

Rotary valves keep on turnin'

A rotary valve increases a mineral company's productivity by standing up to abrasive particle wear.

CASE HISTORY

Finding equipment to withstand the rigors of pneumatic conveying can be a burden, regardless of the nature of the product that is transported. But it can be particularly troublesome in the mining industry, where the particles being conveyed are often very abrasive.

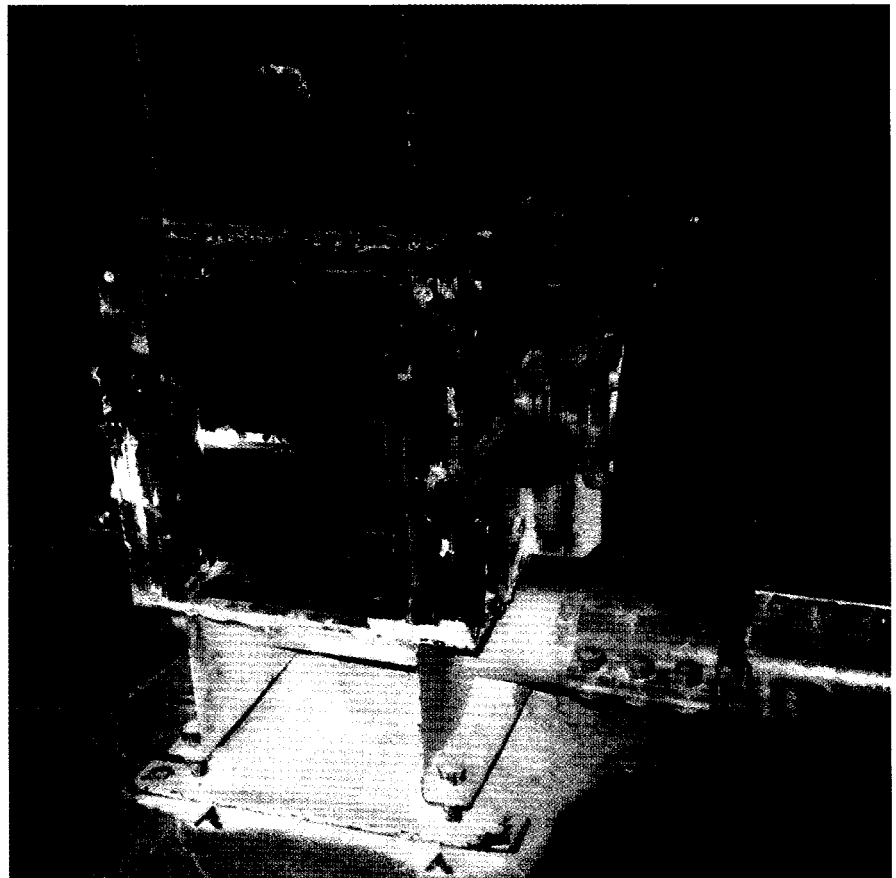
NYCO Minerals, located near Willsboro, N.Y., mines and processes wollastonite, a naturally occurring calcium silicate mineral that has a unique acicular crystal structure. NYCO is a division of Canadian Pacific, which also operates similar plants in Missouri and in Mexico.

Wollastonite is used primarily as a nonhazardous replacement for asbestos fiber in fireproof cement board

and in friction products such as brake pads and disc clutches. It is also a functional filler used to enhance the properties and performance of paints, plastics, and ceramics.

At the Willsboro facility, NYCO operates two plants, one to process and mill the wollastonite into the finished product and another to chemically modify the wollastonite particles. Lloyd James, purchasing agent for NYCO said, "By chemically modifying the wollastonite, we can improve its performance in a variety of plastics applications."

Once modified, the wollastonite becomes a functional component in the plastic, thus improving properties such as impact strength, surface finish, and dimensional stability.



Rotary valves feeding abrasive wollastonite to a pneumatic conveyor were able to withstand the wear.

"We continue to research and develop new uses and applications for our products all the time," James said.

Seven miles from the Willsboro facility, NYCO operates a 10-acre open pit mine. To produce usable wollastonite for their customers, NYCO mines it from the ground, separates it from other rock, and crushes it to a usable size. NYCO subcontracts the blasting, mining, and trucking of the raw material to other companies.

Trucks bring the raw ore to the plant, where it is stored in either a 200- or 400-ton storage hopper. "In conjunction with that we run a stockpile that we can take material out of to feed the plants," James said. "We try to run our mining pit roughly 6 months a year and in that time we take out 260,000 to 275,000 tons of material. The excess that we draw we store in our stockpile behind the plant, which we run when the pit is down."

