Reducing **non-revenue** water

A simple change can bring about significant reduction in non-revenue water. With changes in metering technology, the focus has shifted to monitoring and management systems; however, it seems the heart of the management system is being overlooked. **BY JOHN ALEXANDER, KROHNE**

A REVISIT TO this heart is necessary to help reduce non-revenue water (NRW). NRW is the difference between the volume entering a distribution system and the volume billed to customers. There can be various reasons for this:

- Apparent losses are caused by unauthorised consumption of water and water losses due to measurement errors. The latter arises from using old water meters, leading to under-reading and reduced revenue.
- Real losses are caused by leakage and overflows at storage tanks and pipeline leakages.

The average NRW per country can be substantial – from 7% in Germany up to 20% to 40% for the UK, Spain and Italy, and even higher. With an increased focus on water scarcity, there is also an increased focus on water losses. Understandably, leakages are seen as a major cause for water losses.

Software systems

Spending on software is a large cost to the user or provider of services, and much focus is placed on the software and reports that the system can generate. Not enough thought is put into where the input of the data comes from or how it is interpreted. No matter how smart or good the logging or monitoring systems or software used to measure NRW are, a combined approach is necessary.

Automated systems are essentially there to replace the meter reader, who goes from meter to meter to log the consumption for billing purposes, and to reduce the cost of obtaining the more accurate billing data for improved cash flow and profitability, resulting from the accurate billing of consumer meters.

The trend is for utility companies to move towards automated meter reading systems, as employing people is often a big cost consideration for the authority. The cost of vehicles, fuel and vehicle maintenance is becoming prohibitive, especially in large or remote areas where distances are great. In most cases, the meters are not read at the same time, which makes correlation and water balance difficult. This is where logging and monitoring systems really come into their own.

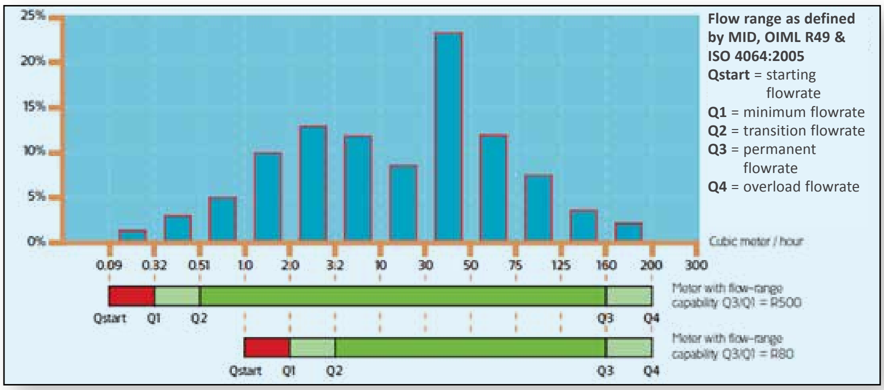
Logging capability and capacity

The intelligent logger is no longer a must for bulk metering and can be considered overkill. The main reasons for this is that many data loggers were available before the advent of telemetry, GPRS/GSM and the internet, and logger manufacturers have upgraded their existing product with telemetry capabilities. The newer systems have smaller logging capacities, as a rule, because the data is transferred more quickly to be evaluated so that actions can be implemented, enabling a quicker response to the analysed data in the case of alarms, for example.

Data is often transmitted on a predetermined time frame. Using telemetry or GPRS data offers a distinct advantage, especially when doing water balances or monitoring night flow and leak detection, as the readings are taken at the same time, which makes comparisons and trends easier to understand and compare, especially when linking to specific times or incidents.

Other key considerations

One of the most important factors to consider in reducing unaccounted-for water is unmetered water, whether revenue water or



The above example represents the consumption pattern of a technical university.
A meter with basic flow-range capability (R80) doesn't record the flow below 1 m^3/h and is accurate only above 2 m^3/h.

A meter with an extended flow-range capability (R500) installed on the same site measures flow above 0.09 m^3/h and is accurate above 0.32 m^3/h. The measurement difference amounts for 17% of the total volume.

