

Flow measurement for irrigation

Achieving accurate measurement with ABB's electromagnetic flowmeters



Accurate flow measurement for pricing and allocation in irrigation applications

Measurement made easy

Achieving accurate measurement with ABB's electromagnetic flowmeters

Introduction

With irrigation accounting for 70 % of the water drawn globally for agricultural use, the need to carefully manage water supplies is of paramount importance. This is particularly the case in arid countries where water supplies are less abundant. To ensure that water is being used as responsibly as possible, it is necessary to carefully measure the amount drawn for irrigation as carefully as possible.

The application

The use of irrigation in agriculture to transfer water from one location to another can be traced back to ancient times. Despite the huge advances made in municipal distribution systems in the same timeframe, the design of many irrigation systems has been subject to limited changes, with many agricultural irrigation systems still being based on traditional methods.

With a growing need to ensure that water is allocated both more responsibly and more efficiently, however, modern irrigation systems, utilizing pressurized pump-fed supplies, are starting to become more commonplace.

Irrespective of the design of the irrigation system, the need to manage the amount of water used means quantities need to be measured as closely as possible. In most cases, this is done for two reasons.

The first reason is pricing. Under-pricing of water is seen to be one of the main causes of overconsumption of water for irrigation. As such, charging users according to the exact amount of water they use at a realistic price is seen as a key way of persuading them to use supplies more conservatively.

The second reason is to effectively ration supplies, with each user allocated a specific quantity of water they may use for irrigation, with any excess quantities charged at an inflated rate.

The challenge

As in any water measurement application, the level of accuracy will hinge on the choice of measurement technology deployed. This in turn will depend on the type and scale of the irrigation system in question, ranging from small-scale single users through to irrigators or authorities managing supplies to several farms.

Various types of measurement techniques can be used for open channel systems, including constriction methods such as weirs or flumes. In closed pipe systems, where a flowmeter can most easily be deployed, options include orifice, mechanical, ultrasonic and electromagnetic technologies.

Orifice plates fitted on open pump discharges present a relatively inexpensive solution by measuring the amount of water flowing through a specifically sized opening. An orifice plate will deliver a relatively accurate measurement, provided that the orifice opening is accurately machined to the right size.

Mechanical propeller flowmeters are also popular for irrigation applications. However, like any meter with moving parts subject to wear and tear, these can quickly suffer reduced accuracy, leading to either under or over-registration of flows. Furthermore, the need for mechanical meters to be periodically tested, recalibrated and repaired also means they have to be removed, requiring users either to replace the meter with a temporary device or cease measurement altogether until the meter is refitted back into the line.

Ultrasonic flowmeters, including portable clamp-on types, use ultrasonic beams to assess the velocity of the fluid, which can then be used to derive a flow measurement. Aside from their higher cost, ultrasonic flowmeters suffer various drawbacks. Transit time meters can struggle to handle flows with high levels of particulate matter, requiring a strainer to be fitted. Both transit time and Doppler meters can also be affected by velocity profile distortions, requiring from 10 to 40 upstream diameters, depending on the severity of the disturbance.

The accuracy of flowmeters in irrigation applications can be affected not just by design but also by their susceptibility to tampering. Particularly where metering is conducted at the point of use, users have been known to make adjustments to achieve more favourable readings which enable them to either pay less or use more water.

A solution

Electromagnetic flowmeters offer an ideal solution for irrigation applications. Compared to other flowmeter types, electromagnetic flowmeters offer greatly enhanced accuracy and repeatability throughout their operational life, with uncertainty of $\pm 1\%$ reading or better. With no moving parts, they do not suffer from problems with wear and tear, minimizing maintenance and require no upstream strainers to filter sediment. A choice of flow primary linings affords further protection against high sediment flows, with users able to choose from a variety of materials, including ceramic linings for particularly abrasive flows.

The ability of electromagnetic flowmeters to better handle distorted velocity profiles also means that the amount of piping upstream and downstream of the meter is minimized, which can greatly reduce the time and cost of installation.

The illustration in Figure 1 shows a recommended arrangement for a surface-located installation. It should be noted that where ABB's WaterMaster and AquaMaster electromagnetic flowmeters are used, there is no need for any pipe lengths either upstream or downstream of the point of installation.

