CONTROL VALVE SELECTION

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Catch 22 problem: To be asked to select the correct type of control valve for an application is rather like being asked to open a crate using the crow bar to be found inside the crate.

It is useful to know the Cv requirement of the application in order to select the type of valve, but to calculate the Cv one needs to know the recovery factor of the type of valve being used.

To overcome this catch 22 situation there is a need for some guide so that an initial selection can be made.

Types of Control Valves

Almost any type of valve can be used for control by fitting an actuator and positioner, though care must be taken to ensure that there is no excessive backlash present and it will be recognised many will not exhibit a good characteristic for precise control.

Table 1. Comparison of different control valves

Application	Globe	Pinch/ diaphragm	Butterfly	Disk	Ball
Controlability/turndown	1	3	1	1	1
High pressure:>30 bar	1	x	x	2	1
High pressure drop ΔP>0,5P1;P1>10 bar	1	x	x	3	3
Slurry	3	1	2	3	3
Cost (< 100 mm)	2	1	3	3	3
Cost (> 100 mm)	3	2	1	1	2
Anti-corrosion	2	1	1	2	2
Size & weight (< 100 mm)	2	2	2	2	2
Size & weight (> 100 mm)	3	3	1	1	3
Temperature > l00∞C	1	x	3	1	2

1: Good; 2: Average; 3: Poor; x: Not suitable

The following are the most commonly used:

Globe (Plug and Seat)

These are the most traditionally used control valves - generally available from 12 to 400mm in all castable materials. Larger sizes are available but it becomes more common to move to an angle construction on these sizes.

Pressure ratings up to ANSI 2500# and higher are available.

The globe valve is very versatile offering reduced trim options as well as a variety of special trims for severe high pressure drop applications. This style of valve is easily adapted for use on cryogenic temperatures, and for high temperature duties.

Turndown capability of 50:1 is available.

Eccentric Plug (Rotary Globe)

A general purpose valve that offers cost effective solutions over a wide range of standard applications. It offers higher Cv values than globe - size for size. It is available from 25 to 300mm to ANSI 600#. Turndown is 125:1.

Butterfly

The least expensive of all control valves. Sizes range from 50 to 3000mm.

Pressure ratings are generally up to 1600 kpa(G).

Temperatures are up to 100∞C. This valve is good for corrosive applications but does not handle high pressure drops well. It is the lightest valve available - size for size. Turndown is 75:1.

Eccentric Disk (high performance butterfly)

A similar looking valve to the standard butterfly this valve is capable of handling much higher temperatures and pressures.

The heart of the valve is the seating arrangement. Many different techniques are utilised to prevent the disk from rubbing in the seat as it does with the butterfly valve. This is achieved by having the disk rotate about a point that is off centre to the line of the seat in one plane and off centre to the centre line of the pipe in the other. This gives a cammed action that the final few degrees of rotation causes the disk to move in a linear fashion into the seat. This means that a metal seat can be utilised, enabling the valve to handle high pressures and temperatures.

This type of valve is generally available from 50 to 1200mm ill pressure ratings up to ANSI 600#.

High pressure drop applications are not recommended. Turndown is about 75:1.

Diaphragm / Pinch

These valves are inexpensive and very simple in operation. They are used extensively in the mining industry for control of slurries and water.

The characteristic is basically quick opening and so these valves do not give precise control or high turndown but function particularly well on level control. Very good for low pressure abrasive applications.

Sizes are available from 25 to 350mm in pressure ratings up to 1000kPa on the smaller sizes and 350kPa above 200mm. Special pinch valves can handle pressures up to 100 bar.

Temperature limitation is about 100∞C. Turndown is 10:1.

Ball

Ball valves naturally have a good control characteristic and give high turndown of l00:1 for standard ball valves and up to 500:1 for vee ported valves.

High pressure valves are available to ANSI 2500# and higher - most valves working at greater than 3000kPa have trunnion mounted balls.

Sizes range from 10mm to 500mm.

High temperatures are handled by valves with metal seats.

Full ball valves are not recommended for slurries due to the solids settling out in the body cavity.

High pressure drops are not handled well due to the ball causing high velocity jets of fluid directed into the seat and body - resulting in erosion.

This design of valve is particularly suitable for use with ceramic materials and can be used on abrasive throttling duties where the pressures and temperatures are too high for pinch or diaphragm valves.

Comparison of different control valves

Table 1 shows the comparison of different control valves.

Selection Procedure

- Estimate the size of the valve by taking one size smaller than the line. If there is no line size available calculate using a velocity of 5m/s for liquids and 40m/s for gases or vapours.
- Use the chart to determine the valve type which best satisfies the requirements of the application.

Generally for larger sizes of l00mm or greater the order of preference assuming cost to be of a high priority would be as follows:

- Butterfly
- Disk
- Rotary plug
- Ball

but using globe if the pressure drop is high and using pinch/diaphragm valves for slurries.

For small valves of less than l00mm the order of preference would be:

- Globe
- Rotary plug
- Ball
- Pinch/Diaphragm

Conclusion

There is nothing definitive about selecting a type of valve and there is seldom a choice that can be considered to be 'right'; some selections will just be better than others - and of course it is easy to chose the wrong one!

References

[1] Sessions MT. 'Selection of control valves - handling high pressure drops'. Electricity + Control, November, 1993, pp 35-38.

Resume

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