Air cannons hammer preheater build-up at Ash Grove Nebraska cement plant

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Efficient material flow is a critical element of dry-process cement manufacturing, and accumulation or blockages can take a big bite out of a plant's profitability. Hang-ups in storage systems and accumulations in process vessels can choke material flow, while bottlenecks create costly reductions in equipment and process performance. Poor material flow raises maintenance expenses and drags profits down. If they become severe, flow problems can bring production to a complete stop. Although many plants still use manual techniques to remove build-up, the cost of labor and periodic shutdowns has led some producers to investigate more effective methods for dealing with this inevitable maintenance.

Ash Grove Cement is the largest American-owned cement manufacturer and the sixth-largest in the nation. The company's network includes nine cement plants, two deep-water import terminals and a major quarry operation in Blubber Bay, British Columbia, as well as subsidiaries consisting of ready-mix companies, aggregate suppliers, packaged materials companies and a paving firm. In all, Ash Grove has a total annual capacity of nearly 9 million short tons of cement, including a wide range of specialty products for difficult service environments. The company has a reputation stretching back to 1882 for running some of the most efficient and best maintained plants in the country.

The facility in Louisville, Nebraska has an annual output of about 1 million ST per year of Portland and blended cement. Located on the south bank of the Platte River between Omaha and Lincoln, the plant was originally opened in 1929 with an annual capacity of 240,000 ST per year, and the operation has been expanded and updated continuously throughout its life.

Among the issues the plant has confronted is material buildup in the precalciner, which interfered with operating efficiency by impeding the flow through the preheater and into the kiln. The staff used the common technique of water lancing to remove blockages, particularly from the preheater tower's riser duct. Twice daily maintenance personnel opened access doors into the tower and removed the accumulation with a high-pressure spray. The work was time-consuming, and the water blasting had a tendency to cause lumps of material to fall into the kiln feed, interfering with production.

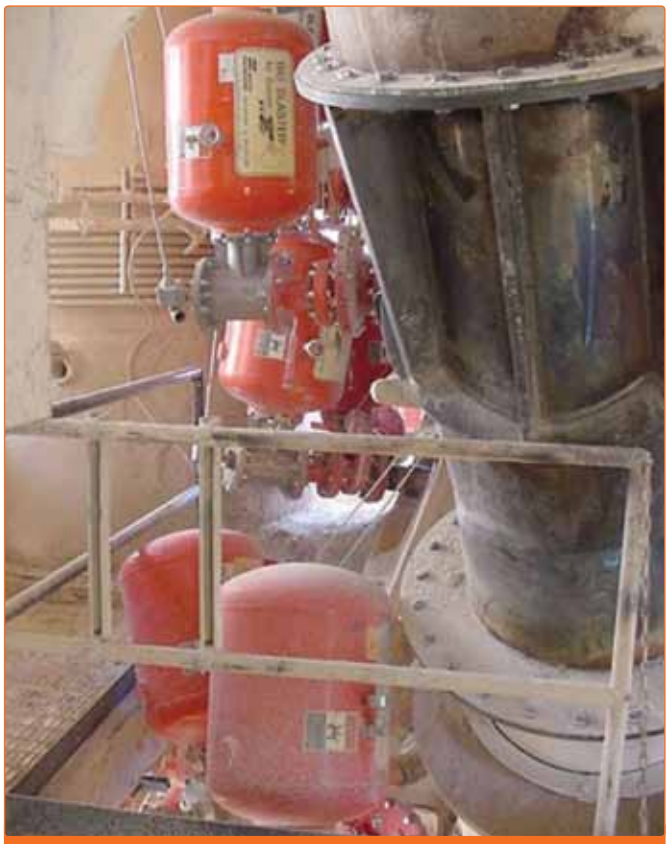
An air-powered solution

In order to prevent the resulting loss of efficiency and clinker quality, a group led by process engineer Mark Junkins investigated possible solutions. They met with material handling experts from Martin Engineering, and together the group designed a system that uses high-performance air cannons to control material build-up and enhance the flow.

The system is based on 25 Big Blaster® XHV Air Cannons, which fire a powerful discharge of compressed air in a prescribed pattern to remove material that becomes adhered to the vessel walls. Introduced by Martin Engineering in 1974, the technology has since developed a proven track record around the world for relieving bottlenecks caused by material buildup in high-capacity storage and process vessels.

Martin Engineering technicians installed the air cannons during a scheduled maintenance outage, starting where the accumulation appeared most severe: below the riser orifice, where the duct is reduced in size to increase velocity. The unique cannon design requires no high-temperature discharge pipes or special mounting plates, and discharge nozzles are embedded directly in the refractory lining of the preheater tower.

