By Susan Forsgard

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Go with the flow of advanced water meter technology

The water meter market is experiencing dramatic changes.

Take a walk through private museums at water utilities, manufacturers' plants or even legal certification bodies and you'll see piston displacement meters from 1893 and velocity meters from 1917. The same types of meters also exist with more recent birthdates of 1951, 1964 and 1972.

Upon inspection, one can determine that some of the dimensions are slightly smaller, the colors are a bit different and the dial plate has been redesigned. Yet it is clear that throughout the 20th century there was little discernible advancement in the fundamental technology of water meters.

Over the past few years, stagnation in the development of water metrology has given way to renewed research and development efforts directed toward changing the look, materials, technology and performance of residential water meters. The result? A water management system or measuring device with astonishing accuracy, a permanent and wide measuring range and, most importantly, the metrology profile on day one is the same throughout the life cycle of the meter.

Traditional magnetic meter technology

Magnetic (mag) meter technology is highly accurate and maintains that accuracy over the lifetime of the product, however, due to an inability to accurately measure low or intermittent flows, the technology has been considered ineffective and expensive for residential applications.

Mag meters operate on the principle of Faraday's Law. The velocity of the fluid is directly proportional to an induced voltage (electromotive force) as the fluid flows through a constant magnetic field. As the velocity of the water increases, the induced voltage increases and in turn the volume of water measured is greater.

To measure an induced voltage that is proportional to the velocity of the water, a constant magnetic field must be created. In traditional mag meter technology this effort requires a great deal of energy.

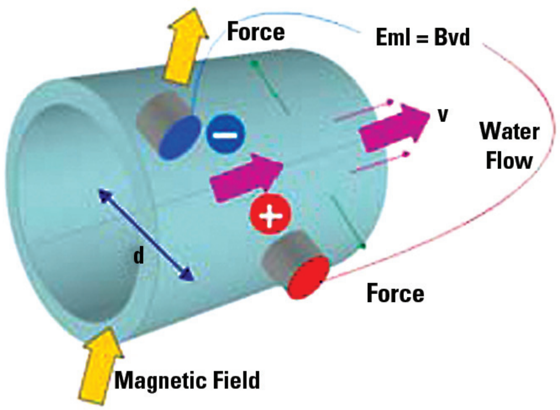

Figure 1: Faraday's Law in Magnetic Meter Technology

As a result, some trade-offs must be made, such as connecting the meter to an external power supply or utilizing a large or replaceable battery, which in turn limits the life span of the product or requires taking measurements at intervals, which reduces accuracy. All of these restrictions made mag meter technology a poor fit for residential applications.

Remanent field technology

The development of patented remanent field technology has enabled the next generation of mag meter technology. Remanence is the magnetization left behind in a material after the external magnetic field is removed. Remanent field technology effectively helps solve the power demands of traditional mag meter technology to serve as a viable option for the residential market.

The new metering technology uses a pulse of energy to magnetize small strips of remanent material. The magnetic field is reversed each time a pulse of energy is emitted to magnetize the material, thereby inducing voltages of opposite polarity on each field flip and eliminating the effects of electrode offset which can interfere with measurement accuracy. Front end amplifier design and sigma-delta analog to digital conversion contribute to improved low flow measurement accuracy over traditional battery-powered mag meters. This is critical for the

A breakthrough in water meter technology delivers unprecedented efficiency through low flow accuracy and high flow durability.

detection of leaks, which is important for both the consumer and the utility.

The remanent material holds its magnetic field strength without requiring continual current consumption. In fact, remanent technology meters also conserve energy by employing low frequency field flipping to switch the magnetic field. As a result, the energy required to power the meter over the course of its lifetime is significantly reduced. This allows the meter to be powered by a traditional battery cell for the 20-year life span required for the residential market.

Another key advantage of sigma-delta analog to digital conversion is the ability to continuously record flow with no gaps in measurement. This is a significant advantage for a residential water meter where the flow is frequently intermittent.

Creating the ultimate flow tube

To create the optimal measuring area for high performance in the mag meter technology, a flow tube must be engineered in the appropriate configuration and of the ideal material.

A rectangular tube is preferable as the cross section allows the magnetic field to be perpendicular to the flow of water, creating a well defined volumetric measurement condition for Faraday's Law. The rectangular cross section minimizes the swirling and turbulence in the water as it enters the flow tube, which reduces the opportunity for empty pipe triggering, and also increases the water velocity which assists in detection of ultra low flows.

Scale buildup, whether inside precision, electromagnetic or positive displacement meters, can also affect meter accuracy. The high velocity bore of the rectangular flow tube design does not promote scale formation; in fact, in early tests, no scale formations were found.

The ideal flow tube must be strong enough to withstand the varying pressure of water flowing through it and maintain its dimensional stability — even in extreme temperatures ranging from minus 30 degrees to plus 160 degrees Fahrenheit. Additionally, it needs to be constructed with a material that meets safe drinking water standards. A glass-infused composite alloy meets the criteria and is also environmentally friendly to manufacture and ship.

Changing from the traditional bronze alloy that served the industry for more than a century has required a dedication to research and development and extensive testing. Engineering tests prove that the strength of the composite alloy flow tube exceeds that of traditional bronze alloys.

Burst pressure testing shows that the new composite alloy based product can resist pressures of up to 1,600 psi, more than one and a half times what traditional bronze alloys can withstand. In tension tests, the threads on the flow tube can withstand over 3,000 pound-feet of force being applied to it without stripping threads or fracturing. In field tests, the installation of the new flow tube revealed that installers were in favor of the composite alloy spuds because it was easier to start the nut on the meter set when the meter was in the pit.

As the water utility industry grapples with challenges ranging from water shortages to declining revenues, the need for forward thinking manufacturers to develop more efficient, more intelligent technologies has never been greater.

The water meter market is now experiencing dramatic changes in the way water is measured. Now that we are measuring differently, what's next? We are already seeing the adoption of advanced metering infrastructure systems that are bringing the benefits of the smart grid to water utilities by enabling greater business intelligence. These technologies will continue to support the utility in its efforts for conservation, improved customer service and operational efficiency.

There is at least one thing we do know with certainty — for the first time in nearly a century, the water metrology exhibit at your local museum is about to change. **WT**

Susan Forsgard is product manager of residential products for Sensus, the leading provider of innovative technology solutions that enable intelligent use and conservation of critical energy and water resources. Sensus has led the discovery, development and implementation of technologies for the energy, water and gas industries for more than a century. In 2010, Sensus introduced the iPERL™, the first available intelligent residential water management system. For more information, please visit www.sensus.com.