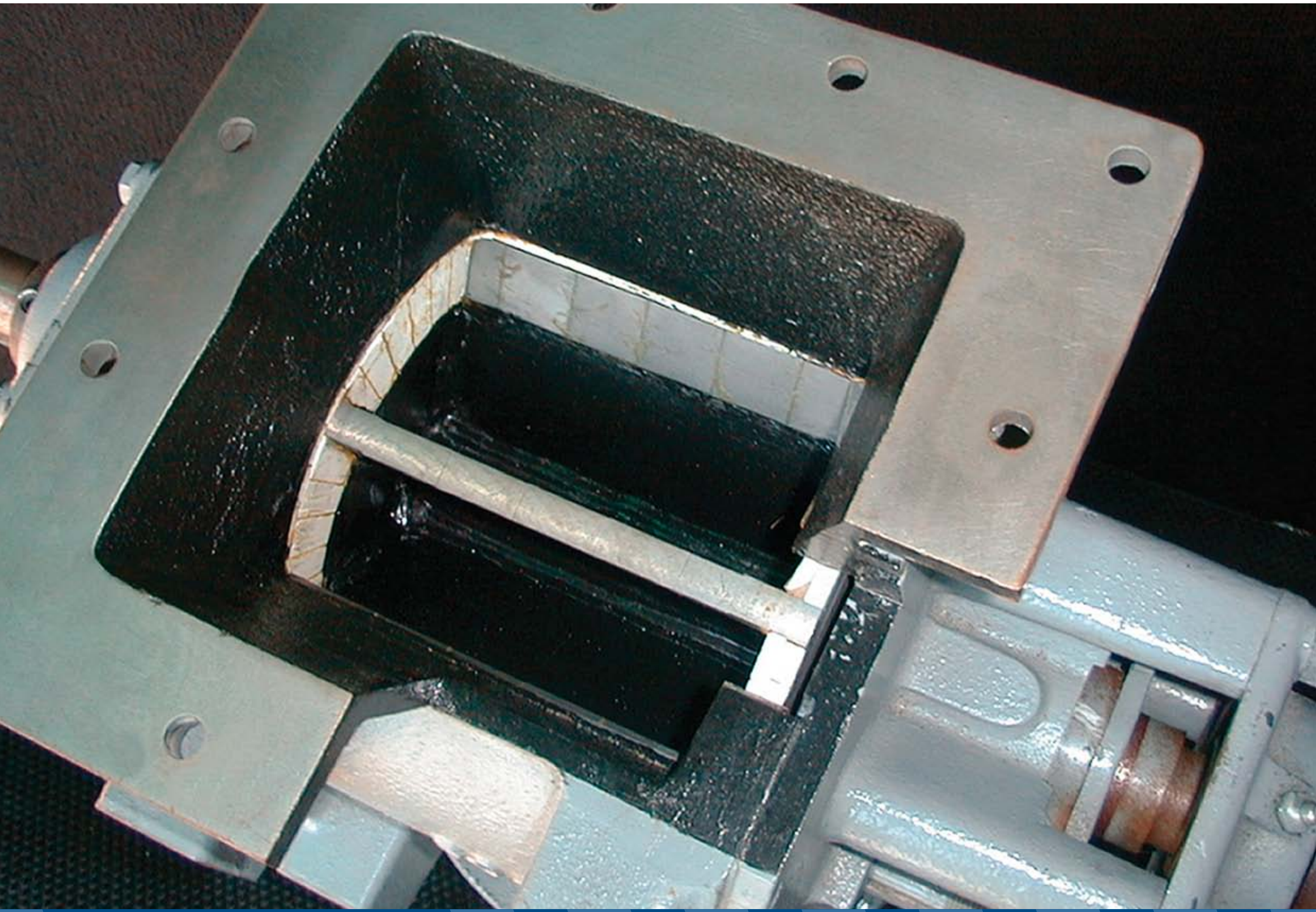
Rugged, reliable rotary valves seal the deal