FIGURE 1 Consumption comparison

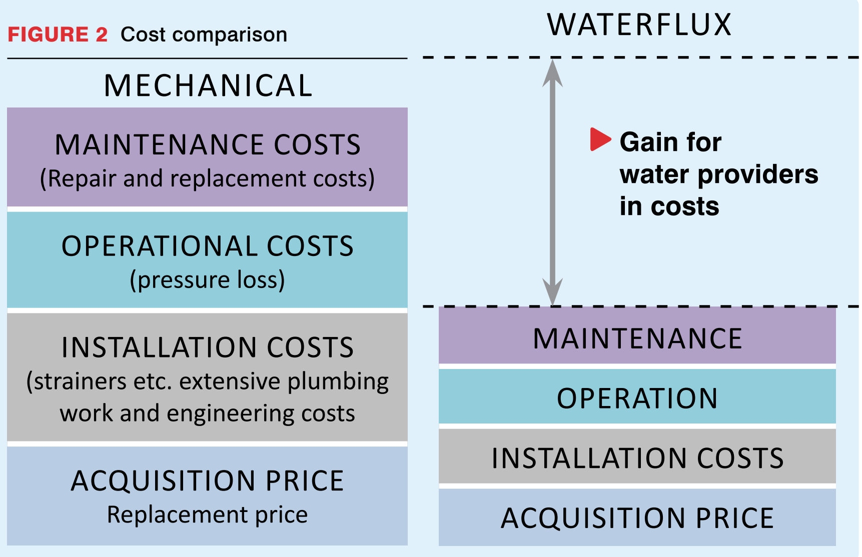
not. Here, the meter or sensor is very important and often not investigated fully in the decision-making process. There has been a fundamental change in metering technology available to the engineer today. The old "you cannot control what you don't measure" adage comes to mind.

Mechanical bulk meters are still the most widely used metering devices by local authorities, water boards, water providers and water associations. This is essentially by default, as no alternatives were available at the time. For this reason, the accuracy limits were adapted to reflect the accuracy of the mechanical devices at the time. The purchase or acquisition price is one of the main drivers but, with the rising costs of water production, and if we really want to reduce energy consumption and unmetered- or NRW, then this aspect of water metering needs to be revisited.

Bulk meters are the largest source of revenue, as they measure the "bulk" of the water. The fastest return on your investment is a project to test and upgrade all high-revenue meters.

New-technology water meters are now available to the utility, offering a great opportunity for NRW reduction. New-technology meters can make water system design and optimisation easier, as some of these meters can be employed with zero inlet, outlet and maintenance requirements, lower pressure drops and the ability to measure a far wider range than mechanical meters (as they are not affected by over-spin, pressure surges, etc.). They also reduce the total actual cost.

FIGURE 2 Cost comparison



Leak detection using water meters

Instead of waiting for annual or monthly water meter readings, a more efficient method for finding leaks is to divide an entire distribution network into sectors or district metering areas (DMAs).

Water meters are installed at strategic points in the network. The readings are compared with the sum of domestic water meters in that specific area. The highest priority can be given to those areas with the greatest apparent loss. It is no longer necessary to close down parts of a distribution network by closing valves. Usually, times of low flow rates (nights) are considered to be the best time to locate leakages. The ability of these meters to measure low flows at night and high flows during normal consumption hours is critical and high turndowns are required. The measurement of the minimum flow is critical and a proper, well-sized or effective meter is necessary.

Due to the technology employed in modern battery-powered water meters, the meters have exceptional turndown ratios, making them ideal for zonal measurement where leak detection can be more easily done than for the small flows in domestic-type meters.

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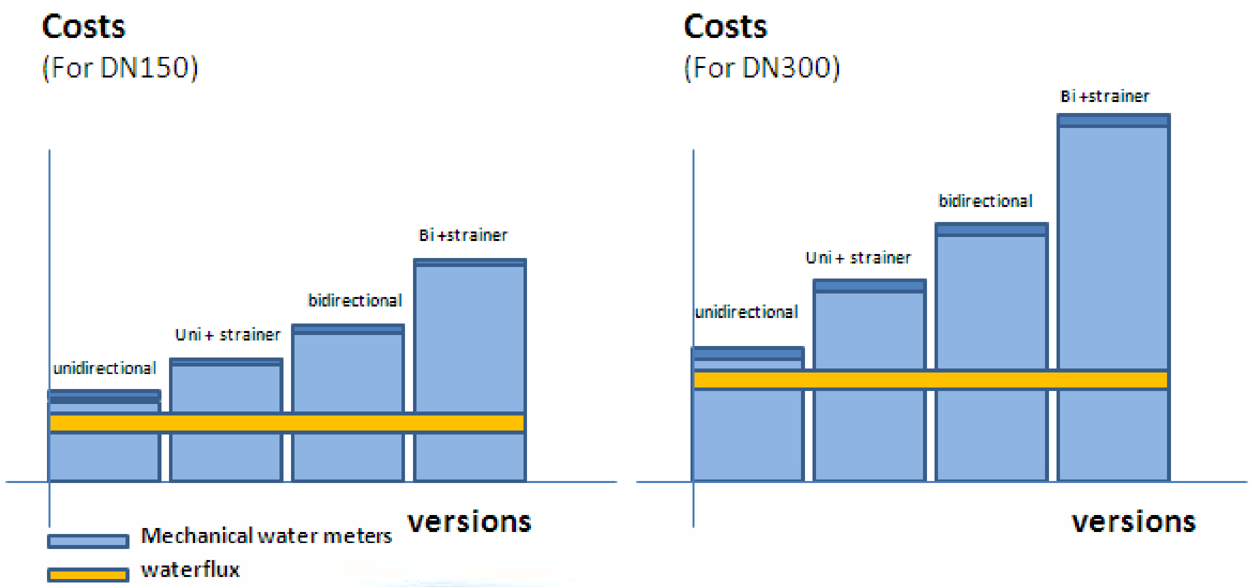
Unconsidered advantages

