

It's OK to be a little dense when conveying salt

A food manufacturer installs a dense-phase pressure conveying system to prevent problems while conveying salt.

New installation

An international food manufacturer recently expanded one of its existing plants in the Midwest to accommodate a new food production operation. Part of the new operation involves conveying granular salt from a bulk silo to two smaller receiving bins connected to volumetric feeders. The company was dissatisfied with its salt-conveying equipment in other parts of its operations, so it worked with a current equipment supplier to find a solution.

Conveying system problems

The company uses dilute-phase vacuum conveying systems in its other plants to convey salt and other dry ingredients. However, the vacuum conveying systems have caused several problems in the salt-conveying process.

“One of the biggest problems was that the systems’ high air velocities damaged the salt granules and created fines,” says the company’s senior vice

president. “We use volumetric feeders to feed ingredients, including salt, to the downstream production processes, and the fines changed the ingredients’ volumes and bulk densities in the feeders’ hoppers, which adversely affected the amount of ingredients being fed at the established feedrates.”

Since the company couldn’t consistently maintain the amount of ingredients being fed into the downstream production processes, some of the finished products would end up having the wrong amount of a certain ingredient, decreasing the product’s quality.

The salt-conveying lines also had a tendency to plug because the conveying systems’ flowrates were often too low, and the pinch valves that directed the salt from one conveying line to another often failed. When either of these problems occurred, the company had to shut down the conveying system to fix it, which increased maintenance costs. “And because we have to keep a production process running



The granular salt discharges from the Mini-Jet at about 500 fpm and moves through a diverter valve, which directs it into the proper conveying line.

continuously,” says the vice president, “the operators had to manually dump the salt into the feeder hoppers while the conveying system was down.”

The company stored large amounts of bagged salt in its plants, because it knew that a salt-conveying system would eventually fail, and it wanted to be sure there was enough bagged salt in stock to keep a production process going. “However,” says the vice president, “having the operators manually handle the salt bags created unwanted ergonomic issues, and having them open the bags and dump the salt into the hoppers exposed them to salt dust. Another problem is that the bagged salt is more expensive than the bulk salt — so the more bagged salt we used, the more our operation costs increased.”

When planning the midwestern plant’s expansion, the company decided to install a different type of salt-conveying system to avoid these problems.

Conveying system solution

Several years ago, the company had experienced similar problems while

conveying certain other powder ingredients. To find an effective conveying system to handle the powder ingredients, “We conducted an extensive search of powder-handling equipment suppliers and researched each supplier’s capabilities,” says the vice president. “After reviewing the information, we focused on the three most promising suppliers. Of the three suppliers, two proposed using a dense-phase vacuum conveying system, and one proposed using a dense-phase pressure conveying system.”

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The vice president and other company representatives visited each of the suppliers’ facilities and test sites and had each supplier run tests. “We wanted to make sure that each conveying system could move our powder ingredients with little or no degradation, and each successfully



An air injector mounted in the conveying line helps move the salt through the line.



The 1-cubic-foot-capacity Mini-Jet, which is mounted directly beneath the bulk silo, can convey up to 1,000 pounds of salt per hour.

did that,” says the vice president. “We also visited several plants to observe each conveying system operating in actual production conditions, and all three systems performed well. But even though all three systems performed similarly, in the end our decision came down to the fact that we had established a good comfort level with one of the suppliers and its services and equipment, which moved the powder with the least amount of product damage.”

Based on this, the company decided to purchase several dense-phase pressure conveying systems manufactured by Nol-Tec Systems, Lino Lakes, Minn., a supplier of bulk material handling systems, including dense- and dilute-phase pneumatic conveying systems and batching and blending systems. Since then, the company has been successfully using the supplier’s dense-phase pressure conveying systems in its plants to move powder ingredients from bulk silos to smaller receiving bins and hoppers.

Consequently, the vice president says, “We decided to use the same sup-

plier’s dense-phase pressure conveying system to move the salt in the new food production operation in the midwestern plant. It was an easy decision to make, because we knew their system would work.”

The new conveying system

After receiving the conveying system, the company’s maintenance crew installed it in the midwestern plant, and the supplier sent a project manager to program the system and start it up.

The positive-displacement dense-phase pressure conveying system consists of one 1,500-cubic-foot-capacity bulk silo; various pneumatic truck-unloading equipment; one 1-cubic-foot-capacity Type 316 stainless steel Mini-Jet (a pressurizable batch vessel); one model 217 automatic hose switch diverter valve; 370 feet of 2-inch-diameter Type 316 stainless steel schedule 10 conveying line, which forms two 185-foot-long conveying lines; 10 Type 316 stainless steel 90-degree conveying line bends (five bends per line); 12 of the company’s Air Assist units (air injectors — six units per line); and two 3-cubic-foot-capacity receiving bins.

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The conveying system also has three 6-inch-diameter air-operated butterfly valves (one installed in the silo bottom and one installed in each bin bottom); seven capacitance probes; three model 276 aeration valves; six aeration discs; and one Allen-Bradley PLC that controls the entire conveying system and

interfaces with a desktop computer in a central control room.

