Case history

Slaker's sealing system seals the deal

A gold mining company installs articulating seals on its lime slakers that are capable of handling shaft misalignment, deflection, and runoff, enabling the slakers to operate more efficiently and last longer.

Operators at the Barrick Goldstrike mining facility in Elko, Nev., were fed up with its lime slakers' problems. Not only were the slakers experiencing normal wear and tear, but excessive leakage, shaft misalignment, runoff, and potential health dangers had become a part of daily operations. The slakers are used during one stage of the company's gold production process to create a slurry used to adjust the pH level in gold ore. The company had tried various methods of sealing to eliminate the problems, including packing glands, ceramic coatings, and packed bearings, but none of these had been a satisfactory solution. The company needed to find an effective way to eliminate the leakage, misalignment, and runoff, as well as the associated maintenance and downtime.

Gold processing causes complications

Barrick Goldstrike mining facility, a property owned by Barrick Gold Corp., Toronto, uses a gold cyanidation system to extract gold from ore taken from its mine. To accomplish this, the ore is first finely crushed and ground into a slurry. Water is removed from the slurry to increase the solids percentage, which helps reduce heating costs during later process steps. The slurry then enters the acidulation stage where sulphuric acid is added to the slurry to remove excess carbonates, which improves efficiency during operations and maintenance.

To improve recovery rates, the slurry undergoes an extra process step called pressure oxidation (or *autoclaving*) after the acidulation stage. "An autoclave is basically like a giant pressure cooker," says Vance Anderson, pressure oxidation (POX) maintenance supervisor at Barrick Goldstrike. "We put slurry and oxygen into the autoclave, which runs at about 420°F and about 440 psi. The oxygen oxidizes the gold sulfide ore and turns it into gold oxide ore." After autoclaving, the slurry is cooled in flash towers and tube heat exchangers before being sent to the neutralization phase.

The neutralization process increases the slurry's pH to prepare for cyanide

The sealing system protects a lime slaker from leakage and contamination and requires no lubrication or routine maintenance.

leaching. "When the slurry exits the autoclaves it has a pH level of about one and contains about fifteen to twenty grams per liter of sulphuric acid," says Anderson. "We raise the pH level to about a ten in order to neutralize the acid. If the pH level is below ten, cyanide in the slurry will gas off and become a health hazard for our operators."

To raise the pH level, operators use milk of lime. This is produced in five lime slakers, which mix water and dry lime together. The slakers are approximately 18 feet long, 6 feet wide, and 5 feet in diameter and operate at approximately 180°F. The U-shaped slakers have top lids to provide easy access for cleaning and maintenance. On each slaker's top is an auger that feeds dry lime into the slaker. Water enters the slaker via a pipe. An internal, 18-foot-long agitator mixes the lime and the water together.

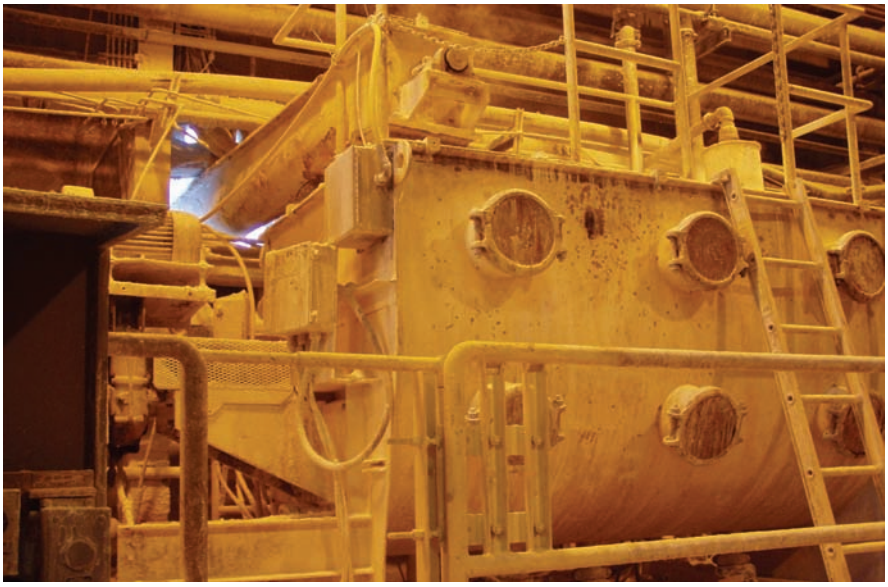
Once it's been slaked into milk of lime, the mixture discharges through a pipe and into one of two milk of lime tanks. The milk of lime then discharges from the tanks, through pipes, and enters the neutralization tanks. Simultaneously the gold slurry enters these tanks and combines with the milk of lime. There are two sets of three tanks — six neutralization tanks in all. Once the milk of lime and gold slurry mixture has passed through all six tanks, the now-neutralized slurry proceeds to the carbon-in-leach (CIL) process, where the gold is extracted from the slurry.

