Case history

Multi-frequency adapter improves screening operation

A metal powders producer installs a multifrequency adapter in a screener to improve screening efficiency and increase on-size particle yields.

F.W. Winter Inc. & Co., Camden, N.J., produces various metal powders for companies that manufacture products for welding, hard-facing thermal spray, deposition coating, and powder metallurgy and metal injection molding applications. The company produces a fine-sized proprietary metal alloy powder for one of its customers and was usually able to produce enough material to meet the customer's requirements. However, when the customer needed more material than usual, the company had a difficult time efficiently screening the quantities needed. To improve screening efficiency and increase on-size particle yields, the company worked with a supplier of screeners and multifrequency adapters.

Producing the metal alloy powder

F.W. Winter's customer requires that the metal alloy powder's particles be equal to or smaller than 325 mesh (44 microns). To produce the powder at the appropriate size, the company first reduces metal alloy to about 230 mesh (about 75 microns) using a mill. The company then prescreens the material using a single-deck screener with a 230-mesh screen. Particles larger than 230 mesh discharge from the screen's top and are sent back to

The multifrequency adapter fluidizes the material on the screen's top to hasten screening and prevent screen blinding.

the mill for further size reduction. Particles smaller than 230 mesh pass through the screen and discharge into a 2,500-pound-capacity bottom-discharge hopper.

In the past, an operator used a forktruck to move the hopper from the milling and prescreening operation to the finished-product screening operation. The operator positioned the hopper above a holding tank and then opened the hopper's bottom-discharge valve to gravity-discharge the material to the tank.

The finished-product screening operation consisted of two 4,000-pound-capacity holding tanks located side by side and four 48-inch-diameter single-deck screeners, two beneath each tank. Each tank's bottom had two independent discharge outlets, and each outlet fed material to one screener via an independent electro-magnetic vibrating feeder. The feedrate was determined by the feeder's vibration frequency — the higher the vibration frequency, the faster the feedrate. When the feeder stopped, the material flow stopped.

Each screener had a 325-mesh screen and an ultrasonic unit, which amplified the screener's vibration to aid screening. Oversize particles (larger than 325 mesh) discharged from the screen's top and were returned to the milling and prescreening operation for further size reduction. On-size particles (smaller than 325 mesh) fell

To prevent premature blinding and extend screen life, the company lays the fine-mesh top screen over the backer screens without tension.

through the screen and were packaged for delivery to the customer.

Problems screening the metal alloy powder

At the optimum feedrate, each screener yielded a maximum of about 25 pounds of on-size particles per hour, with about 80 percent of the material fed to a screener being sent back to the milling and prescreening operation for further size reduction. The on-size particle yield was usually enough to meet the customer's requirements. However, the customer sometimes experienced spikes in demand and required 2 to 3 times the norm. Because the screeners were operating at maximum capacity, the company couldn't keep up with the extra demand without extending plant operation hours and increasing overtime costs.

To increase the on-size particle yield, the company tried changing the screeners' angle and amplitude. "We also started feeding the screeners so that the material was uniformly dispersed in a radial pattern in the center of the screens rather than just dumped on the screens," says Bill Perry, F.W. Winter director of operations. "We even worked with the ultrasonic supplier and compared the differences between continuous versus pulsed ultrasonic units. All of these things incrementally improved the on-size particle yields, but it still wasn't enough."

In addition, the metal alloy powder regularly blinded the screens, which decreased screening efficiency and further reduced the on-size particle yields. "We got anywhere from two to four weeks out of a screen before it became substantially blinded," says Perry. "We had to send the screens to the original screener manufacturer or a local screen cloth distributor to have them restrung, which increased operation costs."

Solution arrives by mail

In early January 2000, Perry received a CD-ROM in the mail from Kroosh Technologies, Mamaroneck, N.Y., a supplier of screeners and multifrequency adapters. The CD-ROM contained information about the supplier's Krooshe multifrequency adapter, which can be retrofit to round or rectangular vibratory screeners. Perry was intrigued by the adapter's capabilities and contacted the supplier to learn more.

In late January, the supplier had Perry fill out a screening questionnaire asking for a general material description, screening operation and equipment description, screen mesh size, current screening results, and desired screening results. After reviewing the company's information, the supplier contacted Perry to set up a material screening test.

The multifrequency adapter consists of three proprietary vibration-amplification mechanisms (also called adapters), six isolation mounts, and a 36-inch-diameter, ¼-inch-wide resonating ring.

In late February, Perry sent about 500 pounds of metal alloy powder to the supplier's 7,000-square-foot test facility, which contains various types of screeners, three working laboratories, analysis equipment, and a toll production bay. For the screening tests, the supplier installed a Krooshe multifrequency adapter in a 48-inch-diameter single-deck screener with a 325-mesh screen. (The supplier used the same model screener and screen cloth that the company does.) After the tests, the supplier ran a particle analysis test of the screened material and sent the test report and material samples back to Perry.

