Case history

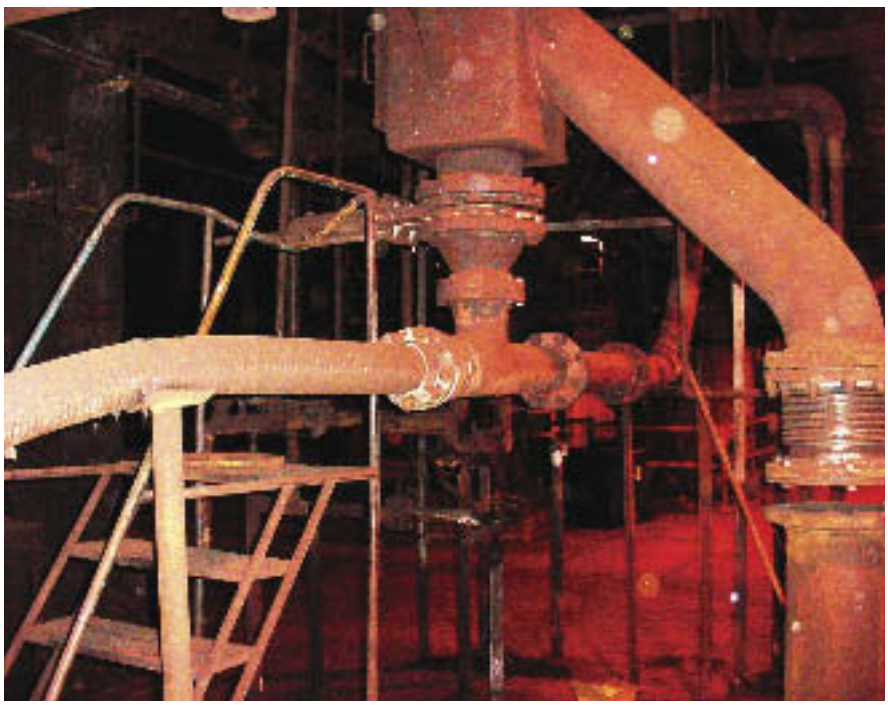
Venturi eductor achieves maintenance victory

A nickel producer replaces a glycol-cooled screw conveyer and rotary airlock with a venturi eductor to successfully convey high-temperature, abrasive dust without constant equipment repairs.

"High maintenance concerns were the biggest driver in getting rid of our old screw conveyor system," says Gary Lederhaus, maintenance section coordinator at Inco Ltd.'s Manitoba Operations. "To process our material at a continuous rate, we needed a highly reliable, low-maintenance system that could handle extremely hot and abrasive materials."

Inco is a worldwide nickel producer. The company's Thompson, Manitoba, operation is a fully integrated nickel production plant with underground mining operations and high-capacity processing facilities. Operators at the Thompson smelter were having problems with a conveying line it was using to cool and convey very hot and abrasive copper calcine dust, a byproduct of nickel processing. The dust was pneumatically conveyed from a roaster operating at about 1,300°F into a sealed feed hopper and then discharged into a hollow-flight, glycol-cooled, twin-screw conveyor. After the material was cooled, it discharged through a rotary airlock into another hopper, where it was then conveyed through a large positive-displacement blower's airstream and into a silo for temporary storage.

The problem was that the equipment required constant maintenance, and equipment failures frequently left production at a standstill. After making several adjustments and replacements, the company knew there had to be a better way to convey the copper calcine dust and began looking at other options. The company needed to quickly and efficiently move 6 to 7 t/h of copper calcine dust through more than 200 feet of piping without exceeding its budget with costly repairs or replacement equipment.



The solids-conveying venturi eductor has three ports: motive, suction, and discharge. The driving air from the main header travels through piping, enters through the motive port, travels through the motive connection, passes through the section chamber, carries the dust through the venturi and more piping, and discharges the dust into a silo.

Constant maintenance triggers concerns

The company was using the screw conveyor because an independent engineering firm had recommended it as a solution to problems the company had been having with a rotary airlock that quickly wore out and needed to be replaced. The rotary airlock and its replacements couldn't withstand the abrasion and high temperatures. The expensive hollow-flight screw conveyor was supposed to cool the dust before it reached the rotary airlock. However, the screw conveyor didn't even last a year.

In addition to the conveyor, the company had to purchase and install pumps, controls, and instrumentation; a new rotary airlock designed to withstand hot abrasive material; a feed hopper; and the blower. Yet, after a mere 9 months in service, the hollow-flight screw conveyor needed a complete overhaul. Plus, the hot abrasive dust had destroyed one rotary airlock every few months. The company estimated that the total cost for repairing and replacing the equipment would be about $180,000 with a 16-week turnaround time. The high overhaul cost coupled with the months of lost production, not to mention the likely future ongoing maintenance costs and the continued risk of failures, prompted the company to start looking for another option.

