Considering **Thermoplastic Valves** for Industrial Applications

CONTENT

EXECUTIVE SUMMARY

Material selection is a key design consideration in any project. Choosing a material that is suitable for the pressure, temperature, fluid being conveyed, and environment will contribute to a reliable and long-lasting piping system.

This white paper addresses the suitability of thermoplastic valves in industrial applications, by exploring the key factors that must be considered when selecting the appropriate material and valve type including:

Understanding Key Differences between Thermoplastic and Metal Valves

Determining Suitability for Specific Applications

Thermoplastic Valve Selection

Each valve will have features and benefits specific to its material and design. Furthermore, much like with metal valves, not all thermoplastic valves are created equal. Selecting a valve that has the best combination of features and benefits for a given application is critical to minimizing cost and maximizing performance and service life.

Many Decision-makers and end-users are familiar with the metal valve options they have, but lack experience and knowledge when it comes to thermoplastic valves. Learning about thermoplastic valves before selecting a valve material for their facility's piping system will ensure that they selected the most appropriate material rather than the most common material and hence maximizing their systems' performance and longevity while minimizing cost and risk.

Understanding Why Metal Valves Are More Common Than Thermoplastic Valves?

Familiarity

Trade schools, colleges, and universities generally teach about metallurgy, and metal piping installation and little about thermoplastics. Furthermore, metal valves have been used in industrial applications for a longer period of time. Therefore, decisions makers have been using metal valves because that is what they are comfortable with.

Risk Perception/Lack of Information

The lack of knowledge and experience with thermoplastic valves can cause decision makers to use metal valves even in applications where they are not ideal and need to be replaced or repaired regularly, even though thermoplastic valves have been around for over half a century. Furthermore, there is a general perception that thermoplastic valves are less durable and will not perform as well as metal valves. However, there are thermoplastic valves available today that are designed and tested to be used in industrial applications and if used in an appropriate application, can exceed the performance of their metal alternative. Many manufacturers also hold years of application experience data that can help decision makers, who may not be familiar with thermoplastics, choose the right valve in the right material.

Thermoplastic valves have become more common in some industrial applications. One such application is where thermoplastic valves are found in a variety of chemical feed systems. Thermoplastic valves have also increased in popularity in pharmaceutical and food processing applications; and in harsh environments such as mining, metal refining, and chemical processing.

At a glance, here's why thermoplastics are a good choice:

Strong chemical resistance internally and externally

Effectively handle fluids as cold as -40°F and as hot as 248°F

Resistant to corrosion and buildup

Easier to install and repair since they weight less than metal and don't require special installation training or tools

Readily available and easy to replace or repair

Operating pressures up to 250psi

Thermoplastic Valves – Determining Suitability for Specific Applications

Thermoplastic valves are a viable option for many industrial applications such as:

Industrial Process Piping

Plant water supply and treatment, building services, chemical transfer, wash water systems, acid products handling for refineries and metal works

Water and Wastewater Treatment

Aeration beds, potable water, treated waste/ water, chlorine injection systems, alum and ferric chloride handling

Food & Beverage

Chemical distribution, building services, compressed air, vacuum drainage, chilled water, chemical drainage, process water

Institutional

Chilled water, pure water, hot and cold water

When selecting a thermoplastic valve material for use in a specific application, engineers and designers, as well as end-users, must consider these key factors:

Chemical Compatibility

Pressure Capabilities

Thermal Properties

Chemical Compatibility

It is important to select a material that is chemically compatible with the fluid being conveyed. Compatibility must be determined for the specific concentration of the chemical and the operating temperature. One should also consider whether the valve will be installed in a corrosive environment. Chemical vapors may affect external components.

Thermoplastics are generally resistant to highly corrosive acids, caustics and salts and resistant to microbial or microbiologically influenced corrosion (microalgae, bacteria and fungi).

Because thermoplastics are nonconductive, they are also resistant to galvanic and electrolytic corrosion. Additionally, compared to metals, biofilm, , crystallization and fouling are less likely to form and adhere to inert, smooth thermoplastics.

Chemical resistance data is readily available for thermoplastics, making it easier for designers to assess suitability. Manufacturers test to both ISO 22088 (Plastics — Determination of resistance to environmental stress cracking (ESC)) and ASTM D543 (Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents) chemical resistance standards to reliably determine a thermoplastic material's chemical resistance, and many perform additional laboratory testing to replicate a unique environment and application.

