Choosing the Appropriate Valve for Your Application

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While cost, brand familiarity and operation method are important considerations when choosing a valve, consider these other factors.

When choosing a valve for an application, there is much to consider. Common concerns usually include cost, familiarity with a brand or type of valve and the method of operation. While these are certainly important factors, other considerations such as chemical resistance, abrasion, temperature and pressure relationships and future maintenance can often be overlooked.

When initially choosing valves, important questions to ask include: Does the manufacturer publish a replacement parts price sheet? Does the manufacturer offer technical support, either online, in publications such as operation and maintenance manuals, or via telephone? Getting answers to these questions will give an operator an idea of what is available from the manufacturer to determine the feasibility of rebuilding or repairing valves, if needed.

Chemical Compatibility

When choosing a valve for a chemical processing application, consider how the chemical and concentration may affect its relationship with the potential valve, and whether the construction of the valve may need to be altered to accommodate it. For example, many operators prefer to use quarter-turn ball or butterfly valves with elastomeric seats and O-rings for the process of disinfecting municipal drinking water systems using sodium hypochlorite at a concentration of 13 percent or less. These valves are typically inexpensive, easy to operate and allow for visual valve positioning determination from a distance (the valve is closed when the valve handle is perpendicular to the piping or open when the valve handle is parallel to the piping).

It may be tempting to select a valve type based only on these few factors, but there is more to consider. The O-ring seals in ball and butterfly valves may degrade over time, or the valve may become inoperable due to chemical attacks on the elastomeric or rubber seals. Additionally, as a ball valve is closed, residual chemical may be trapped in the cavity of the ball, which can crystallize and off-gas, pressurizing the ball's cavity.

Example of a chemically attacked butterfly valve seat

One solution to such corrosion issues is to alter the construction of the ball valve's internal ball by use of a vent hole. Drilling into the ball can prevent pressure build-up, as well as prevent crystallization, depending on the position of the vent hole. A butterfly valve can be fitted with a more chemically resistant seat and seal to increase longevity.

Improved chemical resistance can also be achieved by using a metallic, Teflon-lined diaphragm valve or a diaphragm valve with a plastic body and Teflon seals. These types of diaphragm valves may offer an extended life cycle and increased performance reliability because they have the potential to

Sediment and scoring of the ball in a ball valve

Broken valve stem due to seized ball

improve chemical resistance. However, the operation of these valves is typically based on multiple revolutions of a hand wheel to cycle between the open and closed positions. Consequently, a rising stem or pop-up style position indicator is used to signal open or closed, which may or may not be as easily detectable from a distance. A multi-turn valve may not be the preferred method of operation in such an application.

Media Considerations

In applications where suspended particles are present, or in slurry type applications, valves should be selected based on their ability to persist effectively in these types of aggressive conditions. Maintenance is also another important factor in choosing a valve in these conditions. Ball valves are an appealing choice in such applications because they are relatively inexpensive; however, grainy, sand-like particulate can wreak havoc with ball valves because the Teflon seats are pressed tightly against a highly polished ball. As the valve is cycled open and closed, the particulates in the media can become lodged in the Teflon seats. Subsequent cycling of the valve will create score marks across the surface of the ball, which results in leak paths through the valve. While a ball valve is just as inexpensive and easy to replace as it was to initially install, the total cost over time due to frequent maintenance and replacement

Table 1

(Values shown are one manufacturer's design limitations for their specific 2-in valve only.)

PVC				CPVC					
30° F 70° F	71° F 105° F	106° F 120° F	121° F 140° F	30° F 70° F	71° F 105° F	106° F 120° F	121° F 140° F	141° F 175° F	176° F 195° F
230 psi	170 psi	150 psi	30 psi	230 psi	170 psi	150 psi	120 psi	75 psi	55 psi

will outweigh the initial benefit of choosing the less expensive valve in the first place.

