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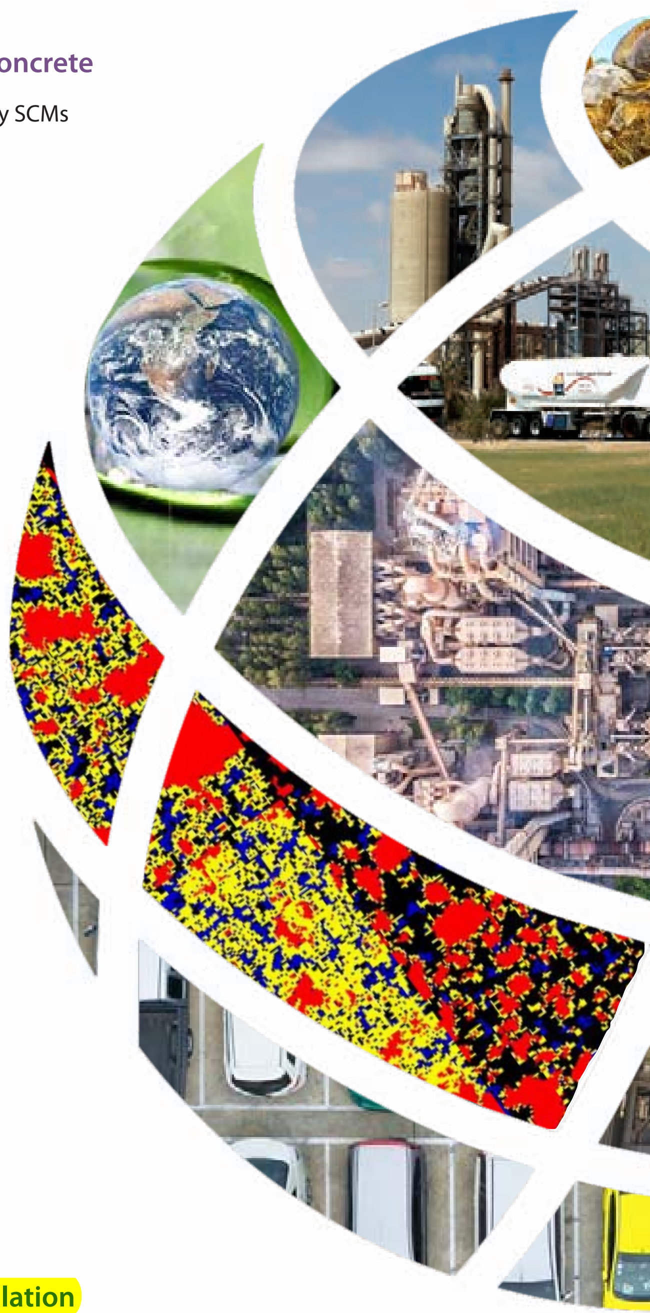


Technical

Brad Pronschinske, Martin Engineering

Go with the flow: Preventing accumulation in cement production

Efficient material flow is a critical element of cement manufacturing, as accumulation or blockages can reduce profitability. Hang-ups in storage systems and build-up in process vessels can impede material movement and cause bottlenecks that interfere with equipment performance and reduce process efficiency. Poor material flow also raises maintenance expenses, diverting manpower from core activities and in some cases introducing safety risks for personnel. There are a number of ways to avoid these pitfalls...

Opposite: Air cannons can help prevent accumulation, while minimising the need for downtime and manual labour. **Source:** Martin Engineering, 2020.©

Even well-designed cement plants can experience accumulation of material, which can have a significant impact on output and profitability. Changes in process conditions, raw materials and even the weather can affect material flow. Even small amounts of accumulation can grow into a serious blockage.

Build-up can occur in many places and in several forms, with varying amounts of moisture. It can be found as dry material that clings to the walls of the pre-heater towers, or to selective catalytic reduction (SCR) units and vessels. Accumulation often appears in riser ducts, feed pipes, cyclones, transfer chutes and storage bins, as well as kilns and coolers. In extreme cases, massive build-ups can suddenly break loose and suffocate the process, potentially causing significant damage to equipment.

