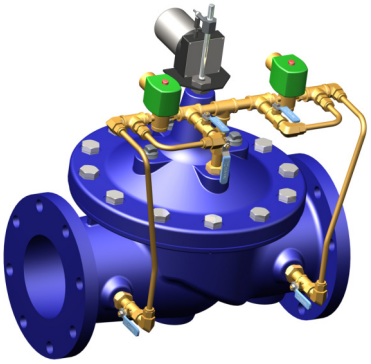
Blending Valve Design to Meet the New Arsenic Rule Requirements

02/15/06 -- By Roger Lah, Cla-Val

Got Arsenic?

After more than 10 years of scientific and political debate, the EPA finally put into effect a new rule that requires all US public water systems to deliver drinking water with less than 10 ppb (part per billion) of arsenic. This new compliance standard is a five-fold reduction from the previous level of 50 ppb.



Arsenic contamination usually occurs naturally, coming from the earth's crust where it is introduced into groundwater through dissolution of minerals and ores and erosion from rocks. In some instances, industrial effluent contributes arsenic to water supplies. Elevated arsenic levels are particularly prevalent in the Western United States.

Compliance Options

According to industry estimates, approximately 4,000 communities in the United States are faced with employing additional strategies to comply with the new arsenic content standard, which went into effect in January 2006. These communities have several alternatives to consider when deciding how to deal with their compliance challenge: treatment, non-treatment, or a mix of both options. While much attention has focused on treatment technology to remove arsenic, other alternatives may provide a simpler and less costly method of compliance.

For instance, if a community has water sources that are below 10 ppb, they may decide to simply abandon the sources that are over 10 ppb. If that is not an option, they may choose to pursue a variety of treatment or non-treatment alternatives. One non-treatment alternative is to blend two water sources to achieve acceptable levels. This is possible when a community has either wells or surface water sources that have arsenic levels well below 10 ppb that can be blended with water that has unacceptably high arsenic levels. Where good sources are unavailable, treatment is required -- but there are still many factors to be considered.

The High Cost of Treatment

Available treatment technologies include filtration, co-precipitation and the use of arsenic absorbent media that can lower concentrations to acceptable levels. Unfortunately, most of these treatment options are quite costly and the desired results may be difficult to achieve in a timely manner. In fact, according to the latest EPA Arsenic Treatment Technology Handbook, installation of an arsenic treatment system for wells producing 2 to 3 million gallons per day can cost as much as $1 million. Moreover, operations and maintenance costs for such systems are estimated to be more than $100,000 annually.

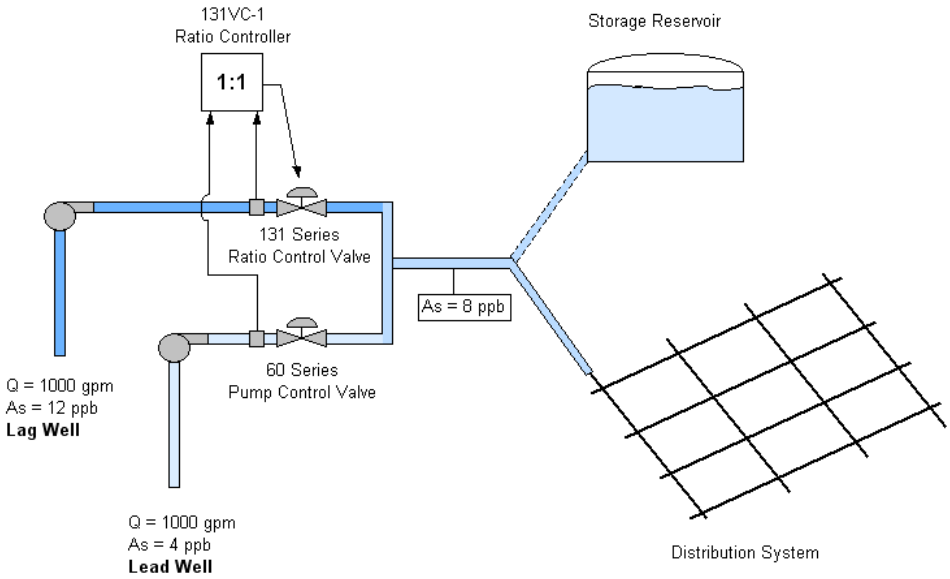
Cost Effective "Non-Treatment" - *Source Blending*

Many of the communities that are facing compliance decisions also must deal with tight or shrinking operational budgets which, in turn, makes the "price tag" for an arsenic treatment system too costly for them to consider. If these communities are lucky enough to have complying water (<10 ppb) as well as non-complying water (>10 ppb), source blending is likely to be the most cost effective option for them to pursue

Utilizing this approach, water with elevated arsenic content is blended with another water source with arsenic levels significantly less than 10 ppb, using a combination of Cla-Val automatic control valves installed on each drinking water system well line to control a blend ratio that results in arsenic levels below the prescribed EPA limit.

How Source Blending Works

The following diagram illustrates a typical setup where the lead well is the better water source than the lag well. In order to maintain an acceptable arsenic level to 8 ppb, the blend ratio should be one-to-one. This means that if the lead well produces less than 1000 gpm, the lag well must track this change and automatically throttle the Cla-Val 131 Series Ratio Control Valve to the same flow as the lead well. Flow meters on each line provide the feedback to an electronic valve controller, which modulates the Ratio Control Valve. A Cap Flow Control Valve serves to limit the well maximum output and control startup surges.



