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International Cement review

A key position

Material build-ups can lead to several issues, including 'snowman' formation in the cooler, resulting in higher fuel consumption. The use of air cannons is one way to reduce the likelihood of snowmen, but sometimes the issue persists. In this case, a repositioning of air cannons can provide the much-needed solution.

■ *by **Brad Pronschinske**, Martin Engineering, USA*

Consistent material flow is an essential part of the cement production process. Each step, from the introduction of raw materials to the loading of the final product for transport, has unique issues. A common problem occurs where clinker discharges from the kiln and falls into the clinker cooler. Chunky material tends to cling to the static cooler grates and/or cooler curbs, building upon itself and eventually creating a super-heated formation known as a 'snowman'.

These material build-ups lead to inefficient operation as they restrict air flow from the cooler to the kiln, damaging the kiln discharge seal and creating what is known as 'false air', which cools the burning zone. As a result, the higher fuel consumption required raises operational costs of the cement plant. Moreover, build-ups can damage the kiln's nose casting, bull nose refractory or even completely choke off clinker flow from the cooler to the kiln, leading to unscheduled downtime.

To remedy this phenomenon, air cannons are often used, but if they experience clogging from backflow – or if they are operating in an environment that is too hot to properly maintain them – accumulations are still likely to form. This issue troubles cement producers all over the world, including HeidelbergCement's Lehigh Hanson cement plant, located in central Alabama, USA.

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> ***Mike Schutt, production manager at Lehigh Hanson***

In operation since 1905, HeidelbergCement's Lehigh Hanson cement plant is the oldest continuously-operating cement producer in Alabama, USA

Cooler concerns

Built in 1905, the Lehigh-Hanson facility is the oldest continuously-operating cement plant in the state. Making Type I/II Portland cement, ASTM C595, and Type N & S masonry, the plant produces a total of 800,000tpa (882,00stpa).

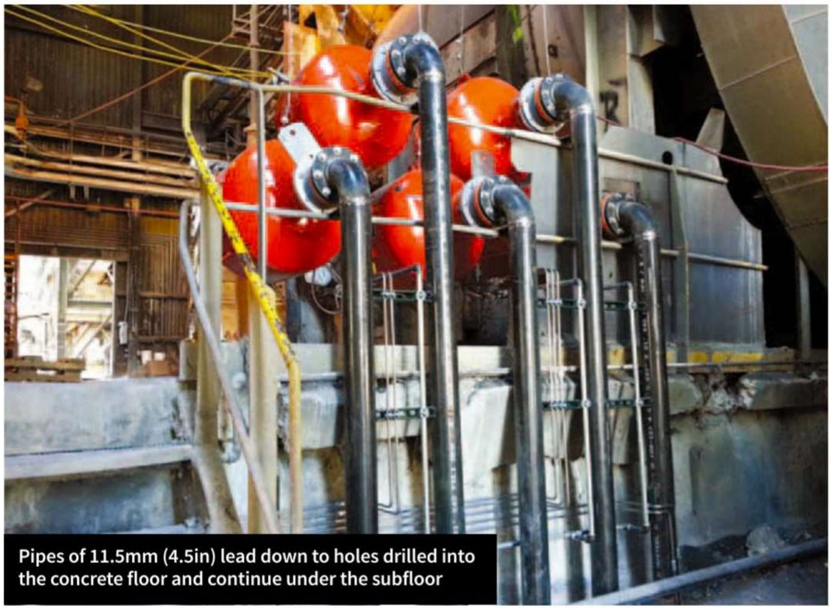
With a 24h production schedule, 160tph (175stph) of raw material is passed through the kiln, reaching a minimum of 1482˚C (2700˚F), while the flame temperature at the kiln outlet reaches 1900˚C (3500˚F). The viscous semi-molten clinker discharges into the cooler onto a sloped static grate and flows to a moving grate system that keeps the cooling material progressing toward the breaker and clinker storage.

Snowmen were forming at the discharge point when the river of material came into contact with the static grate, causing the solid clinker to adhere to the surface and begin to build upon itself. Reaching up to 6m (20ft) tall in as little as a single shift, the build-up could stretch back into the kiln and cause serious issues, resulting in excessive downtime and an increased cost of operation. "Our cannons were located close to cooler walls where the ambient conditions were very hot and dusty, making it difficult to keep the equipment functioning reliably," explained Mike Schutt, Lehigh Hanson production manager.

"Damage to the kiln seal raises our operating costs, but if there is significant damage to the nose casting or cooler bull nose, we are forced to shut down the entire system and rebuild the refractory, which means days of lost production," he contined. "It seemed practical at the time to place our air cannons next to the cooler hot wall where the kiln discharges, but the environment made it nearly impossible to do maintenance on them, which increased the chance of eventual build-up. It was not a sustainable situation."

