HOW GETTING A BETTER VIEW OF WATER CONSUMPTION CAN HELP IMPROVE REVENUE RECOVERY

For water utilities, getting more information on non revenue water offers a great chance to improve financial viability and boost the immediate and long term availability of water supplies. Alan Hunt of ABB's Measurement & Analytics business looks at how high accuracy flowmeters can make sure water gets to the right users and water losses are minimized.

AquaMaster4 family

While water companies worldwide have done a good job in improving their supply side management, there is a growing recognition that sustainability can only be achieved through a robust understanding of the demand being placed on supplies.

When coupled with the issues posed by an ever more unpredictable weather system caused by climate change, the challenges of ensuring a sustainable supply of water for all those who need it call for radical changes in the way that water is collected, distributed and reused.

As these challenges bite, the answer is to make sure that as much water as possible is legitimately consumed within water distribution systems, with as little being lost in transit as possible. While significant advances have been made in reducing water losses in recent years in various parts of the world, a significant amount of the clean water that utilities produce and distribute continues to be unaccounted for, either through real losses caused by leaks and burst pipes, inaccurate flow measurements or unauthorised extractions from pipelines.

Why every drop matters

As every lost drop represents a loss of revenue, there is a clear need to understand where and how it is being lost so that action can be taken.

Research by the International Water Association (IWA) divides the total volume of water supplied to a network into revenue and non revenue water (NRW), the latter being the amount of water that essentially goes missing from a pipeline and cannot be accounted for. This research shows that 24 percent of countries have a rate of NRW greater than 40 percent.

These losses cause a number of problems. One of the chief issues is the waste of energy and other resources needed to replace the lost water. Every drop lost is another drop that must be processed and pumped again, using more dosing agent and energy and adding to the emissions caused by an already energy intensive industry. Another issue is the lost revenue. The World Bank has estimated that the global cost of non revenue water to utilities is around US$141 billion per year. As well as the effect on operating profits and the viability of the business, lost revenue reduces the capital available to invest in improving water networks.

A final question affects the validity of the data used to gather these figures in the first place. If the instruments used to gather the data are not accurate and underestimate the legitimate consumption, then in many places the overall NRW estimate may be grossly overstated.

A number of methods exist to tackle the challenge of calculating NRW, with pressure management, minimum night flow analysis and the IWA's water balance methodology being chief among them.

The water balance method is widely accepted. Using it requires utilities to establish an accurate estimate of water balance, the ratio between actual loss from leaks and other physical causes and the apparent losses from human errors such as billing mistakes, inaccurate reading of manual meters or unauthorized extraction. The process of estimating the water balance components can never be exact, as it will contain uncertainties arising from factors such as inaccurate measurements and unreliable data.

Measure at night for a real picture of losses

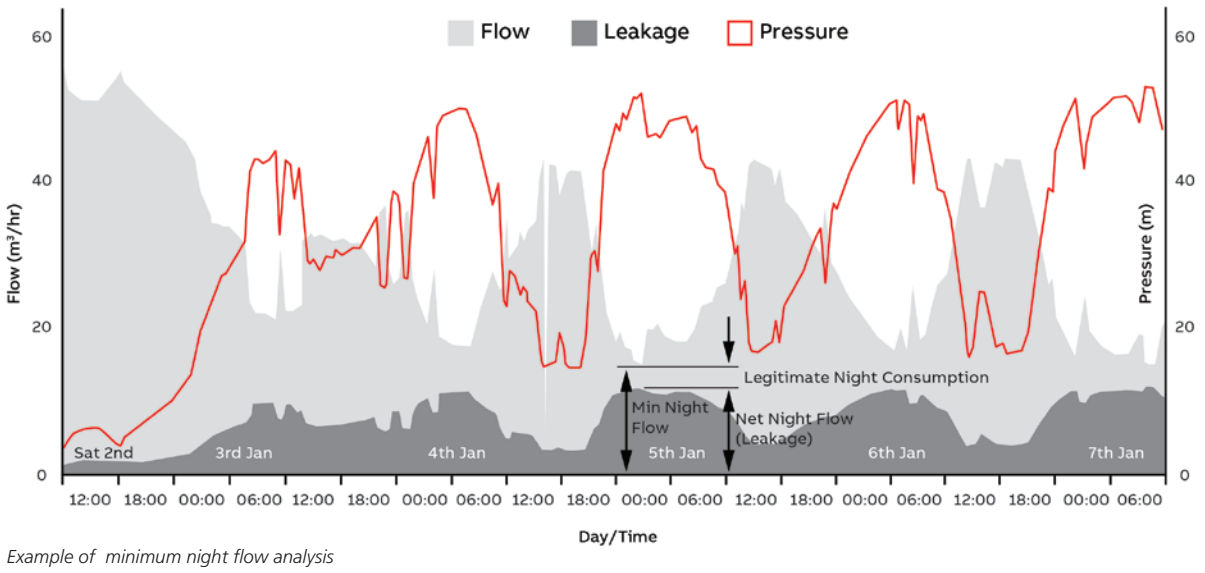
One method widely used to get an accurate estimate of losses is through the measurement of minimum night time flow. At night, water consumption is at a minimum and pressure is high, so any losses will represent a large part of the flow entering the system. Using data from minimum night time flow measurements gives water companies the chance to accurately evaluate net night flow (NNF), an estimate of volume of real losses during the minimum night flow (MNF) period. The NNF is mostly composed of real losses from the distribution network and service connection piping between the water mains and customer meter. However, it may also include leakage on the customer side of the meter and consumption either legitimately or through unauthorized connections.

