How Meter Nozzles Can Deliver Accuracy In Municipal Treatment Facilities

By Jeff Smith
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Accurate Measurement for Oil, Gas, Water

The United States Environmental Protection Agency claims there are approximately 155,000 public water systems in the nation and the public drinking water systems regulated by EPA provide drinking water to 90 percent of Americans. To put this in perspective, a family of four statistically uses 400 gallons of water daily.

As water is becoming more valuable and also less readily available, it's important that the most accurate metering technology is implemented during all phases of the water treatment and metering process. Any leaks, or irregular activity not perceived by the metering applications can create not only inaccurate readings but also can result in significant water loss among other things.

When a flow measurement system is in place and billing becomes a factor regarding either the amount of water delivered or received, those measurement values and metering elements must be accurate to ensure both the "sender" and the "receiver" are providing or paying for the correct amount of flow. But more importantly, in terms of a municipal or water management facility, devices have a defined, limited measurement capacity, and some elements such as metering manholes are at times not properly installed for measurement. This creates an element of difficulty, and measures need to be taken to ensure that effective measurement is installed.

The water treatment process can range from a simple filter and disinfection, to a complex treatment plant. Differentiators like location, water source, and demand, play key roles regarding the type of treatment required for water purification. A smaller community may have access to a relatively clean ground water source which would require minimal treatment. Conversely a larger public water system, particularly when the water source is subjected to repeated human contact, such as heavy recreational use, may require a more complicated treatment process.

The common treatment usually involves initial filtration, coagulation and sedimentation, aeration, and finally disinfection. Even if some of those stages are not implemented, transferring fluids throughout the treatment facility is a step-by-step process that involves high-volume flow transfer, and a demand for precise accuracy.

Through every transfer, the fluids must be monitored, via pipe to pipe conveyance and also free falling discharge. When water flows in a pipe or a channel with a free surface exposed (or via an open channel) gravity provides the moving force. But, as with pressure flow, friction can create an energy loss in gravity flow. Flow in storm or sanitary sewers are primarily open channel flow, except when the water is pumped through a pressurized pipe.

When implementing an effective metering solution it's important to be aware of the surroundings and environment in which the solution will be placed. Metering liquids as they are released either into a free falling environment, or even metering effective discharge levels, is a calculated and important process.
Most routine calculations in the design or analysis of municipal water systems are centered on an element called steady uniform flow. Steady flow means that the discharge is constant with time, whereas uniform flow means that the slope of the water surface and cross-sectional flow area are also constant in the length of channel being analyzed.

Under steady, uniform-flow conditions, the slope of the water surface is the slope of the channel bottom. The top of the inside pipe wall is called the crown, and the bottom of the pipe wall is called the invert. One basic objective of the flow system design is to establish appropriate invert elevations along the pipeline.
The length of wetted surface on the pipe or stream cross section is called the wetted perimeter. The size of the channel or pipe, as well as its slope and wetted perimeter, are important factors in relation to its discharge capacity and also measurement capabilities.

Solutions

Most municipal water systems are built with circular piping. Along with the roughness coefficient, the other important factors in design or analysis are the flow velocity, pipe diameter, pipe slope, and how much the pipe can handle. As transfers are taking place, or flows are being dispensed via a free flow environment, a metering element needs to be implemented at the end of the pipeline to monitor flow and ensure accuracy.

Meter Nozzles
There are solutions to effectively meter flows that are traceable to the U.S. National Institute of Standards and Technology, and also have a discharge coefficient. The most accurate solution would be a flow nozzle. The flow nozzle's basic principle of operation is the same as that of the Venturi meter. The flow nozzle has an entrance section

and a throat, but lacks the diverging section of the Venturi meter. However, flow nozzle accuracies can approach if not achieve the same accuracies of Venturi meters.
Implementing an open channel-specific meter nozzle can dramatically increase accuracy by factoring in design conducive to handling excessive pipe slope or velocity conditions. By implementing an open channel-specific meter nozzle, accuracy can achieve +/-2.0% of max rate while also being paired with a number of secondary read-out devices such as ultrasonic level, pressure transmitters, capacitance probe and others.

Open channel-specific meter nozzles such as Primary Flow Signal's PFS-HN achieve laboratory flow calibration, accuracy of +/-1.0% of max rate, and factors a lower head loss compared to other free discharge devices. In addition, open channel-specific meter nozzles, such as the PFS-HN can be self-supporting, and they do not require concrete work meaning they can be used for a wider minimum to maximum flow rate range depending on available secondary devices. This also means that the installation is simplified and results in an easier and less expensive implementation process.

Conclusion

Accurate flow measurement for open channels is becoming increasingly important. Extensive sloping, sediment or drastic changes to geometry and velocity can, and often does, negatively impact the accuracy and dependability of open flow measurements. Due to the reduction of available stream water, combined with the importance for metering and managing the fluid flow of sewage and other open channel liquid flows, accuracy must be taken into consideration to select an effective solution. To deliver reliable, traceable results requires looking beyond the traditional offerings to the next generation of verifiable traceable flow measurement solutions.

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