When prevention creates more problems

To prevent such accumulation, many plants install air cannons, also known as 'air blasters'. Connected to the plant's compressed air system, the cannons deliver a powerful shot of air to break up accumulation and prevent build-up, ensuring that the material flows through the cooler.



Pipes of 11.5mm (4.5in) lead down to holes drilled into the concrete floor and continue under the subfloor

Lehigh Hanson's first solution had five cannons with standard OEM piping leading directly to problem areas on what operators dubbed the 'hot wall', which was located right next to the hottest part of the cooler. The area has an average sustained temperature of 65-74˚C (150-165˚F) , which makes maintenance during operation impossible. Even during short downtime events for emergency repairs, high-heat personal protection suits were still required.

"The configuration of our blasters was pretty standard but allowed too much backflow into the pipes and cannons," said Mr Schutt. "It became burdensome to maintain." Fine particulates from discharged clinker would migrate up the air cannon discharge pipe. Clinker dust would also settle within the cannon tank, reducing the tank's capacity and decreasing the power and effectiveness of the shot.

According to the production manager, the company attempted to improve operation by testing a different configuration. Technicians removed the five cannons and straight-pipe arrangement to replace it with a massive single tank with five pipe outlets. Unfortunately, this solution had several flaws, eventually forcing operators to monitor the cooler system closely through cameras.

"The system broke down so often, we finally just had to leave it and monitor the material build-up until the very last minute, then shut down the system for maintenance," Mr Schutt said. "This allowed us to get the most production possible, but it caused at least a day of unscheduled downtime a few times per year."

Rethinking cooler build-up

To help find a solution Lehigh Hanson brought in Martin Engineering Product Specialist, Mike Masterson. The expectations for the project required the system to:

- be highly reliable and accessible
- prevent material build-up within the cooler
- withstand a 24/7 production schedule
- reduce or eliminate backflow
- be safely maintained with minimal exposure to heat
- decrease the amount of unscheduled downtime
- reduce the incidence of equipment failure.

The new air cannon configuration was introduced in response to the plant's specific layout and operating conditions. "We worked closely with the contractor to finalise the design and implement the plan," said Mr Masterson. "It is exciting to be part of a new solution."

Completed over a week by a team of four during scheduled plant downtime, the design relocated the cannons away from the discharge area and onto to a preexisting elevated platform several metres away. Five cannons were connected to five U-shaped pipes that curved 90˚ from the cannon, ran vertically 3m (10ft) down and through holes drilled into the concrete floor of the plant's cooler maintenance platform. They then curved 90˚ again and travelled horizontally for 6m (20ft) under the platform to the kiln's discharge area, where they split toward different entry ports for maximum coverage.

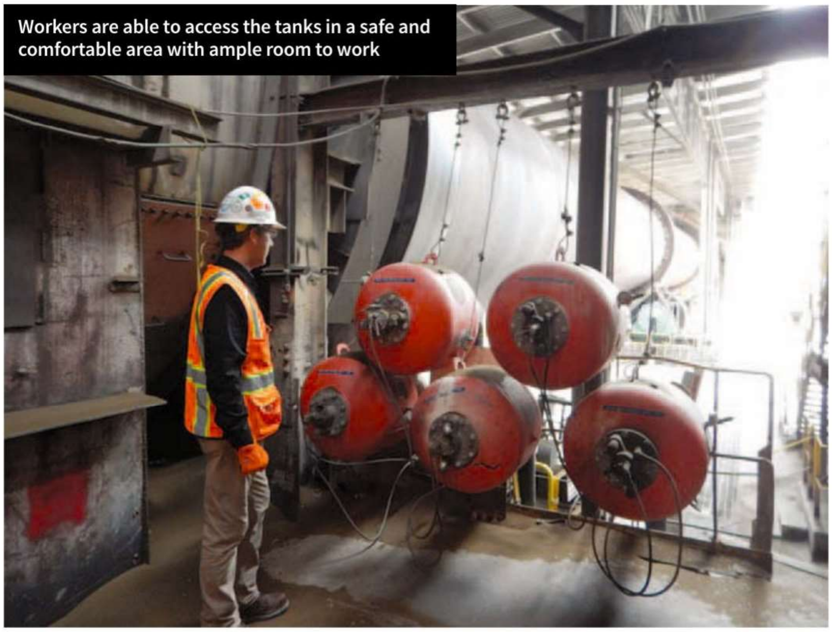
Being located well away from the hot wall and the kiln's discharge zone allows the cannons to be serviced without the special personal protection suits needed for hot areas. The U-shaped pipe directs the powerful shot of air and limits the amount of potential backflow. Any fines entering the pipe are obstructed by the curvature, the distance and the long vertical climb needed to reach the cannon.

Packing a punch

The biggest challenge for the design was the distance the air had to travel before entering the chamber. The longer the distance, the more the air would lose velocity and thus deplete the effectiveness of the shot once it reached the chamber. The solution to this issue was installing larger individual cannons using a positive firing solenoid valve.

