Taking on the big guns

How small but nimble companies compete against the Coriolis and magnetic flowmeter giants

by Jesse Yoder, Flow Research

Coriolis and magnetic flowmeters are two interesting types of flowmeters to study together. Both are classified as new-technology flowmeters, meaning they were introduced after 1950, and are currently the focus of significant product development. New-technology flowmeters are contrasted with traditional technology meters. These flowmeters were introduced before 1950, have a large installed base, and are less the subject of new product development than new-technology meters. Examples of traditional technology flowmeters include differential pressure, positive displacement, and turbine meters.

There are both similarities and differences between Coriolis and magnetic flowmeters. The Coriolis and magnetic flowmeter markets are the two largest flowmeter markets in terms of worldwide revenues, each exceeding $1.0 billion dollars in 2016. In terms of industries, the oil and gas industry, including refining, along with chemical, are the two largest industries for Coriolis. The third largest industry for Coriolis flowmeters is food and beverage. By contrast, water and wastewater is the largest industry for magnetic flowmeters, followed by chemical and food and beverage.

Coriolis flowmeters

Micro Motion was the first company to introduce a working Coriolis flowmeter to the market in 1977. All Coriolis meters at that time had bent tubes. A number of different bent tube designs were developed over the next 20 years, due in part to patent considerations. However, bent tubes caused pressure loss and buildup of fluid around the tubes. This was especially an issue in food and beverage and other sanitary applications.

To counter the problems with bent tube meters, Endress+Hauser (Endress) introduced the first straight tube Coriolis meter in 1987. This meter, which later evolved into the ProMass, had dual straight tubes. In the early 1990s, Schlumberger manufactured a single tube straight tube meter. However, this design was not commercially successful, and had to be withdrawn from the market. In 1994, Krohne brought out the first commercially successful single straight tube Coriolis flowmeter.

Principle of operation

Coriolis flowmeters contain one or more vibrating or oscillating tubes, usually bent. They are made to oscillate by sensors in the form of magnet and coil assemblies mounted on the inlets and outlet of the flow tubes. As the fluid moves through the tubes, they twist in proportion to mass flowrate. The inlet and outlet sensors detect the amount of twist. These sensors measure a phase shift that is proportional to the mass flow.

Coriolis flowmeters got their name by treating the oscillation of the tubes as a form of rotational motion. The Coriolis effect applies to the motion of bodies in a rotating frame of reference. The question is whether the oscillation of the flow tubes is a form of rotational motion, or whether the oscillating motion can be explained as the effect of the inertia of the fluid entering an oscillating field. The examples given to illustrate the Coriolis effect often cite circular rotation, such as the rotation of the earth, or the rotation of a merry-go-round. But oscillating motion typically is motion back and forth, like that of a pendulum.

Regardless of how this issue is resolved, the mathematics may be the same, and it may only be a matter of how the motion

A Tricor Coriolis flowmeter measuring water coming off a separator. (Photo courtesy of AW-Lake)

is described. Early (pre-1975) patents do not attempt to explain how the Coriolis effect applies to Coriolis flowmeters; they simply assume it. While it is unlikely that Coriolis meters will ever be renamed, the question of how they actually implement the Coriolis effect is worth another look.

Leading Coriolis suppliers

The leading suppliers to the Coriolis flowmeter market are Emerson Micro Motion, Endress, and Krohne. These companies are responsible for many of the innovations in the field, as has already been identified. They are also the companies that are leading the way in the development of large line size Coriolis meters, a trend that has become increasingly important in the past five years.

However, not all innovations for most technologies come from the largest companies. Rheonik, a company much smaller than the top three suppliers, was the first Coriolis meter company to manufacture Coriolis meters larger than six inches. In magnetic flowmeters, a variety of smaller companies have come out with successful battery operated meters, while some of the market leaders have yet to implement this technology. In 1987, McCrometer successfully introduced the first cone style meter in the form of the V-Cone. McCrometer invented the class of cone meters, which are now also manufactured by companies such as Cameron and EMCO Controls.