The AquaMaster4 transmitter features a contactless interface using industry standard Near Field Communication (NFC) technology

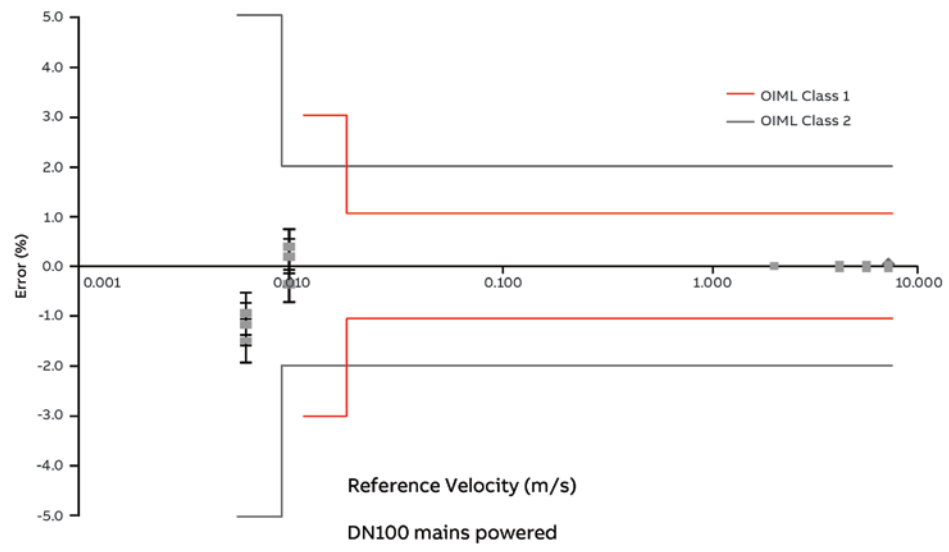
Leading water utilities have configured networks to continuously monitor night flows using district meters measuring flow and pressure. Flow and pressure data is recorded on meters and regularly transferred to a SCADA system. Data is analyzed to confirm its validity and used to derive continuous night flow in each District Metering Area (DMA).

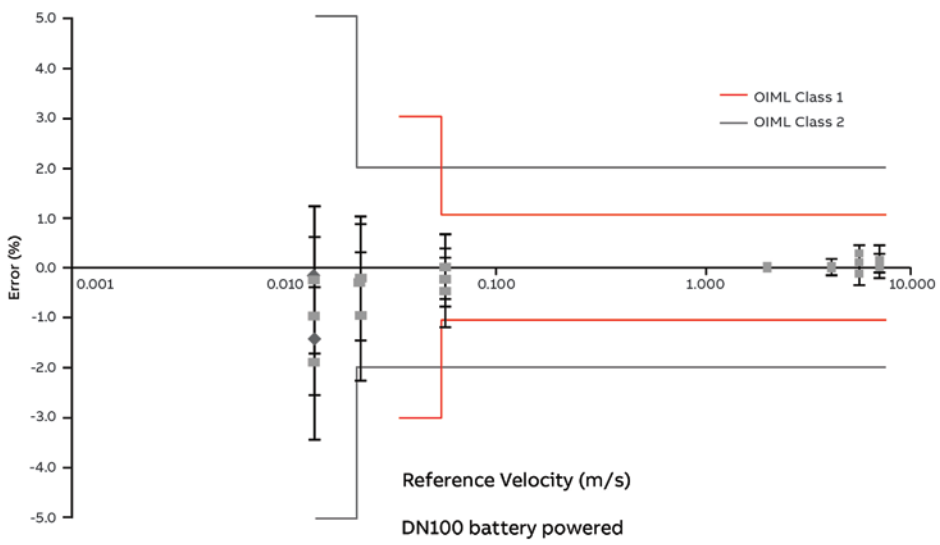
The night flow into a DMA consists of the following components:

- Customer night use, made up of exceptional, non household and household night use
- Reported burst losses, made up of bursts on supply pipes, communications pipes and mains
- Unreported burst losses made up of bursts on supply pipes, communications pipes and mains



Example of minimum night flow analysis





- Background leakage, made up of leaks in plumbing, underground supply pipes, communications pipes and mains

Go electromagnetic for superior accuracy

While there are many electromagnetic flowmeters available on the market, many cannot register very low flowrates or produce an accurate reading of that flowrate.