"Previously, the cannons could be relatively small, because they were closer to the cooler," said Mr Masterson. "But since the air now has to travel further, we installed powerful 150l air cannons. They hold an enormous capacity and deliver enough pressure to carry the air all the way down the pipe system and still pack a serious punch at the end."

Connected to the existing compressed


Workers are able to access the tanks in a safe and comfortable area with ample room to work

"Since the installation, we have had a significant reduction in downtime due to snowman formation."

air system and weighing approximately 59kg (130lbs) each, the Martin cannons supply more force output with less air consumption at half the size of other designs. Each unit fires a shot of air at up to 8.27bar (120psi) from a pressurised tank through the long pipes and spreads the airstream across the area of build-up.

Linked to the plant's logistical software in the central control room, the cannons are set on a 10-minute firing cycle with one discharging every other minute. To prevent unintentional firing due to drops in pressure, which can throw off the sequence and diminish the effectiveness of the system, the cannons are equipped with positive-acting valves. To trigger discharge, a signal from the solenoid is required in the form of an air pulse. Able to be located up to 60m (200ft) away from the cannons, the solenoid panel also allows operators to fire manually if needed.

Maintenance made easy

Though the valves at Lehigh Hanson have not yet needed replacing, they do require periodic maintenance and inspection. Previously, workers donned hot suits and protective gear to enter the area where the cannons resided and they were required to remove the entire cannon from the manifold for valve service. Reported to have been one of the most unpleasant projects in the plant, at least two workers were needed to perform the maintenance and, due to the heat, they were only able to remain in the area for about five minutes at a time.

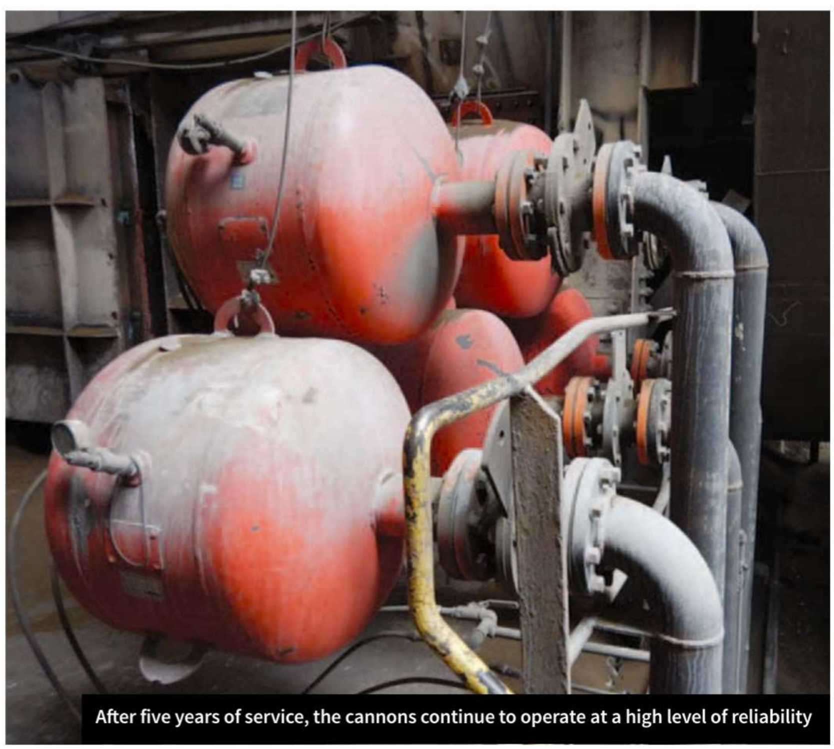
In contrast, the new valve design faces outward, opposite the pipe end, and is serviced without removing the tank. A single technician simply detaches the air and solenoid connections, removes the eight bolts from the valve assembly and slides it out for inspection and maintenance.

Reduced downtime

"The results have been better than we ever expected," said Mr Schutt. "Since installation, we have had a significant reduction in downtime due to snowman formation. Not having to get near the hot wall or put on special equipment has definitely made a difference in the morale of the maintenance and production staff."

By moving the cannons away from the hazardous area, the lack of heat exposure has reduced the impact on the equipment itself, increasing the life of the valves and the tank. Installing the tanks in a safe, accessible area means that workers can inspect the equipment more often and perform maintenance on any one cannon more easily, without downtime.

The cannons no longer experience build-up from backflow within the tank, allowing them to operate at full capacity. "Our new air cannon arrangement has been a great success, and overall we are very satisfied with the design and the equipment," Mr Schutt concluded. "I have no doubt it could be effectively applied to many cement kiln operations around the world and I could see this configuration becoming a standard design across the cement industry." ■


After five years of service, the cannons continue to operate at a high level of reliability