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Taking on the cement challenge

how to cope with this hard-to-handle cargo

Powered by the Roll Gen, a sensor detects material on the belt and communicates with control systems.

Louise Dodds-Ely

Cement plant solves remote conveyor issues using power generation technology

Engineered to operate at high speeds and over considerable distances, conveyors are generally designed with electrical power only at essential locations such as the head pulley, without secondary access for sensors, lights, accessories or other devices, *writes Dave Mueller, Senior Product Specialist at Martin Engineering.* Running auxiliary power can be complicated and costly, requiring transformers, conduits, junction boxes and oversized cables to accommodate the inevitable voltage drop over long runs.

That was the challenge on the outdoor conveyor located between the limestone crusher and stack-out conveyor at the Illinois Cement Plant in LaSalle, Illinois. Operators needed a power solution that was easy to install and maintain, but provided enough current to drive an automated dust-suppression system, a pneumatic belt cleaner tensioner and the air cannon equipment being implemented there. The goal was to curb fugitive dust and spillage, increasing cargo flow efficiency and minimizing labour costs for cleaning and maintenance.

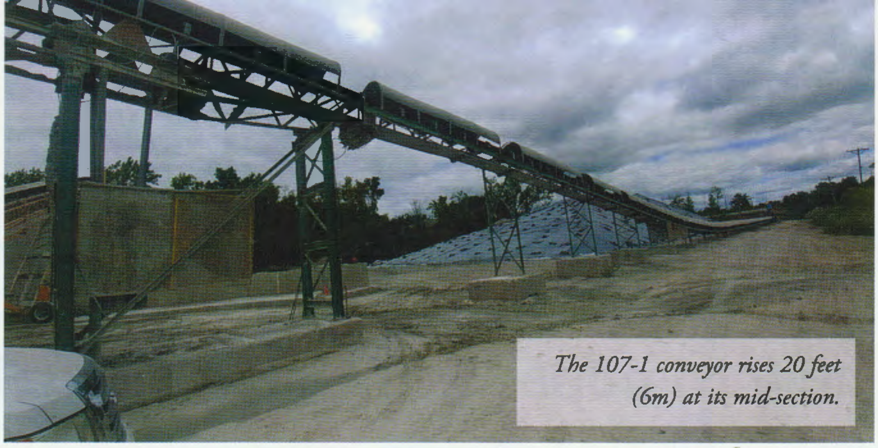
"Running a line from the breaker was more of an investment than we wanted to make without knowing how successful the material control efforts would be," explained Maintenance Planner Brian Brandner. "But when Martin Engineering technicians proposed that they use their Roll Generator to power the new equipment, we were sceptical, because we'd never seen anything like it."

The long ride

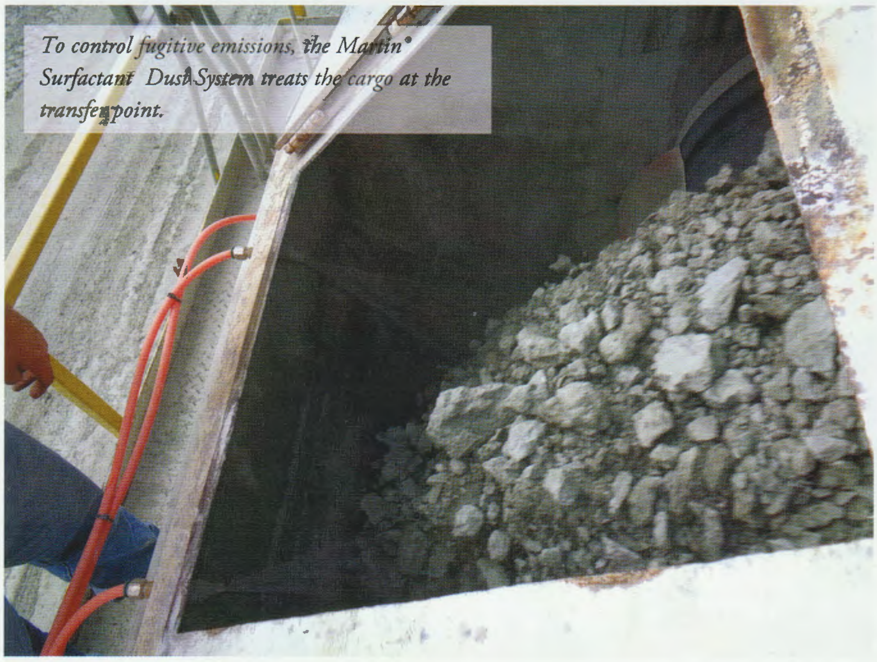
Coming from a quarry six miles (9.7km) away, trucks haul ~20 tons (~18 metric tonnes) of raw limestone per load and drop it into a hopper leading to the crusher, which reduces the rock to 4-inch minus (102mm). The crusher deposits the aggregate onto the 164 foot long (50 m) #153 conveyor that transfers it to #107-1, which is fitted with a baghouse dust collection system at the transfer point.