When it comes to getting an exact picture of water loss in a network, the best data can be derived from measurements taken when demand is at its lowest, specifically nighttime flow. For this reason, MNF analysis is often used as the basis for many strategic and operational decisions.

Based on measurements taken when authorized consumption (i.e. flow rate) is at a minimum and pressure is at a maximum, MNF provides valuable flow data that can be used to derive an accurate estimation of the water being lost from a network.

From this data, water utilities can calculate a value for net night flow (NNF) to achieve an estimate of the www.abb.com/measurement volume of real losses during the MNF period, using the formula:

NNF = MNF – legitimate night time consumption

The NNF is mostly composed of real losses from the distribution network and the service connection piping between the water mains and customer meter. However, it may also include leakage on the customer side of the meter and consumption either legitimately or through unauthorized connections.

For the NNF calculation to be accurate, it is vital to ensure that the flowmeter being used offers the turndown and accuracy needed to measure the required flow rates. If it cannot, then the legitimate nighttime data will be under registered, resulting not only in a figure that does not reflect true NNF conditions but also loss of revenue for that under registered flow.

AquaMaster4's very low flow capability allows water utilities to:

- Accurately register flow data during night time to a level that would not be possible with other brands of electromagnetic flowmeters. Registering this data is hugely beneficial as utilities can increase their revenue by billing this legitimate consumption that they were not able to do before
- Improve their decision making on deployment of resources to tackle water losses by enabling an accurate understanding of legitimate nighttime consumption and the net nighttime flow (NNF)

ABB's AquaMaster4 with its built in data logger runs at high speed, giving the user total flexibility to download logged data frequently, every fifteen minutes if needed. The user can then investigate, in precise detail, flow and pressure activity during a period of interest, at even higher time resolution. Such high resolution data aids step testing, leakage detection and water network analysis.

AquaMaster4 is built on ABB's extensive expertise and detailed knowledge of EMF design, offering lower noise levels and advanced signal processing technology, improved zero stability and hence flow accuracy at low flowrates. With its longer battery life, AquaMaster4 can achieve flow turn down ranges to unprecedented performance levels of R = 1000 for mains power and R = 400 on battery power.

Measure pressure for the full picture

Effective pressure management is central to optimum water network performance. Cities around the world have higher water pressure and all the problems this can bring, while other parts suffer from low pressure. Reducing pressure to reduce leakage can be a solution for higher pressure areas. However, for lower pressure areas, it is not always possible or practical to do this. Effective pressure management starts with effective pressure visualization to enable the right choice to be made. This might include issues at the pumping station, running pumps at a controlled rate to balance water pressures.

When data from hydraulic (flow + pressure) measurement in a network is carefully understood and used, it can lead to significant improvements such as energy savings. In one application, a water utility achieved an energy cost saving of around $100k by effectively managing pressure in its network.

ABB's AquaMaster4 pressure transducer is of the passive piezoresistive strain gauge type with internal temperature compensation resistors that seamlessly connect to the AquaMaster4 transmitter which can measure up to 40 bar pressure. With accuracy of <±0.1% of span + thermal errors, the IP68 rated pressure sensor is easy to install through a simple quick release fitting.

A key function within the AquaMaster4 transmitter is its 'Pressure Height Offset (mm)', which can be used to compensate for the mounting height of the pressure transducer relative to the pipeline height. This allows it to be used in higher altitude locations. A city such as Denver USA, for example, which is 1,600m above sea level, has a lower typical atmospheric pressure by nearly 0.2 bar. This can be compensated for by the AquaMaster4 to enable accurate pressure measurement.

As a digital flowmeter, the AquaMaster 4 also offers the added benefit of simplifying the gathering, sharing and analysis of both flow and pressure data. Historically, water utilities have deployed separate flowmeters and pressure transducers around networks. While this will provide data on network flow and pressure conditions, the separate deployment of instruments represents additional inputs that need to be gathered and managed by water companies, many of which lack the information infrastructures needed to process and analyze it.

With its integrated pressure and flow data logger, the AquaMaster4 provides the flexibility to download logged data, and investigate, in precise detail, flow and pressure activity during a period of interest. When combined with other benefits such as the ability to download and share this data through a smart device, the possibilities for improving network performance through enhanced pressure measurement are greatly expanded.

Summary

The absolute basics in optimum water network management lie in achieving the highest levels of flow and pressure measurement accuracy. In this way, true consumption can be properly understood and every available drop accounted and charged for.

With heavy investment needed to gear up the world's water supplies to meet the ever growing demands being placed on them, flowmeters need to be at the frontline in ensuring that every last dollar is recovered to help cover the cost.

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