VALVE NEWS & VIEWS

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New From Fetterolf

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High Pressure, High Temperature Polymer Valving... Not an Easy Task

Some Things To Think About

"Any sufficiently advanced technology is indistinguishable from magic."
—*Arthur C. Clarke*

"If you are agile, you can give the customer the configuration he wants simply as part of the production process itself."
—*Robert W. Hall*
Assn. for Manufacturing Excellence

"Change is like a steamroller. You either drive it or you become part of the road."
—*Anonymous*

"Worry affects the circulation, the heart, the glands, the whole nervous system. I have never known a man who died from overwork, but many who died from doubt.
—*Charles H. Mayo*

Hoechst Celanese and Allied Fibers were the first companies to use oversized port Wye-pattern Globe valves for stopping the flow of high pressure (5000 psi) and high temperature (750° F) polymers. Valves for this service must be very carefully selected and properly maintained to assure smooth, long-term, reliable plant operation.

Stop valves, upstream and downstream of flow regulating valves, must have high Cv valves and low pressure drop to assure full flow. Vertical stem, standard-type globe valves cannot be used due to high pressure drop caused by numerous changes in flow direction. Wye-pattern, full-ported globe valves are ideally suited for this service. Unrestricted flow patterns are inherent with this design and tight shut-off (ANSI B16-104, Class VI) is easily obtained with proper valve selection.

Figure 1 shows a special polymer shut-off valve. The body is fabricated from 316L stainless steel. Inlet and outlet connections are welded to the body. This is an "oversized" port valve. Usually, Wye-pattern valves have reduced ports or full-port size at best. This oversized port design offers no obstruction to polymer flow, diameter being always larger than the inlet and outlet piping. In a 3" high pressure design, for example, seat diameter is 3.313" (8.6 in^2) while the internal diameter of 3" schedule 160 is 2.624" (5.4 in^2). Looking at a popular high pressure Wye-pattern forged body valve in 3" size, the seat has a diameter of 1.67" and a flow area of only 2.2 in — a reduction in area of 75% from an oversized port design for polymer service.

Fabricated design also lends itself well to rapid fabrication using virtually any alloy (hastelloy, titanium, inconel,

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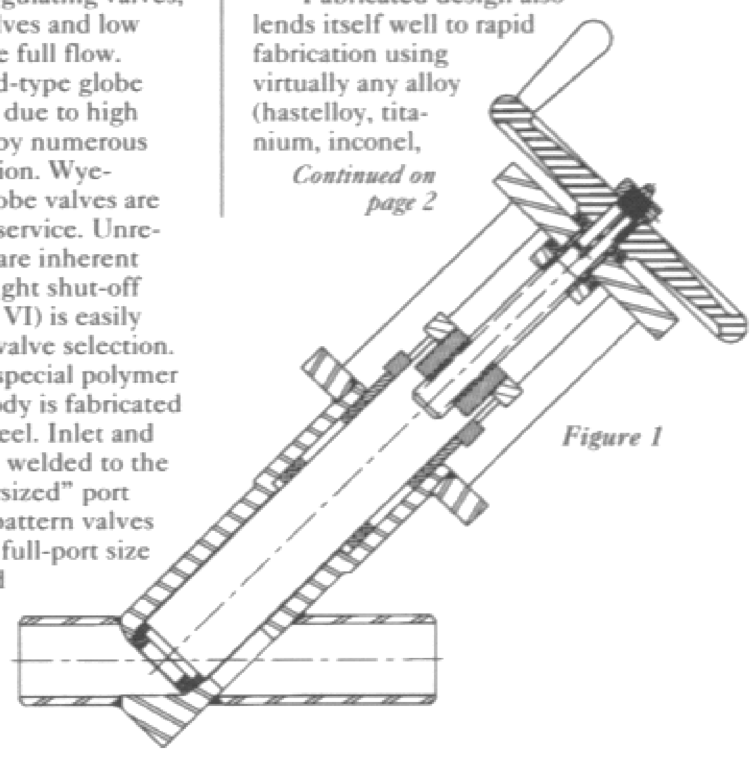

Figure 1

Continued from page 1

High Pressure, High Temperature Polymer Valving

nickel, monel, etc.) in small quantities without the expense of patterns and casting. Valves may also have mismatched ends (2" inlet, 3" outlet) for maximum flexibility in piping design. Also, for uniformity of valve internals, a 3" valve might be used with common internals, having 2", 3" and 4" end connections while 1" internals might be selected for 3/4", 1" and 1-1/2" end connections, greatly reducing spare part requirements.

