dent." That explosion followed two previous smaller explosions and a series of mechanical breakdowns.

- In June 2011 a dust explosion crippled a biomass wood pellet production facility near Waycross, Ga. Production was down for approximately one month.
- On July 15, 2009, a large stack of discarded dock piers burned at the chipper for a power plant located in Clarion County, Pa. Crews were on scene all day and into the night. Every fire department in the area had representatives and apparatus there to help fight the large fire.
- On February 5, 2010, a biomass plant in Brilon, Germany, exploded, killing three workers.

What Does All This Mean?

The numerous instances of fires and explosions at biomass-related facilities prove that biomass is a fuel to be reckoned with. The potential for devastating impacts on lives, property, and electrical reliability does not diminish the potential advantages of using biomass. However, due to the lack of research on biomass and coal-biomass mixtures, many facilities are treating biomass as if it were some inert fuel being added to the mix. Using 30-year-old silos and material-handling systems to move biomass materials whose properties we do not yet fully understand is like putting the horse before the cart. The resulting fires and explosions are proof that this is a serious safety problem that needs to be dealt with.

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Improving Slurry Knife Gate Valves in FGD Applications

The primary considerations in slurry valve selection are reliability in function and design, abrasion resistance, and ease of maintenance. In addition, valves with a straight-through, unobstructed flow minimize the effect of abrasion and therefore reduce the need for maintenance.

Different valve types can have significantly different effects on flue gas desulfurizer (FGD) scrubber reliability. Mechanical equipment within the plant is used continuously and requires periodic service. The right isolation valve can facilitate maintenance of the system's major components without the need to shut down the plant and can avoid disruptive leakages, which can cause significant damage. For example, if leaked slurry collects downstream in the pump casings, it can cause the impeller to freeze and prevent it from turning when the pump is started. The resulting high start-up torque can then damage or break the pump shaft.

Valve Technology in FGD Systems

Previously, valves used in the slurry service were a weak point in the system, and a number of different types have been tried in this application, with varying success. The incorrect use of conventional knife gate valves, ball valves, and plug valves led to clogs, failure to shut completely, or reduced flow capacity. Some advances have been made, yet conventional knife gate design still allows material to build up on the valve seat, restricting closing operation; it also makes the valve seat prone to abrasion.

Butterfly valves are another option, and they are commonly used in European FGD applications. However, these are particularly susceptible to the settling of solids and abrasion. Disc jams are common when solids build up in front of a seat ring, preventing further movement into the open or closed position. Failure of the valve to fully open may amplify pressure drop across the valve during system operation, while failure to close allows slurry to leak through the shutoff valve.

In addition, the design and operation of these valves affect the flow within the pipeline as the valve disc permanently obstructs the flow, even when open. Butterfly valves used in FGD applications, therefore, often require more frequent maintenance, as the valve disc is subject to increased abrasion, leading to a higher chance of failure. The average maintenance-free service life of a butterfly valve in a FGD application has been just two years for some users, which means increased costs.

In recent years, new valve designs have been engineered to meet the specific requirements of FGD technology. Specialist slurry knife gate valves with a push-through/discharge design expel the media where it can be controlled and diverted by a drain plate or catch pan. The fully retractable gate ensures that only the heavy-duty elastomer sleeves contact the flowing slurry when the valve is open. When closed, the gate is only in contact with the sleeves, ensuring zero downstream leakage. These sleeves are usually replaceable on-site, are easy to use, and do not suffer from blockages.

They provide positive isolation and bidirectional shutoff, with 100% seal tightness, which cannot be achieved by other types of valves, such as the butterfly valve, as the system media restricts operation. The retractable gate design reduces the need for complete repair or replacement and, when neces-

sary, the valve can be completely rebuilt on site. Specialist slurry knife gate valves have been proven to last 10 years or longer in FGD systems—much longer than other types of valve, which in some cases needed to be replaced after less than one year.

Elastomer: The Major Differentiator

The elastomer sleeves are the crucial components within slurry knife gate valves, yet not all elastomers guarantee the same results. The key to producing high-performance sleeves within a slurry knife gate valve is the initial selection of ingredients that make up the rubber compound. High-quality ingredients are essential to achieve reliable and long-lasting slurry knife gate valve sleeves, while different compounds are necessary when dealing with different pressures and temperatures.

Over time, the rubber in the valve sleeve can experience reduced mechanical performance, so it is vital that it have the correct properties to function when open or closed and guarantee zero-leakage performance. As the gate in larger sizes can be 2 to 3 inches thick, the rubber needs to be flexible enough to withstand significant displacement when the disc is closed and be as strong as the pipe when open. High-quality elastomers ensure that the rubber has the right mechanical properties to cope with this movement.

Elastomers developed with substandard ingredients or without sufficient testing can fail in a number of ways. For example, exposure to chemical substances can "dry" or cure the elastomer, causing it to harden and therefore lose its elasticity. Once this has occurred, it is no longer able to achieve the tight seal necessary in FGD applications and could lead to leakages. There is also the potential for "chunking," where pieces of the material tear off, or the possibility of the sleeves setting and not coming together after the valve has been closed for a long period.

Proprietary elastomers developed with high-quality products can last 10 to 15 years without replacement but can be changed yearly as a precaution. For this reason, it is vital that rigorous testing is carried out on the rubber compounds used in the development of the elastomers to ensure the longest possible life and best performance in FGD applications.

2. Select the right valve. Tyco's slurry knife gate valves have provided much improved longevity and ease of operation at Xcel Energy's Allen S. King plant. *Courtesy: Tyco Flow Control*

Taking the Lead in Elastomer Technology

Tyco Valves & Controls has a long history in developing elastomer technology and providing high-quality valves to the power industry. Tyco's state-of-the-art polymer lab is located within the Tyco Knife Gate Technology Center in Reno, Nev. In 2009, the lab was enlarged, allowing Tyco to develop what it believes are the most cutting-edge elastomers on the market—in addition to design guidance, application, and maintenance support.

Tyco's specialist team develops numerous rubber compounds and tests them extensively on-site to ensure that they meet the extremely high standards needed for FGD installations. It is impossible to mimic the blends of these elastomers, as the design not only requires the correct chemical composition but also the right curing and manufacturing setup.

Case Study: Allen S. King Plant

Xcel Energy's Allen S. King power plant in Bayport, Minn., utilizes numerous 8-inch and 6-inch open spring return slurry Clarkson knife gate valves as well as 6-inch manual valves from Tyco Valves & Controls throughout its dry scrubber FGD system (Figure 2).

Prior to the installation of Tyco knife gate products, plant engineers experienced continual difficulties with other valve equipment. These could not cope with the extreme conditions of the scrubber, where heavy buildup of recycled ash settled at the front of the seat ring, severely affecting performance and requiring frequent maintenance. Xcel Energy found that Tyco slurry knife gate valves worked well at another plant and decided to replace the existing valves at Bayport. The push-through/discharge design diverts the media away from the seat to prevent buildup, optimizing the valves' performance.

In the three years since installation of the new slurry knife gate valves, engineers at the plant have not reported any maintenance or valve service issues. Having needed to carry out frequent maintenance and repair on the previous equipment, this represents improved efficiency, cost savings, and plant uptime. This positive improvement in performance has led to plans to install additional Tyco slurry knife gate valves at a sister plant in Colorado in the near future. ■

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