Pleased with the test results, which showed that the supplier achieved a 96 percent screening efficiency, Perry contacted the supplier for pricing information. Because the multifrequency adapter's price was more than that of the company's existing ultrasonic units, the company decided to rent one multifrequency adapter with an option to purchase it if it performed as well as the tests showed. In late March, the supplier sent the company a rental agreement, and, in early April, the supplier traveled to the company's facility to install the multifrequency adapter in one of the company's screeners.

The company feeds metal alloy powder to the screener at about 600 lb/h and gets more than 150 lb/h of on-size particles.

The multifrequency adapter

The Krooshe model 48-1 multifrequency adapter consists of three proprietary vibration-amplification mechanisms (also called *adapters*), six isolation mounts, and a 36-inch-diameter, ¼-inch-wide resonating ring that's covered with a nylon gasket. The three adapters are arranged in a triangular pattern, and their tops are connected to the resonating ring's underside. The adapters are installed inside the screener directly under the screen deck so that the resonating ring touches the screen's bottom. The adapters are totally mechanical and are activated by the screener's vibration — when the screener stops operating, the adapters also stop operating.

Each adapter consists of a small rectangular box containing a proprietary mechanism that converts the screener's monoharmonic oscillations into amplified polyharmonic oscillations. When the screener is operating, the adapters capture the screener's horizontal and vertical vibration amplitudes, amplify them by 10 to 100 times, and redirect them to the resonating ring, which transfers them directly to the screen. These amplified vibration amplitudes fluidize the material on the screen's top to hasten screening and prevent screen blinding.

Working out the bugs

After installing the multifrequency adapter in the company's screener, which took about 5 minutes, the supplier also made some screen adjustments. The supplier knew that the resonating ring couldn't directly contact the fine-mesh top screen because the increased vertical vibration amplitude would rip it apart. To solve this problem, the supplier installed two other screens in the screen deck underneath the top screen, making a sandwich with a 6-mesh backer screen on the bottom and a 52-mesh screen in the middle. The 6-mesh screen, which has a greater tensile strength than the top screen, is in direct contact with the resonating ring. It receives the vibration directly from the resonating ring and spreads it out over its entire surface before transferring it to the top screen via the 52-mesh screen.

After making the screen adjustments, the supplier and company operators did a side-by-side test run in which material from one holding tank was discharged at the same feedrate to the screener with the multifrequency adapter and an existing screener with an ultrasonic unit. Both screeners used screens with the same mesh size.

Bob Grotto, Kroosh Technologies president, was present for the test run and says, "They started feeding both screeners at the same feedrate, but we noticed that they weren't feeding the screener with the multifrequency adapter fast enough because the material wasn't covering the screen cloth; it was just going through it. So we dramatically increased the feedrate to that screener. After doing so, one of the operators took a material sample to the test lab, weighed it, and told us that the screener with the multifrequency adapter was screening more than one hundred pounds of on-size particles per hour at more than 90 percent efficiency."

However, after extended screener operation, the company discovered that the fine-mesh top screen would prematurely blind and need to be replaced sooner than expected. The company and supplier investigated the problem and concluded that in contrast to the usual practice, the screen needed to be tensionless for it to operate efficiently. To make the screen tensionless, the company simply lays the top screen over the backer screens and puts the screener's top deck on to secure it. They do no tensioning once the screener's top deck has been secured. Perry says that since making the screen tensionless, "we're replacing the screen every six to eight weeks instead of every two to four weeks."

Improved screening efficiency

Since installing the multifrequency adapter in its screener, the company is able to feed the metal alloy powder to the screener about 6 times faster than it could to a screener with an ultrasonic unit. "We were able to increase the feedrate to the screener, and our yield percentage improved," says Perry, "Now, instead of feeding one hundred pounds an hour to each of four screeners and getting about one hundred pounds of on-size particles, we're able to feed one screener at about six hundred pounds an hour and get in excess of one hundred fifty pounds of on-size particles. This allows us to meet our customer's requirement for extra material when they experience spikes in demand."

The company was also able to streamline its finished-product screening operation. "We removed the two holding tanks and three of the electro-magnetic vibrating feeders and installed a new tank that allows us to use a dump bin to transfer the material from the milling and prescreening operation," says Perry. "We also removed three of the screeners from the operation, because the screener with the multifrequency adapter can handle all the powder production volume we need for this application."

After using the multifrequency adapter for several weeks and seeing the positive results, the company decided to purchase the unit. Perry says, "We had such success screening fine-sized material with the first multifrequency adapter that we transferred the same technology to other applications and products requiring minus forty-four-micron separation (or smaller). Improvements in screening efficiency have substantially augmented our air classification capabilities geared toward serving the various markets for fine metal powders." **PBE**

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