Company considers equipment alternatives

In early 1999, Brad Waylett, a manufacturers' rep, stopped by the company for a visit. After the operators discussed the situation with him, he mentioned a solution he felt would be a good fit for the company's application. However, this solution involved a technology unfamiliar to most of the plant personnel, and the original engineering firm didn't advocate it. Also, since it was much less expensive than other alternatives, it seemed too good to be true. Regardless, the company decided that even if it didn't work, the downside was very limited in terms of cost and time.

The supplier, Fox Venturi Eductors, a division of Fox Valve Development Corp., Dover, N.J., manufactures and supplies a range of venturi eductors, ejectors, and venturi flow controls for pneumatically conveying free-flowing powders and bulk solids. The supplier

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The venturi eductor has no moving parts, seals, or bearings, eliminating the chance for wear, increasing operator safety, and making it ideal for the company's application.

sent the company a standard data application form to fill out to determine how to customize an eductor for the company's application. The form asked questions regarding the application's material type, particle size range, density, properties, flowrate, and more. From the company's data, the supplier put together a proposal for one of its solids-conveying venturi eductors.

The company was happy with the proposal and ordered one eductor, which took only 4 weeks to deliver. The company installed the eductor with no outside help, but, because the company also installed about 200 feet of piping to bypass the original system, the whole installation process took about 2 weeks. Coincidentally, the installation was done during a shutdown after a catastrophic screw conveyor failure, so the timing was perfect. "Because the supplier precalibrated the system, we didn't have to make any adjustments to the venturi eductor," says Lederhaus. "All we had to do was install the eductor and the extra piping, and we were ready to begin our production process again." The company chose case-hardened Schedule 40 carbon steel construction, although other abrasion-resistant options were available.

Solids-conveying eductor solves dilemma

The new system conveys 6 to 7 t/h of copper calcine dust through 130 horizontal feet and 70 vertical feet of 6-inch-diameter piping. To begin the process, the dust is first roast-dried in a roaster that runs on 6-psi air. "We have a forty-eight-inch main header that supplies air in our facility," says Lederhaus. "We installed a line coming off the main header for the air supply to the eductor, which enabled us to get rid of the air blower and compressor that was on the screw conveyor system." Once the roaster temperature reaches 1,300°F, the roast-dried dust naturally falls down to the roaster's bottom where it's conveyed by the eductor through piping and into the silo.

The Fox solids-conveying venturi eductor has three ports: motive, suction, and discharge. The driving air from the main header blows through piping and enters the motive port. Once there, the air travels through the motive connection, which is a nozzle with a gradually reduced interior diameter. As the air passes through the nozzle's tip along the decreasing diameter, its velocity increases. The high-velocity air then passes through the suction chamber (the void underneath the suction port) and the suction port draws the copper calcine dust into the airstream. The airstream carries the dust through more piping and into the eductor's venturi section, which is another pipe constriction that maximizes the amount of discharge pressure at the discharge port. The venturi eductor regulates the material flow, so no material-metering equipment is required. From there, the dust is conveyed through another section of piping and discharged into the silo for temporary storage.

"Because the venturi eductor has no moving parts, there are no seals or bearings that the abrasive material can wear out or parts that high temperatures can expand," says Steve Westaway, Fox Valve vice president. "This makes the eductor ideal for handling hot, abrasive materials like copper calcine dust." Additionally, the eductor has no maintenance requirements. Operators only have to make sure that it doesn't get plugged with any large material chunks. But if a blockage should occur, they don't have to worry about their safety since there isn't any rotating machinery. Also, the eductor has no blowback, which can cause extreme wear problems when conveying abrasive material. The eductor eliminates product bridging and dust emissions and minimizes material degradation.

Eductor delivers success

Since installing the eductor, the company has seen numerous positive results, and all the problems associated with the old screw conveyor system have been eliminated. "The eductor installation has been a total success," says Lederhaus. "From the moment we began operating it, it has been one-hundred percent reliable and has saved Inco approximately four hundred thousand dollars in total costs." That savings is based on the cost of refurbishing the screw conveyor, months of lost production, the cost of at least three $15,000 rotary airlocks, labor associated with uninstalling and reinstalling equipment, power costs, and shipping costs, all of which the company didn't have to pay out. Savings are also gained because the eductor runs off the plant's virtually free, low-pressure utility air supply, and the flowrate has been fine-tuned so that the entire system is efficient, consuming even less air than first recommended.

Because the system now has no moving parts, it's immeasurably more reliable and safer than the previous system. Says Lederhaus, "We took out a lot of unnecessary equipment from the process line so we could convey the dust straight from the roaster to the eductor. It helped us bypass pretty significant pieces of equipment while still completing the same job and saved us money at the same time. We're very happy with the eductor because it solved our initial concern of high maintenance costs. We currently have two eductors in operation, and we're installing two more within the next year for an upcoming project." **PBE**

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