It is the longest outdoor conveyor system on the site, running 600 feet (182m) and discharging either onto the #107-2 stack-out conveyor or the 250-foot-long (75m) belt leading directly into the plant, based upon immediate production needs. The #107-1 conveyor is a 30-inch-wide (762mm) mechanically-spliced belt with a 35° trough that travels at 400fpm (2mps), conveying nearly 300stph [short tons per hour] st/h (272mtph [metric tonnes per hour]) of limestone.

The belt is protected from the weather by a corrugated pipe dome leading from the loading zone along the entire length of the belt, with the exception of the discharge zone at the head pulley. The LaSalle area experiences four distinct seasons, including freezing winters, hot dry summers and rain in between. This means cargo arriving from the quarry can be either wet, dry and dusty or anything in between. The changing conditions present challenges throughout the entire conveying system.



The 107-1 conveyor rises 20 feet (6m) at its mid-section.



To control fugitive emissions, the Martin® Surfactant Dust System treats the cargo at the transfer point.

"After it's crushed, dry limestone increases the potential for fugitive dust during several months out of the year, so we already have a highly efficient dust collection system in place," said Brandner. "The issue is that the filter cartridges plug quickly, due to the moisture, and they are costly to maintain and replace."

Different weather conditions also trigger various types of carryback, and cleanup was labour-intensive. Dry fines adhered due to cargo pressure and dislodged from the return side of the belt, leading to accumulation around the discharge zone. In humid conditions, wet carryback would adhere to the surface and lodge in cracks in the belt, allowing it to travel and spill material along the entire conveyor path as far as the tail pulley.

"The primary cleaner blades we had in place wore quickly, causing spillage that required us to take personnel from other areas to clean the build-up," Brandner explained.

"We were out there cleaning or adjusting the tension to minimize spillage a few times a week. Cleaning would intensify, depending on the material being conveyed or the weather conditions during operation. When it got really cold, we wouldn't have as many issues with dust or carryback, but the frost accumulation required us to keep the belt running at all times, which lowered the blade life and caused undue wear on the belt."

Automation with on-site power generation

Having had a positive ongoing relationship with Martin Engineering for several years, managers at Illinois Cement invited a team to examine the issues on the 107-1 conveyor and offer solutions. Performing a Walk the Belt™ procedure, which assesses every aspect of the system from performance to safety, technicians offered a two-phase plan.

Phase one involved placing a 'smart' dust-suppression system at the transfer point between the 153 and 107-1 conveyors. Phase two included an automated, pneumatically-tensioned belt cleaner and air cannon system at 107-1's discharge zone. Both components are powered by the Martin® Roll Gen™ System.

"It's designed to be a self-contained mini power station that's retrofitted onto existing idler support structures, so the generator can be employed on virtually any steel roller," said Andrew Timmerman, Product Development Engineer at Martin Engineering. "As conveyors move toward more sustainable and autonomous 'smart

The Roll Gen System uses the movement of the belt to produce localized power.

systems,' the Roll Gen eliminates the power accessibility obstacles to employing sensors, cleaners and dust control systems such as we installed for Illinois Cement."

The unit employs a magnetic coupling that attaches a 'drive dog' to the end of an existing roller, matching the outside diameter of the generator to that of the idler. Rotated by the movement of the belt, the drive dog engages the generator through the outer housing's machined drive tabs. The magnetic attachment ensures that electrical or mechanical overload does not force the roll to stop; instead, the magnets disengage from the roll face. By placing the generator outside the material path, the Roll Gen avoids the damaging effects of heavy loads and fugitive material.