One Source

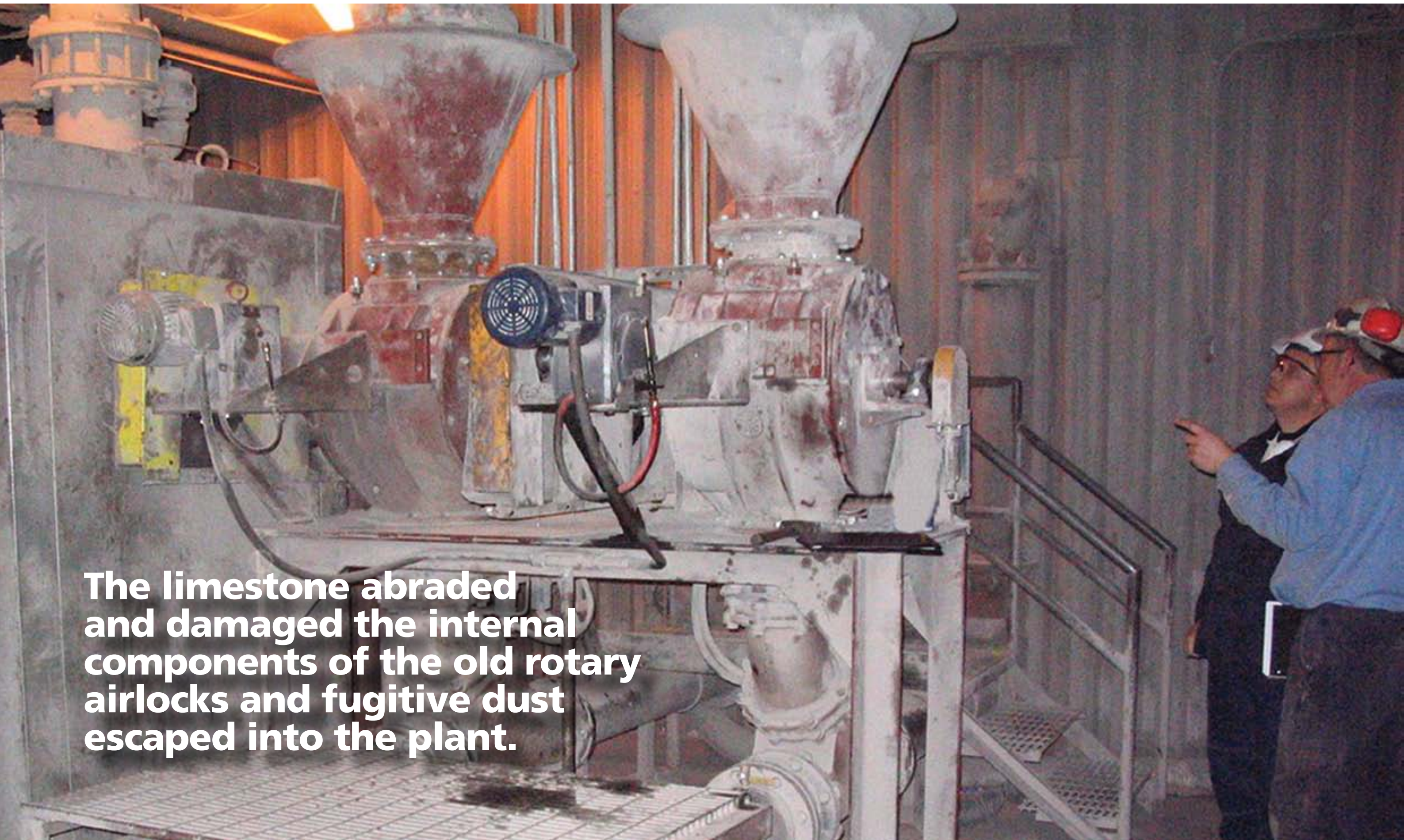
CASE: AC Power in Colver, Pennsylvania

A coal-fired power plant solves a feeding problem by installing ceramic-lined rotary valves in a limestone injection system.

Long life, minimal maintenance

"After a year of use, we found that the first supplier's ceramic-lined rotary valves vastly outperformed the other supplier's valve in terms of price, reliability, and ease of maintenance."

AC Power manages and operates a coal-fired power plant near Colver, Pennsylvania, that burns high-sulfur bituminous coal to generate more than 100 megawatts of electricity for use by consumers in the surrounding area. To maintain EPA air-quality standards and regulate furnace emissions, the plant uses a dilute-phase pressure pneumatic conveying system to inject pulverized limestone into the furnace to absorb the sulfur and convert it into an inert material. The limestone injection system includes two rotary valves used as feeders and four rotary valves used as airlocks. Soon after starting operations in 1995, the plant found that the limestone continually abraded and damaged the rotary valves, necessitating their replacement every 3 to 6 months. In 2007, the plant decided to redesign the entire power-generation system to improve performance and lower operating costs,



The limestone abraded and damaged the internal components of the old rotary airlocks and fugitive dust escaped into the plant.

and as part of the project it needed to find more robust and reliable rotary valves for the limestone injection system.

