Quick Cavitation Fix

By Wes Caudle

Pressure reducing valves give Hutchinson, Kan., consistent flow & pressure

The Hutchinson (Kansas) Water Plant gets its water from 20 wells. The water is pumped out of the wells and into a reverse osmosis (RO) water treatment system to purify it and ensure safe drinking water. At that point, a portion of the water is taken from the main line, run through the RO system and then mixed back with the well water. This is used to lower the total dissolved solids in the water. The plant can handle 10 million gal per day and provides water to 41,000 residents and businesses.

When the plant was built in 2008, it was designed primarily for the large summer water demand and not the lower winter demand. The original mixing butterfly valves were sized correctly for the summer demands, but the lower-demand season meant dropping too much pressure across the valves. With inlet pressure varying from 50 to 90 psi and outlet pressure at approximately 10 psi, the butterfly valves could not handle this variance in pressure without experiencing severe cavitation and damage. The result was extreme noise from cavitation and valves that were failing to perform their jobs after two years.

Cavitation Considerations

Cavitation essentially is rapid vaporization and condensation within a liquid. When local pressure falls to vapor pressure (approximately 0.25 psi/0.018 bar absolute for cold water), vapor bubbles are formed. When these bubbles travel to an area of higher pressure, the bubbles collapse with phenomenal force and great localized stress.

The shock waves and pressure fluctuations resulting from these high-velocity bubble collapses also can cause noise, vibrations, accelerated corrosion and limited valve flow.

There was some consideration of adding another smaller set of mixing butterfly valves for the winter water demand, but that would have involved piping modifications. That was when Todd Nason of Mid-America Valve presented the idea that a pressure reducing valve (PRV) with anti-cavitation trim in front of the plant would be the simplest, most reliable and cost-effective solution. In this case, the PRV would take the main pressure drop, while the mixing butterfly valves would be used for trimming the flow.

Weighing Flow Options

Nason worked with Professional Engineering Consultants (PEC) and the city of Hutchinson to look at all the flow options to determine which one would work and where to place the valve. The decision was made to go with a 20-in. Singer Valve pressure reducing valve (S106-PR-AC) because it has a single rolling diaphragm (SRD) that provides smooth, steady and precise pressure control from maximum to virtually zero flow. The effective area of a single rolling diaphragm remains constant, so the bonnet is smaller and lighter than a flat diaphragm. A measured quantity into the bonnet control chamber always gives the same smooth movement of the inner valve through the entire stroke. A smaller bonnet also makes the valve lighter and safer for maintenance, while the smaller control chamber enables it to respond faster to changing pressures.

By eliminating the seat chatter at low flows (capable to as low as 50 gal per minute), the SRD avoids injecting small pressure pulses into the piping, which, over time, may increase leakage, losses or pipe bursts.

Mid-America Valve and Singer Valve provided training and explanation of valve operation to the six-member Hutchinson staff. Topics covered were functions of the valve and preventive maintenance steps for its first year of service. These include checking and cleaning the stainless steel strainer, exercising the ball valves, checking for and bleeding air from the pilot system, and checking the tightness of all the fasteners, fittings and connections. This training helps ensure that valves operate at maximum efficiency and prolongs the life of the valves with a regular maintenance schedule.

"Once the new PRV was put in place, the unbearable sound from cavitation was no longer present, and we now have consistent reliable flow and pressure," said Don Koci, superintendent of water systems for the city of Hutchinson. "Going forward, the city should not have to incur the costs of replacing the valving on an annual or biannual basis as before. This new valve is factory guaranteed for three years, and with maintaining an effective preventive maintenance program, the valve should operate for decades to come. This also provides further protection to other components on this section of the system, prolonging its lifespan as well." **w&wd**

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