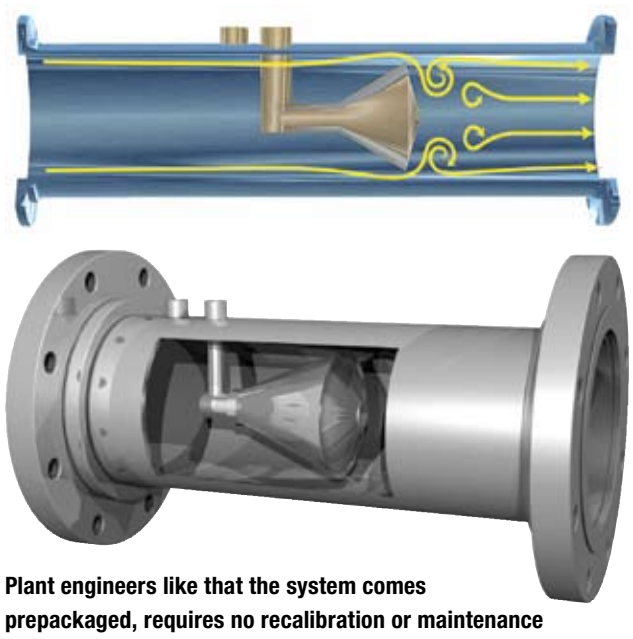
prevailing space limitations

Addressing installation issues during flowmeter selection process

By Marcus P. Davis

Over the course of its life, nearly every water and wastewater treatment plant eventually runs into a real estate problem. This problem usually surfaces during facility retrofits or expansions when installing new or replacement flowmeters and other equipment that requires a prescribed straight run of pipe to operate accurately and efficiently. When a new flowmeter requires a straight run of pipe greater than the space available, continuing with the installation using less-than-adequate straight pipe will often result in an accuracy problem that might not be immediately obvious and can be very expensive to fix later.

Figure 1. V2 System Flowmeter



Plant engineers like that the system comes prepackaged, requires no recalibration or maintenance over a long life and is capable of being built to specifications.

Evolving technologies frequently lead to facility equipment layouts that result in less than the optimal conditions for flow measurement. Inserting pumps, elbows, valves and other equipment in the pipeline near the flowmeter will typically cause fluid flow disturbances such as liquid media swirling, high/low pressure regions and other effects that can result in irregular flow profiles, which compromise measurement accuracy and repeatability.

Typically, flowmeter manufacturers specify anywhere from 20 to 30 pipe diameters of straight pipe run upstream and five to 10 downstream of the flowmeter—depending on the flow-sensing technology in use. Unfortunately, these upstream/downstream pipe requirements are often easily overlooked during the process of choosing a flowmeter because performance, life, maintenance, cost, etc., are the primary considerations in the selection process.

Prevention

The old saying "An ounce of prevention is worth a pound of cure" definitely applies to adding new or replacement flowmeters. The simple answer to the straight-run installation issue is to know your flowmeter and its straight run piping requirements to achieve accurate, consistent measurements. That being said, many times in expansion or retrofit projects there is not enough space to accommodate the flowmeter's required straight pipe runs. There is a temptation to continue with the installation and hope for the best because it looks "close." If there is a problem, however, changing the pipeline layout or moving other devices often becomes impractical and too costly.

A frequently proposed solution to flowmeters with real estate problems can be flow conditioners or flow straighteners. There are various types of conditioners and straighteners available on the market today, such as perforated plates, tube bundles or fins. These devices help eliminate swirl and provide a stable flow profile. One drawback to add-on flow conditioners and straighteners is they inevitably increase headloss, which can result in additional pump energy costs to move water through the facility.

An Alternative Solution

To address this common problem, McCrometer has developed a differential pressure (dP) type flowmeter. Instead of adding a flow conditioner to the pipe upstream from the flowmeter, the V2 System flowmeter features built-in flow conditioning that

reduces the required upstream straight pipe run down to zero to three pipe diameters, which is a 70% reduction in the typical straight pipe run requirement for a standard dP technology meter.

With a wide flow range of 10:1 and low permanent headloss, this flowmeter supports line sizes from 4 to greater than 30 in. No moving parts means little to no maintenance over an installation life that can exceed 25 years.

The space-saver design of this dP flowmeter conditions fluid flow to provide a stable flow profile. The flowmeter features a centrally located cone inside a tube that interacts with the fluid flow and reshapes the velocity profile to create a lower-pressure region immediately downstream. The pressure difference, which is exhibited between the static line pressure and the low pressure created downstream of the cone, is measured via two pressure-sensing taps. The static pressure tap is placed slightly upstream of the cone, and the low pressure tap is located in the downstream face of the cone itself. The pressure difference is then incorporated into a derivation of the Bernoulli equation to determine the fluid flow rate.

The cone's central position in the line optimizes the velocity of the liquid flow at the point of measurement. It forms very short vortices as the flow passes the cone, creating a low-amplitude, high-frequency signal for excellent signal stability, even in pipelines with plant-induced noise from pumps and other equipment. The result is a highly stable flow profile for measurement accuracy to ±1% over a wide flow range of 10:1. All of this is possible with a minimal straight pipe run of zero to three diameters upstream and zero to one diameters downstream from the flowmeter depending on placement relative to valves and other control devices.

