VOL. 35, NO. 8

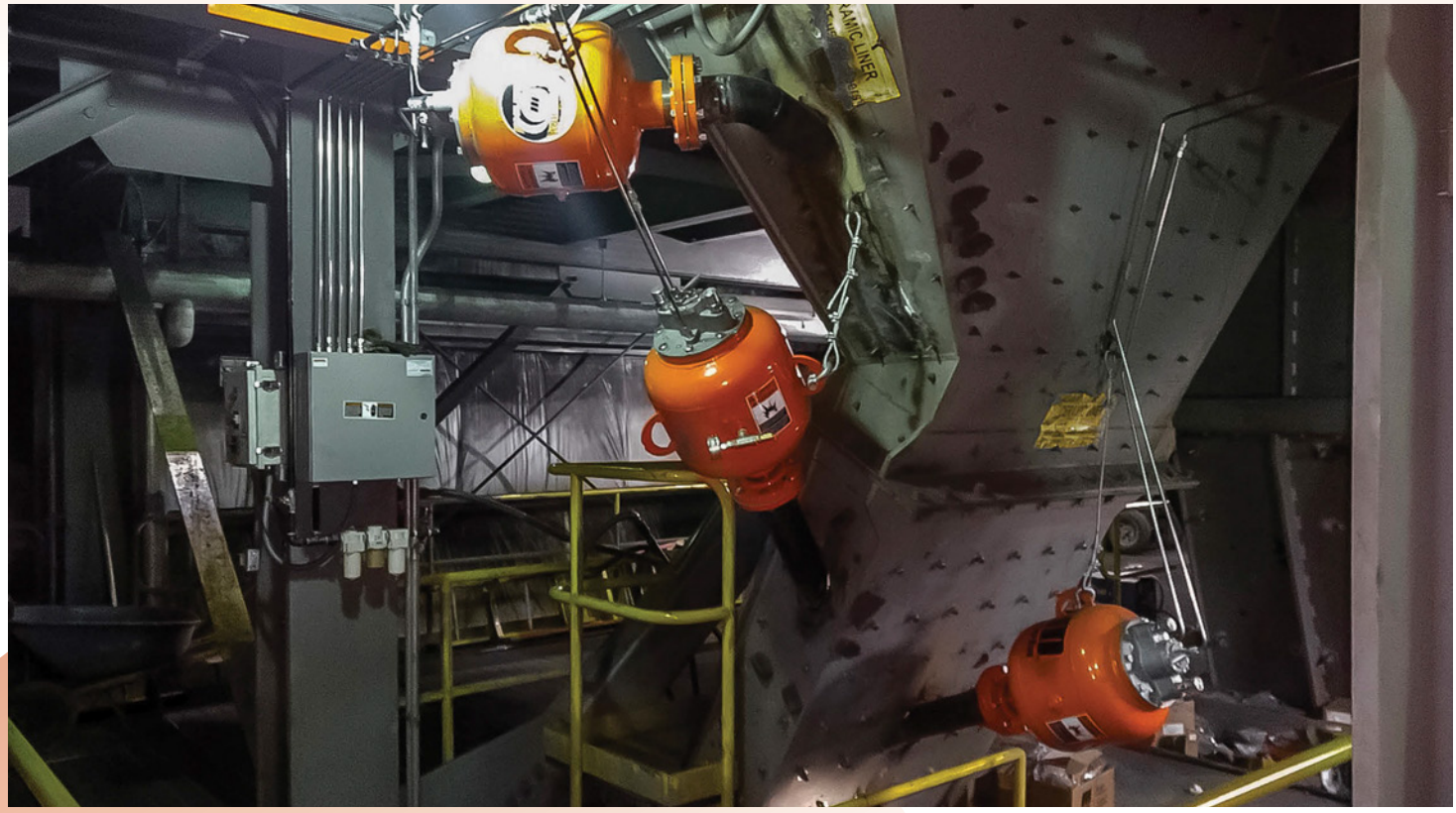
OCTOBER 2022

EFFICIENT PLANT

OPTIMIZING MANUFACTURING SYSTEMS

Cybersecurity

efficientplantmag.com



Air Cannons Drive Material Flow

Buildup clogging an ore-crushing process line is cleared using a compressed-air system.

LUNDIN MINING'S EAGLE Mine in Michigan's Upper Peninsula is the only primary nickel mine in the United States, producing 1.5% of the world's nickel. Using a bench-and-fill stoping process, the company extracts approximately 2,200 st/pd from the underground nickel-copper mine and transports it to the Humboldt Mill. A former iron-ore processing plant, the Humboldt facility's three-stage crushing circuit reduces the material to 3/8 in.-minus, then a single-stage ball mill grinds it further to sand, where it is mixed into a slurry.