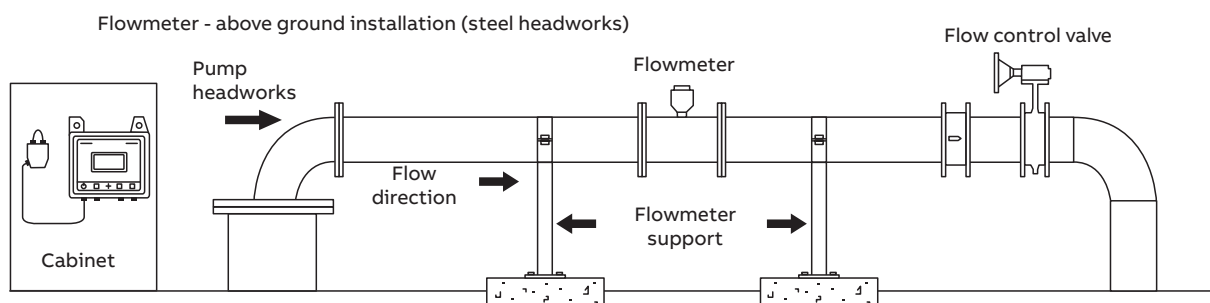


Figure 1 Recommended arrangement for a surface-mounted irrigation flow measurement installation. ABB's WaterMaster and AquaMaster electromagnetic flowmeters eliminate the requirement for the minimum upstream and downstream pipe lengths.

What can ABB offer?

ABB's WaterMaster and AquaMaster electromagnetic flowmeters

ABB's WaterMaster and AquaMaster electromagnetic flowmeters offer the ideal solution for irrigation applications. Both flowmeter ranges bring a host of advanced features and functionality for water measurement.

A key feature of the WaterMaster is its revolutionary octagonal sensor design. By improving the flow profile, the octagonal design minimises the upstream and downstream pipe lengths required from the point of installation, greatly reducing the cost of fitting the meters into new or existing pipelines.

The WaterMaster also features onboard verification capability. Called VeriMaster, it assures operators of the performance of the meter through constant self-checking. When coupled with ABB's VeriMaster software tool, it enables operators to produce a printed verification certificate for regulatory compliance.

All WaterMaster sensors have a rugged, robust construction to ensure a long, maintenance-free life even under the most difficult conditions experienced in water and waste water applications. The sensors are inherently submersible (IP68, NEMA 6P) as standard, ensuring suitability for installation in chambers and metering pits which are liable to flooding.

WaterMaster flowmeters are available in sizes from 10 to 2400 mm ($\frac{3}{8}$ to 96 in). All sizes are buriable and are straightforward to install.

The AquaMaster can be installed anywhere, making it highly suitable for irrigation applications. Available in sizes from 10 to 600 mm ($\frac{3}{8}$ to 24 in), the meter sensor can be buried, fully submerged or mounted in a chamber. The transmitter can be installed with it or separately at ground level up to 200 metres away.

With the introduction of a renewable energy option, the AquaMaster can be installed in even the remotest locations. Adding to the existing battery and mains-powered versions, it can be hooked up to sources as small as a 5 Watt solar panel or a 60 Watt wind turbine generator.



Enabling accurate flow measurement for pricing and allocation, ABB's AquaMaster 3 electromagnetic flowmeter offers the ideal solution for irrigation applications.

Requiring zero pipe diameters upstream and downstream, the AquaMaster is ideal for installations with limited space. The meter's reduced bore sensor conditions the flow profile in the measuring section, flattening any distortions that could affect either upstream or downstream measurement, as proven through OIML R49 and MID testing.

With no moving parts to wear out, the AquaMaster provides a true fit and forget flowmetering solution, with no need for meter maintenance. Its advanced sensor design also means there are no obstructions, minimizing flow pressure loss.

All data collected by the AquaMaster is stored in an integrated data logger, which gathers data on both flow and pressure every 15 minutes. This data can be automatically sent daily via SMS to a receiver of the customer's choice.

Operating both the WaterMaster and AquaMaster flowmeters has been simplified by the use of ABB's universal Human Machine Interface (HMI), which has now been extended across its range of instrumentation products. Based on Windows™ technology, the HMI simplifies operation, maintenance and training, reducing cost of ownership and providing a consistent user experience.

Acknowledgment

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