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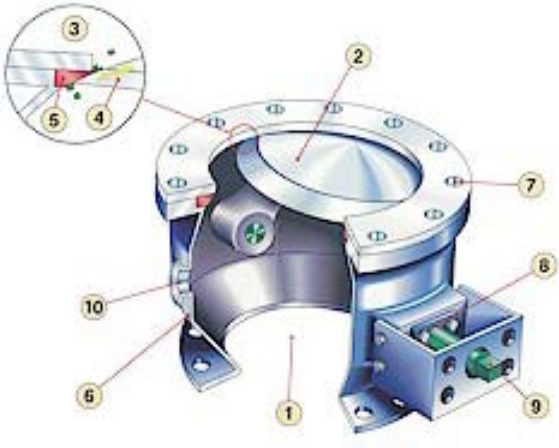
Ask Joe! Column

Spherical Disc Valves For Solids Processing Applications

Guest article by Jim Lenihan, President, Gemco Valve Company

Solids and slurries have completely different flow characteristics than liquid and gases. So it pays to take a little extra time when choosing a valve for powder applications. Let's review the design principles of the spherical disc valve, also commonly called the "Gemco" valve.

A Better Ball Valve



Related to a full-port ball valve, the spherical disc valve design uses a spherical disc section (segmented ball) to provide shutoff. Imagine taking a sphere from a ball valve, and removing 80% of it. You are now left with a spherical shaped disc sized to cover the full port opening. Mounting arms are added to provide a pivot on shafts through the center axis of the original ball. A section of the spherical disc seals against the identical spherical radius of the seat while the rest of the shut-off surface is under-cut below the spherical radius.

The advantages of the spherical disc valve design are:

- The spherical disc wipes the material away from the matching radius of the seat to provide sanitary sealing and longer seat life.
- The spherical disc rotates 90 degrees out of the material flow, to allow mass-flow through its full port.
- The under-cut disc segment provides clearance that prevents powder jamming between the disc and housing.

Some of the factors to consider when choosing a spherical disc valve are:

Materials of construction

The powders and/or solvents to be processed will dictate the product contact material. Cast iron, carbon steels, and aluminum can be used for many industrial applications. Corrosive processes will call for the use of stainless steel, and in some cases material laden with solvents or other corrosives will justify the extra expense of using Hastelloy or other high-nickel alloy to prolong valve life.

For welded construction, 316L stainless steel is preferred. It is more corrosion resistant than 316 stainless steel, and the lower carbon content prevents carbon precipitating from the welded joints.

Seat materials: Very abrasive material will tend to dictate using metal seats versus the more commonly used reinforced-Teflon seats. The metal seal will give longer life and can be used at higher temperatures than Teflon but the shut-off sealing is limited to dust-tight, ANSI class IV or ANSI class V sealing. A reinforced-Teflon seat can be used up to 450 degrees F (230 degrees C), and provide gas-tight or ANSI Class VI shut-off sealing.

Cleanability

The sanitary requirements of a process will govern the surface finishes and other sanitary options. We define finishes as follows:

No surface finish specified: Sometimes referred to as “mill finish” or “as cast”. Fabricated valves will only have the internal welds ground smooth and flush. Common in general industrial applications where cross contamination or cleanability are not a concern.

#2 finish - Ra 33 to 65 microinch - 150 to 180 grit: Also referred to as “buffed, blended or uniform appearance finish”. Often specified for the outside of equipment that will be washed down.

#4 polish - Ra 16 to 32 microinch - 180 to 240 grit: All fabrication and handling marks removed. Surface is buffed to a uniform satin finish. The #4 polish is typical for the interior of equipment that needs to be cleaned between batches to prevent cross contamination.

#7 polish - Ra 10 to 15 microinch - 240 to 320 grit: All surface imperfections are repaired. Often referred to as “pit free” and “mirror finish”. Used for high purity applications such as processing potent pharmaceutical actives. Also used for products that tend to adhere to surfaces.

For automatic cleaning, spray balls or jets should be considered. Another option is a valve that can be dismantled by hand for inspection and cleaning. For safety reasons the size of such valves are typically limited to an 8” port diameter due to the weight of individual components.

Weight

The weight of a valve is especially important for mobile or rotating equipment. High performance and heavy-duty valve models will of course be heavier than regular duty valves. A valve that is dust tight, full vacuum, and 1 bar service, is considered to be regular duty service. Valves that can handle 90 PSI (6bar) to 150 PSI (10bar) are high performance.

For example an 8-inch manually operated regular-duty valve can weigh 55 lbs (25Kg), versus nearly 200 lbs. (90Kg) for an 8" high-performance model. The higher performance valve can weigh four times as much as its regular-duty counterpart.

Mounting arrangements

The typical ANSI 150 # drilling is used as an industry standard for heavy duty and high performance models valves. Quick clamps can also be used for applications up to 30PSI (2bar) and port sizes up to 8".

