AquaMaster™

A new flowmeter for a new era in water management

Ray Keech

Flowmetering in the water industry has long been characterized by the use of traditional easy-to-use, low priced mechanical meters. There are, however, a number of factors that affect the long-term efficiency of these types of meters. Accuracy will steadily deteriorate due to the inevitable wearing of mechanical components, thereby reducing the useful life of a meter. With an accuracy of ±2 percent, regular maintenance becomes an absolute necessity. Another factor is the total cost of ownership, which includes everything from installation through to maintenance, plus the cost of manually collecting information.

Advances in technology and increasing legislative requirements mean that customers now expect, rather than demand, meters with more accurate metering and enhanced monitoring capabilities. ABB's AquaMaster™ electromagnetic flowmeter offers high accuracy, ±0.5 percent, together with low cost of ownership. It has recently been equipped with the option of GSM radio technology, thereby allowing the transmission of important information from remote locations using SMS text messages.

Tens of thousands of flowmeters later, AquaMaster™ units are helping to achieve vast improvements in the way water is metered and managed around the world.

The AquaMaster™ flowmeter has come a long way since the idea was first proposed of applying electromagnetic technology to a market dominated by mechanical flow meters. At that time, in the late 1990s, water companies only used electromagnetic devices on large pipe diameter applications such as district mains, and the idea of applying this approach to revenue applications was a new one.

ABB realised that a battery-powered electromagnetic meter could exceed the current requirements of the market in terms of accuracy. With mechanical meters, water companies were making do with an accuracy of ±2 percent. Metering experts at ABB, however, knew that electromagnetic technology could beat this, thus saving the water companies a lot of money in the process.

Even though the demand for better meters from the water industry wasn't high, confidential consultations with key customers convinced ABB that a new product could generate fresh demand. The company felt the argument for better flowmeters was relatively straightforward and to the point: Improved accuracy will have a direct impact on water companies' bottom lines.

For example, consider a mechanical DN150 flowmeter that is accurate to within ±2 percent. This flowmeter is installed in a line with an average flow rate of 10 litres per second, which equates to an annual usage of 315,360 m^3. Assuming a cost, just for water at US$ 1 per m^3, over the course of one year the potential inaccuracy of the meter means the operator could lose around US$ 4,730 of revenue.

If this meter is replaced with an ABB AquaMaster™ electromagnetic meter, which has an accuracy of ±0.5 percent, then the meter could pay for itself within just 23 days and continue to save money in the future.

Further savings and increased revenue come from the maximum and minimum flow rates, or operating range, of an electromagnetic meter compared with that of a mechanical one. Its unique low flow rate capability enables previously unrecordable minimal night flow rates to be metered. By being able to do this, the savings is doubled to around US$ 9 k per annum.

In addition to the headline improvement in accuracy, there are a number of other well-known advantages to electromagnetic water metering when compared with mechanical devices. First, the fact that electromagnetic systems contain no moving parts eliminates the need for routine maintenance. This in turn means that the overall installation costs are lower, because the end user does not need valves to isolate the meter during maintenance and replacement.

The lack of moving parts also means that the accuracy of electromagnetic flow readings will not deteriorate through wear, whereas a mechanical meter's accuracy will deteriorate with age resulting in under reading. And with so many wearing parts, a typical mechanical meter will have a useful life of just five years, or possibly shorter, if particulates are present in the water. On the other hand, a correctly installed AquaMaster™ should offer fit-and-forget service for about 10 years.

ABB's AquaMaster™ electromagnetic meter, with an accuracy of ±0.5 percent, can pay for itself within 23 days and continue to save money in the future.

1	AquaMaster™ is the first choice for district metering, trunk mains and treatment works applications. Applications successfully targeted include bulk customers such as blocks of flats, hospitals, motorway service stations or airports.

2	The robust IP68 housing must be able to withstand the harshest of environments.

Examples of the kind of applications successfully targeted by today's range of AquaMaster™ meters include bulk customers such as blocks of flats, hospitals, motorway service stations and airports. In fact, AquaMaster™ is the first choice for district metering, bulk revenue, trunk mains and treatment works applications 1. But the special demands many of these place on meters have meant that some clever innovations were needed to turn the initial basic electromagnetic metering concept into the fully working solution now provided by ABB. And interestingly, the product evolved with lots of input from customers.

3	An AquaMaster™ transmitter with GSM and integral GSM antenna.

Improved design features

Wide range sensors

The first target for attention was the sensor itself. Many revenue applications involve enormous variations in the flow being measured. For example, a large airport is likely to be inundated with passengers in the run up to Christmas, yet deserted on Christmas Day. It will also need high volumes of water if there is a fire on site.

This means an extremely high turn-down ratio is needed to ensure that readings will be accurate at both high and low flows. Today's AquaMaster™ meters boast an ISO-certified turn-down of 1000:1!

The key to achieving this lies in a narrow, conical section within the sensor, which boosts the velocity of the fluid and makes it easier for the meter to measure the flow rate accurately, even at very low volumes. The unusual hydraulic contour of the meter also makes it less sensitive to hydraulic disturbances up or downstream, if the meter is positioned, for instance, near a bend or a valve. This enables the AquaMaster™ to give consistent readings that meet the ISO4064 standard of accuracy.

Reduced power consumption

But increasing the velocity of the fluid through the meter also provides another important advantage by reducing the power consumption. In electromagnetic flow meters, the output signal is proportional both to the current through the excitation coils and to the velocity of the fluid, while power consumption in the energising coils is proportional to the square of the current. So increasing the velocity of the fluid by a factor of three enables the engineers to reduce the power to the coils by a factor of nine, without compromising the sensitivity of the meter.