A network of 25 air cannons was installed to remove material that becomes adhered to vessel walls.



The air cannons were installed starting where the accumulation appeared most severe: below the riser orifice, as the duct reduces in size to increase velocity.

Valve performance and timing

All of the air cannons in the main production line network are equipped with the Martin Engineering XHV Valve, designed specifically to deliver premium performance and long service life in preheater towers, clinker coolers and other high-temperature applications. The negative pressure-firing valve was developed to provide reliable operation and long service life in challenging applications.

The XHV valve is constructed with a rugged, short-stroke piston that features a high-temperature polymer seal for dependability and low maintenance requirements. The advanced design delivers high output force and excellent sealing to reduce air loss, as well as rapid discharge and filling. All XHV valves are guaranteed for 200,000 firings, and a removable piston seat simplifies service.

Available in 2-, 4- and 6-inch models and ten different tank sizes, the XHV Valve Assembly features an aluminum piston with a high-temperature polymer face. Because of the short piston stroke (just 5/8" or 16mm), the design minimizes wear on the piston and cylinder. A return spring snaps the piston quickly back into firing position and prevents dust entry.

The company also offers a retrofit kit that allows a simple performance upgrade of air cannons from virtually any manufacturer. A simple, bolt-on attachment allows the XHV Assembly to be installed on existing Martin Engineering internal- and external-valve air cannons, as well as onto competitive models.

The cannons discharge in a timed sequence that moves in an upward spiral around the tower firing about 20 seconds apart, with the entire cycle taking just over eight minutes to complete. Control room operators can alter the schedule to accommodate a range of kiln pressures and operating conditions, extending the sequence to as much as 45 minutes.

A crew from Martin Services installed the entire system, including cannons, air lines and controls, as well as the company's Thermo Safety Shields™ on each unit. Operating like trap doors, the sliding shields bolt in between the air cannon valve and mounting flange, helping to protect workers from exposure to severe heat, gases and high-temperature materials.

Based on its success with the initial air cannon system, Ash Grove started planning a similar system for the plant's second production line. For that operation, engineers designed a network of 15 additional Big Blaster Air Cannons, equipped with Martin® Tornado Exhaust Valves. Described as the latest advancement in air cannon valve design, the patent-pending Tornado valve fires in response to a positive air pressure surge delivered by a solenoid valve, which can be located as far as 200 feet away.

This positive action improves air cannon safety, since the discharge sequence requires a positive signal. Unlike negative pressure-firing designs, a cannon equipped with the Tornado valve will not discharge accidentally in response to a pressure

All of the air cannons in the main production line network are equipped with a negative pressure-firing valve design.

drop, so an air supply failure or broken line won't trigger its firing. In addition, this positive-acting valve amplifies the discharge force, delivering up to 20% greater force than a standard XHV-equipped air cannon of the same size.

Available in 2-, 4- or 6-inch models, the positive action of the valve also delivers faster discharge, amplifying output force by as much as 20% over the standard Big Blaster XHV Air Cannon. In addition, the improved air path of the Tornado fills the reservoir three to four times faster than most standard designs.

Martin Services once again supplied turnkey installation, but by the time Ash Grove could cool the production line and perform routine service to the refractory lining, the technicians had just a few days to complete the air cannon system. In order to accommodate the abbreviated maintenance window, crews worked a round-the-clock schedule, finishing their work just in time for the plant's scheduled return to production.

Results

With the new air cannon network in place, the Louisville plant has been able to significantly reduce the need for water blasting. Material now flows more efficiently, and maintenance personnel have drastically reduced the man-hours that were spent on manual removal.

"We still hydro-lance occasionally, because of changes in raw material or fuel," Junkins explained. "But we don't have the issues we had before. We can see that the air cannon system has paid for itself, by allowing us to maintain production rates without many of the interruptions and issues that water blasting created."

Cannons, air lines and controls, as well as Martin Engineering's Thermo Safety Shields™ were installed on each unit.

The Ash Grove Cement Company has established a longstanding tradition of service, reliability and quality that stretches back more than 125 years. A pioneer of the lime and cement industries, the company was incorporated in Missouri in 1882 as the Ash Grove White Lime Association.

ABOUT THE COMPANY

Martin Engineering supplies conveyor products around the world in a wide variety of bulk material applications, including cement/clinker, rock/aggregate, coal, biomass, feed pellets, grain and other materials. Founded in 1944, Martin Engineering is the world leader in making bulk materials handling cleaner, safer and more productive. The company is headquartered in Neponset, IL, with global reach from operations in Brazil, China, France, Germany, Indonesia, Mexico, South Africa, Turkey, India and the UK.

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