Best Solution for Handling Lime Slurry

TODD LOUDIN, President, Larox Flowsys North America

Lime is used by a large majority of the chemical process industry in either a powder or liquid form. Engineering and maintenance personnel often face a long and potentially expensive trial-and-error period in order to find the best process equipment to handle lime.

Limestone is mined from a quarry in the form of calcium carbonate ($CaCO3$). Then it is crushed and fed into a kiln at approximately 2,000° F, where the carbon dioxide is burned off (calcining) to make 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 more. 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 very jagged and will not dissolve, but rather merely suspended in solution. Any cracks or crevices will cause the lime particles to fall out of suspension and fill these voids. Lime further aggravates this situation when it hardens in these collection points. The lime changes its state to a solid mass of material — commonly referred to as scaling. Scaling causes a pipeline's inner diameter to become smaller and smaller. Material buildup 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 limit cavities, cracks and void areas. Even a small collection point of lime can cause equipment failure and countless hours of downtime and maintenance.

The *ideal* product to supplement lime slurry should be able to clean itself and break apart scale. It should also be completely free of void spaces, cracks, and cavities. A piping product installed in a lime slurry system should be full port in order to limit obstruction and potential lime slurry buildup.

A significantly oversized actuator is a typical initiative for 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 while decreasing downtime as a result of sticking valves, but it will not solve all related maintenance problems. Because lime is very abrasive, it affects most ball and plug valves severely. A hard material cover such as stellite coating on the ball will help protect the valve against the abrasive nature of lime.

The seats also are a major concern. Again, hardened-steel seats with a scraping edge are most likely the best alternative 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 over time in lime slurry. The scaling that occurs in these valves is like a wrecking ball to most polymeric seats. The ball or plug with scale buildup is turned through these seats, usually resulting in a short lifetime. Because ball and plug valves have cavity areas that house the ball or plug, a substantial amount of material accumulates in this void area over time. It is beneficial to install flushing ports in the valve so that the body cavity area can be cleansed water to wipe out material accumulation after each cycle. This process will help minimize material buildup in the cavity area.

It is expensive to build a ball or plug valve with the all of the previously mentioned features. 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, however, the performance of most Teflon-seated ball or plug valves in lime slurry is less that satisfactory.

Gate & Knife Gate Valves

Gate and knife gate valves can be used in many slurry services. Most gate valves force the gate into a wedge area to close the valve, so tight shutoff is not always guaranteed.
Knife gate valves have a sharpened edge to improve the ability to cut through solid

particles. In lime service, the 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 should be increased to give the valve the ability to cut through or close tightly against the lime buildup in the wedge.

The knife of the knife gate is exposed to scaling and the scale buildup on the knife is most likely accumulated from packing problems in knife gates. As the knife opens, the scale buildup is dragged through the packing, which requires increased forces to open the valve. In most instances, there significant packing leaks occur.

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 because they have a straight-through design with no crevices or cavities for material collection. Pinch valves have a proficient self-cleaning effect on scaling materials.

A rubber tube or sleeve is pinched by steel bars on the centerline of the valve, causing it to close. Upon stretching the rubber sleeve, it begins to reach the closing position and the material or scale buildup flakes. As the valve is being closed, the flaking becomes greater, but the fluid velocity increases substantially. Thus, the flaked material or scale is pressure washed from the elastic surface of the rubber sleeve.

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 more hard and durable. The second approach 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 mining applications on very coarse slurries for the past 30 years. With any mineral-based slurry, pinch valves are a very viable option for protecting against abrasion. A pinch valve also offers 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 abrasiveness 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 very carefully and with due diligence. Stainless steel or carbon steel ball valves and plug valves do not vary greatly from one reputable manufacturer to another. Choosing one of the "more reputable" ball or plug valves, will most likely guarantee a valve free from porosity or imperfections. In addition, some ball or plug valves have modified designs to enhance performance in difficult services.

Pinch valves, however, can vary greatly from one another, and rubber quality and properties can differ drastically from one manufacturer to another. A comparable analogy is purchasing automobile tires with the option of either a 30,000-mile set of tires or an 80,000-mile set. Side by side, these tires look almost identical, but the 80,000-mile-rated tire certainly will cost more. The price increase secures two times the useful life of an inferior tire.

My point regarding pinch valves is that if you have tried them in the past and have been unhappy with product performance, then perhaps the make you selected was simply "inferior." 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.

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

Is It a Fit?

I have noticed that 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 cut costs with spare parts and personnel training.

However, what many large plants fail to recognize is that this practice may in turn prove to be very costly. I recall a situation where a company was using a standardized control valve that needed repairing every six months. However, 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 this process. The five-year operating cost of the previously used 22 control valves, excluding the cost of downtime, was $242,000. By replacing these valves with better-suited slurry control valves, the five-year cost was reduced to only $55,000.

The financial ramifications of improper valve, instrumentation, and piping selection for processes such as lime slurry can have a long-term negative impact on most operations. 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.

Chemical process plants can select from a wide array of valves for use in lime slurry service. I did not exclude any types of valves intentionally. I attempted to focus on the types of valves more commonly used in lime slurry, as well as to offer recommendations that might help improve valve performance, regardless of which type of valve is selected. Improper valve selection for lime slurry service can have a significant negative effect on continued operating costs. A larger up-front investment could result in quite substantial savings in the future.

Loudin is president of Larox Flowsys Inc. For more information, please e-mail him at todd.loudin@larox.us *[1] or visit* www.larox.fi *[2].*

Source URL (retrieved on *12/11/2013 - 6:47pm*):
http://www.chem.info/articles/2010/11/best-solution-handling-lime-slurry

Links:
[1] mailto:todd.loudin@larox.us
[2] http://www.larox.fi/