Slakers experience trouble

Operators were encountering numerous problems with the lime slakers. Leakage was causing unnecessary shutdowns and downtime as well as increased cleaning time and costs. In addition, chunks of lime were falling into the slakers, creating shaft deflection, and the lime slurry was getting into the bearings, causing failures.

The company tried several methods to control the leakage, including packing and packing glands. "We had a hard time sealing the slakers," says Anderson. "So not only was there lime coming out of the packing and making a mess, but lime was getting into our bearings and eating the shafts up." The packing was only lasting about 4 to 6 weeks at a time. The company also tried coating the shafts with ceramic to make them more rigid, but that didn't eliminate the leakage problem either.

Maintenance and labor were major concerns. "On each slaker we regularly perform preventive maintenance," says Anderson. "We used to have to pull out all the packing and repack the slaker. Then we'd take the bearings apart, clean them, regrease them, and put everything back together again and start the slaker back up." Operators had to perform these tasks once a week, making one slaker inoperable for about 4 days at a time.



U-shaped lime slakers mix water and dry lime together to create milk of lime, which is used to raise the gold slurry's pH level during the neutralization process.

Company searches for an answer

In early 2004, the company decided to search for a solution to its sealing problems. Around that time, Paul Ireland, Barrick Goldstrike planner, met with George Gillespie, southwest regional manager at Inpro/Seal, Rock Island, Ill. Inpro/Seal manufactures and supplies bearing isolators and other sealing devices used to protect and enhance the reliability of rotating equipment. Barrick Goldstrike had worked with the supplier before and was already using its sealing products on some of the other rotating equipment in the facility. After Anderson explained the current slaker situation, Gillespie recommended a seal that would eliminate the company's troubles.

Back in December 2003, Gillespie had completed a project at a different gold mine that had experienced the same problems Barrick Goldstrike was now having, including seal leakage, contamination, and excess labor requirements. At both mines, operators were unable to fix the problem. At the other mine, Gillespie had installed Inpro/Seal's Articulating Air Mizer-PS sealing system, a custom-engineered noncontact seal with no wearing parts that uses air to create a seal. The seal is specifically designed for applications that encounter shaft misalignment and runout. The sealing system had solved the other mine's problem, and Gillespie was certain it would solve Barrick's as well.

The company decided to try the sealing system and ordered two 2.75-inch-length seals for one of the slakers. One seal would be mounted on each end of the 3-inch-diameter agitator shaft, between the bearing

and the slaker. No testing was done since the seals had been used at the other mine in the same application. The seals were installed, with Gillespie's assistance, in September 2004 during routine maintenance downtime. The company replaced the associated slaker's shafts at the same time. The sealing system was easy to install, and the only adjustments were to the air pressure to find the right balance for the company's application.

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Sealing system solves the problems

The Articulating Air Mizer-PS sealing system is constructed of 660 series bronze and has two spherical interfaces — a stator, which is stationary, and a rotor, which fits inside the stator and turns with the slaker's shaft. The rotor incorporates two or more O-rings that are attached to the shaft and drive the rotor. The O-rings also seal the rotor to the shaft gap and help the seal self-align to the shaft's centerline to easily handle shaft deflection and dynamic misalignments. In this application, vertical and horizontal movement up to ±0.125 inch and up to 10 degrees of angularity isn't a problem. The seal can be designed to handle even more movement if required by the application it's designed for. A very small gap between the stator and the rotor houses eight Teflon-coated bumpers. The bumpers eliminate wear to the seal and help achieve a tight clearance between the stationary and rotating interfaces so that less air is consumed.

