. The diagnostics even adjust for build-up of grime on the inside of the meter, using its multiple paths and enhanced number of measuring chords.

SICK Maihak is a relatively recent entrant to the custody-transfer market, but it has made substantial strides in five years and is among the market leaders. SICK's FLOWSIC600, an ultrasonic flowmeter for natural gas custody transfer, has either two or four measurement paths. SICK's FLOWSIC600 meter emphasizes diagnostics. Using condition-based maintenance (CBM), it can provide a warning whenever key parameters — including turbulence, speed of sound, symmetry, signal-to-noise ratio and profile factor — are exceeded.

Another ultrasonic meter manufactured by SICK is the FLOWSIC100 Flare meter, an insertion meter meant for flare-gas applications. Its unique sensor design enables it to more easily handle high-speed flows. It can be used for compliance with government regulations in measuring CO_2 emissions. Ultrasonic flowmeters compete with thermal meters and differential-pressure flowmeters with averaging Pitot tubes for flare-gas applications.

Ceramics and sapphires

Turbine meters today are more reliable because their moving parts — a traditional source of concern regarding maintenance and repair — are more reliable. With more durable materials for ball bearings, such as newly developed ceramics and synthetic sapphires, turbine suppliers add significantly to meter bearing life. This is important, since some users select new-technology meters over turbine meters simply because they have no moving parts subject to wear.

Other enhancements include the "dual-rotor design" from Exact Flow, Scottsdale, Ariz.; Cox Flow Measurement, Scottsdale, Ariz., and other manufacturers. Dual rotors increase the effective operating range of turbine meters in the smaller line sizes. The two rotors turn in opposite directions, with the first being upstream from the second and acting as a flow conditioner. Flow is then directed back to the second rotor. The rotors are hydraulically connected and continue to turn even at very low flowrates. This innovation has enhanced turbine flowmeters' suitability in low-flow applications. Finally, Elster has released a new "reversible flow" turbine flowmeter that has additional diagnostic features.

Even though multiphase technology has been around almost 30 years, multiphase flowmeters are still in a relatively early phase of development. They are used in the oil and gas industry to measure the percentage and amount of oil, gas and water that comes out of the wellhead before they are separated. Multiphase flowmeters not only analyze the contents of the fluid coming from the well, they also provide information about the fluid reservoir.

Oil and gas companies are embracing the technology. For some applications, it's the only solution going, but the technology also is improving. This includes higher accuracy, but also approved measurement reliability, repeatability, size, complexity and price/performance ratio. Multiphase meters today provide auditable flow measurement with space and weight advantages. They tend to be more accurate than two or three-phase well testers, offering shorter test times, portable units and well optimization.

Suppliers are competing for market share and leadership in this growing market. Greater industry acceptance of Coriolis flowmeters, which are used in some multiphase flowmeters, also contributes to overall comfort with the solution.

Technical advances manufacturers expect over the next few years involve the following:

- Better repeatability across application throughput data
- Improved accuracy
- Fiscal applications
- Salinity measurements
- Full range Gas Volume Fraction (GVF) capability
- Detection and compensation for wax and scaling
- Alternate methods for direct density measurement

As joint ventures own many oil fields, the demand for higher multiphase accuracy for allocation metering and other fiscal measurement is likely to increase.

Suppliers also are exploring non-nuclear multiphase solutions. Experts insist that there are no risks or hazards associated with the nuclear components in multiphase flowmeters. Manufacturers staunchly maintain that nuclear provides the best and most robust measurement. They question the feasibility of obtaining a gas/liquid contrast any other way. However, some suppliers say the industry wants to move away from "problems" on systems with nuclear components. Some companies are producing alternative solutions, including a source based on an X-ray generator that has been successfully field-tested.

Markets driven by innovation

While some technology suppliers pour millions of dollars into research and product development, others sell the same products year after year. Coriolis, ultrasonic and multiphase meter suppliers are actively developing new products. Turbine suppliers also have been active in producing innovations.

It is inevitable that companies not investing in innovation will lose ground to those that have innovative products. That is one reason why the multiphase, ultrasonic and Coriolis markets are the fastest growing flowmeter markets today. New developments are also occurring in thermal flowmeter and mass flow controller markets. But suppliers need to take the need for innovation seriously if they are to stay on top of their game.

Jesse Yoder, Ph.D., is president of Flow Research, Inc. (www.flowresearch.com), a company he founded in 1998. He has 24 years of experience as an analyst and writer in process control. Dr. Yoder specializes in flowmeters and other field devices, including pressure, level and temperature products. He has written over 100 market research studies in industrial automation and process control and has published numerous journal articles.

Different flows, different flowmeters

Below please find elementary descriptions of the most basic flowmeter types.

Promass E 200 Coriolis flowmeter from Endress+Hauser, Greenwood, Mass.

Coriolis – measures mass flow as proportional to the Coriolis force that twists a U-tube installed in the flow line, for curved tube flowmeters.

Magnetic – based on Faraday's Law, which states that the voltage induced across any conductor as it moves at right angles through a magnetic field is proportional to the velocity of that conductor. It is a volumetric flowmeter, said to be suitable for wastewater applications, or any dirty liquid that is conductive or water-based.

FDT-21 ultrasonic flowmeter from Omega Engineering, Stamford, Conn.

Ultrasonic – using ultrasonic transducers, measures the average velocity along the path of an emitted beam of ultrasound. Ultrasonic flowmeters are affected by the temperature, density and viscosity of the flowing medium.

Vortex – detects the frequency of vortex shedding behind an obstacle in flowing fluid by measuring small pressure variations. Measures gas flows from the precession of vortices generated by a fixed set of radial vanes placed in the flow.

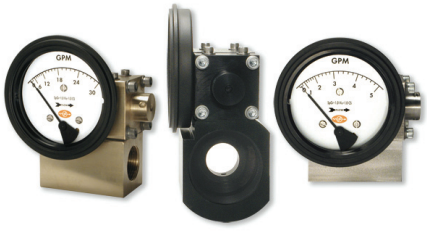
Thermal mass flowmeters – generally use combinations of heated elements and temperature sensors to measure the difference between static and flowing heat transfer to a fluid and infer its flow, based on knowledge of the fluid's specific gravity and density; often used to measure the flow of gases.

Chlorine-Trak 7605 thermal mass flowmeter from Sierra Instruments, Monterey, Calif.

Positive displacement – requires fluid to mechanically displace components in the meter to measure flow. Positive displacement flowmeters measure the volumetric flowrate of a moving fluid or gas. They can be used in very viscous, dirty and corrosive fluids.

Turbine – translates the mechanical action of a turbine rotating in the liquid flow around an axis into a user-readable rate of flow.

Differential pressure – uses the differences in pressure resulting from a constriction as an indicator of flow, based on the relationship between the volumetric flowrate and pressure drop. The primary element restrictor can be an orifice plate, flow nozzle, Venturi tube or some other.



Differential pressure flowmeter from Orange Research, Milford, Conn.