Valves

How to select the correct valve for wastewater treatment applications  By Jega Jeganathan

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.
3. Chemical compatibility: Concentration, percentage of solids, media, and density.

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

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Size (mm)</th>
<th>Isolation</th>
<th>Throttling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Services</td>
<td>≤ 50</td>
<td>Ball</td>
<td>Globe</td>
</tr>
<tr>
<td>Air Services</td>
<td>&gt; 50, 75</td>
<td>Ball, Gate</td>
<td>Globe</td>
</tr>
<tr>
<td>Air Services</td>
<td>≥ 100</td>
<td>Butterfly</td>
<td>Butterfly</td>
</tr>
<tr>
<td>Sludges with Solids/Stringy Materials</td>
<td>≤ 250</td>
<td>Plug or knife gate</td>
<td>Plug</td>
</tr>
<tr>
<td>Sludges with Solids/Stringy Materials</td>
<td>≥ 350</td>
<td>Knife Gate</td>
<td>Knife Gate</td>
</tr>
<tr>
<td>Water</td>
<td>≤ 50</td>
<td>Ball</td>
<td>Globe</td>
</tr>
<tr>
<td>Water</td>
<td>&gt; 50, 75</td>
<td>Gate</td>
<td>Globe</td>
</tr>
<tr>
<td>Water with No Stringy Materials</td>
<td>≥ 100</td>
<td>Butterfly</td>
<td>Butterfly</td>
</tr>
</tbody>
</table>

Table 1: Valves for Various Services.

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.
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 Cv, 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 Cv 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 Cv), 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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