Test center

Test center proves solids-conveying venturi eductor's capabilities

An equipment supplier's test center shows customers the benefits of using a solids-conveying venturi eductor to feed material into a pneumatic conveying system.

Companies that handle dry bulk solids often use a positive-pressure dilute-phase pneumatic conveying system to transfer a material a long distance between process steps, such as from a hopper to a blender. When using such a conveying system, a rotary airlock (also called a *rotary feeder* or *rotary valve*) typically meters the material into the conveying line and creates a seal that keeps the pressurized conveying air in the system. However, a rotary airlock frequently requires maintenance and can damage material, leak fugitive dust, and cause cross-contamination, all of which can keep a company's operation and maintenance costs high and adversely affect the material's end quality. One way to prevent these problems is to use a venturi eductor rather than a rotary airlock or other feed device to feed the material into the conveying line.

To determine if a venturi eductor will work for a particular material, it's best to work with an experienced equipment supplier with a test center. The test center will conduct conveying tests to determine the optimal system operating parameters and best-suited venturi eductor for conveying the material at the required rate without causing material degradation. One such test center is operated by a venturi eductor supplier at its headquarters near Dover, N.J., about 35 miles west of New York City.

Fox Valve Development Corp. manufactures and supplies a range of venturi eductors, venturi flow controls, and other equipment, including solids-conveying venturi eductors and blower systems for pneumatically conveying powders and bulk solids. The supplier also operates a state-of-the-art test center in its 15,000-square-foot manufacturing and engineering facility for testing its equipment with materials used in the cement, ceramics, glass, food, mining, plastics, building products, and

The equipment supplier's test system helps determine the best-suited solids-conveying venturi eductor for conveying a customer's material.

many other bulk solids industries. The test center conducts material tests with a positive-pressure dilute-phase pneumatic conveying system that uses a solids-conveying venturi eductor to feed material into the conveying line. The tests show a customer how the supplier's eductor can successfully convey a material, from extremely fragile to highly abrasive, at a required rate without damaging the material.

According to Steve Westaway, Fox Valve vice president, a venturi eductor can be used to feed powders, granules, flakes, pellets, and many other bulk solid materials into a pneumatic conveying system at a controlled rate. A venturi eductor is a converging-diverging pipe section with an air inlet, a material inlet, and an air-and-material outlet. In general use, the eductor's air inlet is connected to the conveying system's blower-side conveying line, and the eductor's air outlet is connected to the conveying system's receiving vessel side. The eductor's material inlet is connected to a feed vessel, without the need for any type of feed control valve between the two.

During operation, the blower air enters the eductor through a conical nozzle that accelerates the airflow, creating a vacuum below the eductor's material inlet, which, along with gravity, helps pull the material into the eductor, where it becomes entrained in the airstream. The air-material mixture moves through the eductor's diverging air-and-material outlet and on to the receiving vessel.

"A venturi eductor has no seals, bearings, or other moving parts that material can wear out or that high temperatures can expand, making it ideally suited for handling fine, abrasive, flaky, irregularly shaped, or hot materials at low flowrates," says Westaway. "And since there are no moving parts, the eductor requires no maintenance and doesn't cause material shearing, smearing, or degradation, unlike a rotary airlock or other feed device. Additionally, because an eductor generates a vacuum that pulls in material from the feed vessel, the conveying system's pressurized conveying air won't blow back into the upstream feed vessel and cause bridging, fugitive dust emissions, or other maintenance and housekeeping problems."

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The test system can handle light- to high-density materials from micron size to 1-inch chunks at conveying pressures from 0.5 to 110 psi and conveying rates up to 12,000 lb/h.

The test system

The test center's test system is built on a double-deck mezzanine. A 1-ton-capacity receiving vessel with a cylindrical top bin vent filter is installed on the top deck, and a 1-ton-capacity feed vessel is installed on the middle deck directly below the receiving vessel. The receiving vessel is rated for pressures up to 15 psig and mounted on load cells that are connected to a remote digital scale readout. A slide-gate valve between the two vessels controls the material flow from the receiving vessel to the feed vessel. The feed vessel discharge has another slide-gate valve, which connects to a venturi eductor installed in the pneumatic conveying system's conveying line. The slide-gate valve above the eductor is used to shutoff the material flow into the conveying system, allowing for conveying line purging and facilitating equipment changes. The valve doesn't control the material flowrate into the eductor.