The plunger, moving up and down (in and out) on opening and closing of the valve, fills the entire body cavity, allowing little area for polymer to collect and impede valve action. For high temperature service (above 450° F, 232° C), metal-to-metal or a unique titanimum and stainless steel seal ring on the head of the plunger provide drop-tight shut-off for total isolation.

Valves for polymer service are fully jacketed (see Figure 2) to prevent polymer from freezing or solidifying in the valve. Figure 2 indicates an integral, welded jacket which places the heat transfer medium directly against the valve body for maximum heat transfer which is not provided when using bolt-on jackets and heat transfer cement. This particular design utilized concentric reducers on each end of the jacket with enlarged jacket center section to provide an enlarged reservoir around the body/seat area to further improve heat transfer.

Figure 2 also indicates a double packing system where inboard and outboard packing sets are separated by a gland spacer. At the lower end of the inboard packing set, a packing stop ring (or support ring) is carefully machined to the I.D. of the plunger to prevent the high temperature packing from extruding into the polymer flow, possibly causing "specks" in the final product.

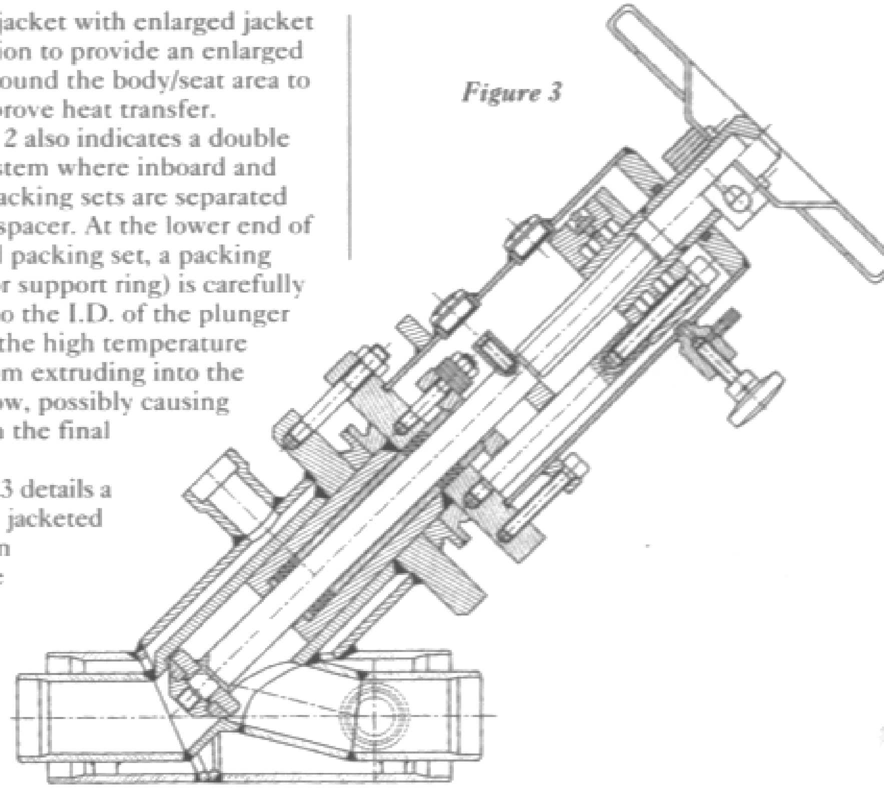

Figure 3

Figure 3 details a very special jacketed Wye-pattern Globe valve for vacuum service where air cannot be allowed to enter the process. In this design, the entire topworks of the valve is encased in a vacuum "can" with a small vacuum needle valve attached. There are two sets of packing. The primary packing provides a barrier between the process and the "can". The secondary packing provides isolation between the "can" and the atmosphere. Should the primary packing begin to leak, a vacuum will be created within the "can". The secondary packing will isolate the atmosphere from the process. The status of the primary packing can be checked by opening the needle valve and listening to the possible "swish" of incoming air into the "can". Access ports allow for lubrication of the stem and tightening of the packing gland. Also note the seal weld is used to connect the body to the bonnet to assure leakage will not occur. Additionally, when opened, the valve is back-seated to keep the system pressure off of the packing.

