



A proven solution: Multiple-port

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Martin Engineering's Multiple-port air cannon system is a proven method of relieving material build-ups in cement plants. Using cyclone technology it is a powerful piece of machinery that produces the necessary volume and velocity of air to displace unwanted blockages quickly and efficiently. As well as outlining the engineering behind multi-port cleaning systems, Martin Engineering gives an update of its latest project at Nuh Çimento in Turkey.

Material flow problems in cement manufacturing are an industry-wide issue. No matter how well-designed, almost any process can experience conditions that contribute to accumulations, which have a significant impact on output and profitability. Build-ups can occur in many places, including dry material being processed, ash that adheres to boiler tubes and walls, or in kilns and coolers. The accumulation can be particularly severe when fuels with high sulphur or chloride content are used, such as petcoke or tyres. In extreme cases, technicians have seen build-ups estimated at 50t of material suddenly break loose, suffocating the process and potentially damaging equipment.

Aside from lost production, the costs of these flow problems can become apparent in a variety of ways. To reduce the rate of accumulation, plants may be forced to cut back on the percentage of supplemental fuels, raising production expenses. Shutdowns to clear the restricted flow are expensive, costing valuable process time and maintenance hours, while wasting energy during re-start. Refractory walls can be worn or damaged by tools or cleaning techniques. When access is difficult, removing material blockages can also introduce safety risks for personnel. Scaffolds or ladders may be needed to reach access points, and staff can risk exposure to hot debris, dust or gases when chunks of material are released.

Air cannon application

Air cannon technology has a long history of service in cement processing, helping to improve material flow and reduce build-up in riser ducts, feed pipes, kiln inlets, cyclones, chutes and storage vessels. The timed discharge of a directed air blast can prevent accumulation or



Figure 1: the Big Blaster® Category 5 Hurricane Air Cannon System is a multi-valve air cannon solution that provides up to five application points using a single 60gal reservoir

blockages that impact process efficiency and raise maintenance expenses, helping manufacturers minimize the need for process interruptions and manual labour.

In many applications, a series of individual air cannons fired in a timed sequence will relieve the build-up problems, but the locations of choke points in some facilities can make installation and service a challenge. Further, because of the harsh operating conditions in cement processing, the working components of conventional air cannons can be exposed to dust, gases and high temperatures that may damage valves and shorten service life. Material avalanches can force debris back through the valves of single air cannons, severely hampering their effectiveness or even rendering them completely inoperative. Poor air cannon performance can also be directly linked to high-pressure water washing, which can cause piston failure and nozzle clogging.

A different approach

To address these issues, Martin Engineering has introduced two multiple-port air cannon systems that use a single reservoir and control unit to replace up to eight traditional tank-and-valve air cannons. With a single air tank discharging through stainless steel hoses and/or rigid pipes, these systems separate the air cannon valves from the discharge points, protecting components from the effects of heat, contaminants, high pressure washing or cardox. Using one air reservoir instead of multiple tanks helps to boost material flow with minimal air loss, while maximising efficiency.

By preventing material build-up, the system helps reduce downtime, equipment wear and maintenance time. The multiple-port design contributes to lower operating costs and improves safety, helping facilities avoid the need for personnel to access the process and manually clean out accumulation.

Figure 2: Martin Engineering has introduced two multiple-port air cannon systems that use a single reservoir and control unit to replace up to eight traditional tank-and-valve air cannons



Figure 3: the Martin® Multi-Port Air Cannon System delivers its air blast to as many as eight ports without conventional valves, using air cylinders designed to operate for millions of cycles without maintenance



Reducing the need for high-pressure washing or air lancing also helps avoid unnecessary wear on refractory walls.

Valve systems

The Big Blaster® Category 5 Hurricane Air Cannon System is a multi-valve air

cannon solution that provides up to five application points utilising a single 60gal reservoir. The design can be equipped with either positive- or negative-pressure firing valves. Martin Engineering's negative-pressure valve was developed specifically to deliver reliable performance and long service life in preheater towers, clinker coolers and other high-temperature applications. The Martin® 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, excellent sealing to reduce air loss, as well as fast discharge and filling. A removable piston seat simplifies service, and all XHV valves are guaranteed for a minimum of 200,000 firings. Adjustable urethane bumpers in the valves allow fine-tuning of force output to meet unique application requirements. Martin Engineering offers a retrofit kit that allows a simple performance upgrade of air cannons from virtually any manufacturer.

