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CHEMICALS, COMPLEX

Insights from managing the Sadara mega-project

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Diverter Valves: No Longer Just for Special Applications

Why we should give more thought to these versatile, durable valves

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In virtually every chemical plant and every chemical process there exists a need to divert process flow from one pipeline to another. This may be accomplished by multiple valving or it may be done through the use of diverter valves specifically designed for this purpose.

APPLICATIONS

The requirement to divert flow from one process stream to another may be as simple as having the ability to maintain one stream in service while another is inspected and/or repaired. Or it may be as complex as switching from one polymer filter to another as one filter becomes dirty and the pressure drop increases, requiring a balance of pressures as one unit is taken out of service and another is brought on line with no interruption of process flow.

Process pumps are sometimes high maintenance items and are thus installed in parallel so that one may be serviced or repaired while the other carries the process load. With the use of a diverter valve, changing from one pump to another becomes an easy task with no process flow shutdown necessary.

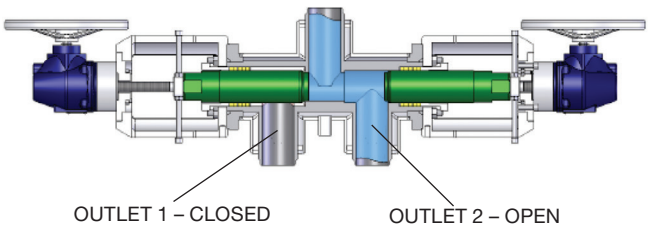
Diverter valves can also be used as dump valves when there is a process upset. Normal process flow goes through one side of the valve while the other side is closed. When an upset occurs, the process side is closed, and the dump side is opened. Frequently the dump side is at right angles on both the process and dump side. Both may have pneumatic or hydraulic actuators for rapid response to a process upset.

KEY FEATURES – DEAD SPACE FREE

Diverter valves are ideal for most polymer applications with slurries as they reduce or eliminate slow and dead space. This is particularly important for a medium that solidifies. Customers in the polymer industry often report severe problems with the ball valves and t-pieces. Ball valves are not really a good choice for polymer slurry service as there is a lot of dead space in and around the ball, between the ball and the valve body, but more importantly in the connecting t-pieces.

As can be seen opposite, when the ball valve is not in operation, medium remains in these dead spaces and can solidify.

STUCK: SOLIDIFIED MEDIA FOUND IN DIS-ASSEMBLED BALL VALVE, LEADING TO SERVICE INTERRUPTION



CROSS SECTION OF A COMPACT DIVERTER VALVE: DEAD SPACE FREE; UNIMPEDED FLOW

Flow is restricted and they soon have to be removed from the line for maintenance.

The diverter valve on the other hand reduces dead space to a minimum due to its unique design. The piston seals flush to the inlet body in the closed position leaving no space for medium to collect in the outlet piping that is not in use. In the open position the piston seals flush with the outlet in use - again leaving no space for medium to stagnate and solidify. The medium flows freely and there are no cavities, spaces or dead areas where medium can stick or solidify. This is the most important advantage of the diverter valve.

Other benefits include:

- the valve acts as a switch valve and an isolation valve in one body;
- the diverter valve can have multiple outlets or multiple inlets;
- slow space is reduced and flow is optimised (particularly with contoured pistons);
- bubble tight seal to process;
- it's easy to add drain, sampling and flushing ports or valves to the body or branches;
- maintenance can be carried out in place (without removing the valve from the line); and
- they are ideal for applications for switching between multiple pumps or filters.

MAINTENANCE CYCLE AND CONFIGURATIONS

Diverter valves require very little maintenance. Stems need to be greased on a regular basis as needed (every 3-6 months), and packing should be replaced every 1-2 years. The operation life of a diverter valve is typically 20 years but we have had several valves in operation for 37 years.

Figure 1 shows a diverter in which the process flow enters the bottom connection and outlet flow is to either or both of the outlet lines exiting in parallel above the valve body. This configuration is frequently referred to as a type M diverter.

Figure 2 indicates the same basic design but with the outlet flow at right angles to the inlet flow. Here again, the outlet flow may be to either, both, or neither of the outlet connections. This design is referred to as a T-type diverter. This design frequently

FIGURES 1–4

Photos provided by SchuF Fetterolf

FIGURES 5–8: TOP LEFT, DIVERTER VALVE USED IN HEAVY OIL UPGRADING; **TOP RIGHT**, DIVERTER VALVE USED IN HEAVY OIL REFINERY; **BOTTOM LEFT**, DIVERTER VALVE USED IN POLYCARBONATE SERVICE; **BOTTOM RIGHT**, DIVERTER VALVE USED IN PTA SERVICE

uses rotating, contoured plungers on one or both sides to assure smooth, unobstructed, flow – particularly in polymer service. In Figures 1 and 2, the angular relationship of the outlet ports may be changed to meet the requirements of the installation, either in the plane of the page or forward out of the page or away from the page.

Figure 3 shows an inline diverter frequently used where space restraints do not allow the use of other designs. Again, both the inlet and outlet connections may be rotated around the central axis to fit the piping requirements.

Figure 4 shows a large fabricated and jacketed diverter using standard stem and disc design. The design is particularly well suited for large sizes with large flow rates. The valve shown has a vacuum hood around the stem and packing area with a small test valve on the hood used to test for packing integrity under vacuum.

Full heat jacketing is available in all designs and may be zoned such that only the flowing side(s) is heated. All types of actuation may be used – manual, electric, pneumatic and hydraulic. One or both sides may be actuated as best suits the situation. Sizes up to 20" are available in ANSI pressure classes 150# through 2,500#. Various materials of construction can be used – stainless steel, Alloy 20, nickel, monel, hastelloy, titanium, as required by the corrosive nature of the flowing fluid.

A WORLD OF CHOICE

Designs may be simple as shown in the figures on the previous page, or as complex as required as shown in the pictures above.

Rotating plungers may be used to assure smooth, unobstructed flow with no 'dead' spots or stagnant areas where material may collect and contaminate future batches or hinder valve operation. In all cases, the valves should be capable of disassembly in place for maintenance and repair.

If required by the system, one side of the diverter may have a straight discharge and the other side may have a characterized valve plug to actually control discharge flow or act as a level control valve or pressure reducing valve.

The diverter valve is one of the less well known valves in industry, but given its versatility, functionality and durability should perhaps be considered more frequently. ■