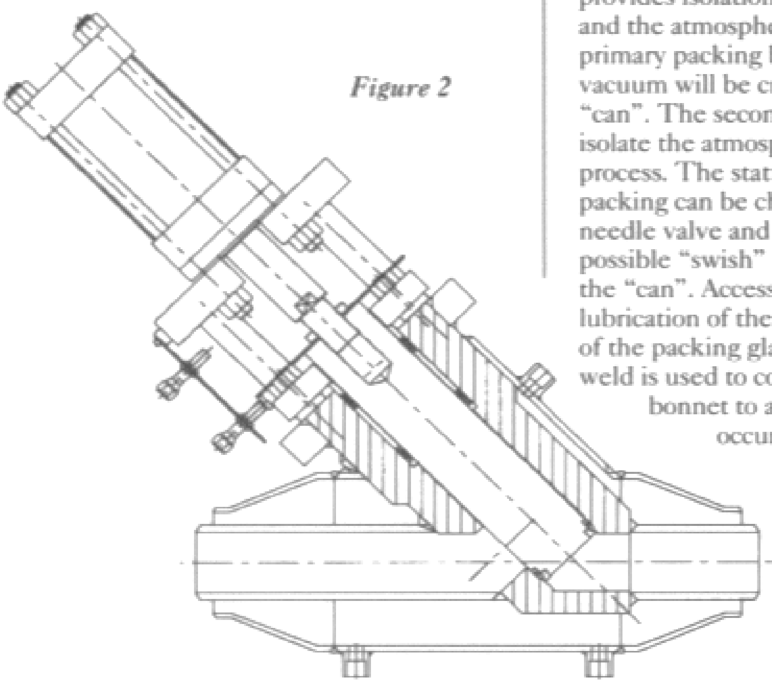

Figure 2

At high pressures, hydraulic (Figure 2) or electric actuation is normally used to overcome the large forces involved. Hydraulic actuation need not require an elaborate hydraulic system. A manual, portable hydraulic pump/reservoir unit, mounted on a wheeled dolly, may be moved from valve to valve and connected via quick-disconnect hydraulic fittings. Hand pump operation will open and/or close the valve. This system is often used for valves which are infrequently operated such as stop valves before and after polymer flow control valves for isolation when control valve maintenance is required.

Wye-pattern valves are now being used rather than ball valves for polymer service. Ball valves tend to drag adhering polymer through the ball seals, damaging them. At the same time, polymer can collect in the ball valve body cavity, eventually "seizing" the ball, making the valve inoperable.

> *"Interviews with... companies indicate that the primary consideration in valve selection is <u>reliability</u>."*

Ball valves are also very expensive in large sizes. The same is true for plug valves. Additionally, ball and plug valves are difficult to jacket with integral jackets to keep them at maximum temperature at all times.

Both ***Hoechst Celanese*** and ***Allied Fibers*** use this type of Ram-Seal® Wye-pattern Straightway Valve for high pressure polymer stop valve service. Interviews with both companies indicate that the primary consideration in valve selection is *reliability*. Initial cost is a minor consideration. As one process engineer put it, "We run a polyester line for up to two years, continuously. We cannot afford unreliable hardware (valves) which might cause an unwanted and expensive shut down."