Category 5 systems can also be equipped with Martin® Hurricane Exhaust Valves. The patent-pending Hurricane valve fires in response to a positive air pressure surge, delivered by a solenoid valve. This positive action improves air cannon safety, as discharge requires a positive signal. Unlike negative pressure-firing designs, a cannon equipped with the Hurricane valve will not discharge accidentally in response to a drop in pressure, so an air supply failure or broken line won't trigger its firing.

The positive action of the valve also delivers faster discharge, amplifying output force by as much as 20 per cent over standard valve designs.

Today's fast-acting valves can release the tank volume in less than 300ms, creating a high-magnitude force at the exit nozzle that's installed through the wall of the vessel or duct. In addition, the improved air path of the Hurricane fills the reservoir 3-4 times faster than standard models.

Multi-port operation

The Martin® Multi-Port Air Cannon System operates on a slightly different principal, delivering its air blast to as many as eight ports using an air cylinder, without conventional valves. These cylinders have been designed for



Figure 3: with a single air tank discharging through stainless steel hoses and/or rigid pipes, multiple-port systems separate the air cannon valves from the discharge points, protecting components from heat, contaminants, high pressure washing or cordox

durability, able to operate for millions of cycles without maintenance. Because the cylinders return the plunger gently to the sealing position after firing, the damaging impact of a spring return is avoided. Refill times are typically in the range of just 20-50 seconds.

Installed in a safe, accessible area, the Multi-Port Systems have all cylinders, solenoids and other moving parts contained within the unit, allowing easy maintenance from a central location. Service personnel avoid exposure to dust, process heat and potentially hazardous heights. When service is required, cylinders can be removed via four mounting bolts and replaced with a spare. Solenoids are protected by a NEMA 4 enclosure and manifold-mounted for easy replacement.

The Multi-Port design uses the single air cylinder valve assembly to replace multiple piston spring valve assemblies, saving space and simplified maintenance. Even though individual air cannons often have a higher peak force than the Multi-Port Systems (10bar vs. 8bar), engineers point out that peak force does not necessarily equate to cleaning performance. In fact, performance is a function of several factors. The key to achieving high kinetic energy is the velocity of air movement, while velocity and volume determine

momentum. For an individual 50l air cannon to achieve the same momentum as a 150l Multi-Port System, the single cannon would have to reach a velocity three times that of the multiple-nozzle systems.

Customers report a variety of additional benefits from the multiple-port approach to designing air cannon systems. In some applications, the improved flow rates allow a higher percentage of replacement fuels and corresponding reduction of primary fuel use. In others, operators have found reduced energy consumption by their heat exchanger ventilators. The systems can also help lower the use of urea needed in selective non-catalytic reduction (SNCR) units through improved flow conditions.

Each multiple-port system from Martin Engineering is customised for the specific application, and is shipped to the location completely fabricated. No special mounting or assembly is required. Installation is simply a matter of setting the unit in place, connecting air and electrical sources, installing nozzles and attaching the stainless steel hoses. Valves and cylinders are pre-plumbed.

The modular design allows easy expansion, if additional discharge ports are needed. These new systems have proven themselves to be reliable and effective in

dry-process cement manufacturing, and in many plants using alternative fuels, they've become indispensable.

Case study

The Nuh Çimento plant in Kocaeli, Turkey is one of Europe's largest, with three clinker production lines and a capacity of 4.4Mta. The plant was battling accumulation in the third line's cyclone discharge pipe, with sticky material creating a partial blockage that reduced the opening at the bottom of the cyclone discharge pipe, significantly affecting production output.

To combat the issues, the plant resorted to replacing the cyclone discharge with a spare, which required a 30-hour shutdown, not including cooldown and restart times. The forced stoppage was required every 5-6 months, when the cyclone discharge was no longer functioning properly. With the line's capacity around 7200tpd, plant officials estimated that they were losing about 18,000tpa of production. They were also expending maintenance time for staff to remove and replace the discharge pipe, as well as cleaning out the clogged one to use for the next replacement.

Martin Engineering service technicians reviewed the bottleneck and assessed the material flow, then determined the optimum locations for air discharge nozzles. They installed two Multi-Port Air Cannon Systems, known for an ability to withstand the type of severe operating conditions in cement processing.

By discharging 10 air blasts in a designed sequence, the two systems effectively break up accumulated material and allow it to return to the process flow, without releasing huge chunks that could damage other components or disrupt processing. The timed discharge breaks down material accumulations and releases blocked pathways, allowing solids and gases to resume normal flow. In order to customize the air cannon installation to the service environment, specific air blast characteristics can be achieved by manipulating the operating pressure, tank volume, valve design and nozzle shape.

Nuh Cement plant reports that the systems are performing with high efficiency, and blockage problems have not recurred. No work stoppage for cleaning has been needed in more than two years of service.