by Jesse Yoder, Ph.D.

Mass Appeal

Market Outlook for Mass Flow Controllers

There are at least 13 different principles used to measure flow, including new-technologies such as Coriolis and ultrasonic, traditional technologies such as positive displacement, and the emerging technologies of sonar and optical. Using any one of these principles, flowmeters measure some state or condition that is correlated with flowrate, then use this value to compute volumetric or mass flow. If flow also needs to be controlled, this is left to another device, such as a valve or a flow controller.

There is another type of flowmeter that not only measures flow, but also has a built-in controller to control the flow. This type of flowmeter is called a mass flow controller (MFC), and it is widely used in the semiconductor industry to measure and control the flow of gases and liquids used in the process of manufacturing computer chips. Mass flow controllers also have an increasing use for measuring flow in industrial applications.

How They Work

Most mass flow controllers measure flow using a thermal principle, although a small percentage use a differential-pressure method. What is unique about mass flow controllers is that they include a bypass that is also known as a flow splitter. The bypass diverts a portion of the flow into a separate channel or capillary tube where the flow is measured.

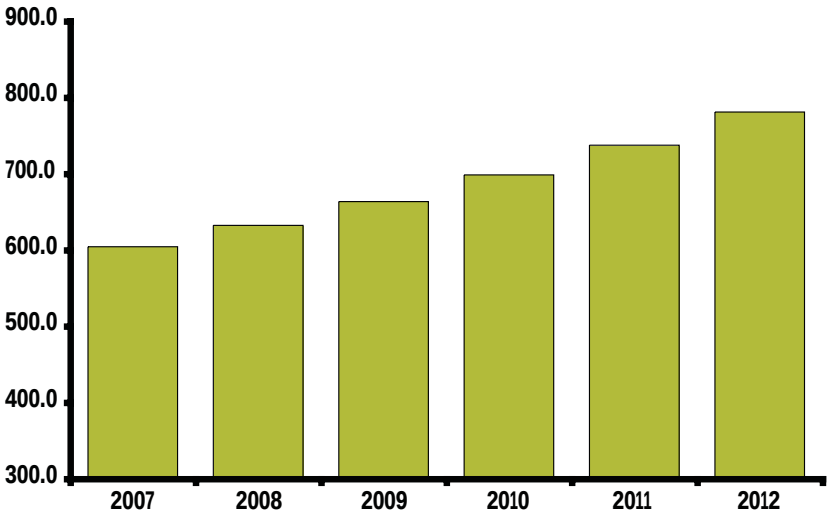
By maintaining a constant ratio between the gas flow in the diverted channel and the flow through the main flow path, the mass flow controller can determine the amount of flow passing through the flow controller based on the measurement of flow in the diverted channel. After the fluid passes through the diverted channel, it rejoins the main flow path and continues on its way downstream. The path of the diverted flow through the controller is shaped like an upside-down U.

The large majority of mass flow controllers use a thermal measurement principle to measure the mass flow in the bypass. The mass flow controller measures the heat dissipation in the bypass capillary tube using resistance temperature sensors and computes mass flow based on this value.

Some mass flow controllers use a differential-pressure method to compute mass flow. These MFCs typically have either an orifice plate or a laminar flow element as a primary element. A laminar flow element has a large number of small diameter channels or capillary tubes.

Mass flow controllers also have a proportional control valve that opens or closes based on a setpoint or desired value. This valve acts to maintain flow in the controller. The controller compares actual flowrate to the desired value. This ability to control the flow as well as measure it is unique to mass flow controllers and is what sets mass flow controllers apart from other flowmeters. A small percentage of mass flow devices go out without a control valve, and those devices are called mass flowmeters rather than mass flow controllers.

Shipments of Mass Flow Controllers Worldwide-Millions of Dollars



Source: Flow Research Inc.

The Semiconductor Industry

The semiconductor market accounts for well over half of the mass flow controllers shipped. While 2007 was a strong year for the semiconductor industry, indications are that 2008 is off to a slower start, according to SEMI (*www.semi.org*), the organization that tracks the semiconductor industry. In addition, the U.S. economy as a whole is experiencing a slowdown, and there are signs this could extend to other global economies as well.