To liberate the nickel and other minerals from the waste materials, a refining process of selective flotation is used. During the crushing process, a mesh screen separates the fines from the remaining aggregate, which is fed back through the process. Fines that pass through a screen fall into a wide-mouthed hopper, leading to a chute that narrows to approximately 8-ft. wide by 2-ft. high and, after a dead drop of several feet, slopes abruptly in about a 45-deg. angle of decline. This slope slows the material descent for a low impact and centered discharge onto a conveyor belt leading to the ore bins. Material buildup began at the hopper and at the discharge slope, but could also occur at virtually any point, blocking the chute.

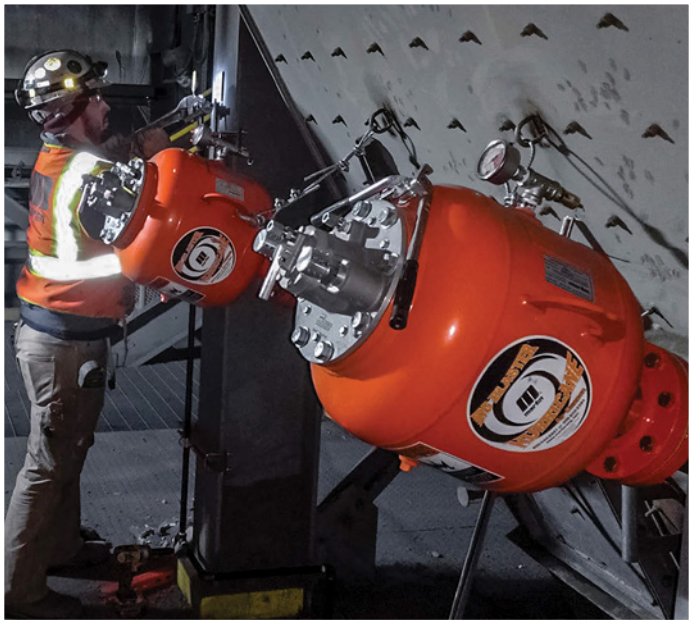
CLOGS AND DOWNTIME

Accumulation would stop the entire crushing process approximately three to four times each shift for as long as an hour, blocking input of material all the way back to the ore storage area. Workers attacked the clog with 15-ft.-

Opposite. Strategically positioned at a 30-deg. angle, the cannons keep material flowing. *Photos courtesy Martin Engineering*

Right. Eagle Mine strives to have the smallest environmental footprint possible.

Below. A single worker can perform maintenance on outward-facing valves, reducing potential risk.



long air lances from the top of the hopper and bottom of the chute. The method used a tremendous amount of compressed air and diverted manpower from other essential duties. Moreover, air lances caused excessive backsplash of wet material, which was extremely messy and potentially hazardous.

Eagle first installed a polymer lining in the chute. When that proved inadequate, operators attached pneumatic vibrators to the vessel wall. Unfortunately, the polymer lining was bolted to the vessel, which caused it to dampen vibration of the units, limiting the force to only the impact zone and not much farther.

"We were forced to default back to air lances, but kept looking for a better solution," said Ted Lakomowski, Lead Reliability Technician at Eagle Mine. He advocated for the initial installation of five 9.25-gal. (35 L) Hurricane air cannons, manufactured by Martin Engineering, Neponset, IL (martin-eng.com), followed by two more positioned in essential spots in the chute. One unit was placed in the area where material discharged into the hopper. Two others were positioned at the hopper slope, where maximum accumulation was observed, and two more were placed along the drop chute. All the tanks were accompanied by a 4-in. pipe assembly ending in fan-jet nozzles.

Offering more force output than designs double their size, with considerably less air consumption, the compact air-cannon tanks measure only 16 in. dia., 24.92 in. long, weighing 78 lb. each. The units fire a shot of 120-psi air through the pipe assembly to the fan-jet nozzle. The nozzle spreads the air stream 12 in. at the exit point, distributing the blast pattern across the wall surface.

The cannons operate on a firing schedule of every 1 to 10 min., adjusted for production volume, time of year, and moisture level. The seven-cannon configuration effectively reduced clogging issues, cut downtime, significantly lowered the risk to operators, and reduced the cost of operation.

"When I did the cost assessment, I was surprised to discover that there was a 1,000% compressed-air savings in using the air cannons over the air lances," Lakomowski said. "It's a significantly lower effect on our system than initially predicted, and managers are very happy about that."

The project also improved safety, as workers no longer spent time using air lances or creating vibration by hammering on the vessel walls. Because they're able to service valves and other wear parts outside the cannons without tank removal, upkeep can be safely performed by a single technician with no heavy lifting involved.

"Just from a safety aspect, this solution has paid for itself," Lakomowski concluded. "The Martin Engineering team was easy to work with and they were cognizant of our budget restrictions. Overall, this was a successful project." **EP**

For more information, visit martin-eng.com.