

## Chemical Dosing at Municipal Water Treatment Plant Improved by Precision Back Pressure Regulator

### Background

The City of Tempe, Arizona recently completed a water quality upgrade to their 50 million gallon/day water treatment facility. This project included an upgrade to their dosing systems for Sodium Hypochlorite (NaOCl), which is used to disinfect the water. Like many municipal systems, the original plant used high-maintenance peristaltic metering pumps for the NaOCl dosing. The Tempe upgrade project replaced the peristaltic pumps with magnetic-drive centrifugal pumps, control valves, and magnetic flow meters to lower maintenance costs and improve accuracy. Back pressure regulators were installed to provide constant pressure across the control valve.

### The Challenge

To address a flow control issue that was preventing dosing through the full specified range, the City of Tempe partnered with Wilson Engineers of Phoenix to analyze the process. Wilson determined that a more precise back pressure regulator could both stabilize and expand the range of control.

As shown in the schematic (page 2), each centrifugal pump supplies several dosing stations with a constant pressure that is determined by the back pressure regulator (BPR) installed at the end of the loop. In order to isolate the control valve from the pressure fluctuations in the downstream water main, a BPR is also installed downstream of each control valve. This combination of two BPRs allows the inlet and outlet pressure of the control valve to be held constant. All of the fluid components are manufactured from polymer to resist the highly corrosive hypochlorite, which is the active ingredient in household laundry bleach.

The original design incorporated traditional spring-loaded back pressure regulators for each of these applications. However, the pressure sustained by these BPRs changed significantly with varying flow rate – as much as 12 to 14 psi



*Close up of 3/4" CPVC Equilibar back pressure regulator in Sodium Hypochlorite service.*

deviation at high flow rate. This pressure "build" is common with compact spring designs because of the additional force necessary to compress the coil spring as the seat opens.

The unwanted pressure build from the spring operated back pressure regulators put the control valve in a challenging environment: valve differential pressure was maximum at low injection flow rates (challenging low flow resolution) and was inadequate at maximum injection flow rates (challenging high end capacity). This limited the range for these injection loops to 3.1 to 6 gpm, which fell short of the required range of 0.7 gpm to 7 gpm.

## Finding More Precise Regulator

To address these challenges, Wilson engineer David Highfield and City of Tempe mechanic Brad Hargin contacted Equilibar of Fletcher, NC to see if their precision liquid back pressure regulator could provide a more stable environment for the control valve.

Equilibar® BPRs incorporate a dome-loaded design and use dozens of parallel orifices sealing on a supple diaphragm to better maintain pressure stability. The dome loaded design uses compressed air to load the internal diaphragm rather than the coil spring used in traditional designs. The advantage is that the force provided to the diaphragm by the air remains constant regardless of the diaphragm's position as it precisely maintains the liquid pressure.

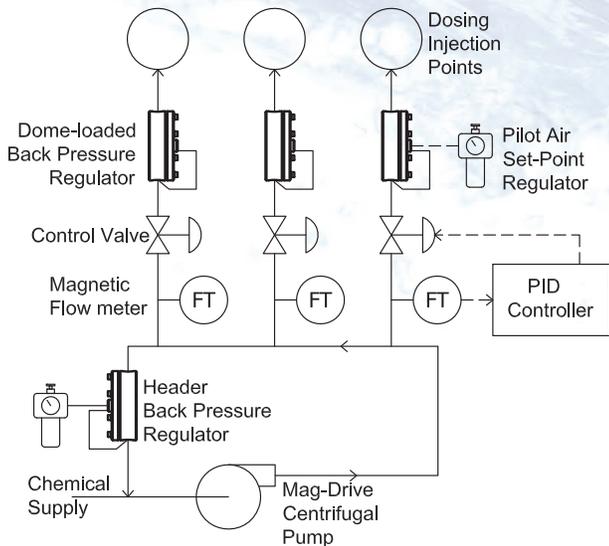
Equilibar engineer Tony Tang customized a ¾" and 1.5" regulators with a 110 psig rating while using CPVC body materials, FKM Viton diaphragm, and Van Stone flanges. Precision air pressure regulators were installed to provide constant pilot set-point pressure to the domes of the BPRs.

## Documenting Improved Range, Accuracy

Highfield's test of the Equilibar in the NaOCl injection system confirmed his theory for improved control. The precision BPR reduced the pressure variability at the control valve outlet by 90%, to less than 1 psi. The resulting stability allowed the control valve to inject throughout the desired range of 0.7 to 7 gpm.

## Other Applications

Dome-loaded back pressure regulators can be adapted to a wide range of applications, from nano flows in the research environment up to the 4" pipe size, using a wide variety of materials. These more accurate and sensitive designs are not necessary for most industrial applications, but can be used where design constraints or additional precision are required.



Simplified schematic showing how the Equilibar® Back Pressure Regulator was used to improve chemical dosing accuracy



A 2" PVC Equilibar Back Pressure Regulator shown with an integrated manual set-point kit

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