The following table provides other blending ratios based on other lead well (or surface water) and lag well arsenic levels. As arsenic levels change, the blending ratios may need to be adjusted periodically.

Blending Ratio of Lag / Lead Flows

- to maintain 8 ppb As (2 ppb lower than EPA requirement)

Lag Well	Lead Well Arsenic (ppb)						
Arsenic (ppb)	1	2	3	4	5	6	7
10	3.50	3.00	2.50	2.00	1.50	1.00	0.50
11	2.33	2.00	1.67	1.33	1.00	0.67	0.33
12	1.75	1.50	1.25	**1.00**	0.75	0.50	0.25
13	1.40	1.20	1.00	0.80	0.60	0.40	0.20
14	1.17	1.00	0.83	0.67	0.50	0.33	0.17
15	1.00	0.86	0.71	0.57	0.43	0.29	0.14
16	0.88	0.75	0.63	0.50	0.38	0.25	0.13
17	0.78	0.67	0.56	0.44	0.33	0.22	0.11
18	0.70	0.60	0.50	0.40	0.30	0.20	0.10
19	0.64	0.55	0.45	0.36	0.27	0.18	0.09
20	0.58	0.50	0.42	0.33	0.25	0.17	0.08

For blending to meet arsenic levels other than 8 ppb, use the equation:

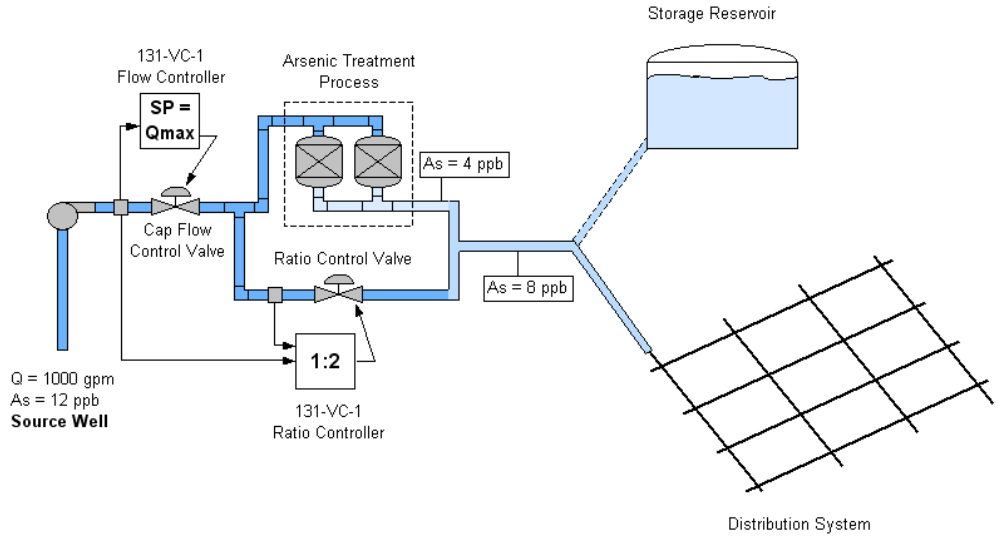
Q ratio = (AsLag – AsBlend) / (AsBlend – AsLead) *where*

Q ratio = Lag well flow / Lead well flow
AsLag = Lag well arsenic (ppb)
AsLead = Lead well arsenic (ppb)
AsBlend = Blended maximum arsenic (ppb)

For example, if the higher Arsenic Lag Well is 12 ppb and the lower Arsenic Lead Well is 2 ppb with a desired 5 ppb blended level the Q ratio (Lag flow / Lead flow) = (2-5) / (5-12) = .43. If the Lead Well delivers 1000 gpm, then the Lag Well must be limited to 1000 x 0.43 = 430 gpm in order to achieve an arsenic level of 5 ppb going to distribution.

Partial Treatment Blending
If a community does not have any water sources that are below the limit, and cannot or will not absorb the cost of treating all of their water, they may be able to utilize a partial treatment approach where only a portion of the water source is treated to remove most of the arsenic and remixed with untreated water with higher arsenic content to meet the prescribed EPA levels.

When employing the partial treatment blending approach, a Cla-Val 131 Series Electronic Ratio Control valve is used to proportionally split the flow so that one portion is treated to remove arsenic and the remaining raw water is remixed after the treatment process to provide water for the distribution system that meets regulatory requirements. If the treatment process removal rate changes with time, the ratio factor may need to be adjusted periodically. Monitoring raw and treatment arsenic levels will determine the split ratio. In this application, a Cap Flow Control Valve serves to limit the well maximum output and control startup surges.



Other variations of this strategy include source blending in combination with partial treatment blending. Regardless of the method selected, the objective is to minimize treatment costs while limiting arsenic to an acceptable level.

Additional and Backup Functions
In addition to electronic ratio control, hydraulic pilots can be incorporated into the valve to control upstream and downstream pressure. That way, the valve can also be set-up to operate hydraulically in the event that power or input signal from the meter is temporarily lost. The bottom line is this: with careful planning and well-considered valve selection, there is a cost effective method to deliver drinking water that satisfies the EPA's new arsenic requirements and one that meets the demands of most any water distribution system.