The limestone injection system

The plant stores the pulverized limestone in a large silo that has two bottom pant legs, each of which has two Airslide™ conveyors that fluidize the material to facilitate gravity discharge. A gate valve at each pant leg's outlet controls limestone discharge from the silo. The limestone passes through a tube to a variable-speed rotary valve feeder that meters it into a bin vent hopper. The limestone discharges from the hopper to a diverter gate valve that directs it to one or both of two variable-speed rotary valve airlocks, depending on the system's feed requirement. The airlock maintains the conveying system's differential pressure and feeds the limestone into a dilute-phase conveying line that moves it into the furnace.

Each pant leg's two airlocks operate at the same speed as the feeder, determined by the sulfur content in the furnace -- the more sulfur, the faster the rpm and vice versa. During maximum operating conditions, all four of the injection system's conveying lines can simultaneously feed limestone into the furnace. The plant operates 24/7, and the system handles approximately 120,000 tons of limestone each year.

Limestone causes feeding problems

The abrasive limestone damaged the rotary valves, "impacting their internal floating shoe and cocking it, making it uneven across the top so one part of the shoe would seal with the rotor vane tips and the other part wouldn't," says Rick Fleegle, AC Power maintenance manager. "It also eroded the rotary valves' rotor vane tips and created more gaps. When this occurred, conveying line air would leak through the gaps in the airlocks back into the bin vents, forcing fugitive dust out into the plant, which kept housekeeping costs high. Air that leaked through gaps in the feeders went up through the pant legs into the silo and disrupted material discharge and impaired system performance."

The air leaks caused the limestone injection system to become unbalanced, and the conveying line or lines downstream of the leak would lose feeding capacity to the furnace, temporarily changing the sulfur emissions. To maintain emissions standards, the plant's operations department had to increase the limestone feedrate to ensure that the proper limestone amount was fed into the furnace.

During the rotary valves' operating life, the plant's maintenance operators had to regularly inspect them for wear and adjust their various components when needed. "They were maintenance nightmares from the perspective of preventive and upkeep work and the time and labor it took," says Fleegle. "And because they wore out prematurely, they added to the overall system operating costs. If we were lucky, we'd get six months of use from one before it had to be taken out of service."

Finding a better rotary valve

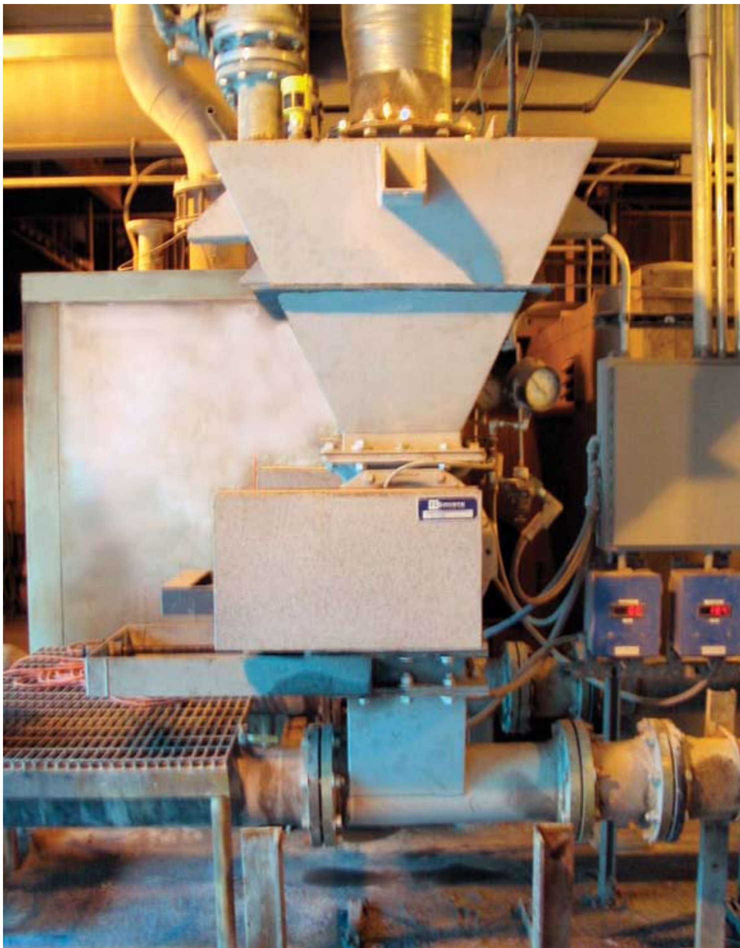
In 2007, as part of the overall system optimization project, Fleegle contacted two rotary valve suppliers to test their valves in the limestone injection system. The two companies had similar guarantees and pricing, but one supplier's valves won hands down, says Fleegle.