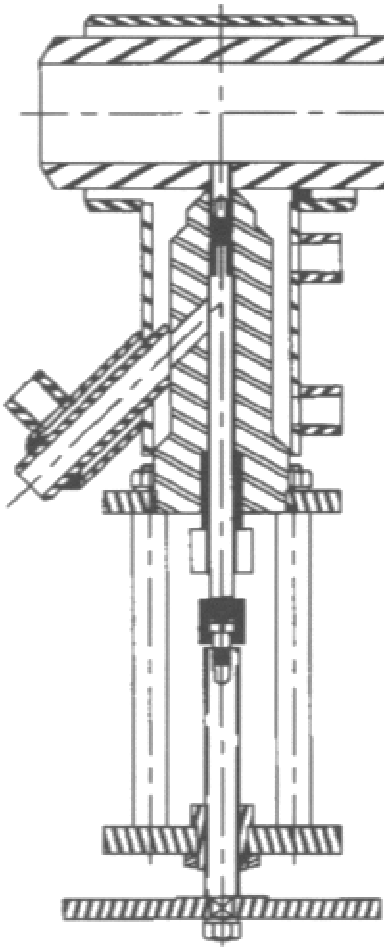

Figure 4

Likewise Sampling valves and line drains for polymer service must be selected with care for many of the same aforementioned reasons. They must provide tight shut-off as well as incorporating a design which will allow them to remain in a closed position for long periods of time and open when required without undue effort. They must be fully jacketed and designed to withstand high pressures and temperatures.

Figure 4 shows a high pressure Sampling valve/Piping assembly. This particular valve was designed for 5000 psi service. It is permanently welded into the double extra heavy core pipe and is surrounded by an integral jacket. Again, a barstock body is used. This valve is for bi-directional flow. It may be used for polymer sampling or for the injection of a "kill" solution to stop a reaction or a solvent to clean the piping system. The same Ram-Seal® design sealing method is utilized and the seal ring/plunger design eliminates voids and stagnant areas with the end of the plunger being flush with the I.D. of the core pipe.

Polymer and monomer filtration systems normally require a valve to switch flow from one filter to another when it becomes dirty, causing an intolerable pressure drop, without interrupting the process. The fully jacketed polymer diverter valve shown in Figure 5 is frequently used in this service. Polymer enters the single connection and may be diverted to the left hand outlet, the right outlet, both outlets, or totally shut off using the same high pressure, high temperature sealing system found in Wye-pattern polymer valves described earlier. In actual practice, both branches are open to control the bleeding of air and the filling with polymer as the clean filter comes on line. System pressure is balanced and air does not enter the process as the new filter comes into service without interruption of process flow. A valve similar to Figure 4 is often used as the air bleed valve. Pressures upward of 5000 psi are frequently encountered so that automatic actuation by air, electric or hydraulic systems are normally used. Likewise temperatures of 750° F call for total integral valve jacketing as shown in Figure 5. ♦

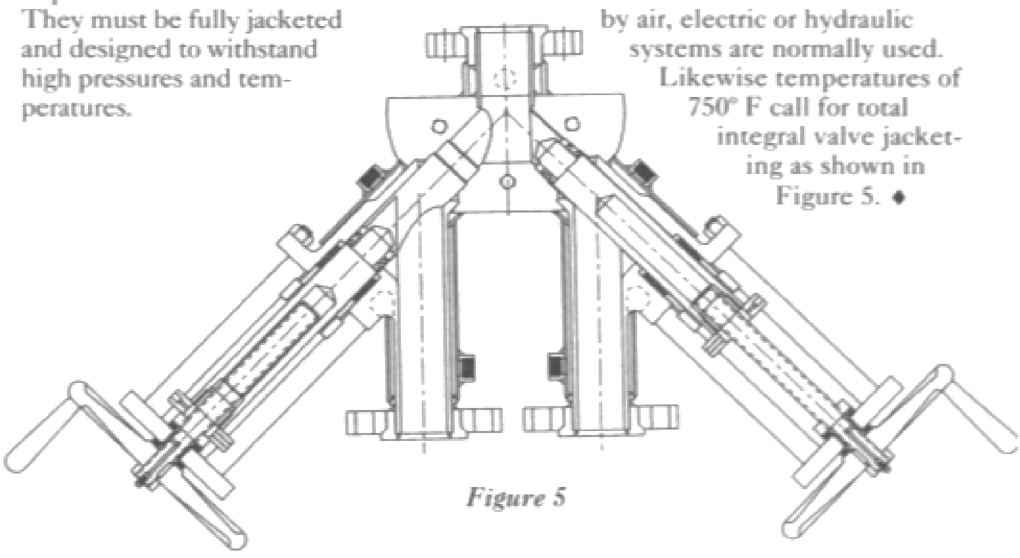

Figure 5

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