36 Flowmeters

Multiphase Flowmeters: A Chorus of Instruments

By Dr. Jesse Yoder
President, Flow Research, Inc.

Multiphase flowmeters are so-called because they measure at least three different phases or components of a fluid when it is composed of fluids of different types. They are increasingly used on oil and gas wells to measure the percentage of water, gas and oil that comes out of the well. While the history of multiphase flowmeters goes back 25-30 years, they have been getting more attention lately. Rising oil prices and energy demand have made the information provided by multiphase meters more valuable.

Multiphase flowmeters provide information about the composition of well fluids, but also about the contents of the underground reservoirs the fluid comes from. One of the original motivations for developing multiphase fluids was to better analyze the North Sea wells as they began to decline in production. Some of this research was conducted by the Christian Michelsen Institute in Bergen, Norway. In fact, many of the research and development activities for multiphase meters are centered in Norway and Scotland. This is mainly due to their proximity to North Sea and surrounding oil fields.

How Multiphase Works

Multiphase flowmeters, because they measure the relative proportion of different types of fluids, combine several measurements. These include pressure, differential pressure (DP) and temperature. Most multiphase meters have some type of nuclear source to help determine the properties of the fluid. Gamma rays are the most common type. Both high-energy and low-energy gamma ray sources are available, and some companies use a combination of the two.

In addition to measuring the relative proportion of different fluid types, multiphase meters measure the flowrate of these fluids. This is most often done with a differential pressure measurement, using a Venturi tube. A combination of pressure, differential pressure and temperature is used to determine density. The purpose of the gamma ray technology is to find out the relative percentage of oil, gas and water that makes up the fluid at a given measurement point. The flowrate of each fluid is determined by combining the value of this percentage with the DP flowrates.

Multiple Multiphase Advantages

It used to be that the only way to determine the quantity of oil, gas and water coming from a well was to physically separate the fluids and measure each one individually. This function was performed by test separators. Multiphase meters measure flow at the wellhead, thereby reducing or eliminating the need for the hardware associated with dedicated test separators. This can be especially crucial on topside oil platforms at sea, where space is very limited.

Multiphase meters supply data about the fluid composition itself, but they also provide valuable data about the well too. For example, if the percentage of water in the fluid starts increasing, or the ratio of oil to gas is reduced, this can be a sign of a declining well. Because multiphase meters provide data in real time, they give quicker response time with more data points than do test separators.

Multiphase meters are good for allocation metering, where fluids from different wells are often commingled and then sent to a processing plant. Without multiphase meters, the fluids from each well have to go through a test separator before they travel to the processing plant. Multiphase meters make it unnecessary to do this physical separation for each well since the composition and flowrates of each fluid type can be determined without physical separation of the fluids.

Multiphase meters deliver real-time data that is similar to that provided by test separators. This can eliminate the need to install individual test separators on each well, in cases where multiple wells are located near each other. This is especially important for subsea applications, where flowlines for well testing can be especially long.

Cost Among Disadvantages

Multiphase flowmeters are the most expensive, and they typically cost even more than large size (e.g., 12 inch) Coriolis meters. The cost of multiphase meters depends in part on their intended application. The least expensive ones are for land-based wells, and some are available for less

than $100,000. The most expensive multiphase meters are for subsea applications, and the price of some of these can exceed $750,000. As a result, multiphase meters tend to be placed primarily on high-value, high-producing wells.

In addition, accuracy levels in multiphase meters are still relatively low compared to other types of meters. Accuracy levels differ depending on the fluid, and can range from ±2% to ±5% or less. Part of the difficulty in achieving high accuracy in multiphase measurement is that the flow-rate measurement depends on multiple variables, including the results of the gamma ray analysis. A multiphase meter is more complex than most other flowmeters, and may incorporate Venturi meters, Coriolis meters and other instrumentation technologies. A multiphase meter is more like a chorus composed of many voices that has to collectively sing a note exactly, while a Coriolis or ultrasonic meter is more like a soloist who just has to hit that high note.

Thus, the technology is still undergoing rapid development. Some end-user companies have been so dissatisfied with the available offerings from the main suppliers that they have undertaken to develop their own multiphase meters. This is pretty much unheard of among other types of flowmeters. Accurate multiphase measurement has become a kind of Holy Grail among oil and gas companies and suppliers.

Suppliers Chase Growing Market

There are a number of suppliers of multiphase meters, including major providers such as Schluberger/Framo, Roxar, Agar, FMC/MPM and Solartron ISA. This is now among the fastest growing niches within flowmeters and is comparable to the growth rate of ultrasonic meters for custody transfer of natural gas. In addition to the companies currently on the market, a number of others are poised to enter the market later in 2012 or in 2013.

Anyone who finds the flowmeter market "boring" should take a look at the multiphase flowmeter market. This is one of the most exciting and competitive areas within flow, and is somewhat comparable to the Coriolis flowmeter market in this way. If you start following this market, keep these two axioms in mind:

- Expect the unexpected

and

- Anything can happen.

For more information, see Flow Research's recently published study on the world market for multiphase flowmeters at www.flowmultiphase.com.