

How to select the correct valve for wastewater treatment applications

By Jega Jegathan

Wastewater treatment plant valves must be selected to operate safely, efficiently, and consistently to avoid unnecessary maintenance. In addition, selection should focus on accuracy, repeatability, and feedback requirements for automated control valves. The following criteria should always be considered:

1. Purpose of the valve: Isolation, or throttling/modulating.
2. Process parameters: Flow, pressure, and temperature.
3. Chemical compatibility: Concentration, percentage of solids, media, and density.
4. Process requirements: Frequency of operation, allowable leakage rate, cleanliness, available space, and structural considerations.

The common valve types used in wastewater treatment facilities for various services (isolation/throttling) are shown in Table 1.

1. Butterfly Valves: Butterfly valves have a circular disc mounted on a shaft in the centre of the valve. They are generally used in wastewater treatment for air supply systems. Butterfly valves are an economical alternative for larger valve sizes (>200 mm), because of the compact valve design, and lighter mass compared to other valves. Furthermore, they have relatively high coefficient of flow (Cv), standard face-to-face dimensions, and can be produced using chemical resistant

materials. In general, sizes available for butterfly valves range from 50 mm to 1200 mm.

The butterfly valve is considered to be a high recovery valve, since only the disc impedes the valve flow path. The Cv is comparatively high and pressure drop across the valve is comparatively low.

Although butterfly valves are economical, they tend to foul up when used on sludges with solids/stringy materials and, therefore, do not handle slurry applications well. Especially vulnerable are the cavities around the disc stem, which can potentially entrap fluids and slurries. Due to this, unwanted contamination is possible in slurry services. These valves are normally not rated as bubble-tight, although some high performance butterfly valves may meet ASME leakage ratings.

2. Gate Valves: Gate valves have a wedge or disc that travels up and down to either block or allow the flow of water. They are mainly used for isolation (shut off) for wastewater applications. The stem of a gate valve can be either rising or non-rising. Rising stem requires clearance above the valve to move up when the valve is opening. This will provide a visual indication of open/close position. If space is limited (e.g., underground applications) or in areas where safety is a concern, a non-rising stem can be used.

In general, gate valves are less expensive for smaller size valves (<300 mm). However, larger valves can be costly and

require adequate clearance for the valve.

3. Knife Gate Valves: Knife gate valves are similar to gate valves; however, the knife edge of the gate can cut through accumulated solids. Knife gate valves are used in wastewater systems for handling abrasive slurries or sludge applications. They are available from standard cast configurations as small as 50 mm to specially fabricated valves up to 1,800 mm. Knife gates for sludge applications should be specified with by-directional pressure rating, making them suitable for unplugging the pipe lines in either direction.

Knife gate valves can cut through slurries, scale, and surface build ups. Since they have an unobstructed flow path, they provide high flow capacity (Cv). They also have small face-to-face dimensions, which assists with weight reduction of the valve and facilitates piping design.

Knife gate valves are not suitable for relatively low pressure applications. Two of the drawbacks are an inability to provide bubble-tight shut-off, and cavity formation. Hence, they are not recommended for high purity applications.

4. Globe Valves: Globe valves have a round body with two cavities separated by a circular opening that is smaller than the pipe size. In general, the sizes available for globe valves are from 50 mm to 200 mm. Valve operation is a linear rising-stem, with a multi-turn hand-wheel.

Purpose	Size (mm)	Isolation (most common)	Throttling (most common)
Air Services	≤ 50	Ball	Globe
Air Services	> 50, 75	Ball, Gate	Globe
Air Services	≥ 100	Butterfly	Butterfly
Sludges with Solids/Stringy Materials	≤ 250	Plug or knife gate	Plug
Sludges with Solids/Stringy Materials	≥ 350	Knife Gate	Knife Gate
Water	≤ 50	Ball	Globe
Water	> 50, 75	Gate	Globe
Water with No Stringy Materials	≥ 100	Butterfly	Butterfly

Table 1: Valves for Various Services.

Globe valves can be used for precise throttling and control services in wastewater treatment applications, since they can easily be automated and are available with positioners, limit switches, and other accessories. In general, control valve manufacturers provide the software for control valve sizing, since it is much more complex than isolation sizing.

Globe valves are relatively low C_v , and are unable to handle slurries. They are relatively expensive. For these reasons, they are not usually specified for control in high purity services or slurry services. Also, the low C_v causes a relatively high pressure drop across the valve.

5. Ball Valves: Ball valves have a ball-shaped plug with a hole bored through its centre. They are normally used in chemical applications, and for isolation purposes for air and water at smaller diameters (<50 mm). They are available from service type valves to high performance valves and readily obtainable in a wide variety of configurations, such as top entry, end entry, and three-piece. In general, the sizes available are from 25 mm to 300 mm.

Some of the pertinent features of ball valves are ease of operation, high pressure and temperature capacities, high flow capacity, and ability to handle severe chemicals. Ball valves are also considered as high recovery valves (relatively high C_v), similar to butterfly valves.

Ball valves are not suitable for slurry applications. As well, the weight of the larger size ball valve is much higher than other similar size valve types.

6. Plug Valves: Plug valves are similar to ball valves. The moving part of a plug valve consists of a tapered plug instead of a ball. Plug valves are mainly used on pipes carrying raw sewage, sludge, and grit. They are also used for digester gas systems.

Plug valves can seal well and they do have tight shutoff. However, some plug valves are made with a reduced port which means that the flow passageway through the valve is smaller than the adjoining pipe's cross-sectional area. This leads to higher pressure drop. Therefore, look for full bore plug valves if you need them. Plug valves are heavy and require more space, but are reliable and durable.

In some cases, plug valves are used for throttling purposes.

Summary

Based on the application, selection of the correct type of valve should be carried out with the following in mind:

- Butterfly valves are high recovery valves but not rated as bubble tight.
- Gate valves are less expensive for smaller size valves.
- Knife gate valves have the ability to cut through slurries and have very low flow resistance. However, they are not suited for high purity applications.
- Globe valves are good for throttling purposes, but have relatively high head loss.
- Ball valves allow quick, quarter turn on-off operation but have poor throttling characteristics.
- Plug valves can seal well, and they do have tight shutoff.

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