

Is Lime Souring Your Valve Operation? Or perhaps we should say is poor equipment performance souring your lime process

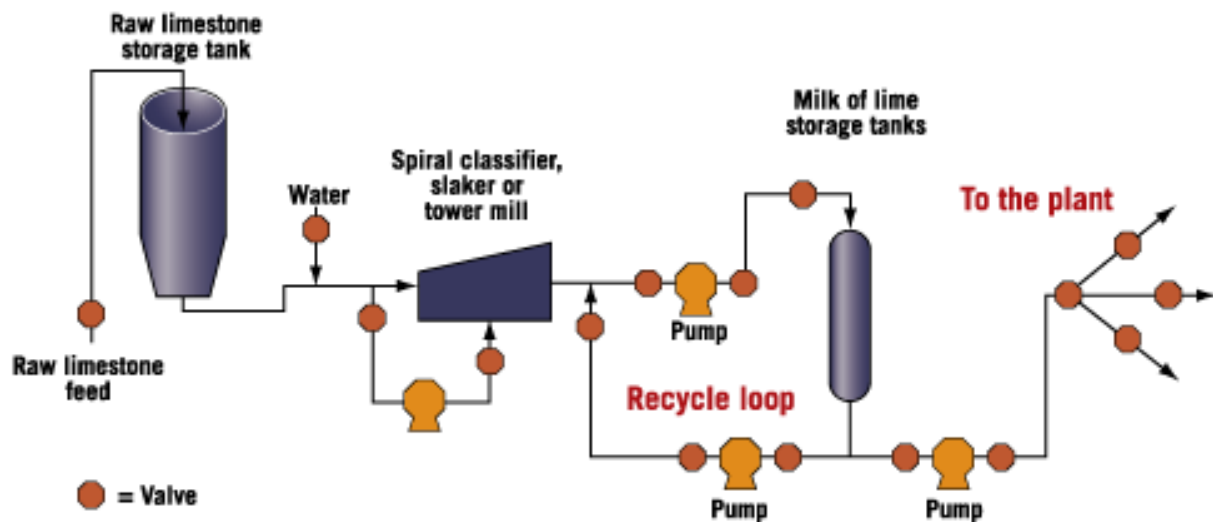
Valves and related equipment in lime slurry service need to be selected carefully to prevent process failure due to components “freezing”

Lime is used by many chemical process industries in either a powder or liquid form. Engineering and maintenance personnel often face a long and expensive trial-and-error period to find the best process equipment to handle lime products.

Limestone is mined in the form of calcium carbonate (CaCO_3), crushed and fed into a kiln at approximately $2,000^\circ\text{F}$, where the carbon dioxide is burned off (calcining) producing calcium oxide (CaO).

CaO is ground into a powder in a tower mill, a spiral classifier, or a slaker. The “milk” of the ground lime is used for many industrial purposes including pH control, power flue-gas cleansing, calcium extraction in pharmaceutical manufacturing, and many other processes.

One of the most common uses of lime in the chemical process industry is pH control. Lime is extremely difficult to handle in piping systems, instrumentation, and valves because its particles are angular, sharp and will not dissolve; the particles are merely suspended in the solution.



Any obstructions or gaps will cause the particles to fall out of suspension and fill the voids, this is aggravated when the lime hardens in these collection points. In a very short period the lime becomes a solid mass of material — commonly referred to as scaling. Scaling causes a pipeline's inner diameter to become smaller and smaller. Material builds up on valve seats and other surfaces can cause the valves to freeze in position.

Tips for lime service

Process equipment, instrumentation, and valves selected for use in lime slurry systems should avoid cavities, voids and obstructions

Even a small collection point of lime can cause equipment failure and countless hours of downtime and maintenance. Products for use with lime slurry should ideally self clean, break apart scaling and are completely free of voids cavities and obstructions. A piping product installed in a lime slurry system should be full bore limiting obstructions and scale build up

A significantly oversized actuator is a typical way of increasing plug and ball valve performance in lime slurry systems. Because the size of the actuator is increased, the output capability is roughly two times the normal manufacturer's recommended torque for clean liquids. An oversized actuator may improve performance with regard to sticking valves, but it will not solve all related maintenance problems

Because lime particulates are very abrasive, it affects most ball and plug valves severely. A hard material surface coating such as stellite on the ball will help protect the valve

Valve seats are also a major concern. Again, hardened-steel seats with a scraping edge are a likely option in lime applications. "Scraping" hard-coated metals will perform better in scaling substances because they have the ability to scrape built-up material off the ball and plug surfaces.