Tricor

The Tricor Coriolis flowmeter was designed and engineered in the United States, Germany, and Switzerland. It is manufactured by KEM (Küppers Elektromechanik) of Karlsfeld, Germany. In June 2011, KEM's sister company, AW-Lake, introduced the Tricor line to North America. AW-Lake is located in Oak Creek, Wisconsin, and is the result of the merger of AW Company and Lake Monitors. AW Company made positive displacement meters, while Lake Monitors manufactured variable area meters. Both KEM and AW-Lake are members of the Tasi Group, which itself is made up of 13 companies. Six companies make up the Tasi Flow Group, including KEM and AW-Lake.

The Tricor line consists of a Classic Series, a Pro Series, and a Specialty Series. While it does not have a straight tube meter, it features both a U-shaped bent tube meter and a diamond shaped bent tube meter. KEM and AW-Lake have taken the approach of developing somewhat specialised meters for specific applications. These include applications in oil and gas, automotive, marine, chemical and petrochemical, and food and beverage. In April 2018, KEM and AW-Lake introduced the world's first MI-002/OIML137 certified Coriolis flowmeter for hydrogen dispensing applications. The latest addition to the Tricor line is the TCD 9000 Series Transmitters that incorporate digital signal processing (DSP). These transmitters were introduced in July 2018.

In terms of technology, it is significant that the Tricor was developed through the collaboration of American, German, and Swiss technology. This type of international cooperation is especially noteworthy in the world of flowmeter product development. Geographically, the company is well positioned to sell into Europe and North America, given the locations of KEM and AW-Lake.

From a strategic perspective, the Tricor represents an attempt by two companies that almost exclusively manufactured traditional technology flowmeters to branch out into new-technology meters. KEM and AW-Lake manufacture and distribute spur gear, helical gear, rotary piston, turbine, paddlewheel, and variable area meters. The only other new-technology flowmeter these companies have in the Tasi Group umbrella is thermal mass flowmeters. Since Coriolis meters are displacing positive displacement flowmeters for many applications, KEM and AW-Lake are well-positioned to take advantage of this trend.

From the left: Vladimir Čepelík (CEO), Hana Simonova, and Petr Piskula of the ELIS team at the headquarters in Pilsen, Czech Republic. (Photo by Flow Research)

Magnetic flowmeters

The Tobinmeter Company first introduced magnetic flowmeters for commercial use in Holland in 1952. Foxboro brought them to market in the United States in 1954. Since that time, more than 50 companies have come to manufacture and offer magnetic flowmeters. Magnetic flowmeters exceed Coriolis meters in terms of worldwide revenues. The stability and reliability of the magnetic flowmeter have made it the world's most trusted type.

It is interesting to compare the sales of magnetic flowmeters in Europe to the sales of these meters in the United States. Magnetic flowmeter sales outpace sales in the United States, plus the top two suppliers are in Europe. Europe, with its lakes, rivers, streams, canals, and oceans, has more need for water measurement than does the United States. Of all the flow technologies, magnetic flowmeters appear to be the meter of choice in Europe. In the United States, differential pressure technology is more prevalent.

Principle of operation

Magnetic flowmeters use Faraday's Law of Electromagnetic Induction. According to this principle, a voltage is generated in a conductive medium when it passes through a magnetic field. This voltage is directly proportional to the density of the magnetic field, the length of the conductor, and the velocity of

the conductive medium. In Faraday's Law, these three values are multiplied together, along with a constant, to yield the magnitude of the voltage.

Magnetic flowmeters use wire coils mounted onto or outside of a pipe. A voltage is then applied to these coils, generating a magnetic field inside the pipe. As the conductive liquid passes through the pipe, a voltage is generated and detected by electrodes, which are mounted on either side of the pipe. The flowmeter uses this value to compute the flowrate.

