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Preventing Clogs and Excessive Wear in Chutes and Transfer Points

Strategically positioned at a 30º angle, a series of Martin Engineering air cannons keep material flowing at a Michigan nickel mine previously plagued by chute blockages. When needed, a single worker can perform maintenance on the cannons' outward facing valves, reducing downtime and potential risk.

Two well-known suppliers of components and systems for bulk handling of minerals recently offered useful examples of technologies available to improve material flow in chutes.

Martin Engineering reported that it installed air cannons in a chute carrying damp fines through the refining process at Lundin Mining's Eagle mine in Michigan's Upper Peninsula. The air cannons mitigated blockages and facilitated the movement of material. The result was improved safety, reduced labor, greater production, and less downtime, according to the company.

The Eagle underground mine is the only primary nickel operation in the United States, producing 1.5% of the world's total Ni production. Ore is stored in a covered coarse stockpile facility prior to transport 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.

Selective flotation is used to liberate the nickel and other minerals from the waste materials. During the crushing process, a mesh screen separates the fines from the remaining aggregate, which are 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 (2.5 m) wide by 2 ft (0.6 m) high and, after a dead drop of several feet, slopes abruptly in a ~45º angle of decline. This slope slows the descent of the fine material 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.

Accumulation would stop the entire crushing process approximately 3-4 times per shift for up to an hour, blocking input of material all the way back to the ore storage area. Workers attacked clogs with 15-ft-long (4.5-m) 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 splash-back of wet material, which was extremely messy and potentially hazardous.

Eagle first installed a polymer lining in the chute. Offering a low coefficient of friction, the lining was bolted to the chute wall and acted like a smooth slide for the material to ride down. Less effective against the adherent qualities of the material than hoped, Eagle next installed pneumatic vibrators onto the vessel wall, intended to agitate the adhered material and promote its descent down the chute slope. But the polymer lining bolted to the vessel dampened the 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 on looking for a better solution," Ted Lakomowski, Lead reliability technician at Eagle mine, explained. A solution recommended by Martin involved initial installation of five 35L (9.25 gallon) Martin Hurricane air cannons, followed by two more placed in essential spots in the chute. One was placed at the area where material discharged into the hopper, two others were positioned at the hopper slope where the most accumulation was observed and two more were located along the drop chute.

The air cannons are compact, according to Martin – their tanks are just 16 in. (406 mm) in diameter and 24.92 in. (633 mm) long, weighing 78 lb (35 kg) each. They fire a shot of air at up to 120 psi (8.27 bar) through the pipe assembly to a fan jet nozzle. The nozzle spreads the air stream 12 in. (304 mm) at the exit point, distributing the blast pattern across the surface of the wall.

Firing on a schedule of every 1-10 minutes, adjusted as needed to accommodate factors such as production volume, time of year and moisture level, the seven-cannon configuration reduced clogging issues and downtime. This 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 one-thousand percent 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."

Material Control is Key in Transfer Points

Mill feed transfer points and scrubber feed chutes are traditionally considered high-wear, high-maintenance installations. However, Alwin Nienaber, technical director at Weba Chute Systems, recently noted that by engineering the transfer point to ensure the correct control of material feed into the mill or scrubber, wear and tear – and probably maintenance – can be significantly reduced.

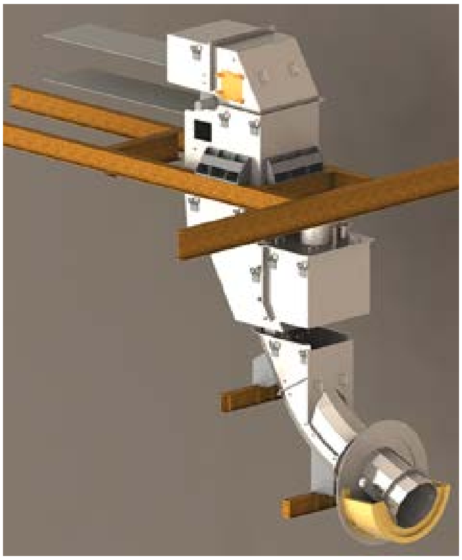
Nienaber said the transfer point into the mill or scrubber is critical, with problems often arising due to the nature of this application. "This area of the plant is subjected to high velocity, which can cause excessive wear and tear and is linked directly to the speed of material being transferred through the chute."

Large quantities of water required for the milling process are fed with the material into a mill or scrubber chute. In ball mill applications, steel balls are also fed through the chute into the mill itself. Traditionally, mills are lined with either cast high chrome, manganese or rubber liners, and even though mill feed chutes may have similar lining materials applied, these are not always sufficiently robust to counter the excessive wear caused by uncontrolled discharge of materials.

"Another challenge in this application is the interface between the stationary chute and the rotating mill," Nienaber said. "Uncontrolled discharge of bulk materials and water will escalate the cost of maintenance, and could result in other related problems, all of which could add up to unnecessary expenditure and added aggravations for the engineers concerned.

"By leveraging the Weba Cascade Chute design we can ensure the most appropriate configuration in the head section of the chute and achieve full control of the material with a significant reduction in wear," he explained.

According to Weba, the chute's design allows customers to limit the impact into the lined feed spout section where water is introduced through a separate flood box. By controlling the product flow in the Weba chute, users can significantly reduce the high wear rates traditionally experienced in a mill feed spout. This will result in a reduction in the associated costs related to transfer points.



3-D rendering of a custom Weba Systems chute.