Most polymeric seats will not maintain durability in lime slurry applications. The scaling that occurs in these valves will damage most polymeric seats. The ball or plug with scale build up is turned through these seats, usually resulting in a short lifetime. Because ball and plug valves have cavities that house the ball or plug, a substantial amount of material accumulates in this area

It is beneficial to install flushing ports in the valve so that the body cavity area can be flushed with water to evacuate material after each cycle. This process will help reduce material build up in the cavity area however it is expensive to build a ball or plug valve with the all of the previously mentioned features and a water flushing system. Typically, the cost of a ball or plug valve equipped with these features can be five to six times the price of a traditional Teflon-seated ball or plug valve.

Unfortunately, the performance of most Teflon-seated ball or plug valves in lime slurry is less than satisfactory

Gate and knife gate valves

Gate and knife gate valves can be used in some slurry applications. Most gate valves force the gate into a wedge area to close the valve, so tight shut-off is not always guaranteed

Knife gate valves have a sharpened edge to improve the ability to cut through solid particles. In lime applications, this seating area is a spot for material accumulation. The lime will accumulate in this area, causing difficulties in valve operation, which could prevent sealing the valve completely against the line pressure. The ideal knife gate valve for lime service features a hard-surfaced leading knife edge.

Actuator forces in knife gates may be increased to give the valve the ability to cut through or close tightly against the lime build-up in the wedge. The knife of the valve is exposed to abrasive debris and will wear quickly; an accumulation of scale will cause packing problems in most knife gate valves

As the knife opens, the scale build-up is dragged through the packing, which requires increased forces to open the valve. In most instances, significant packing leaks occur in this region of the valve. Utilizing knife gates in lime slurry service requires a scraping packing material. This material should be a hardened substance that has the ability to scrape the knife clean with every operation.

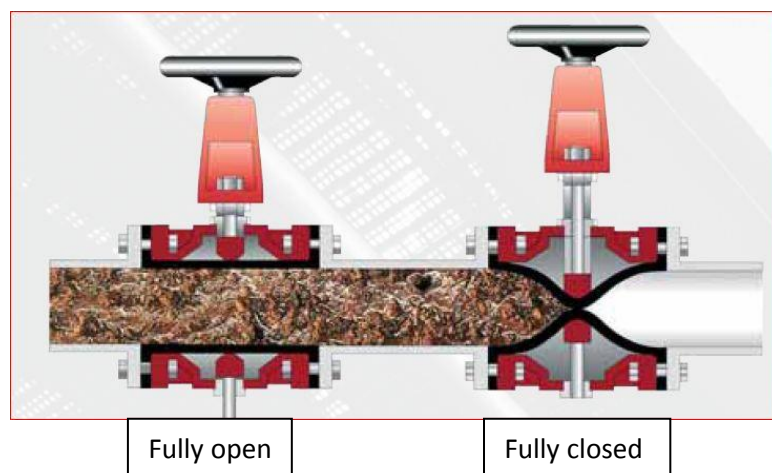
The knife gate valve should have increased actuator forces that are capable of dragging the knife through the packing material

Pinch valves

Pinch valves are an efficient solution for lime slurry service as they address the major causes of poor performance and failure.

They have a full bore design with no cavities or obstructions where material can collect and they have an effective self-cleaning effect on scaling materials.

A rubber tube or sleeve is pinched by steel bars on the centreline of the valve, causing it to close. During the open/close sequence, the sleeve flexes, the process stream velocity increases causing scaling to detach and pass through into the process stream





Pinch valves also address abrasion concerns. When dealing with abrasive flows, there are two options. The first is to make the ball, plug, or gate valve and piping materials much harder, the alternative is to make the valve or piping material softer. Softer materials allow the abrasive particles to bounce off the surface without destroying it.