A ½-inch ID pipe running from the plant's existing air supply to the inlet on the seal directs plant air into the seal chamber. This pressurizes the seal to the required level as needed for the particular application. The air exits between the rotor and stator. The achieved seal's internal pressure and subsequent airflow toward the material side ensures that no contaminants or material gets into the stator and rotor gap and prevents material from bridging, escaping, or damaging the seal.

"The reason we call the seal an air 'mizer' is because it uses as little air as possible to achieve the pressure needed," says Gillespie. "The actual air usage through the seal is about four to six scfm, which is very small compared to other air sealing devices. This system disperses air evenly around the seal so there are no dead spots."

Seals provide numerous benefits

After more than a year of using the new sealing system, no leakage has occurred and runoff has been eliminated. Above all, Anderson is happy with the savings the seals have provided. "Operators no longer have to spend up to forty hours several times a month changing or replacing packing or cleaning and regreasing the bearings. These new seals have given us tremendous savings in terms of labor, maintenance, repair costs, decreased downtime, and lost product. It used to take up to forty manhours of downtime each time to perform preventive maintenance on the slakers. Now, because we don't have to work on the seals, it only takes about fourteen manhours to get the slakers up and running. That labor saving has made the seals' cost well worth it."

The seals require no lubrication or routine maintenance, and they're expected to last indefinitely. However, should a seal ever need replacing, the company's mechanics can easily do it themselves.

"This articulating sealing system has a very flexible design," says Gillespie. "Everything is custom-designed, yet I can go in on a Monday, take all the dimensions, send them to engineering, and by Wednesday or Thursday of that week the customer will have a custom-designed seal in their hands. And once we have that custom design, as with these lime slakers, we can build and ship additional seals within twenty-four hours of taking the order. It doesn't take six months to get them."

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The new sealing system provided a permanent solution to Barrick's problems, and the company has now installed the seals on all five of its lime slakers. **PBE**

Note: To find other articles on this topic, look under "Mixing and blending" and "Valves" in *Powder and Bulk Engineering*'s Article Index at www.powderbulk.com or in the December 2005 issue.

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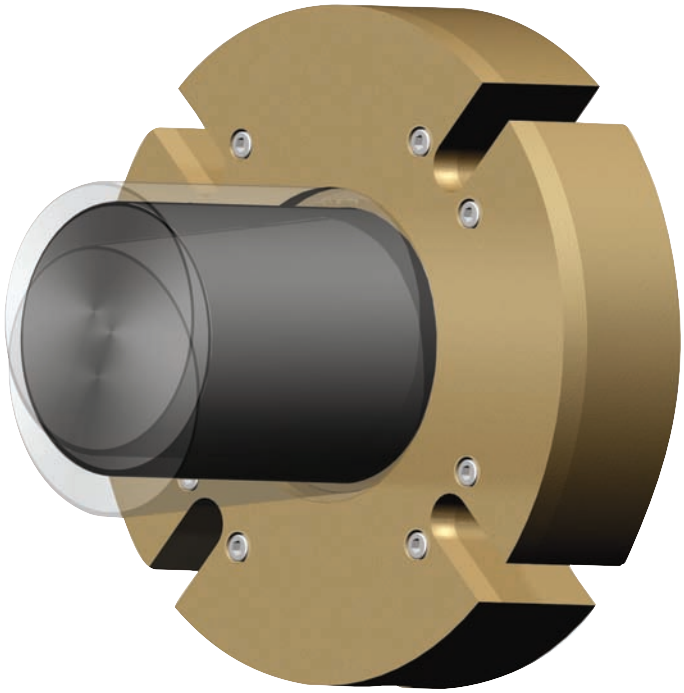

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