Some valves will include blind tapped holes, which may be a problem if the valve is mating with existing blind tapped holes. Another option one might consider is to choose oversized flanges, which allows for through holes. DIN and special drilling are engineered to order. Though for regular duty service valves, ANSI and DIN bolting can be overkill.

Actuation

When selecting an actuator one must consider the materials being processed, available air supply and failsafe operation. As with other quarter turn valves; levers, gear drives or chain operators are all options to consider. Pneumatic and hydraulic, operators are available in double acting or failsafe modes.

Pneumatic operation should be the first choice for price, reliability, and speed. When handling solids a higher factor of safety is used to calculate seat torque requirements. The factor is typically 1.5 instead of the more commonly used 1.25 safety factor used for liquid and gas valve calculations.

For solids that “set-up” or harden, an oversized actuator and specially designed discs that can be incorporated to break through the hardened cake when the valve opens or closes. Actuators are typically sized for 80-PSI (5.3bar) pressure. If the available supply air pressure is dependably higher (100 to 120PSI) or lower (40 to 60 PSI), you will need to consider this factor when sizing the valves actuator.

For fail-safe operation, spring return actuators are the normal. When a spring return type actuator is used, it is oversized to compensate for the spring as well as the unseating, run, and seating torque required for valve operation. This can lead to weight and space problems as well as extra cost.

One fail-safe option to consider is to use a double-acting actuator in conjunction with a pneumatic accumulator sufficiently sized to close the valve. So when there is a loss of pneumatic pressure, a pressure switch activates the accumulator and closes the valve.

Flow Control

Fast acting (1 to 5 seconds), quarter turn valves are ideal for flow control of solids. A pneumatic (3 to 15 PSI) or electro-pneumatic (4 to 20 milli-amp) positioner can take a signal from a manual adjusted pressure regulator, or from a computer controller. The pneumatic positioner is often used in manually-operated filling stations, whereas the electro-pneumatic positioner is typical for automatic loss-in-weight systems.

Spherical Disc Valve Examples:

Light Weight Valve: The versatile TLD valve is typically used for processing light density materials such as foods and pharmaceuticals, and on rotating and mobile equipment where weight is a concern.

The valve is offered as dust tight, full vacuum, and low-pressure (1 bar) services. Common installations of the TLD valve include inlet/outlet ports on rotating or stationary blenders and Intermediate Bulk Containers (IBC’s).

Sanitary Valve: The sanitary K valve is designed to USDA and FDA guidelines, which eliminate threads, keyways, and crevices. The split body design means it can be completely disassembled by hand to allow for quick and easy inspection and cleaning.

It is used for charging/discharging. Commonly used in the food and pharmaceutical industries where cleanability is required.

Heavy Duty Valve: The T valve is designed for heavy-duty service and comes with oversized flanges with through holes for mounting to blind flanges. Options include high temperature or pressure (3 bar) designs.

It is typically used for slurries, abrasives, and heavy density materials. This valve is commonly used for charging and discharging of hoppers, tanks, silos, conveying systems, and weighing systems.

High Pressure & Corrosion Valve: The P21 valve is specially engineered to meet rigorous demands of pressure and corrosive applications. The valve is designed and built to ASME standards for pressure-assisted sealing from full vacuum to 10 bar, and at temperatures up to 450 degrees Fahrenheit.

This valve is often used for reactor feed valve or as an isolation valve.

Other Valve Combinations and Options:

Retractable Sleeves: Retractable sleeves are designed for the dustless transfer of solids from one process to another. They are usually interlocked with the valve. A mobile vessel or container is located so the retractable sleeve engages and seals automatically. Once the seal is confirmed, the valve opens to allow material transfer safely and efficiently. Options for retractable sleeves can include inflatable seals for hazardous environment, spring-return air cylinders for fail-safe operation, metal bellows for high-pressure applications, and “clean-in-place” fittings.

Diverter Valves: The diverter valve places the spherical disc valve in a ‘Y’ junction. This allows the valve to select a product feed stream from one of the two inputs, or to direct one incoming stream of material to either of the two outlets. Diverter valve use varies greatly from rock crushers to food processing.

Airlocks: Airlocks are designed to control the flow of material between two atmospheres. They typically consist of two valves connected by an intermediate chamber. Airlocks are often used instead of rotary feeders, which are prone to high maintenance and leakage of material and gases.

Summary

Choosing the best valve for your powder application will bring many benefits. The payback will be better performance, lower maintenance costs, and better product quality, over the life of the processing equipment. For more detailed information visit the “Design Principles” page at Gemco Valve Company .

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Welcome to Ask Joe!, a monthly column by our resident materials handling guru, Joe Marinelli of Solids Handling Technologies. Joe addresses the issues that bug you the most. And Joe knows!! Formerly with Jenike & Johanson, Solids Flow and Peabody TecTank, Joe is an expert on materials handling.

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