For this reason, pinch valves have been used in a variety of mineral process applications on very coarse slurries for the past 30 years

With any mineral-based slurry, pinch valves offer a high degree of abrasion resistance, they also offer protection against clogging or jamming that can occur with other valves in lime slurry service

Many valves such as ball valves with stellite or harder coatings may be able to withstand the abrasive nature of lime slurry however, they are subject to jamming or clogging because they have cavities that allow for material collection

Pinch valve selection must be performed carefully by a valve specialist and not just selected to fit the pipework size. Stainless steel or carbon steel ball valves and plug valves do not vary greatly from one manufacturer to another. Choosing one of the more "reputable" ball or plug valves, will most likely provide a valve free from porosity or imperfections and some of them have modified designs to enhance performance in difficult services

Pinch valves vary greatly from one manufacturer to another, sleeve design and quality is the key to correct operation and mean time to maintenance

A good analogy is purchasing car tyres with the option of either a 30,000-mile set or an 80,000-mile set. Side by side, these tyres look almost identical, but the 80,000-mile-rated tyre certainly will cost more. The price increase provides two times the useful life of an inferior tyre

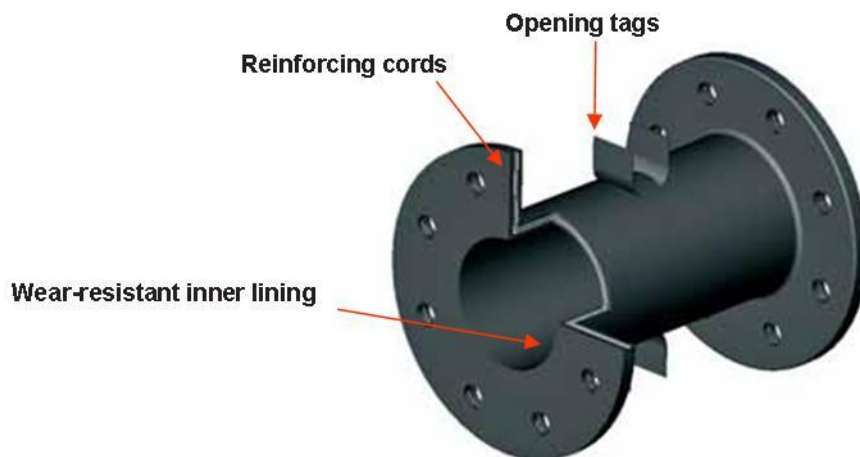
The comparison to pinch valves is that if you have tried them in the past and been unhappy with the performance, then perhaps the product you selected was simply inferior and unsuitable for your application. You might wish to give pinch valves another try with a different make and manufacturer, good designs are available and reputable companies will stand behind their products after the initial sale

A high-quality pinch valve typically handles lime slurries without any special product enhancements but there are number of features that will provide benefits to your operation

A major consideration when using pinch valves is that only the sleeve is in contact with the process stream. The benefit to this is that you only need to have one part in your inventory, you will not need to replace pins, hinges, gates, knives, domes, balls or any other components at service interval

Taking the tyre analogy little further, high performance tyres will have different chord patterns wound into the carcass and side walls to a standard tyre

The better valve manufacturers use chords to reinforce the high stress areas of the sleeve such as the flange sections. To assist in opening the sleeve especially where the application demands quick action, the valve and sleeve should use opening tags. This design feature secures the sleeve to the pinch bars ensuring that the valve opens effectively in all conditions



A pinch valve or diaphragm valve that has a preset weir could decrease valve performance quite substantially. This non-flexible weir will accumulate scale; because it does not flex, it will result in increased wear to the rubber sleeve. The non-flexible weir also defeats the self-cleaning effects of pinch valves, **is it a fit?**

Many manufacturers and valve users try to force their standard valves into applications in which they do not belong. Obviously, a large process plant tries to standardize products as much as possible in order to manage costs such as parts inventory and personnel training, what many large plants fail to recognize is that this practice may be very costly

A situation in the USA was where a company was using a standardized control valve that needed repairing every six months. When they finally switched to a product that was more suited for a slurry process, the plant was able to double its mean time between failures. The plant had 22 control valves in the process. The five-year operating cost of the original valves excluding the cost of down time, was \$242,000

By replacing these valves with better-suited slurry control pinch valves, the five-year cost was reduced to only \$55,000. Although a simple lime slurry control loop for pH control in many chemical plants is a very small portion of the process, it can be a large drain on operating costs. Plant decision-makers would be wise to choose process valves and instrumentation for this portion of the process carefully

Conclusions

Chemical process plants can select from a wide array of valves for use in lime slurry service hopefully none of these have been omitted from consideration

This paper attempts to focus on lime slurry handling, our experience and offers recommendations that may help improve valve performance, regardless of which type of valve is selected

Incorrect valve selection for lime slurry service can have a significant negative effect on whole life costs. A larger up-front investment could result in quite substantial savings in the future



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