Flow Metering Provides Field-Proven Accuracy

By Bruce Briggs
Source: Primary Flow Signal, Inc.

North America is a world leader in the extraction and use of shale gas and is poised to be a key player in the future due to the large supply in the US and Canada along with more favorable regulations and more advanced technology than other regions. In addition, there is considerable worldwide interest in shale gas retrieval technology which, if applied around the world, will change both the geopolitical and economic conditions within regions and countries.

Despite the potential of shale gas, extracting this valuable commodity requires special technology, and using it efficiently involves top-quality equipment, including accurate, reliable flow metering solutions.

Differential flow rate meters

Differential flowmeters called Venturi meters and wedge-type meters are unlike many metering technologies because they have no moving parts. Accuracy is derived from the flow of liquids through the special design and can be as high as +/- 0.25% in the case of the Venturi products and +/-0.5% in the case of the wedge-type products. As such, these are uniquely suited to provide high-accuracy readings and reliability in harsh environments.

The Venturi design dates back to the 1800s. This long service history means an abundance of independent calibration data to support claims of accuracy and reliability. Further, Venturi meters are proven for a large range of media, with minimal impingement on flow and in a variety of applications. In some contexts, Venturi and wedge-type meters are the only reliable option, especially when dealing with heavily contaminated, abrasive, or irregular line fluids like drill muds or tar sands. Additionally, the meters can be customized to measure fluids over a large range of pressures and Reynolds numbers.

Differential meters are constructed in a variety of materials depending upon the specific application requirements. Typical material ranges from 300 series stainless steel to Monel, Hastelloy, or even synthetics. Venturi meters can be custom-manufactured for a massive range of applications, tolerances, and budgets. In addition, and as each application warrants, internal abrasion-resistant surfacing and steam jacketing can be provided.

The measurement process remains inherently the same whatever the scale of the meter. Differential metering relies on the Bernoulli effect, a principle of physics that extrapolates the flow rate of a fluid as it passes through a slight constriction in its flow. This can be calculated based on measurements sampled by two simple mechanical taps, located upstream and in the middle of the constriction for Venturi meters and upstream and downstream of the constriction in the wedge-type meters. Extrapolating from this simple principle, engineers can custom-design meters that will accurately measure different lines of media and flow conditions by subtly altering the internal geometry and Bernoulli calculations.

Often Venturi meters are close-coupled with flow-rate controllers for an accurate, wholly compact system control within an application – offering an optimum level of performance, flexibility, and reliability.

Complex piping configurations that would create poor accuracy conditions for other types of metering technologies are not an issue for either the Venturi or wedge-type device. This includes installations where there are direct coupled disturbers on both the upstream and downstream ends of the meters.

Turbine meters

Turbine meters are another classic technology ideally suited for shale gas application requirements as well as a variety of other oilfield, industrial, and commercial environments. Providing value and accuracy for measuring clear liquids and gases, turbine meters also can be custom-manufactured to suit different operating parameters.

Industrial-strength turbine meters consist of a helical steel rotor mounted on tungsten carbide bearings that spins within a length of pipe. Fluids flowing through it spin the rotor, with higher flows leading to higher speeds. As the rotor spins, a magnetic sensor in the housing picks up its speed by counting the rate at which rotor blades pass it.

As with differential meters, turbine meters also can be custom-designed to fit the applications and can be constructed from a variety of materials depending upon the temperature, pressure, flow rate, and flow medium requirements, including level of viscosity. Materials are selected for durability, corrosion resistance, and value.

Turbines have more specific application requirements compared to differential Venturi and wedge-type meters and, by nature, have a shorter service life. Because of this, shale gas operators require accessible replacement and rekitting to maintain maximum operational uptime and maximum, safe, peak operational efficiency. By design, turbine meters are easy to replace and can be switched out quickly and relatively effortlessly. Turbines are meant to provide measurement for applications on a smaller scale than those typically seen in Venturi meters.

Choosing a meter

Selecting the right flowmeter supplier is of paramount importance because the quality, reliability, accuracy, and longevity of a metering solution rely on experience and a company’s commitment to full-service design, manufacture, calibration, and ongoing service. Faulty or inaccurate measurement can have huge financial implications and directly correlate to revenue and profit. It is therefore of the upmost importance that a company focuses on three key areas to ensure cost-effective and accurate flowmeters for every element of the hydraulic fracturing process.

- **Quality**. It is important that a company designs and calibrates its meters, monitors, and flow controllers to the highest standards using independent verification and meeting all prerequisite certifications. The meters must be precision-crafted by skilled machinists from the best available materials so these also are cost-effective. The meter’s engineers must understand the non-traditional extraction processes where the flowmeters will be implemented to determine the best metering option for an installation.
- **Reliability**. Inherent in the design of differential meters is a tough mechanical simplicity. Turbine meters depend on the quality of the design, workmanship, and materials as well as proper installation. A key element, especially when dealing with viscous materials, is that the meters can be purchased and replaced

in a relatively quick turnaround so valuable production time is never sacrificed for performance and accuracy.

- **Accuracy**. Differential flowmeters and turbines can be designed and calibrated to deliver accurate performance. Independent calibration provides a greater level of insurance against low performance; suppliers who calibrate both in-house and independently offer a more conservative and reliable option.

As gas exploration and extraction expands, so too does the need for durable and accurate equipment that is able to thrive in the difficult conditions of the shale gas industry. Differential flowmeters and turbine meters can be uniquely trusted to provide essential flow readouts and flow control. Shale gas developers need not trade off accuracy, safety, and minimal environmental impact for good value and maximum production uptime and revenue.

About the Author: Bruce Briggs is the president and principal of Primary Flow Signal Inc., a global manufacturing, engineering and technology resource focusing on highly accurate, repeatable and reliable differential flow meters. In his more than 30 years in the industry, Mr. Briggs has built, arguably, the largest team of expert flow metering, hydraulic and applications engineers, along with technicians and specialists of diverse critical expertise. The companies are comprised of a number of enterprise-owned, fully integrated manufacturing facilities offering a world-class platform for solutions and support for the oil and gas, power, municipal water, wastewater and automotive markets.