Leading suppliers

Krohne is one of the leading suppliers of magnetic flowmeters. The company's headquarters for magnetic flowmeters is located in Dordrecht, the Netherlands. However, it manufactures magnetic flowmeters in the Netherlands, Brazil, India, and China. On 1 October, 2018, the company opened a new US manufacturing facility in Beverly, Massachusetts. There, it will manufacture both flow and level products, including magnetic flowmeters.

Endress is also a leading European supplier of magnetic flowmeters. The flow division is based in Reinach, Switzerland. It is one of the most innovative manufacturers of magnetic flowmeters offering a wide variety of products designed for specific applications through special combinations of sensors and transmitters. Endress offers a wide variety of liners designed to accommodate a wide range of industries and applications.

Flonet

Just as is the case with Coriolis meters, the leading suppliers account for many of the innovations in the field. At the same time, there are smaller magnetic flowmeter companies that compete effectively in this crowded field by selecting individual markets and applications to serve. One of these companies is Eliz Plzen (Elis), located in Pilsen, the Czech Republic. Elis is the largest of a small group of flowmeter companies in the Czech Republic. The company was founded in 1990, and it offers both magnetic and ultrasonic flowmeters.

Elis offers magnetic flowmeters in sizes from ¼ inch to 48 inches (DN 6 to DN 1200). It offers a choice of five electrode materials, and multiple linings including hard and soft rubber, PFA, and PTFE. Industries served include water and wastewater, chemical, petrochemical, power, HVAC, pharmaceutical, oil and gas, and food and beverage. Applications include drinking water, wastewater, slurries, food liquids, and chemical liquids.

Elis was founded in 1990 by František Zýka and four colleagues from the Electrotechnical Research Institute of Skoda Plzen. The company was formed shortly after the "Velvet Revolution," during which Czechoslovakia was transformed into a democratic state. At that time there was a government edict to measure the consumption of all types of energy and media that were subject to commercial transactions. For this reason, Elis initially focused on the production of heat meters in water and steam and later water meters and flowmeters for liquids.

Initially Elis purchased heat and energy meters from other companies. Over time, the company concluded after technical analysis that it could develop a superior product by engineering its own flowmeters. Elis first developed its own ultrasonic meters. When it became time to enter the water industry, Elis developed its own magnetic flowmeters.

Today, Elis exports 90% of its products to over 50 countries worldwide. It is especially strong in Russia and in the Middle East. In addition to its innovative and highly engineered products, Elis competes by offering short delivery times, customised solutions, and fast service solutions. It also competes by taking advantage of what it calls "best price production" in what is a highly competitive market.

Conclusion

What can we learn from this comparison of the leading Coriolis and magnetic flowmeter companies with the smaller companies we have looked at that are in the same market? Endress, Krohne, and Emerson Flow Solutions set the Gold Standard for flowmeter companies, and are among the most innovative and technically advanced flowmeter companies in the world. And yet there are smaller companies that compete on specific applications, delivery times, customer service, and customised solutions. There are many other excellent companies besides those described here.

Many people tend to just look at products without considering that when you buy a product, you are really buying a company. I have seen companies with highly sophisticated products lose business due to an inability to provide quotes, slow delivery times, a refusal to return phone calls, and lack of a coherent internal organisation. The high number of recent mergers and acquisitions, in which two companies with very different cultures and overlapping personnel try to become one entity, often takes its toll on customer satisfaction. And this can also lead to a "brain drain" where people with a lifetime of experience are ushered out the door without so much as a one day notice.

The mere fact that so many high-quality companies survive in the flowmeter world shows that there are many ways to compete

The mere fact that so many high-quality companies survive in the flowmeter world shows that there are many ways to compete, in addition to competing on products. Creating innovative products, doing market research, listening to the voice of the customer, and targeting specific applications are just four of the many ways to build a successful flowmeter company in a highly competitive world. And don't forget that smaller companies can be more nimble, giving them still another advantage.

For more information:
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