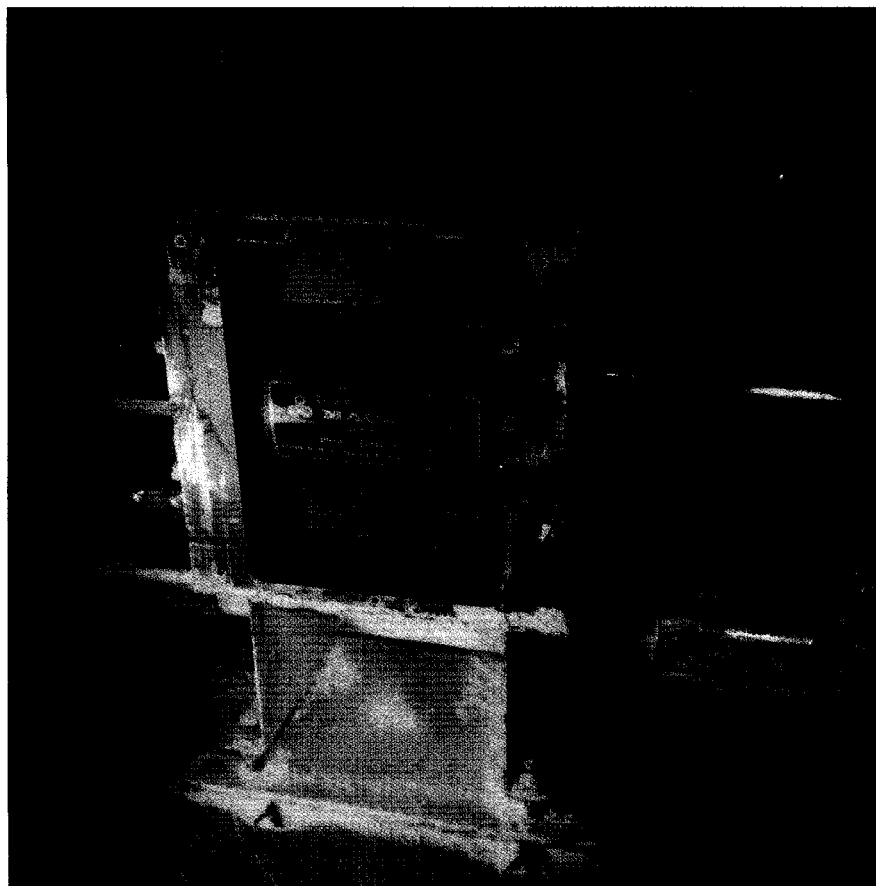
At the plant, belt conveyors take the material from the raw storage hoppers to a series of crushers, where it is crushed to minus two inch and dried. Rotary crushers further reduce the raw material before the wollastonite particles can be completely separated from other materials in the ore, including garnet and diopside.

A combination of shaker and belt conveyors carry the ore through a series of magnetic separators, which draw the garnet away from the white wollastonite slivers.

"We market [the garnet] as well," James said. "Everything we take out of the ground we actually can sell, so it's kind of a unique operation in that way."

The wollastonite is milled and then packaged. The particle size of the finished wollastonite varies widely. Depending upon the final application, it

"We can tell what the rotary valve is putting out when we start bagging. If the packaging tank continues to run out of feed, we know that the valve might be wearing out. We are constantly monitoring the valve."



These rotary valves are made of a hardened alloy and maintain a two-vane seal on both sides at all times during operation.

can be milled from 1,250 microns up to the 200-mesh market grade.

"After milling, the wollastonite is conveyed in bucket elevators and then gravity fed into [one of four 250-ton finished product bins]," James said. "There are no conveyors there."

NYCO sells approximately 90 percent of its wollastonite in packaged form. The remaining 10 percent is shipped in bulk. The finished product is fed through valves into pneumatic conveyors that carry it into one of two packaging hoppers. A rotary bagger, capable of bagging 14 bags per minute, packages the final product in 50-pound and 25-kilogram paper bags, which are palletized in 1-ton units.

"It's fully automated," James said. "The operator just has to put the bags on the machine and take the finished pallets off at the other end."

The company also ships the wollastonite in semibulk bags. "We have bags that range from 1,000 to 4,400 pounds," James said. "After it's packaged we have trucks that carry it to the wharf and rail services in Montreal. It's sold and distributed throughout the world."

Rotary valve wear and tear

Pneumatic conveying is used extensively throughout the NYCO process to transport the wollastonite from finished-product tanks to the packaging stations. During the process, rotary valves feeding material to the pneumatic conveyor lines would wear from the abrasive particles.