A more suitable choice for a slurry type application is a butterfly valve fitted with disc and seat materials that provides for better abrasion resistance. A butterfly valve can be rotated in-line so that the orifices around the disc—when open is top and bottom as opposed to left and right—permit a less interrupted flow of media through the valve. A valve that can be rotated in-line at initial install also aids in the opening of the valve because particles will tend to settle at the bottom. When the valve is opened, it will wipe the seat and allow the initial slurry of particles to pass directly through the valve and downstream.

A butterfly valve that can be rotated in-line during initial installation to permit a less interrupted flow of media through the valve

Other possible alternatives to a ball valve are gate-type or rubber pinch valves. In a gate valve, the valve plug completely lifts out of the orifice, permitting straight through flow. In a pinch valve, the entire diameter of the valve is "pinched" together via a lever to close and released to open. These types of valves and their configurations require less maintenance because there are fewer moving parts that come into contact with the media, which results in overall lower operation costs, although initial installation costs may be greater.

Temperature and Pressure Considerations

All valve materials have specific physical properties and characteristics affected by either temperature, pressure or both. Typically, a valve manufacturer will label their valve with a maximum allowable working pressure and a normal or maximum allowable working temperature.

When determining the maximum allowable working pressure at a maximum working temperature, remember that these may not be the same. The maximum allowable pressure and maximum allowable temperature are determined by standard industry-accepted testing methods and exist individually. This is most evident when dealing with thermoplastic materials. Elevated temperatures cause plastic materials to soften, decreasing their maximum pressure potentials. As an example, one valve manufacturer lists the temperature range of PVC (Polyvinyl Chloride) as 32-deg F to 140-deg F, and CPVC (Chlorinated Polyvinyl Chloride) as 32-deg F to 195-deg F. Table 1 represents this manufacturer's 2-in ball valve in PVC and CPVC thermoplastic materials and its subsequent pressure values at varying temperatures.

As the working temperature increases, the working pressure decreases. This chart reflects a relationship between pressure and temperature that this specific manufacturer has designed and tested, taking into account the limitations of the thermoplastic materials used and the industry standards for working pressure requirements.

When designing a piping system that includes pipe, valves, fittings, gaskets and other instruments, the maximum allowable working pressure ratings and maximum allowable working temperature ratings for that entire system are only that of the lowest temperature/pressure rated component.

Maintenance

When choosing a valve for an application, maintenance should not be overlooked, especially in an application that involves moving parts or the presence of chemicals that may attack your system, causing it to fail. If the application is prone to wear over time, or is susceptible to chemical attack, and the intention is to rebuild valves, it makes sense to not only choose valves that have a certain degree of familiarity, but are also backed by a manufacturer who supports this type of program.

If considering future repair at the outset of application set-up seems too daunting, another option to consider is purchasing an additional valve to keep on-hand in case the primary valve fails to perform. The failed valve could then be repaired at a later date, eliminating valuable system downtime and the stress that accompanies time-sensitive repairs. Planning for emergency situations goes a long way in saving costs and keeping a piping system operational.

In addition to addressing maintenance due to damages, it is also important to perform routine maintenance that can help prolong the valve's life. Periodically exercising or cycling a valve is one way to do this. Resilient seated butterfly valves, for example, that remain closed for extended periods of time will likely be difficult to open again due to the discs and seats setting to one another. A butterfly valve that remains in the open position for an extended period of time could also become difficult to close.

When choosing a valve, let the manufacturer know the application demands and ask if there are any manufacturer recommendations for maintaining the valve in that particular application. Most manufacturers will have gathered feedback from various industries as to the levels of performance operators are experiencing with their valves.

Though cost is usually one of the main considerations when choosing valve types for an application, and while the initial set-up cost is certainly important, it is also essential to keep the overall operation of the system in mind. By carefully considering chemical components involved in the application and the media the application will handle, how these will affect application components such as valves and other moving parts and the possibility of future maintenance, it is possible to increase the longevity of the system by increasing chemical resistance and being prepared for valve repair or replacement.

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