When assessing the chemical resistance of a valve, it is important to consider such variables as:

- Temperature, concentration, and time of exposure to the fluid
- Unexpected discharge
- Line repurposing or the difference in application settings
- Resistance of valve seats and seals to the fluid being conveyed

Pressure Capabilities

Thermoplastic valves are generally limited to a pressure rating 250 psi. The identified pressure ratings are determined at 73°F (23°C) and if operating temperatures increase from 73°F (23°C), a correction factor must be applied to the pressure rating. Valves, fittings and other components need to be derated with temperature. All thermoplastic valve manufacturers will have pressure/temperature derating data available.

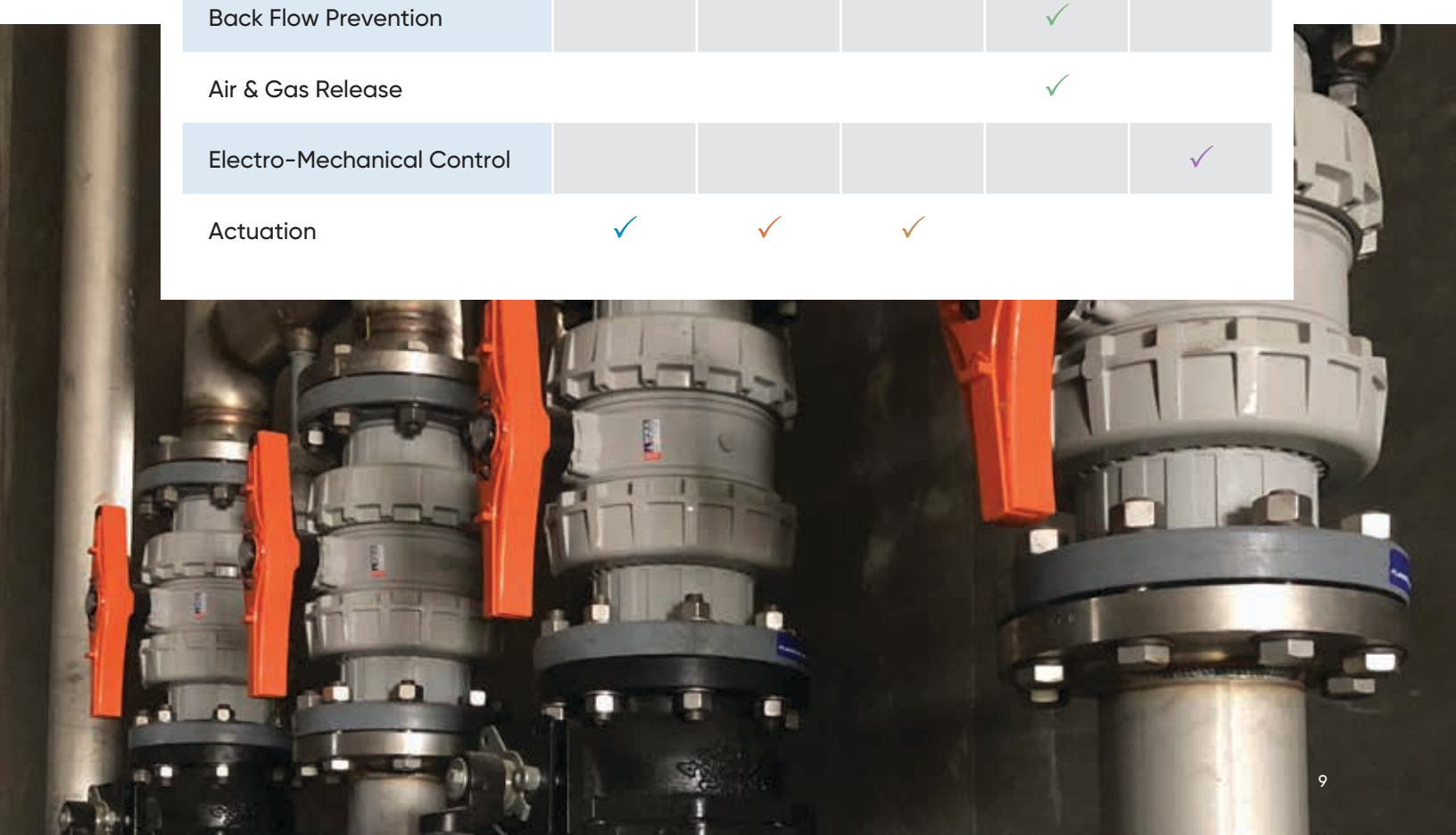
Thermal Properties

Thermoplastics can effectively handle fluids as cold as -40°F and as hot as 248°F depending on the material and valve configuration

Thermoplastic Valve Selection

Similar to metal valves, a variety of thermoplastic valve options are available decision-makers will need to determine the best type of valve for their application. When selecting a thermoplastic valve, it is also important to find a valve designed for industrial applications. Below are some of the most common thermoplastic valve types available, the applications for which they are most suited and the features and benefits that identify an industrial grade valve.

