



Fractional Cv Control Valves for Water Treatment Plant Application

Chemical feed control in water treatment applications used to be handled by expensive, high maintenance metering pumps. Recently, project engineers decided to try low flow, fractional Cv control valves operated by a motor actuator to do the job. Read on to know if these valves are the better alternative for water treatment applications.

By Lyle Hamilton, Richards Industries

A major water provider in the southern California area recently completed the expansion of one of their largest water treatment plants in order to help meet the demands of the

growing number of residents in its service area. The company provides water to well over three million people delivering an average of 630 million gallons of water daily. This recent expansion effectively doubled the plant's capacity.

The plant takes water from an aqueduct and treats it for distribution to their customers. The expansion included all the chemical feed systems used for pH control, taste, odor control, cleaning, removal of solids and contaminants, and



Contouring the stem blank



The stem and orifice are installed into a special test fixture

disinfection of the water.

The expanded chemical systems included ammonia, alum, caustic, chlorine, dry polymer, ferric, fluorosilic acid, and sodium hypochlorite. The following utility systems were expanded as well; finished water, fire water, grey water, hot water, industrial water, plant water, potable water, process water, service water and sump water.

Historically, the chemical feed control in water treatment applications was handled by expensive and high maintenance metering pumps. The project engineers decided to try low flow, fractional Cv control valves operated by a motor actuator. Valves of this type use hand fitted trim consisting of a single piece stem/plug with a needle like control profile and

a precision orifice manufactured by electric discharge machining for extreme accuracy and high turndown. The motor actuator uses microprocessor control to insure repeatability. These features, coupled with the lower initial cost and less maintenance, provided a cost effective solution for the customer.

This same water provider has since expanded several of its smaller plants in a similar fashion utilizing the same control valves for all of the chemical feed systems.

Fractional Cv low flow valve trim differs from common globe style trim in several ways: The usual globe style plug with a contour machined on a CNC lathe and a standard seat ring cannot deliver the fine control needed for applications like those at the water treatment plant. Low flow trim uses a needle like stem in a precision orifice that has a length to diameter ratio much higher than standard globe style seat rings. This type of trim requires totally different manufacturing techniques.

The CNC lathe is a wonderful tool but it cannot machine parts to the extreme tolerances and close fits required for fractional Cv trim sets. Instead of machining parts complete, the lathes make "blanks" that are then carefully

sized to their final configuration by other means. Orifice blanks are made into finished parts by Electric Discharge Machining (EDM). EDM removes material with a controlled electric spark between an electrode and the work piece. Both the rate of material removal and the amount of material removed is carefully controlled by voltage, electrode gap distance, and electrolyte. The result is a precision, constant diameter orifice many times longer than its diameter.

The needle shaped stem blank is then mated with an orifice, and rather than using a machine tool to establish the final contour, it will be hand fitted to provide the exact annular flow area around the needle like stem and through the orifice. At the beginning of the process there is a near interference fit between the stem and its matching orifice. Material is very precisely removed from the needle portion of the stem by turning in a small lathe while a highly skilled technician applies a variety of abrasive pads by hand to the rotating work piece to produce the desired final trim set. At various points during this procedure, the technician will flow test the stem and its orifice in a special test valve on a purpose built flow bench using high pressure nitrogen. He takes measurements using pressures and rates that have been optimized for the fractional Cv that the final trim set is expected to develop. Once the desired Cv has been established, the stem and orifice combination is marked for identification and stocked in a special container as a matched set. The trim sizes produced by this method range from Cv 0.02 to all the way down to Cv 0.00001

Selecting Trim

Once specific application data is received, special software is needed to properly size low flow applications. Traditional sizing routines and software assume that the flow is turbulent. This is not the case when considering lower flows where the requirement is for Cv 0.2 or less. A special sizing routine is needed once the Cv falls below 0.2 as the flow may be laminar or transitional. Flow curves for each trim between Cv 0.02 to Cv 0.00001 are a part of the special software which uses the valve



Preparing for the flow test

Reynolds Number to select the curve which best fits the application data. The software will display the trim set which is represented by the selected curve. Although fractional Cv control valves are more difficult to size and manufacture, they are a cost effective solution to

complex metering pumps. They are also much easier to repair as spare parts are readily available in the form of repair kits which include a new matched set stem and orifice, along with new gaskets and stem packing



Flow testing with nitrogen

About the Author

Lyle Hamilton is a Project Engineer for Richards Industries in Cincinnati, Ohio. He joined the company after graduating from the University of Houston in 1996 as the primary engineer for the company's Jordan brand industrial valves, and is now also the primary engineer for the Lowflow brand fractional Cv control valves and the Steriflow brand Sanitary Valves.

