Don’t just go with the flow

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Process Management

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Many new products or advances on old products can often be met with a sense of ‘if it ain’t broke, don’t fix it’. However, by simply embracing the latest Electro-Magnetic flowmeter technology, many water and wastewater industrial applications can benefit from improvements in operational efficiency and reduced operational expenditure.

Operational efficiency was reported as the number one issue for the water industry in the latest State of the Water Sector Report, which was released in October last year by Deloitte and the Australian Water Association (AWA). However, many in the industry are still reluctant to implement some newer technologies that could potentially provide operational efficiency benefits.

Consider the Electro-Magnetic flowmeter, which has long been seen as a commodity product, with little differentiation from one brand to the next. You’ve seen one, you’ve seen them all, right? This mindset limits and denies the full understanding of the positive benefits provided by advances in technology, and an opportunity to reduce operational expenditure.

It is simply not comparing apples with apples and, more importantly, doesn’t factor in what isn’t known. A lower initial capital cost purchase may seem like the better economic option, but it may have the converse effect and open the door for ongoing increased operational expenses that will be difficult to stem or impossible to reverse in the long run. New technology provides you with the capability of futureproofing your assets.

What is the basic flowmeter principle of operation?

Perception is that an Electro-Magnetic flowmeter is a ‘Volume flowmeter’. However, it’s not! It’s a ‘Velocity measurement device’ which as an end result provides a ‘Volume calculation’, not a ‘Volume measurement’. This Velocity measurement is based on Faradays law.

Faradays law (E=KxDxBxV) states when a conductor of a certain length cuts through a perpendicular magnetic field it will induce an EMF (E) which is equal to the Proportionality constant (K) x Conductor length (D) x Magnetic field strength (B) x Velocity of conductor (V). The variables here are defined as ‘Secondary variables’. Stability of the secondary variables is critical as any changes will influence the velocity measurement affecting stability, measurement confidence and flowmeter performance.

With the Secondary variables remaining stable, the higher the liquid velocity the higher the EMF Induced; the lower the liquid velocity, the lower the EMF Induced. The Volume calculation is then performed providing the Calculated volume (Q=VxA) — Volume (Q) = Velocity measurement (V) x Cross-sectional area (A). Accurate volume calculation requires the pipe to be full and the flowing velocity needs to remain above 0.3m/s. Beneath 0.3m/s velocity, the inaccuracy is exponential due to insufficient inertia in the velocity of the conductor moving through the magnetic field to induce a stable EMF. The flowmeter will still measure to a minimum flow to 0.01m/s but not at the flowmeter’s stated accuracy.

Smart Meter Verification

So why is understanding the principles of operation going to assist in ensuring your operational costs are reduced?

Some current and historical on-demand meter verification practices require site visits by Specialist Technicians, often from the supplier rather than in-house technicians.

After having scheduled the visit, the work required to verify the meter will be carried out on site using typically a proprietary ‘meter validator’ that checks some of the secondary variables against a generic meter lookup table which resides in the third-party device. Alternatively, you may just be paying for a simple loop check to ensure the meter is reporting as it should be. After this check you receive a certificate that is realistically valid only for the point in time when the flowmeter was checked. Secondary variables deteriorating from that point onwards could remain undetected influencing operations until the next routine check, which as well as requiring additional payment also means the meter has been reporting incorrect data for many weeks or even months.

Emerson’s patented In-situ Smart Meter Verification technology has changed all this. The ‘Smarts’ integral to the flowmeter, continuously (24/7) or using on-demand capability, check the signature (referenced secondary variables) of the sensor and transmitter without the need of a Specialist Technician. The Secondary variable values are absolute points of reference in the field. Any change of these absolute values (signature) exceeding your programmable threshold results in non-conformance detection raising an alert via the display, telemetry (bi-directional remote communication), digital output, HART, SCADA

input, wireless, wireless HART etc. Having these 'Smarts' within the flowmeter reduces operational expenditure and increases confidence in flowmeter performance without the additional ongoing OPEX costs.

Case study 1: Water treatment application

A wastewater treatment plant in Western US recently improved efficiency and reduced operating costs by installing a Rosemount 8750W Magnetic flowmeter with Smart Meter Verification. Other benefits included improved reservoir and production management and reduced health safety and environmental risk.

In order to maintain optimum viability of the biologically active materials in the sludge, the wastewater treatment facility needed accurate sludge flow measurements. If the readings are not accurate and biological activity is reduced, this could result in the possible requirement of additional chemical treatment of the wastewater.

Previously, the facility used magnetic flowmeters from a different manufacturer. The installed meters needed to be physically removed from the flow line for calibration. Removing the meters from the flow line would expose workers to process materials. To avoid exposure, calibrations were not performed and this resulted in sludge flow readings that were not valid.