	Ball Valves	Butterfly Valves	Diaphragm Valves	Check & Vent Valves	Specialty Valves
On/Off Service	✓	✓			
High Capacity	✓	✓			
Throttling	✓*	✓	✓		✓
Quick & Frequent Cycling	✓				✓
Slurries/Dirty Fluids		✓	✓		
Filtering					✓
Back Flow Prevention				✓	
Air & Gas Release				✓	
Electro-Mechanical Control					✓
Actuation	✓	✓	✓		



BALL VALVES

Ball valves are available from 1/2" to 6" sizes in PVC, CPVC, ABS, PP, PVDF and most commonly specified and used for on/off service, while profiled ball valves are available for throttling applications in 1/2" to 4" sizes. Multi-port ball valves (e.g. 3-way ball valves) allow for mixing, diverting, and bypassing flow and are available from 1/2" to 4" sizes. Industrial grade ball valves should feature full port flow, smooth internal components, a minimum 220 psi pressure rating, integral mounting options, cushioned Teflon seats, double O-ring stem seals with shear points below the seal, blocking true union ends, and built-in tools that allow for simple installation and maintenance.

Ball valves should be used only with clean fluids because grit, sediment and other dirt will damage the ball and PTFE seats.

A profiled ball valve's ability to regulate linear flow depends on the design of the ball profile, which can be different depending on the valve manufacturer. **Ball valves must be vented if used with volatile fluids that off-gas, such as sodium hypochlorite or hydrogen peroxide. Manufacturers vent ball valves by placing a small hole on the upstream side of the ball.**

BUTTERFLY VALVES

Butterfly valves are available from 1-1/2" to 16" sizes with PVC, CPVC, PP, GRPP bodies, and PVC, CPVC, ABS, PP, PVDF disks, ideal for on/off service, but can be used for throttling flow. Installing a lugged version at the end of the line allows downstream piping disassembly with the upstream system still under pressure. Thermoplastic butterfly valves are available with molded over-molded or insert lugs. Over-molded lugs allow for bidirectional use. The extensive size range and material availability make butterfly valves suitable for a wide range of applications.

Butterfly will operate with dirty fluids containing sediment. If used in an application with dirty fluid, installation orientation is important. The valve should be installed on a 45 or 90 degree angle to prevent sediment from building up at the lower shaft seat and causing excessive wear. Industrial grade butterfly valves will have a profiled liner for minimized breakaway torque, locking and handles, and a non-wetted shaft so that additional compatibility or corrosion does not need to be considered as the shaft is often metal.

DIAPHRAGM VALVES

Diaphragm valves are available from 1/2" to 4" sizes in PVC, CPVC, ABS, PP, PVDF and are the perfect solution when flow throttling is required, and dirty or volatile fluids are involved. The weir style design — no dead space in the valve — is extremely good for abrasive slurries. These valves are widely used in high purity applications because their design minimizes friction and subsequent particle creation when cycling the valve open or closed.

The design of diaphragm valves allows them to be used in high-cycle applications without wear to their sealing surfaces. Because their open-to-close cycle is greater than 90 degrees, they can be used for more precise throttling than standard ball or butterfly valves. In the closed position, there is no entrapment of fluid within the valve body; this means that diaphragm valves are a good choice for volatile fluids that off-gas or high purity applications where stagnation can lead to bacterial growth. Diaphragm valves are not full port and therefore the Cv value should be considered. Industrial grade valves will have optimized Cv values, locking handles with position indication, and integral mounting options .

BALL CHECK VALVES

Check valves are available from ½" to 4" sizes in PVC, CPVC, ABS, PP, PVDF and used to prevent the backflow of process media, which could lead to the mixing of two incompatible fluids or result in the undesirable drainage of a system line or tank.

These valves are typically gravity-operated and depending on the design, require very little back pressure to seal. Ball check valves are ideal for vertical service and some designs can be used horizontally. When used horizontally, there must be enough back pressure generated to force the ball to seal since there is no assistance from gravity. Spring-assisted options exist to negate this problem but create corrosion and maintenance concerns. Industrial quality ball check valves will have optimized flow characteristics to minimize pressure loss, chatter and wear; and can be installed horizontally .

CONCLUSION

Engineers, contractors, project managers and decision-makers need to consider all available materials when assessing and selecting the valves at their facilities. They should consult with specialists and manufacturers that have the relevant expertise and experience with thermoplastic valves to ensure the material and type of valve they select are the best choices for their specific industrial application.

While metal valves are more common in certain applications, specifying them out of habit, without challenging the status quo may be doing a disservice . Depending on the application, , thermoplastic valves can offer overall performance improvements and may ultimately deliver a superior TCO and ROI.