The test center can conduct material tests using 1-, 2-, 3-, or 4-inch-diameter conveying lines with four 10D 90-degree long-sweep bends and can convey material 70, 150, or 220 feet in the 3-inch line and 75 feet in the 1-, 2-, and 4-inch lines.

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A control bench located on the ground floor houses the system's instrumentation and controls, including the scale readout, pressure gauges, temperature gauges, and start and stop controls. A small portable hopper with an eductor is also available for connecting to the conveying lines, allowing a technician to manually feed small material amounts or difficult-flowing materials into the system. If a precise material feedrate into the system is required, the technician can use a portable screw feeder to meter the material into the portable hopper. Both the feed vessel and portable hopper can be fitted with different eductor sizes, depending on the test requirements.

Conducting a material test

A typical test center customer might want to know whether a positive-pressure dilute-phase conveying system with a venturi eductor can gently convey a breakfast cereal product at 100 lb/min through 120 feet of conveying line with four long-sweep bends with minimal breakage or degradation. After contacting the test center, the customer fills out a questionnaire that provides detailed information about the product's characteristics and conveying requirements. The customer sends a material safety data sheet (MSDS) with the material samples, and the test center sets up the test system to best meet the customer's requirements.

In this example test, a technician uses a forklift to place a pallet of test product onto the test system's middle deck near the feed vessel's top loading hatch. The technician then loads the appropriate material amount into the feed vessel, closes the hatch, and starts the system. After the feed vessel's shutoff valve opens, the material is pulled into the eductor at a set rate and conveyed through the conveying line at a low velocity, discharging into the receiving vessel.

Once all the material is in the receiving vessel, the shutoff valve closes, the system shuts down, and the technician disconnects the eductor from the feed vessel. The technician transfers the material into the feed vessel again, places a container below the feed vessel, and discharges the material into the container, which is shipped back to the customer for independent particle analysis and breakage testing. After each test, the test system is thoroughly cleaned to minimize cross-contamination risks.

"It takes us about half a day, from start to finish, to complete a typical battery of tests," says Westaway. "We typically set up the test system the night before so it's ready to go when the customer arrives in the morning to witness the tests, and we welcome them taking pictures and video for their documentation. After completing the tests, we provide them with a report that documents all of the test information, including pipe size, conveying pressure, conveying rate, and recommendations for their system's operating parameters."

The test center

The test center only handles materials rated 0 or 1 on the Hazardous Materials Identification System (HMIS) hazardous material rating scale, which excludes toxic, hazardous, explosive, and flammable materials. The customer can send the material to the test center in containers ranging from small bags up to 2,000-pound bulk bags. The customer can also send extra empty packaging containers for shipping back the tested material.

The test center can handle a range of free- to difficult-flowing materials, from light-density puffed rice and expanded perlite to high-density copper pellets and lead shot, with particles of all shapes ranging from micron size to 1-inch chunks. The supplier maintains an up-to-date database containing the established conveying characteristics of more than 4,000 materials the test center has worked with over the years, so not every customer needs to conduct a conveying test. But even with documented tests, some customers want to see proof that the system can convey their material at the required rate without degradation, says Westaway. "So we'll set up

the test system with the appropriate conveying parameters and venturi eductor to prove to them that using an eductor instead of a rotary airlock creates simpler, more reliable conveying with better end results and lower operating and maintenance costs." **PBE**

Note: Find more information on this topic in articles listed under "Pneumatic conveying" in *Powder and Bulk Engineering*'s Article Index in the December 2012 issue and at *PBE*'s website, www.powderbulk.com, and in books available through the website in the *PBE* Bookstore. You can also purchase copies of past *PBE* articles at www.powderbulk.com.

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