The conveying system’s dust collection system consists of one model 238 reverse-pulse cartridge-filter dust collector mounted on the bulk silo’s top and two model 317 reverse-pulse cartridge-filter dust collectors, one mounted on each receiving bin’s top.

The salt-conveying operation begins when a truck with a 1,500-pound-capacity pressure tank delivers the salt to the plant. The truck driver connects a pneumatic conveying hose to the tank’s discharge valve and activates its onboard PD blower, which pressurizes the tank and blows the salt from the tank up into the silo top. As the salt fills into the silo, the displaced air and salt dust are pulled into the silo’s dust collector, which filters the salt dust from the air before exhausting the clean air into the plant. At the same time the dust collector is filtering the air, it’s also systematically reverse-pulse cleaning the many rows of filters.

The bulk silo has three capacitance probes (a high-, mid-, and low-level probe) that are mounted inside and that continuously send signals to the PLC. The PLC sends the information to the desktop computer in the central control room, allowing an operator to monitor the salt level inside the silo. After the high-level probe indicates that the silo is full, the operator activates the conveying system and the system begins conveying salt to the two receiving bins.

Each receiving bin has a high- and low-level capacitance probe mounted inside. When the salt level in a bin reaches the low-level probe, the probe signals the PLC, and the PLC switches the diverter valve to the conveying line that feeds the bin. The PLC then opens the butterfly valve in the silo’s bottom cone for about 20 seconds, allowing 1 cubic foot of salt to gravity-discharge into the batch vessel, which is installed directly beneath the silo. To aid material flow from the bulk silo, the supplier in-

stalled three aeration valves in the silo's bottom cone to prevent bridging and ratholing. (The supplier also installed three aeration discs in each receiving bin for the same purpose.)

The PLC then closes the butterfly valve and compressed air flows into the void above the salt and below the valve, pressurizing the batch vessel to about 30 psi. The pressure causes the salt to discharge from the batch vessel's bottom into a short length of conveying line at about 500 fpm and to move in dense phase through the diverter valve into the bin's dedicated conveying line. Once in the conveying line, the salt moves 160 feet horizontally and 25 feet vertically through five 90-degree bends. As the salt discharges into the bin, the bin's dust collector filters the salt dust from the displaced air and exhausts the clean air into the plant.

This process continues until the salt level reaches the receiving bin's high-level probe, which signals the PLC to shut down the conveying system. It takes about two cycles to completely fill a bin, and each cycle takes about 2 minutes. If a bin sends a low-level signal to the PLC while the other bin is being filled, the PLC is programmed to finish filling the first bin and then switch the diverter valve and begin filling the other bin.

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"To prevent material degradation, we leave salt in the conveying line at the end of each cycle to prevent high-velocity air surges that can fracture the salt granules," says Arlen Johnson, Nol-Tec regional sales manager. "This keeps the granular salt intact and al-

lows the company to maintain a consistent feedrate from the volumetric feeders beneath the receiving bins."

Because salt remains in a conveying line after each cycle, the supplier installed six air injectors at strategic points along each conveying line after the diverter valve. At the same time the batch vessel is being pressurized, air flows to the air injectors and into the conveying line to help start moving the salt remaining in the line. The air injectors only function in the active conveying line moving salt to a bin. (The six air injectors in the other line remain inactive.)

The company never has to adjust the PLC's settings. An operator just hits the start button and the conveying system functions automatically based on the salt levels in the bulk silo and receiving bins, conveying up to 1,000 pounds of salt per hour. If the bulk silo's salt level reaches the low-level probe, the PLC will automatically shut down the conveying system and sound an alarm in the control room, alerting the operator that it's time to fill the bulk silo. The company operates the system 24 hours a day, 7 days a week, and typically refills the bulk silo about once every week.

Conveying system success

Since installing the dense-phase pressure conveying system in the mid-western plant, the vice president says, "There's been no conveying system downtime and no maintenance or repair costs. Our product quality has also improved because the salt-conveying system doesn't break down the salt granules, which allows the volumetric feeders to feed the same amount of salt at the established feedrate all the time."

Additionally, the company no longer has to buy as much bagged salt as a backup for the salt-conveying system. "This has helped us reduce operation costs and improve operator ergonomics, because the operators don't have to manually handle salt bags anymore," says the vice president. "Op-

erator safety has also improved because the supplier's dust collectors prevent the plant air from being contaminated with salt dust."

"Overall," says the vice president, "we're very happy with all of the supplier's equipment that we've installed in our various plants, and the salt-conveying system's performance has been very reliable and good for us. In fact, we're currently in the process of expanding two other plants, and we'll be installing the same salt-conveying system in each one." **PBE**

Note: To find other articles on this topic, look under "Pneumatic conveying" in *Powder and Bulk Engineering's* Article Index at www.powderbulk.com or in the December 2005 issue.

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