The semiconductor market is a cyclical market, and market cycles are often between 12 months and 18 months. Even if the semiconductor market remains in a downturn for the rest of 2008 and into 2009, the chances are very high that it will pick up and come back strongly when it rebounds. While it is difficult to predict the exact length of semiconductor market cycles, demand for MFCs is likely to pick up along with the semiconductor market as it recovers. As such, the long-term prospects for MFCs look quite good.

Alternative Energy Drives Growth

In addition to the semiconductor industry, mass flow controllers have experienced growing use in certain industrial markets. Some of these industrial segments, such

as automotive and aerospace, are going through difficult times due to rising energy costs. Others, such as fuel cells and power, are thriving due to the search for alternative energy sources. The need to find alternative energy sources will drive additional research and development in the foreseeable future. Mass flow controllers will benefit from these industrial segments, as MFCs are commonly used to measure and control gas flows in these segments.

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Demand from Emerging Markets

The economies of China, India, and other emerging markets in Asia and elsewhere are continuing to grow at a rapid pace. Even if these economies are affected by a global slowdown, their continued population growth will result in demand growth in a variety of industrial segments, including energy consumption, food/beverage, automotive, power and other segments. China and India will also be a source of continued demand for computers and semiconductor products. All these forces will foster increased use of mass flow controllers in these emerging markets.

Automation & Accuracy

In some cases, gas flow is measured and controlled using a combination of a variable-area flowmeter and a needle valve. While some variable-area flowmeters have been developed with an output signal, the majority of these flowmeters still need to be read manually. In many cases, the needle valve is adjusted manually.

The trend today is toward the automation provided by mass flow controllers, as opposed to the manual operation of variable-area flowmeters. End-users are looking for the higher accuracy of mass flow controllers, and they are also looking to automate their gas measurement and control systems as much as possible. Mass flow controllers will benefit from this trend towards automation.

Limiting Factors

Even though mass flow controllers have a competitive advantage over variable-area flowmeters and needle valves, this combination of variable-area meters and needle valves still remains a low-cost solution for some gas flow measurement and control applications. Competition is also coming from Coriolis flowmeters and other multivariable flowmeters that measure mass flow. While mass flow controllers remain dominant for gas flow measurement and control applications — especially for line sizes of two inches and under — competition from other flow technologies is strong in certain application scenarios.

Technology Suppliers

Some of the leading suppliers to the mass flow controller market include Horiba/STEC (*www.horibastec.com*) and Celerity (*www.celerity.net*). Celerity has been active in acquisitions, purchasing the gas MFC line of Mykrolis from Entegris in February 2006. In addition to the mass flow controllers, this acquisition by Celerity included vacuum gauges, pressure transducers, scales, displays and pressure gauges.

Brooks Instrument (*www.brooksinstrument.com*) and Bronkhorst (*www.bronkhorst.com*) are two companies that are particularly active in the industrial and laboratory/research environments. Brooks Instrument, long a division of Emerson Process Management (*www.emersonprocess.com*), made its own news in December 2007 when it was sold to American Industrial Partners (*www.aipartners.com*), a private equity investment firm. In addition to mass flow controllers, Brooks is also a supplier of Coriolis and variable-area flowmeters.

A Look Ahead

Going forward, look for continued growth in the mass flow controller market. While the total market may show limited growth during this time of slow growth for the semiconductor industry, some industrial and laboratory/research market segments are in a time of expansion. This especially includes those segments associated with the search for alternative energy sources. Regardless of the slowdown in the semicon market, mass flow controllers are still very much in demand today, and they figure to be in store for a more pronounced rise as the semicon market recovers.

***Jesse Yoder, Ph.D.**, is president of Flow Research Inc. in Wakefield, Mass., a company he founded in 1998. He has 20 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 100 market research studies in industrial automation and process control and has published more than 75 journal articles on instrumentation topics. Dr. Yoder is the author of "The World Market for Mass Flow Controllers," which was published in July 2008 by Flow Research. Flow Research maintains a knowledge Web site devoted to the mass flow controller market. This site is located at www.flowmfc.com. Dr. Yoder can be reached at jesse@flowresearch.com or 781 245-3200.*

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