"For the test, we replaced both feeders and one airlock with one supplier's ceramic-lined valves, and we replaced one airlock with the other supplier's rotary airlock. After a year of use, we found that the first supplier's ceramic-lined rotary valves vastly outperformed the other supplier's valve in terms of price, reliability, and ease of maintenance. After completing the test, we replaced the three remaining airlocks with the first supplier's valves." This supplier, FLSmidth, Bethlehem, Pennsylvania, supplies equipment, machinery, services, and complete production lines and plants to the power, cement, mineral, and other industries.

The ceramic-lined rotary valve

The 300-millimeter ceramic-lined rotary valve consists of a cast-iron housing, two end plates, a rotor, and a rotor shaft sealing system. The housing's bore is lined with 0.100-inch-thick (2.54-millimeter-thick) alumina ceramic tile, the bore throat has a 0.100-inch-thick (2.54-millimeter-thick) tungsten

The rotary valve's ceramic-lined housing and tungsten-carbide-coated components have allowed it to feed 120,000 tons of limestone per year for more than 3 years without showing significant signs of wear.



Decreased costs

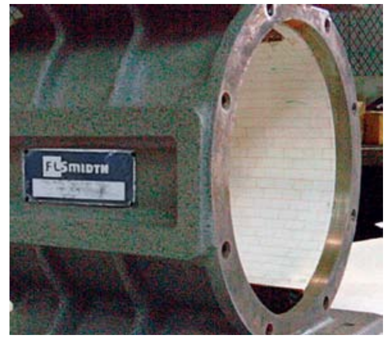
carbide coating, and the cast-iron end plates have a 230 to 250 Brinell hardness. The valve's eight-vane, closed-end, carbon steel rotor has a 0.100-inch-thick (2.54-millimeter-thick) tungsten carbide coating, and the rotor vanes' beveled tips are also coated with tungsten carbide. The shaft sealing system's outboard-sealed ball bearings, Teflon-packing shaft seals, and air-purge seal connections require little maintenance and prevent fugitive dust from migrating out.

The heavy-duty rotary valve can handle such abrasive materials as limestone, fly ash, mineral ore, sand, cement, and many others in both pressure and vacuum pneumatic conveying systems. The valve can feed material at up to 1.09 cubic feet per revolution, handle differential pressures up to 15 psi, and operate in temperatures up to 350°F (175°C).

Limestone feeding problems solved

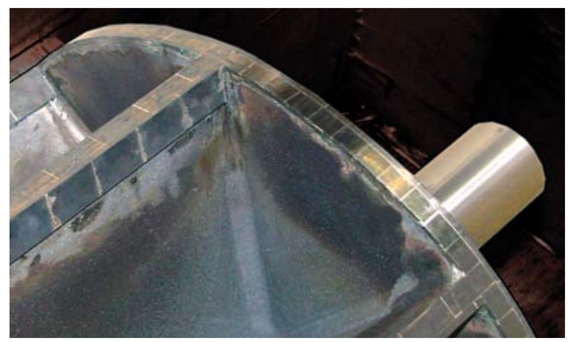
The rotary valve's abrasion-resistant ceramic lining and tungsten-carbide coatings provide a long operating life with minimal maintenance requirements. "Since installing the valves, our operating and maintenance costs have decreased because we don't have to buy new ones every three to six months," says Fleegle. "And system downtime has been greatly reduced because we no longer have to stop so frequently to inspect, adjust, or replace the valves. The only preventive maintenance we occasionally have to do is adjust the packing on the shaft. This has allowed us to reallocate labor resources to other areas of the plant."

The plant is still using the same rotary valves it installed 3 years ago, and, according to Fleegle, even though they're starting to show a little wear, they still have operating life left in them. "We have two spare valves in the warehouse right now, so when any of the valves need changing out, we'll be able to do it quickly. We'll send the worn valve back to the supplier so they can recondition it back to the original state, which is something we couldn't do with the previous ones. Being able to use a reconditioned valve instead of having to buy a brand new one will save us money in the long run."



Detail of ceramic-lined bore

Tungsten-carbide vane tips and shrouds



The supplier's rotary valves are smaller than the ones the plant was previously using, but they can feed more limestone with better control and no blowback. "The new valves provide a more consistent and reliable feedrate to the furnace, which allows us to keep the system balanced and maintain emissions at a more constant level," says Fleegle. "Because of this, we've reduced our limestone consumption and housekeeping has been a lot easier and less time-consuming. Based on replacement costs alone, the return on investment for the new rotary valves was a little more than a year."

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