Addressing dust

To manage the dust, technicians installed a Martin® Surfactant Dust System at the transfer point between 153 and 170-1 to deliver a chemically-enhanced water spray as a topical treatment for material at the point of emission. Triggered by a sensor as soon as the load enters the transfer point, the system supports dust mitigation measures already in place to minimize the labour needed for maintenance and replacement of the dust collector cartridges.

Powered by the Roll Gen, the automated control panel features a manual shutdown on its face, as well as a material sensor that can be adjusted to fine-tune the system's sensitivity and duration of spray. The pump box houses the water intake hose, dosing pump and booster pump. To maximize the effectiveness of the surfactant additive, specialized nozzles evenly distribute the engineered spray, delivering full coverage and shutting off when material is no longer present.

"All of the components are industrial-rated to ensure that they can withstand long operational periods in punishing environments," Timmerman said. "An automated system defeats its purpose if it frequently needs maintenance, so the control panel carries a NEMA 4 rating to protect the inner workings from the outside elements."

Cleaning the belt

Close to the mid-point of the system, conveyor 107-1 begins a gradual 20-foot (6m) rise and discharges into the transfer chute leading either to the stack-out conveyor feeding the storage area or the main conveyor entering the plant. At that transfer point, technicians installed a Martin® QC1™ Primary Cleaner XHD (extra heavy duty) tensioned with an Automated Blade System (ABS).

Built for demanding applications in varying

The Roll Gen (top right), air cannon (middle) and solenoid control box.

observed that the decreased spillage resulted in a proportional increase in fines discharged down the transfer chute. Exposed to the outside environment, the chute began to form significant buildup along the sides, at the diverter gate and on the internal shelf meant to slow the flow of material. The technicians had a solution to this unexpected result, and to mitigate the buildup, they installed a Martin® Hurricane Air Cannon.

The 70-litre (18.5 gallon) tank is attached to the chute wall by a straight pipe assembly, fed by the plant's existing compressed air system. Firing a blast of air

environments like those found at Illinois Cement, the QC1 XHD can withstand temperatures from –30°F (–34°C) to 300°F (148°C). Handling belt speeds of up to 1,200fpm (6.1m/s), the patented blade design maintains a tight edge against the belt, while passing smoothly over the mechanical splice to deliver reliable cleaning across all stages of the blade's life.

Connected to a small 24V DC air compressor and a control panel powered by the Roll Gen, the ABS pneumatic tensioner delivers precise monitoring and tensioning to reduce the labor typically required to maintain optimum blade pressure through manual adjustment. Equipped with sensors to confirm when the belt is running empty, the system automatically backs the blade away, minimizing unnecessary wear to both the belt and cleaner. Upon detection of an empty belt, the system is set to run for one full belt rotation (about three minutes) to clean the surface thoroughly before pulling away. The result is consistently correct blade tension with reduced power demand on start-up, all managed without operator intervention.

"The new cleaner has been a game changer when it comes to the amount of maintenance, equipment wear and manpower for cleanup," Brandner pointed out. "The blade's no longer just scraping an empty belt, which has extended the blade's operational life and been a lot easier on the belt face and splice."

Timmerman said that after the new systems were implemented, operators reported a 75–80% reduction in carry-back. "Decreased spillage means less cleanup, but it also had another outcome," he said.

