Test center finds powder conveying solutions

An equipment supplier's tests help a company choose a pneumatic conveying system for magnesium oxide powder.

Premier Magnesia, West Conshohocken, Pa., processes various chemical compounds, including s magnesium hydroxide and magnesium oxide products. The products are used in a wide range of industries, including power generation, water treatment, animal feed production, and more. The company needed to move two varieties of magnesium oxide (MgO) from a screener to a storage silo at a rate of 5 to 8 t/h at its Gabbs, Nev., facility.

The first variety, with large +100 mesh particles, is used in animal feed. The particles tend to degrade when transported, which made finding a conveying solution challenging. The second variety, with smaller −100 mesh particles, is used in the creation of Epsom salts. The particles are free-flowing and aerate well.

Processing the powders

Premier Magnesia screens the magnesium oxide to separate the +100 from the −100 mesh particles. Once the particles are separated, the company transfers the materials into silos for storage until they're loaded into trucks. In the past, the company used screw conveyors to transfer both particle sizes. As customer demand increased, more material was needed, and it had to be transferred into larger silos, which created a problem.

"We needed to use the warehouse space, so we didn't have room for a big screw conveyor on the floor," says Ed Thomas, process engineer at Premier Magnesia. "Our other option was to put the conveyors on the outside of the building or high up, but that would have made maintenance more labor intensive."

The company questioned whether the larger particles could be pneumatically conveyed without degradation and what feedrate would be feasible. Thomas assumed the −100 mesh MgO would be easier to pneumatically convey because it was less likely to degrade. But he was unsure if dense, semi-dense, or dilute phase would be the best solution for the smaller particle size.

The supplier runs various tests on the supplied material to determine which solutions best fit the application.

"We didn't know the answers," Thomas says, "and to just guess at pneumatic conveying wasn't going to work. You can do all the calculations, but unless you actually do a test, you just don't know."

Searching for the solution

Cyclonaire, York, Neb., provides a variety of pneumatic conveying and dust collecting equipment. The company offers material testing on its equipment at its full-scale test center. The 5,000-square-foot indoor testing facility provides customers with the necessary information to make informed decisions when it comes to the best conveying equipment for their situation.

Premier Magnesia had worked with this equipment supplier on past projects and didn't consider any other suppliers for the new equipment. "They have good engineering, and they're far more interested in getting it technically correct than selling you a piece of equipment," Thomas says.

The supplier's test facility provides long conveying line lengths — up to 1,137 feet — and has conveying line diameters ranging from 2 to 8 inches. Equipment available in the test center includes a bulk bag unloader, hoppers, multiple low-pressure blowers, a high-volume 100-psig compressor, an air management system, filter- receivers, and dust collectors. State-of-the-art controls allow instantaneous and average airflow measurements, cycle times, conveyed weights, and pressure measurements.

The test center allows for testing of dry bulk materials in dilute, semi-dense, and dense phases. Testing can be performed in vacuum, pressure, and combined vacuum-pressure modes. The test center also has an infrared moisture analyzer, recording microscope, and analytic lab scales.

The supplier can design a line configuration to meet each client's target feedrate, air usage, conveying pressure, degradation requirements, and other important parameters. The supplier can set up equipment to simulate transfer to or from railcars, silos, and bulk bags and can even simulate the client's in-plant processing or bulk storage setup.

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A wide range of equipment is available to test how a customer's material reacts in simulated plant conditions.

Characterizing the materials

In early 2014, Premier Magnesia sent 5 tons of each particle size of MgO to the test facility for analysis and testing. Before the testing, the supplier performs computerized material analyses, including an automatic sieve analysis and bulk density, moisture content, and particle surface characterization tests. These tests are important because material characteristics, such as particle size, moisture content, abrasiveness, friability, cohesiveness, toxicity, and static charge are all important factors when considering a pneumatic conveying system.

"You can have an almost identical material, but it might convey differently," Thomas says. "The density, particle shape, and degradation can be completely different. You can't just look it up in a reference book. I think every material should be tested before you go out and buy anything."

Testing the system

After analyzing the magnesium oxide from Premier Magnesia, the supplier determined that a pneumatic conveying system would be an effective solution for the smaller particles and set up equipment in the facility to test this conclusion and determine what variation of the technology would provide the greatest efficiency.

Before the testing started, test center personnel met with Thomas and his colleagues, who had come to watch the tests. "They have a really unique way of starting the equipment testing," Thomas says. "They go through exactly what pneumatic conveying is, what dense and semi-dense phases are, and the advantages of each. We got refreshed before we went out into the test facility to make sure everyone was on the same page from the start."

While you can have the test results sent to you in a report, Thomas emphasizes the importance of observing the equipment in action. "It's a valuable part of any testing that goes on, no matter what the process," Thomas says. "Having someone from the company there to interpret what's happening is crucial. You can read about results, but seeing them with your own eyes is completely different."

The test center has an observation deck where clients can watch the system in action from various angles. "They would show us exactly what they were doing at each stage," Thomas says. "One section of pipe has Plexiglas so you can see the material either going by in surges in dense phase or see it flying by in dilute phase."

Once the testing began, the material was discharged from a bulk bag into the pneumatic conveying system. The material passed through the conveying lines, and was discharged into a filter-receiver, where it was separated from the conveying air. The material then went into a storage hopper and was analyzed again to determine how the system had affected it.

After testing on several different systems, it was apparent that a dilute-phase conveying system would be the most efficient solution for the −100-mesh MgO. "After watching all the tests, it was clear that dilute was going to give us the flowrates we needed," Thomas says.

The supplier also tested the +100-mesh material, running it through a dense-phase system and then a semi-dense-phase system, but both resulted in too much degradation. The material collapsed too easily, creating more −100-mesh particles. Because the material was so fragile, Premier Magnesia decided that a screw conveyor from a different supplier would be necessary for the larger particle size. The mechanical conveying system would require more intensive labor for both installation and maintenance, but the degradation ruled out the possibility of pneumatic conveying.

After testing, the material is analyzed to see how the equipment affected it.

"I already knew going in that the degradation might be prohibitive on the +100 MgO," Thomas says, "but on the −100 MgO, degradation didn't matter. Generating more fines with the smaller particles wasn't going to be a problem."

Installing the equipment

Based on the tests, Premier Magnesia purchased the recommended pneumatic conveying system from the supplier for the -100-mesh MgO. In December 2014, the company installed just over 400 feet of 6-inch conveying line from the screener to the silo. At each turn, the company used a 90-degree elbow with a lazy sweep instead of a sharp turn to maintain air velocity. The company also installed a pressure-release valve and a baghouse on top of the silo.

The system requires 1,500 cfm of airflow and would typically require a 125-horsepower fan. However, due to the plant's high elevation, the blower's motor needed to be oversized to provide the necessary airflow. Along with a 150-horsepower motor, a variable-speed drive was installed to provide a softer start, gradually increasing the drive's speed instead of going from stopped to full speed too quickly.

Within 15 minutes of the equipment's installation, material was being introduced, and the system was up to full speed. Typical material flowrates are between 5 and 8 t/h, but the system was designed to reach flowrates of up to 10 t/h in case of future growth.

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Since its installation, the system has run exactly as planned without any downtime. Premier Magnesia couldn't have been happier with its experience. "Both the production and test facilities were very clean and precise," Thomas says. "It's a first-class operation. They're problem-solvers from the very first run all the way through the process. They have a great history with pneumatic conveying. It was great to work with people like that." **PBE**

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