Using the advanced diagnostic capability of the newly installed Rosemount 8750W magnetic flowmeter with Smart Meter Verification, biological activity of the sludge has been maintained at the desired level, increasing the efficiency of the treatment process. This has reduced the need for chemical usage leading to lower chemical costs. Manual checks of material balance and manual adjustments to plant records were also reduced, leading to lower operating costs. In addition, there is no need to remove the flowmeter from the line for maintenance, reducing the safety risk to plant personnel. Finally, with more consistent biological activity in the sludge, the risk of lowered plant throughput was eliminated.

Case study 2: Energy management application

A large university in the US recently improved its chilled water billing accuracy with meter verification and high accuracy calibration.

The university wanted to improve billing accuracy and reduce flowmeter verification costs on its chilled water billing meter. It was using a magnetic flowmeter with an accuracy of ±0.50% for billing chilled water usage. Since the flowmeter was being used for billing purposes, it was important to verify the flowmeter was operating correctly. Therefore, the university hired an outside

The benefits of advanced technology

Ground and wiring fault detection — uncover installation issues before they affect operation.

Remote diagnostics — forewarned is forearmed, so technician time is lessened and revisits eliminated.

Remote verification — use advanced telemetry to verify remotely from anywhere in the world.

contractor to verify the calibration twice per year. The contractor only verified the transmitter using a calibration standard and did not verify that the sensor calibration had not changed. By only checking the transmitter, the contractor did not provide a complete verification of the flowmeter performance. In addition, the university had to pay $2800 per year for the verification service, resulting in increased maintenance costs.

Also, during the test, the meter needed to be taken offline and users were not billed for usage while the transmitter test was in progress, resulting in lost revenue. The existing flowmeter had an accuracy specification of only 0.5%. The low 0.5% accuracy specification resulted in higher variation in the flow rate measurement, decreasing billing accuracy.

The university replaced its flowmeter with a Rosemount 8700 Magnetic Flowmeter with the in situ meter verification diagnostic and the high-accuracy calibration option.

The flowmeter verification diagnostic enabled the customer to perform a complete verification of both the sensor and transmitter, ensuring the calibration had not changed relative to the factory calibration. This was completed biannually per the university's quality plan. Using the AMS Suite: Intelligent Device Manager, a report was then printed for record-keeping purposes.

By having the meter verification diagnostic capability built into the transmitter, an outside contractor was no longer required, saving $2800 per year in maintenance costs. In addition, the flowmeter remained online during the test, increasing billing accuracy by minimising lost revenue due to downtime. The 8700 magnetic flowmeter system's high-accuracy option enabled the university to improve flow uncertainty from 0.50 to 0.15%, further improving billing accuracy.

Improved technology delivers overall savings

Magnetic flowmeters now encompass a range of technologies that deliver improvements via remote diagnostic reporting. Such technology informs the user of abnormal situations throughout the life of the meter — from installation to maintenance and meter verification (MV).

Basic diagnostic capability includes coil and transmitter fault notification, electronics temperature, reverse flow and empty pipe warnings. More advanced diagnostics include identification of ground or wiring faults affecting flowmeter operation, through to in situ continuous Smart Meter Verification (SMV) and meter verification on demand.

This allows users to modify business practices for improvement in plant availability and output, as well as reducing overall costs through simplified installation, maintenance and troubleshooting.

A common magnetic flowmeter installation issue is the lack of a proper ground, without which the meter will not read flow correctly. By continually monitoring the line noise voltage across the frequency spectrum, grounding and wiring fault diagnostics detect and alert the user immediately if the meter wiring or grounding needs to be fixed, saving commissioning time, reducing installation costs and preventing inaccurate measurement.

Verifying flowmeter calibration is costly, as it usually requires the flowmeter to be removed from the line and recalibrated in a flow lab or validated using a flow provider. More recently, verification using a field verificator has become a widely used solution, but it still requires extra equipment and is a time-consuming process requiring travel to the meter for testing, potentially to a remote location.

The use of telemetry avoids these issues. The 'Smarts' within the flowmeter incorporate the same push technology employed when email is pushed to a mobile phone. There is no need to poll for information and scroll through reams of data, as the notification is automatically generated. A message specific to the issue (eg, 'meter verification failed' or 'ground wiring alert') is pushed to the user, reducing time to action.

Verification can be carried out remotely and SMV certification documentation automatically produced without being on-site and without expensive additional equipment, as the 'Smarts' are in the transmitter.

In the case of service requirements, having access to remote diagnostics means the user is immediately alerted when a problem is identified and that technicians understand the exact nature of the issue prior to arriving onsite. Field service teams can be more effectively scheduled, unnecessary call-outs eliminated and on-site time reduced.

As magnetic flowmeters in water applications have a potential 20-year life span, the ROI for a self-verifying meter and advanced diagnostics could be as short as 12 months, with substantial ongoing savings realised over the life of the equipment.

In tougher economic conditions, it's more important than ever to determine where the money is going and how it can be better utilised. Factoring in the ongoing costs associated with capital purchases should be a key activity for all business entities and not just an afterthought. Be proactive, not reactive.