Transfer chute flow

While monitoring the results of the installation, Martin Engineering technicians

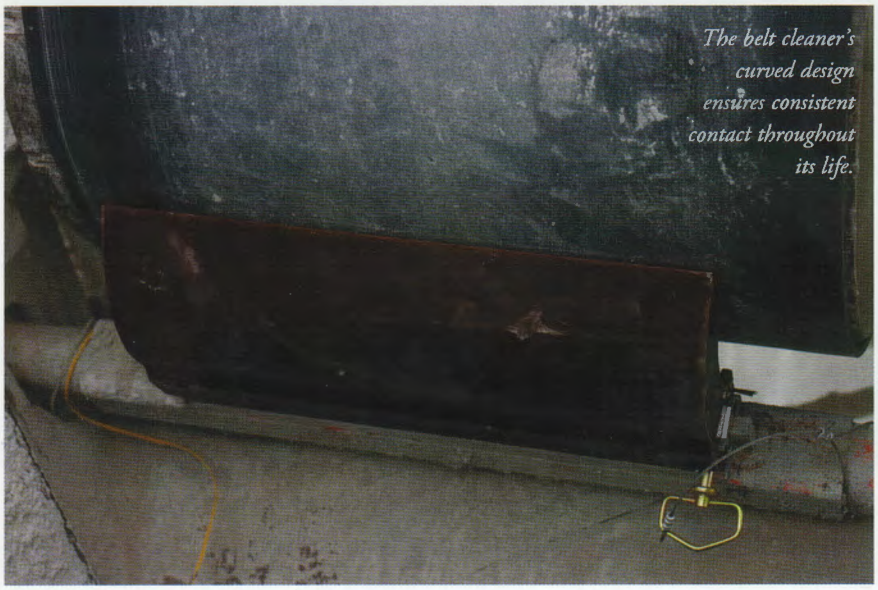
The 70-L Hurricane Air Cannon features a fan jet nozzle for wide coverage.

at up to 120PSI (8.27BAR) from a pressurized tank through a 12-inch (305mm) fan jet nozzle, the air stream is shot at a downward angle of approximately 225° across the surface of the shelf and down the wall. With an effective area of up to 22.6ft³ (640 L), the air blast mitigates material buildup and promotes cargo flow.

To eliminate the risk of unintentional firing due to drops in pressure, the air cannon's valve requires a positive signal from the solenoid in the form of an air pulse to trigger discharge. Engineered to fire only when the belt is running and loaded, the system eliminates wasted air from firing when there's no cargo on the belt or when the conveyor is idle. The control panel is powered by the same Roll Gen as the ABS, while also giving operators the ability to fire the cannon from ground level.

"When there's cargo flowing, the cannon fires about every ten minutes, which keeps fines from clinging to the walls and promotes proper flow," Brandner said. "If the material is extra wet and building up faster than usual, we can just go over and fire it manually at any time."


The Automated Blade System eliminates the need for manual blade tensioning.


The belt cleaner's curved design ensures consistent contact throughout its life.

Results

After several months of operation, with some minor adjustments, the automated equipment has exceeded performance expectations. This includes the effectiveness of the Roll Gen system, which has delivered consistent power to the necessary systems.

"We've been closely monitoring performance and found little to no degradation in energy output so far," Timmerman pointed out. "Neither unit has required maintenance, and wear on the equipment has been minimal. "

The use of multiple technologies working in tandem to control material flow and prevent fugitive particles has dramatically improved the material handling system's efficiency. The modifications have helped Illinois Cement reduce labour and equipment expenses, considerably cutting the manpower needed to clean spillage along the conveyor path. The result is a cleaner, safer and more productive operation.

"The entire project has been a success, particularly in how many man-hours we save in maintenance and upkeep," Brandner concluded. "The tensioning system does a great job, and the Roll Gen puts out enough power that we're considering adding an automated secondary cleaner and a vibrating dribble chute to capture even more carryback. We're looking forward to working with the Martin Engineering team in the future."

Martin Engineering is a global innovator in the bulk material handling industry, developing new solutions to common problems and participating in industry organizations to improve safety and productivity. The company's series of *Foundations* books is an internationally-recognized resource for safety, maintenance and operations training — with more than 10,000 print copies in circulation around the world. The entire 500+ page volumes can also be downloaded as free PDFs from the Martin website. Martin employees take an active part in ASME, SME, VDI, CMA and CEMA, and the firm played a pivotal role in writing and producing the 7th edition of the CEMA reference book, *Belt Conveyors for Bulk Materials*.

Martin Engineering products, sales, service and training are available from factory-owned business units in Australia, Brazil, China, Columbia, France, Germany, India, Indonesia, Italy, Mexico, Peru, Russia, Spain, South Africa, Turkey and the UK.


The control panel enclosure carries a NEMA-4 rating to withstand the elements.