It is not often considered that new-technology meters offer additional advantages over traditional, mechanical meters, in that they can be used for effluent measurement, wastewater and potable water. They are truly multipurpose devices. This offers the user additional benefit of spares reduction.

Unmetered value

Unregistered or unmetered values are by far the most important factor contributing to NRW. Mechanical meter accuracy limits are often the determining factor for meter selection. It is specifically for this reason that new-technology meters, such as battery-powered electromagnetic water meters, offer huge advantages in reducing unaccounted-for or unmetered water and NRW.

Meters should be selected according to flow rate, not line size, and many meters are oversized, as the consultants select according to the line size, extra expansion capacity and safety factors. The advantage of new-technology meters is their turndown ratios that enable them to measure low and high flows, which provides a distinct advantage over mechanical meters. Mechanical meter accuracy classes are referred to



and described in SANS 1529, and the MID MI-001 and OIML R49 specifications (MPE = maximum permissible error):

Minimum flowrate – Q1 MPE ± 5%
Transitional flowrate – Q2 MPE ±2%
Permanent flowrate – Q3 MPE ±2%
Overload flowrate – Q4 MPE ±2%.

If we take new-technology meters such as the Krohne Waterflux 3070 and compare it to a mechanical bulk meter, both DN 80, we can see a huge reduction in unmetered water, due to the better accuracy of new-technology meters of 0.2% of measured volume. Using the MID, sample calculations are shown below.

Sample calculations

Mechanical bulk water meter of DN 80, Q3 = 40 m³/h, with a typical measuring inaccuracy at Q3 = 2%:

- 0.8 m³/hour unmetered through the device
- 19.2 m³/day unmetered through the device
- 7 008 m³/annum unmetered through the device.

Battery-operated electromagnetic water meter of DN 80, Q3 = 40 m³/h, with a typical measuring inaccuracy at Q3 = 0.2%:

- 0.08 m³/hour flow unmetered through the device
- 1.92 m³/day flow unmetered through the device
- 700.8 m³/annum flow unmetered through the device.

This is a tenfold improvement over a mechanical meter. In monetary terms, if we took a bulk charge from R3.48/kl to R3.97/kl, in the case of Rand Water's proposed tariff increase, the difference would be:

- mechanical meter: 7 008 m³ at R3.97 (new proposed tariff) = R27 821.76
- Waterflux: 700.8 m³ at R3.97 (new proposed tariff) = R2 782.18.

The difference is that the water provider could recover R25 039.584 if the meter were a custody transfer or billing meter. This, of course, is a massive reduction in NRW.

If the meter were being used to reduce unaccounted-for water, this would see a reduction 6 307 m³ of water not being accounted for by a mechanical meter. Some would argue that the meter would not be measuring continuously over 24 hours at Q3 but, even at 50% of Q3, it still presents a significant recovery compared to mechanical meters.

The acquisition price may be higher than a mechanical meter but the 100% payback or ROI would take less than a year.

It can be seen from the calculation comparison that the inaccuracy of mechanical meters makes it difficult to determine and identify leaks. The more accurate, new-technology meters with their large turndown ratio (500:1) can determine flows almost immediately, which can alert the water provider early in the case of a potential leak. Pressure in the DMA can then be reduced until the leak source is determined or repaired. A cost comparison between the two technologies is shown in Figure 2. This does not include the recovery gain by the water provider if the meter were a billing one.

Ever-increasing costs

It is clear from government publications that water is going to get more and more expensive and, in future, costs will determine the location of water-demanding industries. These rising costs mean that more accurate metering will save bulk users money and provide a fairer means to measure consumption. Increasing electricity costs will also add to the cost of water purification and distribution – costs that will ultimately be passed on to consumers. It is, therefore, only fair that water metering should be more accurately measured.

Conclusion

New-technology meters offer water providers the necessary tools to enable effective strategies to help reduce NRW. Accurate meters play an important strategic role in leak detection, billing improvement and NRW reduction, which should not be underestimated. New-technology, battery-powered water meters provide rapid payback or ROI when compared to mechanical meters. As water is becoming more and more costly, it should indicate to the authorities and consulting engineers that the time has arrived to reassess the bulk meter philosophy. 3S