Lost production is probably the most conspicuous cost of these flow problems, but the expense can become apparent in a variety of other ways. Shutdowns cost in terms of downtime and maintenance and restarting the plant wastes energy. Refractory walls can be worn or damaged by tools or cleaning techniques. When access is difficult, removing material blockages also introduces safety risks. Scaffolds or ladders might be needed and staff risk exposure to hot debris, dust or gases when chunks of material are released.

Many of the most common problem areas for accumulation are classified as confined spaces, requiring a special permit for workers to enter and perform work. The consequences of inexperienced or even untrained staff entering a silo or hopper can be disastrous, including physical injury, burial and asphyxiation. If disrupted, material adhered to the sides of the vessel can suddenly break loose and fall on a worker. If the discharge door is open, material may suddenly evacuate, causing unsecured workers to get caught in the flow. Cleaning vessels that contain combustible dust, without proper testing, ventilation and safety measures, could even result in a deadly explosion.

Right: Safe, effective cleaning requires tools that work inside the silo from the top, controlled by personnel outside. **Source:** Martin Engineering, 2020.©

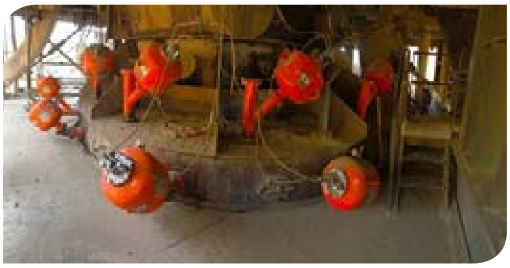
Some larger facilities choose to purchase their own equipment to clean process equipment and storage vessels, as well as train their personnel, while others find it more appropriate to schedule regular cleanings by specially-trained contractors, which, for smaller plants, can often be accomplished for less than the total investment of in-house cleanouts.

At one plant, for example, there was a silo blockage so severe that it had been out of use for several years. While it took the outside contractor almost two weeks to fully evacuate the vessel, the process restored 3500t of 'live' storage capacity. At another facility, a crew was able to remove enough 'lost' product that the value of the recovered material actually paid for the cost of the cleaning. In short, regular cleaning of storage vessels can quickly turn into an economic benefit, not an expense. It is an investment with a measurable ROI.

Seeking solutions

There are a few types of equipment used for this purpose. One operates like an industrial-strength weed whip or strimmer, a rotating a set of flails that strike the material. This approach eliminates the need for confined space entry and hazardous cleaning techniques, typically allowing the material to be recaptured and returned to the process stream.

Technicians lower the device all the way down through the topside opening, then start at the bottom of the buildup and work their way up, undercutting the wall accumulation as it falls by its own weight. In extreme cases, a more extreme 'bin drill' can be used to clear a 30cm pathway as deep as 45m in order to begin the cleaning process.



Flow aids

Flow aids can reduce or even eliminate the need for cleaning. One method is through industrial vibrators designed for bin and chute applications. Electric vibrators are generally the most efficient and deliver the longest life, lowest maintenance and lowest noise. The initial cost for an electric vibrator is higher than for pneumatic designs, but the operating cost is lower. Turbine vibrators are the most efficient and quietest of the pneumatic designs, making them well suited to applications in which low noise, high efficiency and low initial cost are desired.

Air cannons are another approach to maintaining good material flow, particularly in larger vessels. Air cannon technology has been used in cement manufacturing for nearly 50 years, helping to improve material flow and reduce maintenance. The timed discharge of a directed air blast can prevent accumulation or blockage. By facilitating flow and minimising build-up, air cannons help bulk material handlers minimise the need for process interruptions and manual labour.

The two basic components of an air cannon are a fast-acting, high-flow valve and a pressure vessel (tank). The device performs work when compressed air (or some other inert gas) in the tank is suddenly released by the valve and directed through a nozzle, which is strategically positioned in the tower, duct, cyclone or other location. Often installed in a series and precisely sequenced for maximum effect, the network can be timed to best suit individual process conditions or material characteristics.