Application Example

A small municipality in the western U.S. found its treatment plant needs changed over time and it now needed to measure finished water. The original pump station design did not include a flowmeter and there was not sufficient room for a typical solution due to the piping layout.

The new flowmeter would need to operate over a 10:1 flow range with low headloss, accuracy of ±1%, and fit in a space of less than 2 ft with two clear well pumps upstream and an ell with valves downstream leading to distribution.

The city engineers liked the fact that the dP technology V2 System flowmeter came prepackaged and ready for installation, required virtually no recalibration or maintenance over a long life and was capable of being built to their demanding specifications. They installed an 8-in. flowmeter, and to simplify the installation, the meter was shortened from the standard lay length of 34 to 21 in. To better connect to the existing piping, the meter was made with a flange connection on the inlet and a plain end connection on the outlet.

The low-headloss and self-conditioning characteristics of the system allowed the municipality to install a solution that met all installation requirements while providing outstanding flow rate data without the need for maintenance or recalibration.

While flow conditioners are an answer to flowmeter straight run space limitations, it is best to avoid the problem in the first place. It is important to consider the installation requirements of any flowmeter during the selection process. WWD

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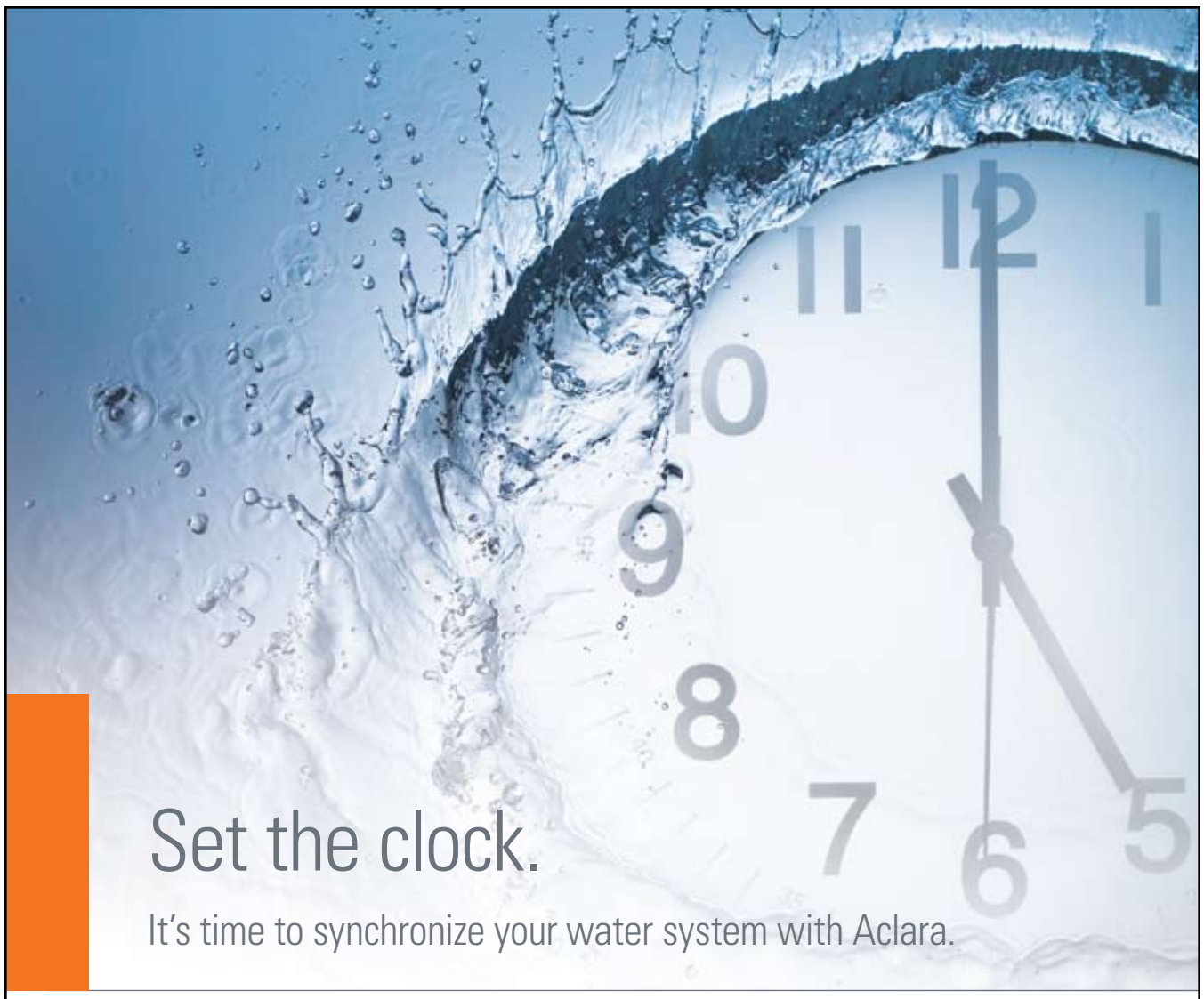

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