"Once the valves began to wear, pressure from the pneumatic conveying line would blow back into the tank, keeping wollastonite from falling into and through the rotary valve," James said. "We can tell how the rotary valves are performing when we start bagging. If the packaging line continues to run out of product we know that we are losing conveying capacity and that the valve is probably wearing out.

We must constantly monitor these valves, because if we're waiting for product, we're losing production."

The worn valves required a complete changeout, as both the vanes and the body suffered wear from the wollastonite particles. To replace the valves, operators had to shut down the pneumatic conveyor. As a result, plant production suffered.

The worn valves also increased plant maintenance costs. Added to the cost of new valves, James said, was the increasing number of maintenance hours.

"They gave us a 3-month trial period. We didn't have to pay for it. They just put it in, and if it held up for those 3 months we would pay them. It wasn't really costing us anything but time."

"A number-one headache in our plant has been rotary valves," James said. "It's been a constant search to find an airlock that would work well. In one application, we were changing out the rotary valves in the neighborhood of every 4 to 5 weeks. Wear is our biggest problem. No matter where you go in our plant, there is a wear issue."

Finding a rotary valve to withstand the wear

Finding the proper rotary valve has been a continuous challenge for NYCO personnel. "We've certainly tried," James said. "By that I mean we've gone around the country buying different valves, trying to make them work."

Each of the valves was similar and each delivered the same results when subjected to the abrasive wollastonite: None withstood the abrasion for any length of time.

James said NYCO personnel searched mining industry magazines and other publications to learn about different valve options. "If it looked like a good valve, we'd give a shot," James said. "We called the manufacturer and told them what we needed and that I would send them some sample product. The manufacturers took a look at some of our products, and I actually had some say, 'No, we don't want this. It's too abrasive.' So it has been a trial-and-error thing."

One rotary valve sales representative who was familiar with NYCO's products approached the mineral company, confident the valve he was selling would work. With nothing to lose, NYCO decided to try a PMV rotary valve made by Precision Machine and Manufacturing.

"They gave us a 3-month trial period," James said. "We didn't have to pay for it. They just put it in, and if it held up for those 3 months we would pay them. That was good of them to do. They were backing their materials, and it wasn't really costing us anything but the time to install them."

Rotary valve installed

In April 1998, NYCO installed two rotary valves, one at each on-site plant. "We told them what we had used before," James said, "and the manufacturer matched it with their model."

The installation went smoothly. Once the rotary valves were in place, they began to operate without any problems.

The rotary valve's components include flanged roller bearings at both ends, a high-pressure air ring, a closed-end eight-vane rotor, chrome-barreled side- and end-wear plates,

and adjustable shaft-packing seals. Each end-plate also features two clean-out ports and ports for seal air.

The sides of the unit are drilled to allow 3 or 9 o'clock drive mounting positions and a running clearance of 0.01 inches. Constructed of 500 Brinell alloy, the rotor maintains a two-vane seal during operation. The barrel sides and end plates are constructed of the same alloy to resist wear from abrasive materials. High-temperature paint provides added protection.

"We were changing valves out every month or month and a half. One of the [new rotary] valves has been installed here for more than 7 months. So we are getting plenty of wear out of them."

The bolt-together design allows individual pieces to be replaced when they become worn. Operators can take the pieces apart by removing the correct bolts, thus simplifying any needed repairs. The pieces are dowel-pinned for easy alignment while the bolts are secured.

"In the past you either had to repair the body or the rotor. One or the other would be completely shot and the entire valve was replaced," James said. "These new rotary valves allow operators to change just the part that's worn."

Decreased wear and maintenance; increased productivity

By better withstanding the abrasive environment, the rotary valve has in-

creased plant productivity and reduced maintenance costs. James said the new rotary valve has helped the plant operate at consistent production levels by maintaining a regular flow of wollastonite from the finished-product bins to packaging.

"We were changing valves out every month or month and a half," James said. "One of the new valves has been installed here for more than 7 months. So we are getting plenty of wear out of them. We are spending a lot less on maintenance."

In fact, James estimated that maintenance time has been cut in half. The valves still require repair, he said, but not the frequent complete replacements that once halted plant operations.

"I think the valves are well made," James said. "The tolerances are a lot tighter, and I think it is in the precision of the machining of the parts myself. They are just better made than others."

Thus far, the rotary valves have exceeded NYCO's expectations. Two valves remain in constant operation, James said, one at each plant. The plant has replaced some valves and keeps two extras on hand as replacements for when the time comes.

"As of today we are averaging about 6 months," James said, "but some are running longer." **PBE**

**Precision Machine and
Manufacturing, Eugene, OR**

541/484-9841

#350