Increasing the velocity of the fluid through the meter by a factor of three enables engineers to reduce the power to the excitation coils by a factor of nine.

Low power consumption is vital in many of the applications targeted by AquaMaster™, because the installations are often remote and inaccessible, for example, under a busy road. There may be no mains power available and difficult access means that batteries must last for years rather than weeks.

ABB supplies many mains-powered AquaMaster™ meters, but it estimates that about 85 percent of today's AquaMaster™ installations are battery powered. With AquaMaster™, which currently achieves a three-year battery life, further enhancements are scheduled for release to extend this to six years.

As well as an energy saving sensor, the meter's transmitter electronics have also been designed to draw as little power as possible. The design achieves a high signal-to-noise ratio but with a very low average power consumption. The trans-

mitter runs off a 3.6 volt power supply, where 15 volts is more typical. Achieving this has meant the use of very efficient switching power converters.

The battery pack itself is also crucial. ABB opted for lithium thionyl chloride technology even though certain limitations of this technology had to be overcome. For example, the internal resistance of the cell varies depending on the usage and remaining capacity. If the battery is not used for a while the internal resistance becomes very high. Although it corrects itself after a few minutes, this can be a problem because it could limit the amount of power that the AquaMaster™ can draw at times of peak demand.

To overcome this, ABB uses hybrid layer capacitor technology, which effectively lowers the resistance and allows the peak power to be drawn immediately. Other considerations for AquaMaster™ applications include the possibility of being submerged in water or buried under a busy road. Either way, the robust, IP68 housing must be able to withstand harsh environments 2, including being buried 10m deep with an articulated lorry driving overhead.

Increased functionality

The AquaMaster™ family also offers a range of options, depending on the particular needs of the end user. Flow measurement is often accompanied by other equipment such as pressure sensors. The next obvious step was to integrate pressure sensing as an option within AquaMaster™.

Data logging is another common requirement, so the AquaMaster™ family offers an option of logging the flow rate and pressure every 15 minutes. By virtue of the digital connection between the flow measurement and the datalogger, it allows high resolution data to be logged at a faster logging rate not possible with traditional solutions. In addition, AquaMaster™ offers high speed, high resolution logging up to an interval of 15 seconds in a second logger channel.

Traditionally any data logged is recovered manually by sending someone to the site to recover the data. This is done by either downloading it to a PC, or sometimes by retrieving the entire datalogger and rotating it with a second one. Providing fresh control instructions to the equipment presents exactly the same problem.

A recent innovation from ABB is to equip AquaMaster™ meters with the option of GSM radio technology 3. Released in late 2003, the GSM option means that information can be transferred remotely using SMS text messages over a mobile phone. In the case of battery-operated meters the radio module kicks in at certain pre-programmed times, typically once a day, to conserve power.

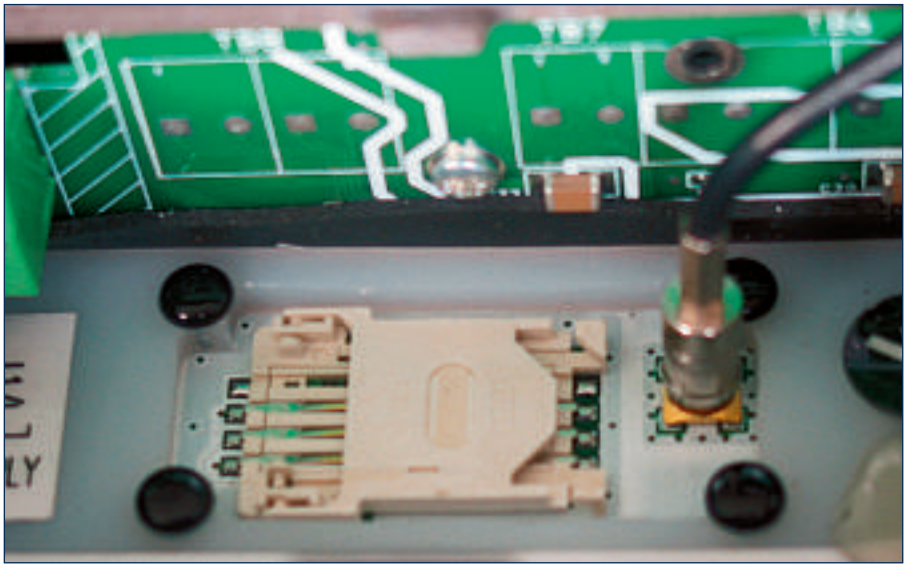
AquaMaster™ meters are equipped with the option of GSM radio technology allowing the remote transfer of information using SMS text messages over a mobile phone.

The use of SMS opens up a lot of possibilities. The latest AquaMaster™, for instance, can dial out on an alarm, so if somebody tampers with it the system will send an SMS message alerting the owner to the problem 4.

When the first AquaMaster™ meters hit the market in 2001, they were totally unique. Now, some three years later, only one other supplier has recently decided to offer similar electromagnetic technology aimed at the same applications. Yet even this lone competitor does not offer any of the capability and optional extras available with the AquaMaster™. ABB is the only company offering the whole package.

But staying ahead of the competition for the next few years will mean listening to what customers want and continuing the vigorous process of innovation that has already brought the AquaMaster™ this far.

4	SIM card-holder within the AquaMaster™ transmitter.



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